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For a healthy life

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BOOK OF ABSTRACTS

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ABSTRACTS

CNICPRONAT 2025: 2ND INTERNATIONAL SYMPOSIUM ON NATURAL PRODUCTS

PN01/THE LONG AND WINDING ROAD FROM HERBS TO MEDICINES

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Medicinal plants have been used for centuries by civilizations around the world and are still used today. According to World Health Organization (WHO) statistics, herbal medicine is recognized by 110 Member States. In Cuba, phytotherapy is the most widely used form of Natural and Traditional Medicine. Despite its antiquity and modern relevance, herbal medicine faces multiple challenges. Recent approaches based on advances in fields such as structural biology, genomics, proteomics, and bioinformatics have contributed to reviving herbal medicine on a scientific basis. However, understanding the use of medicinal plants by traditional medical systems such as Traditional Chinese Medicine or Ayurveda faces challenges that are still not fully understood. Furthermore, funding problems, methodological gaps, and a lack of evidence often lead to suboptimal therapeutic use of medicinal plants and their products. The overexploitation of some species, the resulting loss of biodiversity, and the climate change are threats that must also be taken into account. The lecture will focus on WHO's efforts to develop Traditional, Complementary, and Integrative Medicine, as well as on Cuba's perspective. Research, the integration of its results into healthcare, the preservation of natural resources, and an adequate dissemination of scientific information are considered key elements to move forward medicinal plants along their long and winding road in the modern world.

Keywords: Traditional medicine, herbal medicine, Phytotherapy, medicinal plants.

Modality of presentation: Lecture

PN02/BEESWAX ALCOHOL (ABEXOL) PROTECTED LIVER AND BRAIN AXIS VIA ANTIOXIDANT AND ANTI-INFLAMMATORY ACTIVITIES: THE BEST LIPID-SOLUBLE ANTIOXIDANT TO CELL AND MEMBRANE

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The antioxidant and anti-inflammatory abilities of beeswax alcohol (BWA) are well reported in animal and human clinical studies, with a significant decrease in malondialdehyde (MDA) in the blood, reduced liver steatosis, and decreased insulin. Prolonged consumption of D-galactose (Gal) has been associated with severe damage in the liver and brain via exacerbation of oxidative stress, nonenzymatic glycation and the ageing process. The current study was initiated for comparative assessment of beeswax alcohol (BWA, final 0.5% and 1.0% w/w) and coenzyme Q10 (CoQ10, final 0.5% and 1.0% w/w) against high cholesterol (HC, final 4%, w/w) and galactose (Gal, final 30%, w/w) induced adverse events in zebrafish during 24 weeks of consumption. HC+Gal consumption adversely affected zebrafish survivability (82.1%), which substantially improved to 91% following 0.5% and 1.0% BWA consumption. In contrary, no effect of CoQ10 consumption (1.0%) was observed on the survivability of zebrafish. Nevertheless, both BWA and CoQ10 displayed a significant ($p<0.001$) preventive effect against HC+Gal-induced body weight enhancement. The HC+Gal-induced cognitive changes marked by staggered and confused swimming behavior, retarded swimming speed and motion pattern (restricted to the bottom of the tank) were efficiently restored by the BWA. A significant higher residence time in the upper half of the tank, 3.1-and 4.5-fold reduced time of latency along with 3.5-fold and 4.1-fold higher swimming distance was logged in the 0.5% and 1.0% BWA groups, respectively, than the HC+Gal consumed zebrafish. In addition, BWA effectively alleviated the total cholesterol (TC) and triglycerides (TG) levels disrupted by the consumption of HC+Gal. Also, the HC+Gal alleviated plasma high-density lipoproteins-cholesterol (HDL-C) was 2.6-fold ($p<0.001$) enhanced in the 1.0% BWA consumed group, which was significantly 1.5-fold ($p<0.001$) better than the effect of 1.0% CoQ10. Similarly, BWA displayed a superior impact over CoQ10 to mitigate HC+Gal-induced plasma AST and ALT levels, hepatic IL-6 production, generation of oxidized species, cellular senescence and fatty liver changes. Besides, BWA efficiently protects the brain against HC+Gal-induced oxidative stress, apoptosis, and myelin sheath degeneration. Conclusively, compared to CoQ10, BWA efficiently subsides the HC+Gal impaired liver functionality dyslipidemia, protecting the brain and improving the cognitive behavior of zebrafish.

Keywords: Beeswax alcohol (BWA), behavioral analysis, brain, coenzyme Q10, CoQ10, D-galactose, senescence, swimming distance, myelin

Modality of presentation: Lecture

PN03/BEESWAX ALCOHOLS (ABEXOL): AN ANTIOXIDANT AND ANTI-INFLAMMATORY ACTIVE INGREDIENT, WITH PROTECTIVE EFFECTS ON GASTROINTESTINAL TRACT

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The gastrointestinal tract is the duct of the digestive system composed of a complex system organs that include: mouth, esophagus, stomach, intestines, colon and anus. Digestive diseases such as esophagitis, gastric and duodenal ulcers, and ulcerative colitis have a high impact on the morbidity and disability of the world's population. Oxidative stress and inflammation are pathophysiological processes that contribute to the development and progression of these diseases. Beeswax alcohols (BWA) registered as Abexol have exerted antioxidant and anti-inflammatory effects in experimental models and clinical studies. This work aims to summarize the preclinical evidence of the beneficial effects of BWA on the gastrointestinal tract. BWA has been effective in protecting the mucosae of the esophagus, stomach, duodenum, and colon, preventing or reducing the severity of experimentally induced-damage in rodents; these effects are associated with its antioxidant and anti-inflammatory properties. In conclusion, BWA constitutes a potential preventive and/or therapeutic alternative for the health of the gastrointestinal tract.

Keywords: Beeswax alcohols, antioxidant, anti-inflammatory, esophagitis, gastric ulcer, ulcerative colitis

Modality of presentation: Oral

PN04/NEW CHEMICAL-PHARMACEUTICAL DEVELOPMENTS WITH PURIFIED EXTRACTS FROM BEESWAX (*APIS MELLIFERA*)

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Among the main components of beeswax (*Apis mellifera*) are esters formed by higher fatty acids and alcohols. The latter, with between 24 and 34 carbon atoms, and 1-triacontannol (C30) as the main component, constitute the chemical quality markers of an extract obtained and purified from said wax, which constitutes the active ingredient used in the manufacture of Abexol tablets, an antioxidant, anti-inflammatory, and gastroprotective nutritional supplement. New chemical and pharmaceutical developments have led to the development of two formulations with purified extracts from beeswax containing fatty alcohols: Abexol in the form of an oral suspension, a product with greater pharmacological potency than tablets, as demonstrated preclinically and in a clinical trial; and a dermoprotective cream, with antioxidant and anti-inflammatory effects, for the treatment of skin damaged by various conditions. As part of the design and development of these products, taking into account the slightly soluble and poorly permeable nature of the active ingredient, a microparticulation process was established to increase its bioavailability. Analytical methods were also developed and validated for both final products, and stability studies were conducted in different containers, both accelerated and long-term under the conditions of Climatic Zone IV. These new chemical and pharmaceutical developments have enabled both products to obtain sanitary registration in Cuba, as well as the patent for Abexol suspension in Cuba and other countries. Both products are currently in the commercial introduction phase.

Keywords: Abexol, beeswax, suspension, dermoprotective cream, stability.

Modality of presentation: Oral

PN05/ABEXOL® SUSPENSION: GASTROPROTECTIVE AND ANTIOXIDANT

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The beeswax' six primary aliphatic alcohols mixture (Abexol®) that contains triacontanol as most abundant component has been shown anti-inflammatory, antioxidant, and gastroprotective effects. This active ingredient has been marketed in tablet form for several decades and was more recently developed in suspension form. The objective of this study was to evaluate the preventive and therapeutic pharmacological efficacy of Abexol® suspension on ethanol-induced gastric ulcer in rat. Animals were distributed into four experimental series in which Abexol® suspension was administered as single or repeated oral doses (25–200 mg/kg) depending on the study; alcohol, agent damage-inducing gastric mucosa, was administered orally two hours before or one hour after the treatments administration. In all studies, Abexol® suspension decreased the ulcerated area and increased gastric mucus content, as well as improved mucus quality. Additionally, histological analysis of gastric tissue demonstrated that repeated doses of Abexol® suspension protected and preserved tissue structure. In conclusion, Abexol®-suspension constitutes a new alternative with potential preventive or therapeutic effect for gastric health in humans.

Keywords: Abexol®, gastric ulcer, ethanol, rats

Modality of presentation: Oral

PN06/COMPARATIVE STUDY OF THE EFFICACY AND SAFETY OF ABEXOL (SUSPENSION VERSUS TABLETS) IN PATIENTS WITH GASTROINTESTINAL SYMPTOMS

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Gastrointestinal diseases (which include diseases of the upper and lower gastrointestinal tract, liver and pancreas) as a whole are a major health problem worldwide, constituting the third leading cause of death, if cancers of the gastrointestinal system are included. Abexol is a mixture of primary aliphatic alcohols purified from beeswax (*Apis mellifera*), that produces anti-inflammatory, antioxidant and gastroprotective effects, as well as it is safe and well tolerated. The objective of the work was to investigate and compare the efficacy and safety of Abexol (suspension versus tablets) in patients with gastrointestinal symptoms. Monocentric study, open-label, randomized design, with two parallel groups receiving Abexol tablets (150 mg/d) or Abexol suspension (75 mg/d) for 8 weeks. Primary efficacy variable (significant improvement in the total score of Gastrointestinal Symptom Rating Scale [GSRS]). Significant reduction in intensity of gastrointestinal-symptoms and reduction in the consumption of antacids are considered secondary efficacy variable. Short form-36 (SF-36) quality of life questionaire was evaluated as collateral variable. Data were analyzed as per intention to treat. A significantly decrease in the overall score of the survey was observed with respect to the baseline level ($p < 0.001$) of 81.4% in the Abexol suspension group and 77.9% in the Abexol tablets group. At the end of the trial, most gastrointestinal-symptoms disappeared or reduced significantly. The frequency of consumption of neutralizing antacids was low. The significantly improvement in the perception of the state of health obtained in the Abexol is in correspondence with the improvement achieved in some of the components evaluated in the SF-36 questionnaire. Both treatments were safe and well tolerated. Abexol suspension showed efficacy and safety similar to Abexol tablets in patients with gastrointestinal symptoms, but using half the dose.

Keywords: Abexol suspension, Abexol tablets, Gastrointestinal symptoms, GSRS, SF-36

Modality of presentation: Oral

PN07/REPEATED DOSE TOXICITY (90 DAYS) OF SACHA INCHI OIL IN SPRAGUE DAWLEY RATS

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Sacha inchi (*Plukenetia volubilis L.*) is a plant native to the Peruvian Amazon. The oil obtained from its seeds contains high levels of alpha-linolenic acid and linoleic acid, which may provide protective effects against inflammation, cardiovascular disease and cancer. The objective was to determine the toxic effects of administering orally of Sacha inchi oil for 90 days to Sprague Dawley rats. Animals were randomly assigned to experimental groups (20 animals each), a negative control group and three groups treated with Sacha inchi oil, at 250, 500 and 1000 mg/kg of body weight. During the period of administration, the animals were observed closely for signs of toxicity. Weekly, all animals were weighed and food consumption measurement. At the end of the treatment were carried out hematological and blood biochemical determinations and were determined organ weight/body weight ratios. Full histopathology was carried out on the organs and tissues of all animals in the control and high dose groups and to animals of all other dosage groups, for those tissues where changes or lesions are observed. No evidences of treatment-related toxicity were detected. There were no significant differences in any of the analyzed variables between the control and treated groups. It is concluded that Sacha inchi oil orally administered to rats was safe and that no treatment-related toxicity was detected. Thus, the highest dose evaluated (1000 mg/kg) can be considered as a non-observable toxic effect dose in rats.

Keywords: rats, Sacha inchi oil, toxicity

Modality of presentation: Oral

PN08/ROLE OF METABOLIZING SYSTEMS AND TRANSPORTERS IN THE NATURAL PRODUCTS-DRUG INTERACTIONS, ITS IMPACT IN THE HUMAN HEALTH

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Natural products (NP) may interact with conventional drugs, altering the its pharmacodynamic or pharmacokinetic and leading to clinically significant interactions. NP are taken not only by health persons who want to protect themselves from the onset of disease or to improve their well-being, also by patients suffering from life-threatening conditions who simultaneously receive one or more drugs. These patients are subjected to suffering the effects derived from the co-administration of both, thus it is a point of discussion. Pharmacological interactions possibly derive from the modulation in expression and function of two major pharmacokinetic disposition systems, cytochrome P450 (CYP) and the multidrug transporters, where the P-glycoprotein is identified as the major. Mixtures and compounds isolated from its have been identified as substrates, inhibitors or inducer of cytochromes and transporters in humans. This works offers an overview of the knowledge about on the effects of NP on P450 enzymes and human variability in the response. Examples are revised, including evidences about the modulation of the P450 system and transporters by Cuban NP. The elucidation of these interactions are important not only to predict possible undesirable effects deriving from the concomitant intake of NP and conventional drugs, of these interactions as a way to increase the bioavailability of drugs that are P-gp substrates, as example. Thus, a better understanding of interactions of NP with these systems will help the regulation of the use of NP as drugs and food supplements.

Keywords: Natural products-drug interactions, P450 system, transporters

Modality of presentation: Oral

PN09/COMPARATIVE STUDY OF SPECIALIZED METABOLITES IN NATURAL PRODUCTS EXTRACTED BY NADES SYSTEMS

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The use of greener alternatives for extracting specialized metabolites is of great interest such as natural deep eutectic solvents (NaDES), which consist of the use of eutectic mixtures of primary metabolites, using a hydrogen bond acceptor (HBA) and a hydrogen bond donor (HBD). This project evaluated the extraction of specialized metabolites, using choline chloride as HBA and fructose, glucose, citric acid and lactic acid as HBD, at a ratio of 1:1, 1:2, 1:3, and 1:4, determining that the solvent with the highest efficiency is choline chloride:lactic acid 1:4; therefore, this solvent was employed to extract the specialized metabolites from the leaves of *Uncaria tomentosa* (Wild ex. Schult) DC., *Cascabela thevetia* (L.) Lippold, *Moringa oleifera* Lamarck, *Calendula officinalis* L., *Petiveria alliacea* L., and from the fruits of *Spondias dulcis* Forster, *Matisia cordata* Bonpland, *Passiflora edulis* Sims var. edulis, *Musa acuminata* Simmonds and *Euterpe oleracea* Mart, which are plant species widely commercialized in Colombia. The samples were evaluated by UV-Vis spectrophotometry and the volatile compounds by gas chromatography-mass spectrometry, identifying steroid, terpenes and fatty acids.

Keywords: Specialized metabolites, NaDES, chloline chloride, fatty acids

Modality of presentation: Oral

PN10/CHITOSAN NANOPARTICLES FOR THE ENCAPSULATION OF A POLYPHENOL-RICH EXTRACT FROM *BACTRIS GASIPAES* AS RAW MATERIAL FOR COSMETIC INDUSTRY

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In this study, chitosan nanoparticles were produced by ionic gelation loaded with a hydroalcoholic extract of the pulp of peach palm (*Bactris gasipaes*), as it is rich in polyphenols. First, different polyphenol extracts were obtained from the pulp of peach palm by ultrasound-assisted maceration through an experimental design, Box-Behnken matrix, where the proportion of the water: ethanol solvent (30:70, 50:50, 70:30), pH (4,0, 5,0 and 6,0) and extraction time (5, 10 and 15 minutes) were varied to optimize the content of polyphenols extracted and quantified by the Folin-Ciocalteu method. Additionally, the sun protection factor by spectrophotometric method and antioxidant capacity by the ABTS method of extracts were quantified. Subsequently, the extract with the highest polyphenol content was encapsulated by ionic gelation between chitosan and phytic acid with high-intensity ultrasound assistance. It was found that the best conditions for the extraction of polyphenols were a pH of 4.57, extraction time 15 min and solvent ratio 70: 30, ethanol: water giving a polyphenol content of 13377.8 ± 313.5 Gallic acid/ g and an antioxidant capacity of 2226,1 ± 136.5 mol of trolox / g. Low and medium values of photoprotection were obtained. In addition, the nanoparticles with this extract presented a size of 333.4 ± 31.5 nm, zeta potential of +41.5 ± 1.5 and polydispersity index of 0.227 ± 0.030. This research opens the doors to show that chontaduro can be used as a raw material for the cosmetics industry, improving its properties through nanoencapsulation.

Keywords: Chitosan nanoparticles, Peach palm, Polyphenols, Sun protection, Extraction.

Modality of presentation: Oral

PN11/EVALUATION OF THE ANTIOXIDANT CAPACITY OF *VACCINIUM MERIDIONALE* SWARTZ EXTRACTS IN COSMETIC EMULSIONS

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Antioxidant compounds were obtained from juices, filter cake and wine residues of *Vaccinium meridionale Swartz* by ultrasonic assisted extraction (UAE). The extracts were characterized by measurements of the sun protection factor (SPF), obtaining values between 3 and 5, indicating a low protection against UV radiation. The antioxidant capacity was also evaluated using the ABTS method, with values reported between 6000 and 12000 µM/L equivalent of Trolox, with juice being the most active source, followed by filtration cake and finally wine residues. Subsequently, emulsions type O/W were formulated using different values of the hydrophilic- lipophilic balance (HLB: 8, 10 and 12), by combining the non-ionic surfactants Lanette® 0 and Tween 80. The formulations were physico-chemically evaluated for 30 days at 40 °C. It was observed that a higher value of HLB reduced viscosity, increased cremation rate and raised pH of emulsions (range 5-7), suggesting a possible limitation for their capillary application. In addition, the antioxidant capacity of emulsions decreased during storage, which is attributed to the degradation of bioactive compounds under thermal stress conditions. Finally, this study allowed the development of prototypes of O/W emulsions with potential use as hair products with antioxidant activity.

Keywords: Extract, Antioxidant capacity, emulsion, extract

Modality of presentation: Oral

PN12/PRECLINICAL MOUSE TUMOR MODELS: CHALLENGES AND PERSPECTIVES AT THE CENTER OF MOLECULAR IMMUNOLOGY

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Preclinical tumor models serve as a valuable intermediate tool connecting *in vitro* studies with human scenery. In recent decades, special biomodels have increased to ensure greater extrapolation of results to clinical practice. On the other hand, the manipulation of the immune system in cancer and/or inflammation process is as important as appropriate selection of the biomodel. Based on ten years of preclinical mouse tumor assays at the Center of Molecular Immunology (CIM), this work provides an overview of how contemporary research on preclinical tumor biology in mice was conducted. Here, the analysis showed that more than 60% is related with tumoral models and the rest is non-tumoral sceneries (manipulation of immune systems, inflammation assays). The cells-line-derived models is the majority assays. Primary tumor and metastasis are equally used. In parallel, the analysis of ectopic, orthotopic, experimental and spontaneous biomodels, conventional and special lines mice suggested focusing on modeling tumor progression and metastasis. In conclusion, we identify different challenges and discusses potential ways in which preclinical tumoral biomodels could improves for better relevance, reproducibility and extrapolation to clinic. Our future is focus in the orthotopic biomodels.

Keywords: biomodels, tumors, inflammation, preclinical studies, challenges and perspectives

Modality of presentation: Oral

PN13/PREVENOX®: THERAPEUTIC CANDIDATE WITH ANALGESIC EFFECTS

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Pain is a sensory and emotional experience whose prevalence is frequently associated with several diseases and aging; being a symptom that causes disability and suffering, negatively impacting the quality of life of the people who suffer from it. The most consumption pharmacological group in the world worldwide are non- steroidal anti-inflammatory even when they do not always favor the benefit/risk ratio by the wide range of adverse effects associates with its use. The study of natural products as therapeutic alternatives with analgesic efficacy and better safety profile constitutes a current problem. Prevenox®, a mixture of high molecular weight saturated fatty acids in the form of potassium salts, is registered in Cuba as antioxidant supplement. The objective of this work was to evaluate the analgesic effects of Prevenox ingredient active in two experimentally induced pain models in rodents. Two experimental series were performed in which Prevenox was administered orally (25 - 800 mg/kg) to rodents previously to pain induction. In the first series, pain was induced by intraperitoneal administration of acetic acid (2 %) in mice and in the second, by subplantar formalin (5 %) in rats. Prevenox® significantly reduced hyperalgesia, as clinically assessed by the number of acetic acid-induced abdominal writhing. Furthermore, at the highest doses tested, formalin-induced edema and clinical variables of pain (paw raised, shaking and licking) and behavior (crossing and stopping) associated with inflammation were decreased. These preliminary results could be explained by its anti-inflammatories and antioxidants effects, without ruling out a possible effect on the peripheral or central nervous system. In conclusion, oral treatment with Prevenox® was effective in relieving induced pain in rodents, suggesting its potential use as an analgesic in various pathologies.

Keywords: Prevenox®, pain, analgesic effects, experimental models

Modality of presentation: Oral

PN14/UTILIZATION OF *PINUS OCCIDENTALIS* SWARTZ SAWMILL WASTE IN THE DOMINICAN REPUBLIC: FIRST PHYSICAL AND CHEMICAL CHARACTERIZATION FOR FOOD AND MEDICINAL PURPOSES

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Agroforestry residues are a significant source of greenhouse gases, which are released as a result of the decomposition of plant material. The use of ¨Pino Criollo¨ (*Pinus occidentalis* Swartz) as raw material for wood production in the Dominican Republic generates an estimated volume of 24 thousand cubic meters of waste in the different sawmills in the country. This residue can become a raw material to obtain products with high added value, given the high polyphenol content that has been reported for other pine species. The preparation of a standardized extract from *P. occidentalis* S. from processing waste can achieve a dual objective: 1. Reduce the effects of polluting gas production, and 2. Use this extract to obtain health product formulations (nutritional and/or medicinal). This work presents the results of the physical-chemical characterization of pine sawmill waste in three sites in the Dominican Republic (Constanza, Jarabacoa and Bahoruco), located at different heights above sea level. The characterization included fat and total polyphenol content by Soxhlet extraction with n-hexane and ethanol-water (70:30), respectively, as well as the determination of the antioxidant activity of these extracts (DPPH technique) by UV/VIS spectrophotometry. Additionally, heavy metal content was determined by ICP-OES. Samples obtained from plant material from the Bahoruco sawmill had the highest fat content compared to Constanza and Jarabacoa, while the Constanza sample had the highest polyphenol content and, therefore, the highest antioxidant activity ($p < 0.05$). All samples had heavy metal contents below the maximum permissible limits. These results constitute the first report on the physicochemical characterization of Pino Criollo, which constitutes a scientific novelty.

Keywords: *Pinus occidentalis* Swartz, Pino criollo, Antioxidant activity, polyphenol content, physical-chemical characterization

Modality of presentation: Poster

PN15/CHEMICAL SYNTHESIS AND PURIFICATION BY COLUMN CHROMATOGRAPHY OF MANGIFERIN-SELENIUM COORDINATION COMPLEXES

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In this work the synthesis, purification, and spectral analysis of mangiferin (MF)-selenium (IV) coordination complexes are reported for the first time. The aim of this work is for increase the bioavailability of MF and evaluating their potential as potential new antitumor agents against solid tumors. The study variables of the synthesis reaction between MF (Nate Biotech, China, 95%) and sodium selenite (Fisher Sci, USA, 99%) were the stoichiometric ratio of MF: Se, pH, temperature, and reaction time using methanol (Carlo Erba, Italy) as the solvent. The best results of MFSe complexes were obtained at pH = 8.0, room temperature (25 °C), and 4 h of reaction. The pH adjustment was achieved with the addition of triethylamine (Sigma, USA, 99%). The solvent was removed by under vacuum rotaevaporation (Yamato, Japan, model R202A), and the reaction product was placed in a vacuum desiccator for 48 h. The separation was performed on a gel filtration chromatography column LH20 at atmospheric pressure (LH-20, Cytiva, Sweden) with methanol as the mobile phase. The results of the spectral analysis of the complexes (HPLC-MS, FT-IR, and 1H-NMR) are shown.

Keywords: Magiferin, synthesis, mangiferin (MF)-selenium (IV) coordination complexes, putification, spectral analysis.

Modality of presentation: Poster

PN16/SYNTHESIS OF INDIUM, GALLIUM AND SAMARIUM DIACETYLCURCUMIN COMPLEXES AND BIOLOGICAL EVALUATION

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Natural products represent a source of bioactive molecules with diverse applications in food, supplements, drug development, and materials. The rhizome of *Curcuma longa* is characterized by containing curcuminoids, including curcumin, demethoxycurcumin, and bisdemethoxycurcumin. Reports reveal its antioxidant, anti-inflammatory, neuroprotective, anticancer properties, and anti-Alzheimer's disease. Structurally, curcuminoids consist of a β-diketone group bonded to an unsaturated diarylheptanoid chain, which contributes to their potential optical properties. However, the low solubility and bioavailability of these curcuminoids limits their efficacy to overcome these inconveniences, structural modification and chelating with metals have been done. Diacetylcurcumin (DAC) is a derivative of curcumin in which phenolic groups are converted into esters. In the present work, the metal-complexes of DAC with indium, gallium and samarium were synthesized and characterized by spectroscopic and spectrometric techniques. Additionally, its antioxidant and cytotoxic activities were evaluated. The results indicated that the stoichiometry of DAC-Ga complex was ML2 and ML3 for DAC-In and DAC-Sm complexes, with yields of 60-76%. The maximum absorption band of the metal complexes (416-417 nm) were slightly red-shifted compared with DAC (408 nm) maximum absorption band, maintaining their spectrophotometric properties. The DAC-Sm complex (IC_{50}= 1.71±0.25 μM) exhibited the best capacity to inhibit lipid peroxidation compared to DAC (IC_{50}= 3.14±0.28 μM), also inhibited cell growth of U251 (100%), K562 (81%), MCF7 (68%) and SKLU-1 (59%) cancer cell lines at 10 μM. The DAC-In and DAC-Ga complexes were inactive in these evaluations. DAC-Sm complex is still unexplored and the improvement in its biological activity motivates further investigations.

Keywords: diacetylcurcumin, samarium, indium, gallium, metal complexes, antioxidant, cytotoxic

Modality of presentation: Poster

PN17/ANTIOXIDANT CHARACTERIZATION OF AN ANTI-AGING FACIAL COSMETIC

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Skin aging is a time-dependent process of the organism and is accelerated by different extrinsic factors such as UV rays mainly from sunlight. Its effects can be prevented and repaired by using cosmetic treatments designed with this objective. Natural cosmetics have experienced a great boom and currently there is a greater demand for these products due to the benefits generated in the health of consumers and their friendly relationship with the environment. Natural components such as *Plukenetia volubilis L* oil and sericin hydrolysate, with significant antioxidant characteristics, would provide more effective formulations to treat skin aging. Objective: To evaluate the antioxidant properties, photoprotective capacity and safety of the anti-aging facial cosmetic composed of the biological active ingredients *Plukenetia volubilis L* oil and Sericin hydrolysate. The antioxidant capacity of the anti-aging facial cosmetic was evaluated through the quantification of phenols and the FRAP and DPPH methods. Its photoprotective capacity against UV rays was measured by calculating the Sun Protection Factor. Its safety was determined using *in vivo* methods of dermal and ophthalmic irritability. The phenolic content was 0.889 ± 0.056 mg AG equivalent/g of product. The results obtained in the FRAP and DPPH methods were 229,220 µM AAsc equivalent/mL and 5,858 ± 0,497 µM Trolox equivalent/mL, respectively. The sun protection factor was 6.14. It was not classified as a dermal or ophthalmic irritant. The anti-aging facial cosmetic demonstrated to have antioxidant and photoprotective capacity and to be safe, which will contribute to delaying aging.

Keywords: skin aging, antioxidants, photoprotection, safety, anti-aging facial cosmetic

Modality of presentation: Poster

PN19/INCLUSION COMPLEXES OF BETA-CYCLODEXTRIN AND DIACETYLCURCUMIN WITH ZN(II) AND MG(II) OBTAINED THROUGH MECHANOCHEMISTRY: STRUCTURAL CHARACTERIZATION, SOLUBILITY AND CYTOTOXICITY

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The synthesis of inclusion complexes with Beta-cyclodextrin (beta-CD) with metal complexes of diacetylcurcumin (DAC) with zinc(II) and magnesium(II) was achieved through a mechanochemical route. The metal complexes and their corresponding inclusion complexes were characterized using physicochemical and spectroscopic methods such as: melting points, Fourier transform infrared spectroscopy, ultraviolet-visible spectrophotometry (UV-Vis), mass spectrometry, nuclear magnetic resonance in liquid (^{1}H NMR) and solid states (^{13}C NMR, CP-MAS), thermogravimetric analysis and differential scanning calorimetry. Additionally, comparative assays of aqueous solubility and cytotoxicity were conducted between the metal complexes of diacetylcurcumin and their inclusion complexes. The results of ^{1}H NMR and UV-Vis confirmed that the inclusion complex DAC-Zn/beta-CD presents a 1:2 stoichiometry, while mass spectrometry allowed us to propose two forms of association of beta-CD with the metal complex DAC-Zn (inclusion and association). In the case of DAC-Mg/beta-CD, one molecule of DAC-Mg is detected associated with one molecule of beta-CD, forming an inclusion complex with a 1:1 stoichiometric relationship. The inclusion complexes DAC-Zn/beta-CD and DAC-Mg/beta-CD showed a significant increase in cytotoxic activity against the studied cancer cell lines compared to their guest molecules, DAC-Zn and DAC-Mg, respectively. This result corresponds to the increase in their solubilities in aqueous medium, which was 4 and 5 times greater compared to the metal complexes, DAC-Zn and DAC-Mg, respectively. These results demonstrate the importance of improving the solubility and consequently the bioavailability of curcuminoid metal complexes in physiological assay media through the formation of inclusion complexes with Beta-cyclodextrin.

Keywords: diacetylcurcumin; metal complexes; inclusion complexes; beta-cyclodextrin complexes; solubility, antitumoral activity

Modality of presentation: Poster

PN20/ESSENTIAL ASPECTS OF PROTOCOL TO CONDUCT A CLINICAL TRIAL TO NUTRITIONAL SUPPLEMENT DEPREXIL®

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Clinical trials for natural products should be designed ensuring quality clinical research that provides knowledge of therapeutic, prophylactic and diagnostic interest. Deprexil® oral solution is a product designed and manufactured by Laboratorios Catalysis S.L.; as functional nutritional supplement, which consists of diverse active subtances: L-Arginine, L-Carnitin, Extract of aerial parts of Alfalfa, Extract of the leave of Ginkgo, Vitamin C, L-aspartic acid, Vitamin B6, Folic acid and selenium. All these substances together help to prevent neurodegenerative processes, dementia, depression and anxiety. Objective: To describe essential aspects of the design of the protocol of the clinical trial of the nutritional supplement Deprexil® to comply with regulatory requirements. The developing process of the protocol of the clinical trial of nutritional supplement Deprexil® from Laboratorios Catalysis, SL, was deepened taking into account the guideline to create a protocol of CENCEC, based on national and international regulations for natural products. The main variables of the designed protocol were life quality and safety of nutritional supplement Deprexil® together with the treatment of cognitive stimulation in patients with mild cognitive impairment and mild Alzheimer disease. A controlled, placebo, randomized and double blind study was used to increase the probability of comparing different treatment groups, to minimize selection biases, to obtain reliable and valid scientific data with a sample size of 100 subjects. The assessment of life quality and safety were defined as specific objectives. The essential aspects of the developed protocol design complied with regulatory requirements for natural products. This allowed its approval by the Ethics committee of Research, the regulatory authority and the beginning of the clinical trial.

Keywords: Clinical trials, Deprexil®, nutritional supplements

Modality of presentation: Poster

PN21/ENHANCEMENT OF HDL QUANTITY AND QUALITY BY CUBAN POLICOSANOL (RAYDEL®) TO TREAT HYPERTENSION AND DYSLIPIDEMIA: COMPARISON WITH COPYCAT AND SUGARCANE EXTRACT POWDER

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Policosanols offer several beneficial effects to treat dyslipidemia and hypertension; however, a comprehensive functionality comparison of various policosanol brands has yet to be thoroughly explored. The efficacy of Cuban sugarcane-extracted policosanol (Raydel®), a purified blend of eight long-chain aliphatic alcohols, was compared to copycat sugarcane-extract powder (SCEP) to assess their effects on dyslipidemia, oxidative stress, and vital organs of zebrafish under the influence of a high-cholesterol diet (HCD). Zebrafish were fed with HCD (final 4%, w/w) infused either with the policosanol (PCO, final 1%, w/w) or SCEP (final 1%, w/w). Post 14-week consumption blood and organs were harvested and processed for the pathological examination. Following 14-week consumption, the PCO-supplemented group exhibited higher zebrafish survival probability (0.95), which was substantially compromised in the SCEP supplement group (0.84). Both PCO and SCEP showed a substantial impact in ameliorating the HCD-disrupted plasma lipid profile; however, the PCO supplementation exhibited a significant (p<0.05) better effect, showing a 13.1% reduction in total cholesterol (TC), a 25.3% decrease in triglycerides (TG), and a 16.7% increase in high-density lipoprotein cholesterol (HDL-C) compared to the SCEP. Likewise, significantly (p<0.001) 1.2-fold and 1.6-fold higher plasma ferric ion reduction ability (FRA) and paraoxonase (PON) activity were noticed in the PCO-supplemented group than the SCEP consumed group. The HCD disturbed blood glucose level, malondialdehyde (MDA), and sulfhydryl content were substantially reverted by PCO, while SCEP supplementation proved ineffective. PCO supplementation displayed a substantial inhibitory effect against HCD-induced hepatomegaly, hepatic damage, fatty liver changes, and inflammatory markers. Furthermore, PCO mitigates HCD-induced nephromegaly, reactive oxygen species (ROS) generation, and senescence, whereas SCEP exhibits no therapeutic efficacy. Likewise, PCO effectively protects the brain against HCD-triggered ROS, apoptosis, and accumulation of oxidized lipids 4-hydroxynonenal (4-HNE); in contrast, SCEP supplementation showed almost no effect in reducing such adverse changes. Conclusion: The comparative finding between PCO and SCEP highlights the protective effect of PCO against HCD-posed oxidative stress and dyslipidemia via the enhancement of antioxidant markers leads to protection of liver, kidney, and brain, while SCEP failed achieve similar outcomes. Cuban policosanol (Raydel®) has more desirable properties for the *in vitro* synthesis of rHDL with stronger anti-glycation and antioxidant activities than those of Chinese policosanol (BOC Sciences).

Keywords: Cuban Policosanol, hypertension, dyslipidemia, oxidative stress, zebrafish

Modality of presentation: Lecture

PN22/ LONG-TERM BENEFITS OF POLICOSANOL+ASPIRIN IN THE FUNCTIONAL RECOVERY OF NON-CARDIOGENIC ISCHEMIC STROKE (NCIS) AND ASSOCIATED POST-STROKE COGNITIVE IMPAIRMENT (PSCI)

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Stroke is a leading cause of mortality and long-term disability, including PSCI. Previous studies with policosanol 20mg/day (poli 20) + aspirin (AS) 125 mg/day exhibited short and long-term benefits in the functional recovery of patients with a recent NCIS. The effects of poli 20 + lower AS doses on NCIS recovery and long-term PSCI remained unexplored. This study investigated the long-term effects of poli 20 + AS 81mg/day (poli/AS) on functional and cognitive outcomes in patients with NCIS compared to placebo + AS 81mg/day (pla/AS). This was a randomized, double-blind study. Patients with NCIS, a modified Rankin Scale score (mRSs) of 2 – 4, and PSCI confirmed by Luria's test, were randomized, within 30 days of stroke onset, to poli/AS or pla/AS for 12 months. The primary outcome anticipated significantly more poli/AS patients achieving mRSs ≤1 than pla/AS patients. Secondary outcomes included a significant increase of Barthel Index with poli/AS along with a PSCI improvement at 1-year post-stroke, both compared to pla/AS. Changes on lipid profile were monitored. Of 100 randomized patients, 98 completed the study. Significantly more poli/AS patients (46/50, 92%) ($p<0.001$) than pla/AS patients (23/50, 46%) achieved mRSs ≤1. Poli /AS significantly lowered mRSs ($p<0.001$), whilst increasing Barthel Index ($p<0.01$) both versus baseline and pla/AS). More poli/AS (31/50, 62%) than pla/AS patients (14, 28%) achieved PSCI improvement. Lipid profile benefits and good tolerability were confirmed. This study demonstrates, for the first time, that poli/AS significantly improved the functional recovery and long-term residual PSCI after suffering a NCIS, versus pla/AS.

Keywords: non-cardiogenic ischemic stroke, post-stroke cognitive impairment (PSCI), aspirin, modifies Rankin scale, Barthel Index, Luria test, policosanol, placebo

Modality of presentation: Lecture

PN23/POLICOSANOL (SUGARCANE WAX ALCOHOLS) 20 MG/DAY IN CUBAN PRE-HYPERTENSIVE OR GRADE I HYPERTENSIVE PATIENTS: A RANDOMIZED, DOUBLE-BLIND, MULTICENTRE STUDY

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To evaluate the effects of treatment with policosanol on blood pressure values and lipid profile in patients with pre-hypertension or grade I hypertension, as well as its safety and tolerability in these types of patients. The study had a multicenter, randomized, double-blind, placebo-controlled design, in outpatient conditions, with two parallel groups that received policosanol (20 mg/d) or placebo for twelve weeks. The sample consisted of 400 patients: 200 patients with pre-hypertension (SBP: 120-139, DBP: 80-89 mmHg) and 200 patients with grade I arterial hypertension (SBP: 140-159, DBP: 90-99 mmHg). with one or two cardiovascular risk factors, without prior antihypertensive treatment, of both sexes, aged between 20 and 59 years, without a history of diagnosed vascular diseases. For each stratum: Stratum 1 (pre-hypertensives) and Stratum 2 (grade I hypertensives) the same treatment groups were established. The primary efficacy variable was the significant reduction in systolic and/or diastolic blood pressure values with respect to the beginning and the placebo group, while the secondary efficacy variables were considered to be the significant reduction in the levels of LDL-C and total cholesterol, as well as a significant increase in HDL-C. 400 patients were included in the study (200 with pre-hypertension and 200 with grade I arterial hypertension). At the end of 12 weeks of treatment, policosanol significantly reduced systolic and diastolic blood pressure values (main efficacy variable) compared to initial values and the placebo group. Policosanol also significantly reduced LDL-C and total cholesterol levels, in addition to increasing HDL-C levels (secondary efficacy variables) compared to baseline values and the placebo group. Policosanol was safe and well tolerated. Policosanol (20 mg/d) for twelve weeks reduced blood pressure values both in pre-hypertensive patients and in patients with grade I arterial hypertension, in addition to producing a beneficial effect on their lipid profile, being safe and well tolerated.

Keywords: policosanol, pre-hypertension, grade I hypertension, blood pressure, lipid profile

Modality of presentation: Oral

PN24/*ACROCOMIA CRISPA* EXTRACTS WITH ANTIOXIDANT, ANTI-INFLAMMATORY AND PROTECTIVE PROPERTIES IN EXPERIMENTAL MODELS OF ACUTE KIDNEY INJURY AND DIABETES

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Acute kidney injury and diabetes mellitus represent a serious global health problem due to their high morbidity and mortality. Oxidative stress and inflammation play a fundamental role in the development and progression of these diseases, which supports the efficacy of natural extracts with antioxidant and anti-inflammatory properties on both pathologies. Polar and apolar extracts obtained from the fruit of *Acrocomia crispa* (Arecaceae), rich in medium-chain fatty acids and polyphenols, respectively, inhibited lipid peroxidation *in vitro* and *in vivo*, as well as prevented protein oxidation *in vivo* and increased catalase enzymatic activity; effects associated with the sequestration of hydroxyl radicals and iron ions. In addition, they presented the profile of dual anti-inflammatory agents by inhibiting the enzymatic activities of lipoxygenase and cyclooxygenase *in vitro* which supports its anti-inflammatory effects *in vivo* in models of acute and chronic inflammation. The apolar extract, administered orally, protected against renal I/R- and kanamycin-induced renal damage by reducing serum levels of urea, uric acid, and creatinine, as well as histopathological damage in the kidney; it also exerted antioxidant and anti-inflammatory effects. Oral administration of the polar extract prevented hyperglycemia and body weight loss induced by streptozotocin and dexamethasone in rodents, while decreasing histological damage and inflammatory cell infiltration in the pancreas, and exerting antioxidant and anti-inflammatory effects.

Keywords: Diabetes mellitus, Acute kidney injury, antioxidant, anti-inflammatory, Acrocomia crispa

Modality of presentation: Oral

PN25/CHARACTERIZATION AND STABILITY STUDY OF ACTIVE INGREDIENT D-014, OBTAINED FROM CUBAN COROJO (*ACROCOMIA CRISPA*)

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D-014 is a new active ingredient, composed of medium-chain fatty acids (C12 – C18), and polyphenols (piceatannol and resveratrol), among other compounds, with the potential to prevent type 2 Diabetes Mellitus by preventing hyperglycemia, as well as metabolic and oxidative stress alterations associated with the experimentally induced diabetic state in animal models. This active ingredient is obtained from dried and milled whole fruits of Cuban corojo palm (*Acrocomia crispa*), a Cuban endemic species of the Arecaceae family. Taking into account the potential use of this active ingredient, its preliminary quality specifications were determined by analyzing 12 batches, based on its organoleptic characteristics, loss on drying, relative density, refractive, acidity and saponification index, unsaponifiable material content, and total fatty acid and polyphenols contents. Its stability was studied in amber glass bottles, under accelerated stability conditions (40°C and 75% HR) for 12 months, and under conditions of refrigeration (8°C) and Climatic Zone IV (30°C and 75% RH). The quality parameters of D-014 met the requirements of the pharmaceutical industry.

Keywords: Phytopharmaceuticals, D-014, characterization, stability

Modality of presentation: Oral

PN26/EFFECTS OF *ACROCOMIA CRISPA* EXTRACTS ON METABOLIC COMPLICATIONS ASSOCIATED WITH REDOX IMBALANCE IN DIABETES

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Diabetes mellitus is a disease characterized by a state of chronic hyperglycemia that develops concurrently with a redox imbalance, triggering complications related to disturbances in the metabolism of carbohydrates, proteins, and lipids. Natural substances with antioxidant effects have been shown to be effective in reducing blood glucose levels; among which are medium-chain fatty acids and polyphenols. The objective of this study was to evaluate the effects of an extract obtained from the fruit of *Acrocomia crispa* on metabolic parameters and oxidative stress markers in rats with streptozotocin-induced diabetic complications. The extract of *Acrocomia crispa*, rich in polyphenols and medium-chain fatty acids, was administered orally at doses ranging from 0.5 to 100 mg/kg for 30 days. Indicators of renal and hepatic damage, as well as redox status variables, were determined. The results demonstrate the hypoglycemic effect of the studied extract, as well as its ability to restore the redox balance and the variables associated with metabolic, hepatic, and renal complications, which are characteristic of diabetes. In conclusion, the extract of *Acrocomia crispa* represents a potential therapeutic candidate for the treatment of diabetes and its complications.

Keywords: Diabetes, *Acrocomia crispa*, oxidative stress, polyphenols, fatty acids

Modality of presentation: Oral

PN27/PROTECTIVE EFFECTS OF *ACROCOMIA CRISPA* FRUIT EXTRACT ON PANCREAS HISTOLOGY IN EXPERIMENTAL DIABETES

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Diabetes mellitus is a chronic disease associated with alterations in the functioning of the pancreas, due to dysfunction and death of ß cells in the islets of Langerhans (IL). Taking into account the hypoglycemic properties of an extract obtained from the fruit of *Acrocomia crispa*, this work focused on evaluating its effects on the histological structure of diabetic rat's pancreas. Oral repeated treatments with *A. crispa* extract were evaluated in two experimental series. At the first one, diabetes was induced with alloxan (120 mg/kg) and *A. crispa* extract (5 and 100 mg/kg) was administered during 15 days. In the another series, streptozotocin (60 mg/kg) was used to induce diabetes and *A. crispa* extract (0.5- 25 mg/kg) was given through 30 days. In histological sections of the pancreas, insulitis score, ILs count, total area of the IL, and density of ß cells were calculated. Diabetes induced significant increase of insulitis as well as reduction of IL area and ß cell density. The extract of *A. crispa*, at the assayed doses, favored morphological recovery of the ILs and the decrease of inflammatory cell infiltration, thus significantly reducing the grade of insulitis in both diabetes models. In addition, it significantly increased IL area and ß cell density (alloxan-induced diabetes) and IL number (streptozotocin -induced diabetes). In conclusion, *A. crispa* extract exerts protective and anti-inflammatory effects on the pancreas of diabetic rats, possibly associated with the presence of resveratrol and piceatanol in its composition, which present hypoglycemic, anti-inflammatory and antioxidant effects.

Keywords: Diabetes mellitus, pancreas histology, islets of Langerhans, ß cells

Modality of presentation: Oral

PN28/EFFECTS OF *ACROCOMIA CRISPA* FRUIT EXTRACT ON RENAL MORPHOFUNCTIONAL CHANGES IN DIABETIC RATS

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The oxidative and inflammatory processes involved in diabetes mellitus result in kidney damage. An extract obtained from *Acrocomia crispa* fruits contains polyphenols and fatty acids that are associated with preventing diabetes and kidney damage through antioxidant and anti-inflammatory mechanisms. The objective of this study was to evaluate the effects of *A. crispa* extract on renal morphofunctional changes in two rat models of diabetes. Animals were randomized in three experimental groups for each model: a positive control (alloxan 120 mg/kg or streptozotocin 60 mg/kg), a healthy negative control and one treated with repeated oral doses of *A. crispa* extract (5 mg/kg). Routine histological technique was used to process the kidneys; wherein the histopathological grade of damage at the glomerular, tubular, and interstitial levels was assessed in five cortical fields. Positive controls showed glomeruli with synechiae and enlarged mesangium, focal tubular degeneration, and mild interstitial inflammatory infiltration. *A. crispa* extract significantly decreased renal histopathological changes at the glomerular and interstitial levels in both models, while it only reduced tubular damage in the streptozotocin induced diabetes model. In summary, *A. crispa* extract prevented kidney damage associated with alloxan- or streptozotocin-induced diabetes by decreasing histopathological markers of kidney damage; these effects could be related to its antioxidant and anti-inflammatory properties.

Keywords: Kidney damage, diabetes mellitus, *Acrocomia crispa* extract, renal histopathology

Modality of presentation: Oral

PN29/EVALUATION OF *CHLAMYDOMONAS REINHARDTII* AS A FUNCTIONAL FOOD

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Microalgae are a group of autotrophic microorganisms and found in freshwater, marine and soil ecosystems. It is not only rich in nutrients such as protein, but also has a variety of biologically active substances, such as unsaturated fatty acids (DHA, EPA, AA, etc.), carotenoids (β-carotene, astaxanthin, lutein, zeaxanthin, etc.), pigment-protein complexes (phycocyanin, phycoerythrin, etc.), polysaccharides, active peptides, etc.,so it is widely used in various nutritional products and dietary supplements.As a good model organism, the unicellular algae *Chlamydomonas reinhardtii* is used for theoretical research on molecular and cell biological processes.In 2019, it was recognized as a "Generally Regarded as Safe"(GRAS) by the USA Food and Drug Administration(FDA) and can be consumed in unlimited quantities. It has been approved for sale as a "new food raw material" in Europe, the United States, Singapore, China and other places, and has broad application market prospects. This project uses the independently developed high-density culture technology of *C. reinhardtii* to solve the current problems of low yield, easy contamination, and unstable quality between different batches in open culture of algae production. The fermentation culture method greatly increases the biomass of *C. reinhardtii* and efficiently empowers output value. The laboratory uses CRISPR-Cas9 gene editing technology, UV and ARTP mutagenesis and other technologies to genetically improve algae species and screen strains with higher nutritional value. They can then be applied to various functional foods and health products, enriching existing food varieties, meeting the people's increasingly diversified food consumption needs, and promoting the high-quality development of the functional food industry.

Keywords: *Chlamydomonas reinhardtii, functional food, microalgae*

Modality of presentation: Oral

PN30/EVALUATION OF ANTI-AGING PROPERTIES OF PEPTIDE EXTRACT OBTAINED FROM ENZYMATICALLY HYDROLYZED QUINOA PROTEIN (*CHENOPODIUM QUINOA*)

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Currently, skin aging is a problem with a growing effect that affects the self-esteem and health status of the population. The development of products of natural origin has proposed a new alternative to this challenge and bioactive peptides or protein hydrolysates have shown to have different biological activities. In this way, the present research sought to evaluate the anti-aging properties of a peptide extract obtained from the enzymatic hydrolysis of quinoa protein using actinidin as an enzyme. From the execution of the enzymatic hydrolysis, a degree of hydrolysis (DH) of 21.96 % was obtained, and when evaluating the anti-aging properties of the peptides, an antioxidant activity of 77.2 % and collagenase enzyme inhibition activity of 87.9 %, were obtained. Finally, elastase enzyme inhibition activity of 30.98 % was reached. The attributes of the peptides derived from quinoa protein were demonstrated.

Keywords: Bioactive peptides, anti-aging, quinua, actinidin, enzymatic hydrolysis

Modality of presentation: Oral

PN31/RECENT DEVELOPMENTS IN CHARACTERIZATION AND STABILITY STUDIES OF NEW VASOACTOL FORMULATIONS

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Film-coated tablets containing 6 mg of the Active Ingredient (AI) Vasoactol have been marketed in Cuba and other countries since the 1990s for their antioxidant and ergonenic properties, with excellent acceptance by patients. This AI, which is extracted and purified from Cuban refined sugar cane (*Saccharum officinarum*) wax, contains fatty alcohols from 24 to 34 carbon atoms as main components, as well as very long chain fatty acids in smaller proportions. New formulations of Vasoactol have been recently developed in different laboratories, namely "Pharmaceutical Laboratory Oriente", "Pharmaceutical Company March 8", and "National Center for Scientific Research". These new formulations, also containing 6 mg of AI, were another tablet formulation without coating, hard gelatin capsules and softgel capsules with the AI microparticulated in a vegetable oil. Chemical-pharmaceutical development of these new formulations has required their characterization, quality control and stability studies. Results of these works validated that new formulations fulfill current pharmaceutical requirements. Accelerated and climatic zone IV stability studies of these new products demonstrate the same high stability of original tablets of Vasoactol, corroborating the high intrinsic stability of this AI.

Keywords: Vasoactol, pharmaceutical formulation, tablets, capsules, stability

Modality of presentation: Oral

PN32/PALMEX®: A THERAPEUTIC OPTION FOR MANAGEMENT OF LOWER URINARY TRACT SYMPTOMS IN MEN WITH BENIGN PROSTATIC HYPERPLASIA

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Benign prostatic hyperplasia (BPH), a common urological disease in aging men. Pharmacological treatment of BPH includes inhibitors of prostatic 5α-reductase, ADR-α1 antagonists, combination therapy and phytotherapeutic options. The lipid extract of the fruits of the Cuban royal palm (*Roystonea regia*) (Palmex®) has been shown to improve lower urinary tract symptoms (LUTS) in patients with BPH, an effect that seems to be attributable to multiple mechanisms such as the inhibition of prostatic 5α-reductase and the antagonism of α1-ADR receptors as the most important, but also to the contribution of antioxidant and anti-inflammatory effects. The objective of the work was to evaluate and compare the efficacy, safety and tolerability of treatment with Palmex®, saw palmetto, finasteride, terazosin or tamsulosin administered for six months to patients with BPH. The present analysis includes the data of all patients included in randomized, double-blinded, short-medium, comparative, and long-term clinical studies. Studies included ≥ 40 years' men, with evidence of the LUTS according to International Prostate Symptoms Score (IPSS). Primary study outcome was the improvement of maximum urinary flow (Qmax), while significant decreases of IPSS values, prostate size, and residual post-voiding volume were secondary efficacy variables. Statistical analysis according to Intention to treat. Six hundred night patients with diagnosis of BPH were included in the treatment phase and received Palmex®, saw palmetto, finasteride, terazosin or tamsulosin. All groups exhibited a significant mean increase in Qmax from baseline to six months. Likewise, all the treatments significantly reduced the IPSS scores, also decreasing the prostate size and the residual post-voiding volume. No significant differences among the groups were found regarding any efficacy variable. In the long-term study, Palmex® also significantly reduced the IPSS scores. Palmex® demonstrated a comparable efficacy to saw palmetto, finasteride, terazosin and tamsulosin in patients with BPH, being safe and well tolerated.

Keywords: Palmex, Benign prostatic hyperplasia, LUTS, IPSS scores, Qmax
Modality of presentation: Oral

PN33/RESULTS OF THE RODENT QUARANTINE IN THE VIVARIUM OF THE NATURAL PRODUCTS CENTER DURING THE PERIOD 2023-2024

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Rodent quarantine in the vivarium not only protects the established colony but also offers direct benefits to the newly arrived animals. Gradual adaptation and reduction of stress caused by transport, early detection and treatment of potential health problems, and improved psychological well-being are essential aspects that vivarium staff take into account to benefit the newly arrived rodents, thereby improving their well-being. This work presents the results obtained during the quarantine of Sprague-Dawley rats between 2023 and 2024. Parameters such as body weight, food consumption, body condition, and behavior were evaluated. The results showed a linear increase in body weight compared to the initial weight during the quarantine period. Food and water consumption remained within the established range for the species. The animals were in good body condition, and no physical alterations were observed. The development of natural behaviors characteristic of the species was observed. No signs of acute or chronic stress were observed. We conclude that the absence of clinical or behavioral abnormalities confirms the successful adaptation of the animals during the quarantine period, ensuring an adequate state of well-being before their inclusion in the experimental protocols.

Keywords: Rodent quarantine, body weight, body condition, behavior and animal welfare

Modality of presentation: Oral

PN34/PRODUCTION OF A RECOMBINANT ENDODEXTRANASE VARIANT (R–TMDEX49A–ΔSP–ΔN30) IN KOMAGATAELLA PHAFFII (*PICHIA PASTORIS*) FROM SUGARCANE MOLASSES

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The presence of dextran in sugarcane juice (*Saccharum officinarum*) causes significant losses by increasing the viscosity of these juices and affecting the filtration, clarification and crystal formation process. Enzyme dextranase is commonly used to eliminate contamination by this polymer in the manufacture of sugar. The production of this enzyme from cheap substrates could be a profitable alternative for this purpose. In this work, the growth and production of dextranase TmDEX49A-ΔSP-ΔN30 by *Komagataella phaffi* DEX49A-ΔSP-ΔN30 was evaluated from different concentrations of free reducing sugars (20, 40 and 60 gL^{-1}) of final sugarcane molasses. The best concentration of free reducing sugars for the growth of *K. phaffii* DEX49A-ΔSP-ΔN30 and the production of the dextranase DEX49A was 40 gL^{-1} with an enzymatic activity of 203.2 $IU.mL^{-1}$. It was determined that the increase in agitation at 175 rpm favors microbial growth (13.8 gL^{-1}) and the production of dextranase DEX49A-ΔSP-ΔN30 (285.38 $IU.mL^{-1}$). DEX49A-ΔSP-ΔN30 was determined for its specificity and % dextran removal, which reached higher catalytic activity over 110 kDa dextran and 98.23 % dextran removal in sugar samples. Using a mathematical model, the empirical values of dextranase activity were adjusted as a function of pH and temperature where a maximum of activity was obtained (687,986 $U.mL^{-1}$) for a pH of 5.16 and at a temperature of 47.16 °C.

Keywords: recombinant endodextranase, dextran, *Komagataella phaffi*

Modality of presentation: Oral

PN35/RECOMBINANT DEXTRANSUCRASES TO PRODUCE DEXTRAN AND OLIGOSACCHARIDES FROM CANE SUGAR

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Dextran-type homoexopolysaccharides are among the first polymers of microbial origin to be produced on an industrial scale. They have a wide range of applications in the pharmaceutical, food, food, feed, cosmetic and chemical industries. Currently, dextrans are obtained from wild strains of the *Leuconostoc* genus, but recombinant variants that could in principle be more efficient are not available. The aim of this work is to obtain recombinant dextranasucrase enzymes, producers of linear dextrans and branched oligodextrans. The genes encoding the dextranasucrase enzymes DSR-V and DSR-F, from *Leuconostoc citreum* strains, were modified by site-directed mutagenesis and subsequently expressed in *E. coli* strains. As a result, the gene region encoding the DSR-V dextransucrase was isolated and it was shown that this enzyme produces a polymer identical to the commercial clinical grade dextran T 70 in terms of α (1-6) linkages content. On the other hand, a chimeric dextransucrase (DSR-F-ΔSP-ΔGBD-CBM2a) fused to a cellulose-binding protein domain (CBM2a) was constructed. This fusion, in addition to showing affinity for cellulose, maintained its peculiar transferase activity by synthesizing and/or branching oligodextrans of 8-12 glucose units. The enzymatic biocatalysts DSR-V and DSR-F constitute promising alternatives for the conversion of cane sugar into high molecular weight linear dextrans and branched oligodextrans, respectively.

Keywords: recombinant dextransucrases, dextran, *Leuconostoc citreum*

Modality of presentation: Oral

PN36/MEDICINAL PLANTS AS NATURAL REPELLENTS AGAINST MOSQUITOES

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In the Americas, more than 500 million people a year are at risk of contracting arbivirosis. The main culprit is the *Aedes aegypti* mosquito. As part of the measures taken by the National Health System to control the vector, the monitoring and management of resistance to the insecticides used are included. The present research allows the identification of medicinal plants with insecticidal and/or repellent action and their most frequent form of use. A study was carried out using the qualitative method, through a bibliographic and documentary review in digital data sources of wide scope (Google, Scielo, DOAJ, Latindex and SCOPUS). The quality and timeliness of the articles analyzed were taken into account. Plants with insecticidal action were divided into ovicides, larvicides and adulticides, taking into account the botanical species and the part of the plant used, *Moringa oleifera* having the best projection in this sense because it fulfills the three actions described. The repellent activity was divided into two aspects, direct use on the skin or as an environmental repellent. In the former, Allium sativum, *Cymbopogon citratus* and *Cymbopogon nardus* showed the best profiles. While in the use as an environmental repellent, other plants such as *Rosmarinus officinalis, Coffea arabica*, *Menta piperita*, among others, stand out. These results propose natural alternatives that are friendlier to the environment, as well as more environmentally friendly.

Keywords: medicinal plants, *Aedes aegypti* mosquito, repellent

Modality of presentation: Poster

PN37/PRECLINICAL STUDIES IN THE EVALUATION OF NATURAL PRODUCTS AT THE NATIONAL CENTER FOR SCIENTIFIC RESEARCH (CNIC)

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Preclinical research is essential to ensuring the safety of new pharmaceutical products, including those of natural origin, and is an essential requirement for conducting clinical trials and obtaining approval for use. It covers everything from chemical identification and product development to pharmacology and toxicology to assess its potential therapeutic effect and safety profile. Its success requires the contribution of study directors and qualified professional and technical staff from different specialties: chemists, pharmacologists, toxicologists, histopathologists, veterinarians, regulatory specialists and qualified support staff. The objective of this work was to show the potential of the Natural Products Center belonging to the CNIC to carry out the obtaining and development of new products of natural origin, covering the entire stage of preclinical trials. All preclinical studies, from Chemistry-Pharmaceutics, through Pharmacology and Toxicology, comply with good non-clinical laboratory practices, with all methods standardized and validated according to specific regulations, ensuring integrity, quality, and traceability of the data generated. Biological profile tests, whether pharmacological or toxicological, can be performed *in vitro* or *in vivo*, the latter being of greater scope. Toxicological tests, in particular, are certified by the Center for State Control of Medicines (CECMED) in Cuba, as toxicology is highly regulated internationally. These types of tests commonly include single doses, repeated doses, reproductive and developmental toxicity, as well as genotoxicity. The facilities meet the requirements, the staff is competent, the equipment is calibrated, and the testing systems are adequate. The use and care of laboratory animals is in accordance with ethical standards for this purpose and a determining factor in research is to minimize their unnecessary use. In conclusion, the development of preclinical studies of natural products at the CNIC allows for obtaining reliable, high-quality results to establish a safe dose range, providing data for the identification, evaluation, and management of risks for human use.

Keywords: Non-clinical GLP, natural products, preclinical test

Modality of presentation: Poster

PN38/ORAL ACUTE TOXICITY OF NEW EXTRACT FROM *ACROCOMIA CRISPA* FRUITS IN RODENTS

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D-014 is a new extract obtained from *Acrocomia crispa* (corojo palm) fruits, which contains polyphenols and a mixture of fatty acids, mainly lauric, oleic and myristic. Oral treatment with D-014 has reduced blood glucose levels in streptozotocin-induced diabetes in rats, which may potentially help mitigate type 2 diabetes progression and its complications. The objective of these studies was to determine the toxic effects of D-014 administered orally to female Sprague Dawley rats and NMRI mice, using the acute toxicity class method. The animals were randomly distributed into two experimental groups: a control group treated with the vehicle (Tween 65/water) and a group treated with D-014 at a dose of 2000 mg/kg of bodyweight. Animals were observed at different intervals during the first 24 hours and daily up to 14 days. Bodyweight was recorded at the day of dosing, to week, and at the time of sacrifice. Food consumption was controlled throughout the experience. There were no deaths or evidence of signs indicative of toxicity in any of the species. In the analysis of bodyweight and food consumption there were no significant differences between the treated groups and the controls. No macroscopic findings were observed during necropsies either. D-014 presented low intrinsic toxicity in rodents, showing toxicity greater than 2000 mg/kg of bodyweight, so its toxicity can be declared as not classifiable according to the class method of acute toxicity.

Keywords: *Acrocomia crispa*, diabetes, fatty acids, polyphenols, rodents, toxicity

Modality of presentation: Poster

PN39/ORAL SUB-CHRONIC TOXICITY TEST (90 DAYS) OF *THALASSIA TESTUDINUM* EXTRACT POWDER IN RATS CENP: SPRD

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Thalassia testudinum represents one of the most abundant seagrass species on the coast of Havana and the Caribbean in general. There are few reports in the literature on the potential of *T. testudinum* as an agent with possible therapeutic use. ICIMAR has developed an extract, with potential therapeutic use as a phytomedicine. The aim of this study was to determine the signs of manifest toxicity in Cenp: SPRD rats following repeated dose administrations. 4 experimental groups were formed: Control, Low, Medium and High Dose. with 20 animals, 10/sex except Control and High Dose. The study lasted 90 days plus 28 days of recovery. The substance was administered orally. Daily clinical observations were made, and body weight and food consumption were evaluated. Hematology and blood biochemistry examinations were performed on all animals at the beginning, at the end of the administration period and once the recovery period had concluded. A complete necropsy was performed on all animals. Post-mortem body weight and relative weight were determined. All organs and tissues were preserved for histopathological examination. The trial concluded with a survival of 99%. There were no clinical signs of toxicity in the animals or in body weight. Nor were any alterations indicative of biological damage detected in the hematological or biochemical variables, nor were any anatomopathological alterations attributable to the test substance found. It is concluded that after repeated doses of *Thalassia testudinum* extract in powder form orally for 90 days no toxic effects occurred at the doses evaluated.

Keywords: *Thalassia testudinum*, repeated dose toxicity, rats, extract

Modality of presentation: Poster

PN40/GENOTOXIC EVALUATION OF GROWTH REGULATING SUBSTANCES INTENDED FOR THE AGRICULTURAL SECTOR

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In Cuba, products with bioregulatory activity have been obtained. The development of these products must be carried out in parallel with an evaluation system that allows to know with certainty the impact on human, animal and environmental health that these products can cause. Therefore, it is essential to carry out a biological evaluation of these products, which includes studies on their possible toxic and genotoxic activity. Among the genetic assays with mammals, is the study in mouse bone marrow erythrocytes that has been widely used as an indicator of genotoxicity *in vivo*, so our main objective is to determine the genotoxic potential of jasmonic acid and the Indoleacetic acid. We used Cenp: NMRI mice of both sexes, administered orally, and two controls (negative (CN): sterile and positive water: cyclophosphamide 40 mg/kg), with a subacute treatment protocol (2x + 24h). The results show that there are no significant differences between the treatments, nor between the sexes with respect to the cytotoxicity index, there were no differences between the experimental groups treated with jasmonic acid and indoleacetic acid and the control group (water) in relation to the increase in micronucleated polychromatic erythrocytes. When analyzing these results, we can conclude that, under the conditions of the test and with the applied dose level, jasmonic acid and indoleacetic acid did not show clastogenic or cytotoxic effects in the bone marrow of the mouse

Keywords: bioregulatory activity, indoleacetic acid, jasmonic acid, mouse, toxic, genotoxic, clastogenic, cytotoxic

Modality of presentation: Poster

PN41/EVALUATION OF THE BIOLOGICAL AND DRUG-TOXICOLOGICAL EFFECT OF IL-2 MUTEIN NAFC IN MICE C57BL/6/CENP

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Interleukin 2 (IL-2) has been used in metastatic cancer therapy, but high doses induce severe toxicity. A new molecule of non-alpha mutein of human IL-2 was recently obtained, linked to the Fc component (IL-2 NAFc mutein), which has an increase in the serum half-life, so it should exert an antitumor effect at lower doses. It is necessary to evaluate its effectiveness and the toxicity it could cause. To evaluate the effect on experimental metastases of MB16F0 melanoma, C57Bl/6/Cenp mice were used, which received 5 x 104 melanoma cells through the tail vein and were administered different treatments applied intraperitoneally for 5 days. To evaluate the possible toxic effects, in C57Bl/6/Cenp mice, the therapeutic dose and a higher dose, 40µg (2X), were administered for 5 consecutive days, comparing it with its predecessor, the mutein obtained from *E. coli* and using IL-2-Fc as a positive toxicity control. It was found that Mutein IL-2 NAFc has an antitumor effect on lung metastases induced by MB16F0 melanoma using lower doses than its predecessor. In addition, this molecule causes less toxicity than IL-2 Fc, since administration at a therapeutic dose did not affect body weight values, it did not affect the values of: Red blood cell count, Leukocytes, transaminases, direct bilirubin, total proteins. It did not cause alterations at the administration site, nor variations in the weight of the liver, thymus, spleen and lungs.

Keywords: Interleukin 2 (IL-2), mutein, cancer, metastatic

Modality of presentation: Poster

PN42/INTEGRAL ANALYSIS OF HISTOPATHOLOGICAL CHANGES IN PANCREAS AND KIDNEYS OF DIABETIC RATS

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Diabetes mellitus (DM) is a chronic disease, being one of the top ten causes of death in Cuba. The evaluation of histopathological alterations of damaged organs in experimental models of DM is mainly performed using qualitative, semiquantitative or quantitative methods independently, which does not allow an accurate result. This work aims to design a methodological tool based on the dual application of semiquantitative and histomorphometric methods for evaluating histopathological changes in pancreas and kidneys of diabetic rats. Sprague-Dawley rats were divided into two groups: healthy and diabetic (Alloxan 120 mg/kg). After 15 days of DM progression, pancreas and kidneys were removed, fixed, paraffin embedded, and sectioned. Using hematoxylin and eosin stained sections, insulitis score was assessed in pancreas, while glomerular and interstitial damage scores, as well as glomerular area and diameter were evaluated in kidneys. Additionally, Gomori Aldehyde-Fuschin stain was used in pancreas sections to analyze the area of Langerhans islets and β cells density. Alloxan administration caused islets alterations, resulting in irregular shapes and leukocytosis, leading to a significant increase in insulitis and a significant decrease in both the area of the islets and β cells density. Also, there was an increase in the grade of glomerular and interstitial damage, along with a decrease in glomerular diameter and area in diabetic animals. The combined application of semiquantitative and histomorphometric methods allowed us to integrally characterize the histopathological changes in pancreas and kidneys of diabetic rats, which guarantees the possible use of this methodological tool in other models of DM.

Keywords: Diabetes mellitus, alloxan, pancreas, kidney, histopathology, methodological tool, rats

Modality of presentation: Poster

PN43/MONITORING AND QUARANTINE RESULTS OF NMRI AND C57BL/6 MICE HOUSED IN THE VIVARIUM OF THE NATURAL PRODUCTS CENTER

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Quarantine is an essential step in the reception of laboratory rodents before their incorporation into experimental tasks, as it allows the health status of newly admitted animals to be assessed, prevents the introduction of pathogens, and acclimatizes the animals to the environmental conditions of the vivarium. This procedure guarantees the health of the colony, the validity of the experimental data, and compliance with ethical and biosafety standards. This study aims to evaluate the adaptation of NMRI and C57BL/6 mice during the quarantine period from 2023 to 2024. Parameters such as body weight, food consumption, body condition, and the animals' behavior were assessed. The results obtained showed that during the quarantine period, both strains showed an increase in body weight and food consumption consistent with the values reported for the specie. They showed good body condition without physical alterations and exhibited normal behaviors for the specie and an absence of stereotypies or signs of stress. We conclude that the quarantine conditions of the vivarium were adequate for the animal welfare, ensuring that they are ready for experimental use.

Keywords: Quarantine, NMRI, C57BL/6, body weight, body condition, behavior and animal welfare
Modality of presentation: Poster

PN44/EVALUATION OF PHYSIOLOGICAL AND BEHAVIORAL PARAMETERS OF WISTAR RATS DURING QUARANTINE IN THE VIVARIUM OF THE NATURAL PRODUCTS CENTER

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During rodent quarantine, it is essential to evaluate physiological and behavioral parameters to monitor their health, adaptation to the environmental conditions of the vivarium, and the suitability of the animals for inclusion in experimental studies. Compliance with the quarantine period in rats is not only an ethical and legal requirement but also an essential practice that ensures the health and the animal welfare of the colony, contributes to generating reproducible scientific data, and guarantees the biosecurity of the vivarium. This study aims to present the results obtained during the quarantine of Wistar rats. Physiological parameters such as body weight, food consumption, body condition, and behavior were evaluated in the animals. The results obtained showed that the rats maintained a stable weight and food consumption within the ranges expected for the Wistar strain. They displayed good body condition with no physical signs of alteration and exhibited appropriate behavior. We conclude that the absence of clinical and/or behavioral abnormalities reaffirmed that the quarantine conditions of the vivarium were adequate for the successful adaptation of the animals, ensuring their readiness for experimental use.

Keywords: Quarantine, Wistar rat, body weight, body condition, behavior and animal welfare.

Modality of presentation: Poster

WORKSHOP: EVALUATION OF TECHNOLOGIES FOR THE EXTRACTION OF NATURAL PRODUCTS WITH ORGANIC SOLVENTS FOR USE IN THE PHARMACEUTICAL, FOOD AND COSMETIC INDUSTRIES. UNDP PÉREZ-GUERRERO FUND.

PN45/OPTIMIZING POLICOSANOL YIELDS: A CROSS-META ANALYSIS OF SIX MAIN BIOREFINING PROCESSES WITH UNCERTAINTY ASSESSMENT AND IBERO-AMERICAN INSIGHTS

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This Cross Meta-Analysis (CMA), registered in PROSPERO (CRD42023425955), addresses two knowledge gaps by conducting a regionalized and simultaneous analysis of articles and patents on six Policosanols (Pc) extraction routes. Using extensive databases and bibliometric tools (Bibliometrix, Biblioshiny, Orbit Business Intelligence, SciFinder, Web of Science, Scopus, and VOSviewer), this CMA examines 18 Ibero-American countries and global trends. This investigation gains significance from its dual context: the burgeoning global bioeconomy and strategies for pre-venting and treating cardiovascular diseases. Existing reviews on Policosanols (Pc) primarily focus on applications and testing, rather than extraction techniques, lacking regional perspectives and uncertainty assessments. This study addresses these gaps, employing a methodological framework supported by supplementary materials. The objectives include a state-of-the-art assessment, network analysis, trend identification, gap detection, ranking Pc extraction methods by yield (Y), and uncertainty evaluation. This systematic approach enables: 1. Comprehensive synthesis of findings; 2. Identification and mitigation of potential issues; 3. Adaptation and evaluation of procedures and criteria; 4. Objective appraisal of final syntheses; 5. Minimization of arbitrary decisions and rework; 6. Enhanced collaboration opportunities. Key findings indicate balanced bioeconomic competition in patent claims, the need for global cooperation and aca-demic-industry connections in Ibero-American countries, and notable contributions from Cuba, Spain, Brazil, Chile, Mexico, and Portugal. Covering 20 raw materials, yield analysis reveals: 1. High-yield routes ($0.511 \leq Y \leq 0.700$): three methods; 2. Moderate-yield routes ($0.381 \leq Y \leq 0.510$): four methods; 3. Low-yield routes ($0.251 \leq Y \leq 0.380$): seven methods.

Keywords: Cross Meta-Analysis, Cardiovascular disease prevention/treatment, Policosanol extraction yields, Uncertainty assessment, Ibero-American countries

Modality of presentation: Oral

PN46/STUDY ON THE SOLUBILITY OF POLICOSANOL IN ORGANIC SOLVENTS

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Policosanol (PC) is a mixture of long-chain fatty alcohols extracted from sugar cane wax that possesses anticholesterolemic and nutraceutical properties. No information on its affinity and solubility in organic solvents is reported in the scientific literature. The objetives of this work was to determine the Hansen solubility parameters (HSP) of PC, its solubility in hydrated ethanol, hexane and acetone, as well as to fit different solubility models of PC for each solvent. HSP of PC were determined according to the methodology described by Hansen, C. with the use of 32 different solvents and gravimetric determination of the soluble fraction to estimate its degree of solubility, according to the classification of the North American pharmacopoeia. Solubility was determined at temperatures of 10-50 ^{o}C and the use of GC to determine the alcohols solubility profile. Determination of HSP of PC showed that it is best represented by a double Hansen sphere, given its dual affinity with polar and non-polar solvents. The study of solubility in ethanol showed that alcoholic strength affects the solubility of PC, even with increasing temperature. The solubility in hexane was slightly higher than in acetone and, in both cases, the Apelblat, Buchowski, Akbari, Dideban and Farhang (ADF), theoretical and Hildebrand-Scott models were fitted. The study of the HSP of PC will allow the evaluation of other solvents for the extractive and purification processes of this product, while the solubility models obtained represent a contribution to the knowledge useful for the existing technologies.

Keywords: Policosanol, Hansen solubility parameters
Modality of presentation: Oral

PN47/TECHNO-ECONOMIC ANALYSIS OF ALTERNATIVES TO IMPROVE THE CUBAN SUGARCANE WAX REFINING TECHNOLOGY USING SUPERPRO DESIGNER

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Sugarcane wax is a co-product with attractive potential, in which several bioactive components are present for pharmaceutical and cosmetic purposes. Sugarcane wax is also considered a substitute for leading vegetable waxes in the international market. The extraction and refining technologies that have been reported in Cuba do not always manage to deliver a wax that meets the quality demanded by the market, a problem that finds a solution with the development of innovative technologies that allow increasing yields, quality and reducing costs. The main objective of this work is to achieve a validated model of the Cuban sugarcane wax refining process using the SuperPro Designer simulator and to evaluate alternatives in order to reduce consumption rates and increase stability in the final product quality, according to customer demand. The model obtained reproduced 39 of the 44 variables used for the validation of the process and their values are within the interval of the historical values of the process. The intervals in which the model does not reproduce the historical values, absolute error of these variables was less than 4 percentage units. When evaluating the proposed modifications, alternative number 2 showed a reduction in several consumption indices of the plant and a greater stability in the quality of the refined wax.

Keywords: Sugarcane wax, Biopharmaceuticals, Octacosanol, Superpro Designer, Refining wax process, Biorefinery, Ethanol

Modality of presentation: Oral

PN48/ENVIRONMENTAL IMPACTS OF SUGARCANE WAX BIORREFINING VIA SWENSON PROCESS: A LIFE CYCLE PERSPECTIVE WITH REGIONAL ANALYSIS AND SOLVENT CHOICE

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To reduce the negative impacts of the production cycle and improve the efficiency of raw cane wax production practices, a comprehensive understanding of its environmental impact is fundamental. Life Cycle Assessment (LCA) evaluates the full spectrum of environmental burdens associated with a product or process. This work conducts LCA of the Swenson Process (SP), focusing on comparative energy advantages in Northeast Brazil versus Cuba (Global Warming Potential over a 100-year timescale (GWP-100) and environmental impact assessment of heptane-based extraction versus toluene. The LCA was conducted using openLCA© software and Ecoinvent© database, monitoring 16 input and output variables in a production flow processing 15 t/h of filter cake to produce 5.54 t/d and 4.95 t/d of raw wax using heptane and toluene, respectively and with the aid of Montecarlo Simulation (MS). MS indicate that the total GWP-100 of the SP is (9.6±2.8) ×103 and (11.0±3.4) × 103 kg CO2 eq/t raw wax for heptane and toluene respectively in Cuba, while for Brazil these values decrease to (4.9±1.3) ×103 and (6.1±1.8) ×103 kg CO_2 eq/t raw wax, respectively. The analysis also revealed that while heptane showed no significant toxicity risks, toluene exhibited measurable human non-cancer toxicity effects. The lower GWP-100 impact estimated for Brazil versus Cuba, primarily due to differences in electricity grid composition, suggests significant environmental benefits for implementing this technology in this leading sugarcane-producing country. The LCA of SP for raw cane wax extraction demonstrates that the heptane-based process generates lower environmental impacts compared with toluene.

Keywords: Swenson Process, environmental impacts of solvents, filter cake valorization

Modality of presentation: Oral

PN49/GREEN EXTRACTION OF CITRUS RESIDUES: CHARACTERIZATION AND VALORIZATION FOR BIO-BASED MARKETS

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This study was conducted in partnership with a leading brazilian citrus juice company to characterize the residues generated from orange juice processing and develop a sustainable pectin extraction method using a green solvent. Physicochemical analysis of the peel flour revealed high levels of dietary fiber, polyphenols, and flavonoids, alongside strong antioxidant activity, suggesting potential in functional foods, cosmetics, and nutraceuticals. Citric acid was selected for its safety and alignment with food industry standards. Through an experimental design, pH (1.5–3.5), extraction time (60–120 min), and solid-to-liquid ratio (15–45) were varied, while the temperature was fixed at 70°C, resulting in a maximum pectin yield of 30% and an esterification degree of approximately 66%. These values confirm the effectiveness of citric acid as a green solvent, surpassing more aggressive acids. In addition to pectin, the residue can provide essential oils and other high-value compounds, further expanding its commercial potential. The process illustrates circular economy principles by transforming underutilized byproducts into valuable ingredients, reducing costs, and promoting “clean label” solutions. The sustainable use of citrus residues meets global demands for responsible industrial practices, strengthening competitiveness and broadening the market reach of citrus juice company. Future research will address scalability and economic feasibility on a larger scale, reinforcing the relevance of this method for innovation and corporate social responsibility.

Keywords: citrus residue, green solvent, citric acid, pectin extraction, degree of esterification, circular economy

Modality of presentation: Oral

PN50/SUPERCRITICAL CO_2 EXTRACTION OF *SCHINUS TEREBINTHIFOLIUS*: PROCESS OPTIMIZATION AND BIOINDUSTRIAL POTENTIAL

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This study evaluated the supercritical CO_2 extraction of *Schinus terebinthifolius* fruit under two temperature conditions (40°C and 60°C) at a constant pressure of 90 bar. At 40°C, the extraction yielded 0.152% (mass of extract per mass of biomass), which increased to 0.999% when the temperature was raised to 60°C. Chromatographic analyses revealed notable differences in composition: monoterpenes were more abundant in extracts obtained at 40°C, while sesquiterpenes became dominant at 60°C. These findings underscore the impact of temperature on both yield and chemical profile. Supercritical CO_2 extraction offers an environmentally responsible and solvent-free method of producing value-added components from *S. terebinthifolius*, preserving the integrity of thermolabile substances. The resulting extracts are rich in bioactive compounds, which may have diverse applications in sectors such as cosmetics, pharmaceuticals, and food technology. By enabling selective extraction without toxic solvents, this approach aligns with sustainable process development and can support the creation of high-value, plant-derived products for bioindustrial use.

Keywords: *Schinus terebinthifolius* extract; supercritical CO_2 extraction; terpenes; bioactive compounds; sustainable processing

Modality of presentation: Oral

PN51/SINGLE CELL PROTEIN PRODUCTION FROM LIGNOCELLULOSIC WASTES: AN EXPERIMENTAL MODEL APPROACH

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The increase of human population requires supply of protein in the form of meat, which must be produced from fish, chicken, cattle, among others. Thus, animal meal with high content of protein remains as a major problem to solve human needs of meat. Single Cell Protein (SCP), the dried cells of microorganisms, is rich in proteins and could be used as dietary base or as supplement. Thus, in this work we explored the used of *Trichoderma harzianum* to produce SCP using cellulose as model of lignocellulosic wastes in temporary immersion bioreactors. We observed depletion of 16 g of cellulose within 14 days of culture yielding up to 6 grams of SCP with crude protein content of 15 %. The use of temporary immersion bioreactors provided slightly better results than liquid culture in flasks, using only a fraction of electric energy since agitation was only pneumatically provided for 2 minutes every 3 hours. The novel use of these bioreactors is promising since bioreactor adaptation is feasible to heat the liquid phase up to 50° C to enhance cellulose hydrolysis and culture the fungi at safe temperature in the immersion chapter, seeking reduction of the process time.

Keywords: Single Cell Protein, Thrichoderma, immersion bioreactor

Modality of presentation: Oral (Virtual)

PN52/NEW PLANT CELL CULTURE PLATFORM FOR VINBLASTINE AND VINCRISTINE PRODUCTION

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Vincristine and vinblastine are potent plant antileukemics for several types of cancer. Unfortunately, the world faces shortages due to the current challenging production process based on extraction from *Catharanthus* foliage. Thus, novel processes must be developed. Plant cell suspension cultures of *Catharanthus* have been perceived as a feasible production platform but neither vincristine nor vinblastine are usually detected in suspension cultures, as confirm by our results. This can be attributed to the fact that their synthesis requires translocation of intermediates between specialized cells in plant tissues, which do not occur in suspension cultures. We then explored the used of cell organoids, tissues that self-organize in liquid culture in the form of spherules to acquire *in vivo*-like organ complexity seeking production of vincristine and vinblastine. This approach was successful and contents of vinblastine up to 0.12-0.18 mg/kg were confirmed by tandem liquid chromatography quadrupole time of flight mass spectrometry while fine suspension cultures were unproductive. Consequently, we concluded that cell organoids of *Catharanthus* is a promising platform to produce vinblastine.

Keywords: *Catharanthus*, vinblastine, plant cell culture

Modality of presentation: Oral (Virtual)

PN53/XYLITOL PRODUCTION BY NATIVE MICROORGANISMS FROM LIGNOCELLULOSIC RESIDUES

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Xylitol ($C_5H1_2O_5$) is a five-carbon sugar alcohol primarily used in the pharmaceutical and food industries as an alternative sweetener to glucose and as a protective agent against tooth decay by controlling the growth of *Lactobacillus* and *Streptococcus mutans*. It has a sweetening power similar to sucrose but with a lower caloric value (2.4 cal/g). Xylitol is produced from commercial xylose, but this process is costly and not environmentally friendly. An alternative is to obtain xylose from the hydrolysis of hemicellulose present in sugarcane bagasse. However, yeasts capable of metabolizing this xylose and being tolerant to inhibitors such as furfural and hydroxymethylfurfural are required. Therefore, this work aimed to isolate, select, and identify yeast strains capable of metabolizing xylose to produce xylitol and being tolerant to inhibitory compounds like furfural and hydroxymethylfurfural present in acid hydrolysates rich in xylose from sugarcane bagasse. Additionally, it sought to obtain kinetic parameters of yields, productivity, and efficiency in fermentation. Ninety strains were isolated. After primary and secondary selection, yeasts of the genus *Meyerozyma sp.* and *Candida sp.* were identified, reaching xylitol concentrations up to 9.48 g/L at 92 hours of fermentation using xylose from lignocellulosic residues. This approach highlights the importance of biotechnology in the food industry, promoting the use of renewable resources and improving sustainability in the production of alternative sweeteners like xylitol

Keywords: xylitol, *Candida*, isolation

Modality of presentation: Oral (Virtual)

PN54/NEW ADVANCES IN POLICOSANOL RESEARCH

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The Active Pharmaceutical Ingredient (API) Policosanol is extracted and purified by original Cuban procedures from Cuban refined sugar cane (*Saccharum officinarum*) wax. The main components and quality chemical markers of this API are eight fatty alcohols from 24 to 34 carbon atoms, which are present in specific defined ranges. Nevertheless, these alcohols are not the only active component of Cuban Policosanol, where minor compounds also have pharmacological activity. The specific mixture of all compounds that make up Cuban policosanol act synergically, which guarantees the proved safety and efficacy of this API. Cuban policosanol tablets containing 5, 10 and 20 mg fatty alcohols have been marketed in various parts of the world since the 1990s. Despite the passage of time, global interest in this product continues and its sales continue to increase. Consequently, the development and stability studies of new up-dated formulations continues, namely tablets with aqueous coating, tablets with microparticulate API and hard gelatin capsules. Accelerated, climatic zone IV, and ongoing stability studies of these new formulations demonstrate the same high stability of original tablets (5-years shelf live). Additionally, new clinical trials continue to demonstrate new beneficial effects on patient health.

Keywords: Policosanol, pharmaceutical formulation, tablets, capsules, stability

Modality of presentation: Oral

PN55/THE PRODUCTION OF NATURAL COSMETICS AND SYRUP BASED ON THE PRINCIPLE OF SYMBIOTIC ECONOMY

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To live in good health, humans need pure water, healthy food, and clean air, all provided by our environment. However, modern societies have adopted an extractive economy, which harms ecosystems, biodiversity, water, air, and food. To break free from this, we must embrace a regenerative, collaborative, and symbiotic economy. This economy follows four principles of living systems: purify, regenerate, fertilize, and produce. For example, Phytobokaz produces Galba oil from *Calophyllum calaba*, cultivated through agroforestry and agroecology, where fauna and flora collaborate symbiotically. Domestic bees pollinate flowers, and bats harvest seeds, ensuring optimal ripening. The oil has antioxidant, anti-wrinkle, and regenerative properties, and its by-products, like fruit shells, are used to produce activated carbons that remove pharmaceutical residues. Another example is Virapic® syrup, made from *Neurolaena lobata* (herbe à pic), a plant used for over 5,000 years. In cultivation, it is grown with *Indigofera suffruticosa*, a nitrogen-fixing legume, creating a symbiotic system with bacteria, fungi, and plants. The syrup has antiviral and immunomodulatory effects, effective against RNA viruses like influenza, dengue, and COVID-19. Recent studies show that flavonoids and sesquiterpene lactones in *Neurolaena lobata* block viral replication and regulate immune responses. These productions require understanding biodiversity and technical processes from seed to finished product. This approach enhances biodiversity and ensures high-quality products, promoting a shift from scarcity to abundance.

Keywords: Natural products, symbiotic economy, interconnections, plant

Modality of presentation: Lecture (Virtual)

PN57/COMBINATION ANTI-CANCER THERAPY WITH NATURAL PRODUCTS AND INORGANIC PHARMACEUTICALS: A NEW DEVELOPMENT AGAINST TRIPLE NEGATIVE BREAST CANCER

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Triple negative breast cancer (TNBC) is a subtype of breast cancer that lacks estrogen, progesterone, and HER2 receptors. Therapeutic options for treating TNBC are limited, and the chemotherapeutic drug, cisplatin, reported various side effects. As reported in the literature, combination anti-cancer therapy with natural products and inorganic pharmaceuticals, e.g., cisplatin have been reported as early as 1991 to fight cancer.[1] To be honest, some new strategic approaches for cancer treatment, including the combination therapy of cisplatin and natural products, have been evaluated with some degree of success, but only a few reports have been published with non-platinum-based complexes. In this presentation, we will discuss our success with the synergy with combination anti-cancer therapy with natural products and some inorganic pharmaceuticals.

Keywords: Triple negative breast cancer; natural products; cisplatin; combination therapy

Modality of presentation: Lecture (Virtual)

PN58/UNCOVERING THE BIOSYNTHETIC PATHWAY OF CORIOLIC ACID THROUGH TRANSCRIPTOMIC AND MOLECULAR APPROACHES

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The species *Coriaria myrtifolia* L. accumulates in its seeds an unusual fatty acid known as coriolic acid, which holds potential value for various industries, including the chemical sector. This organic molecule consists of 18 carbon atoms and features two conjugated double bonds at positions Δ9 and Δ11 in cis/trans configuration, along with a hydroxyl group at position Δ13. The biosynthetic pathway responsible for coriolic acid production remains unknown. As the genome of *C. myrtifolia* is not yet available, two complementary approaches have been undertaken to investigate the biosynthetic route of this fatty acid and identify gene sequences involved in lipid accumulation. First, massive sequencing of the developing seed transcriptome, followed by in-depth analysis and read processing, has allowed the identification of putative enzyme sequences associated with triacylglycerol assembly and storage. Additionally, degenerate primers targeting conserved regions of candidate genes, fatty acid desaturases 2 (FAD2), were designed and used to amplify gene fragments from cDNA derived from developing seeds. These fragments were sequenced and used to obtain full-length coding sequences via gene-specific primers and rapid amplification of cDNA ends (RACE). Once complete coding sequences were retrieved, they were cloned and heterologously expressed in *Saccharomyces cerevisiae* and the oilseed plant *Camelina sativa* to functionally characterize the corresponding enzymes and elucidate their role in coriolic acid biosynthesis.
This work was funded by the Spanish Ministerio de Ciencia e Innovación through the grant PID2023-148125OB-I00.

Keywords: coriolic acid, unusual fatty acids, transcriptomics, heterologous expression, lipid biosynthesis
Modality of presentation: Oral

PN59/REGULATORY STRATEGY FOR TRADITIONAL AND COMPLEMENTARY MEDICINE DEVELOPMENT. A VIEW FROM CUBA

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Developing a comprehensive regulatory strategy is essential in navigating the development complex landscape of any medicinal product in order to ensure successful market entry. This strategy serves as a roadmap, aligning scientific innovation with regulatory requirements to bring safe and effective natural products, to focus on key components of a regulatory strategy, besides that, to describe the main elements to consider for herbal medicine development program and to illustrate the main herbal medicines in Cuba. The main components of a regulatory strategy are: target product, profile clinical and non-clinical development plans, engagement with regulatory authorities, **r**isk management and life cycle management. On the other hand, the non-clinical studies advances will be shown. The package of non-clinical studies should cover all information needed for the safe transposition of drugs from animals to humans. For traditional medicine is also important the ethnomedical evidence, taking into account different levels of evidence, in order to get the best results, it should be explored the most appropriate research approach and maximize the utilization of technology for TCM. Cuba has long tradition of using traditional medicine and there are some plants which have been investigated for medicines by meticulously planning and engaging with regulatory bodies, companies can navigate the approval process more effectively, bringing therapies to patients in need.

Keywords: Regulatory strategy, traditional medicine

Modality of presentation: Oral

PN60/FOS NUTRITIONAL SUPPLEMENT ENHANCES GROWTH AND IMMUNE SYSTEM IN TILAPIA LARVAE (*OREOCHROMIS NILOTICUS*)

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Aquaculture is an important economic activity worldwide, supplying the requirements of a considerable variety of nations. The larval stage is one of the most important periods during the production cycle in aquaculture. The present study investigates the effects of the prebiotic fructooligosaccharide (FOS), a sugar derivative of high added value, and the synthetic peptide GHRP-6 in the growth of fish, as well as its repercussion on a series of digestive enzyme activities and immune response parameters. Tilapias (*Oreochromis niloticus*) larvae were divided into three groups: group 1, fed with pre-formulated feed; group 2, fed with feed + FOS; group 3, fed with feed + GHRP-6. We measured the gain in size and weight at 72 and 87 days after starting the diets. We measured immune system parameters (lysozyme and anti-protease activity) and digestive enzyme activities (α-amylase, trypsin, and esterase activity) in larvae homogenates at the end of the trial. Results showed stimulation of growth (in both size and weight) in those fish fed with feed + FOS. Meanwhile, digestive enzyme activity was only stimulated in those fish fed with feed + GHRP-6 On rough terms, both food combinations stimulated the immune system. Our study suggests that both FOS and GHRP-6 could be very attractive additives to include into the tilapia larvae feeding and increase the efficiency of the production

Keywords: tilapia larvae, innate system, growth

Modality of presentation: Oral

SIMA 2025: VIII INTERNATIONAL SYMPOSIUM ON ENVIRONMENT

MA01/IMPACT OF CLIMATE CHANGE ON THE DURABILITY OF MATERIALS

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The entire infrastructure of civilization is based on the use of different materials. Buildings, structures, vehicles, communications, domestic and industrial equipment, hospitals, their equipment and instruments, and others are part of today's civilization. Greenhouse gases are the main cause of climate change, but they also have different physical and chemical properties that can undoubtedly affect the durability of materials. Material degradation occurs through the interaction of the environment with the materials' surfaces. The most likely effect of climate change is the interaction of greenhouse gases with materials under the required surface moisture conditions. CO_2 is the most important greenhouse gas. Its hydrolysis causes acidic conditions that can affect all susceptible materials, such as concrete, reinforced concrete, stones, etc. The conditions where carbonation reaches its highest values are different from those where chloride penetration is greatest. The greatest carbonation of concrete should occur in protected or semi-protected atmospheres. NOx is a corrosive gas that oxidizes to its acid form on damp surfaces or in damp porous material systems. Nitrogen oxides also play a role in the aging of polymers. Sulfur oxides are very aggressive to metals and other materials; however, their concentration in air is decreasing. Methane is a fairly inert gas and is not expected to have any effect on materials.

Keywords: Climate change, greenhouse gases, materials durability

Modality of presentation: Lecture

MA02/ENVIRONMENTAL SUSCEPTIBILITY AND DEGRADATION OF CULTURAL HERITAGE AT THE TROPICAL RAIN FOREST OF MEXICO

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The Reserve of the Biosphere of Calakmul, is a vast tropical rainforest territory located in the south east of Mexico. There are innumerable man-made structures erected by the ancient Maya civilization by using the available calcareous stone materials to create awesome buildings, stelae, sculptures, mural paints between others, that remain until now in archaeological sites in spite of their particular environmental aggressivity. By the other hand, this natural environment has a delicate equilibrium, because of that, local or global change create susceptibilities that are cause of risk for the historical infrastructure in this region of Mexico. In this contribution, we present data from fifteen years of investigations, made in the tropical Rainforest of Campeche, Mexico, following a methodology of diagnosis based in the use of NDT test and the monitoring of atmospheric variables known by its roll in the degradations of for materials. These procedures have been systematically implemented since the creation of the National Laboratory of Science for the Conservation and Research of Cultural Heritage (LANCIC); a multidisciplinary collaborative initiative research aimed at conservation of the historical infrastructure of Mexico.

Keywords: degradation, cultural heritage, carcareous stone, tropical rain fores.

Modality of presentation: Lecture (Virtual)

MA03/STUDY ON ATMOSPHERIC CORROSION OF DIFFERENT METAL MATERIALS FROM CHINA IN THE COASTAL TROPICAL CLIMATE OF CUBA

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A study on atmospheric corrosion of different metal materials from China in the coastal tropical climate of Cuba was carried out. Different metal materials specimens with standardized dimensions were placed under outdoor exposure condition during one year of study. Experimental coastal atmospheric corrosion station was used. The mains were, to describe the aggressivity environment in the experimental coastal atmospheric corrosion station. To demonstrate the Corrosivity categories of the atmosphere and morphologies of atmospheric corrosion for the metal materials studied. To predict the Corrosivity categories determined at time of exposure higher than one year. A very aggressivity environment was shown in the coastal station. Of metal materials studied, only Copper showed a Very high (C5) Corrosivity category of the atmosphere. A High (C4) for the Carbon steel and alloy steels was showed. Morphology of atmospheric corrosion was generalized. However, in the two alloys aluminum, Medium (C3) Corrosivity category was showed. Due to passivation condition in the alloys aluminum, maximum deep and average deep pitting values were very high. Therefore, a correspondence between Corrosivity category determined and both parameters that characterize the pitting corrosion did not exist. In spite of both parameters values were lower in the Zinc where Corrosivity category was C4, the correspondence existed. For the stainless steel, both parameters were lower. According to prediction, Corrosivity categories of the atmospheres for the all metal materials were keeped from two up to twenty years of exposure. However, for the Zinc, Corrosivity category decrease from C4 up to C3 was shown.

Keywords: metal materials, corrosivity, atmosphere, atmospheric corrosion, exposure

Modality of presentation: Oral

MA04/PREDICTION OF BURST PRESSURE IN ASTM A106 GR B STEEL PIPES USING TRADITIONAL STANDARDS AND THE FINITE ELEMENT METHOD

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Steel pipelines play a fundamental role in energy security, as they are the primary means of transporting essential fluids such as oil, natural gas, refined products and water. External corrosion is one of the critical factors affecting the structural integrity and operational safety of steel pipelines, therefore, knowing the burst pressure is a key parameter to ensure their mechanical integrity and efficient operation. In order to know the burst pressure of an ASTM A106 Gr B steel pipe, different standardized methodologies such as: ASME B31G, RSTRENG-1, Shell-92, DNV, PCORR and Fitness for Service (FFS) were evaluated and compared with the finite element method, taking into account variables such as residual wall thickness, corrosion depth and mechanical properties of the steel. The results show that some models are more accurate in predicting the burst pressure under certain corrosion conditions, while others are more conservative in more severe scenarios. In addition, the limits and advantages of each model are discussed, providing an in-depth analysis for their applicability in the operational context. This analysis allows a better understanding of the factors influencing the failure of corroded ASTM A106 Gr B steel pipelines, which contributes to the development of better maintenance and prevention strategies in piping systems.

Keywords: Finite Element, Mechanical Integrity, Burst Pressure.

Modality of presentation: Oral

MA05/BIOACTIVE HYDROXYAPATITE MICROWAVE SYNTHESIS: COATINGS ON TI6AL4

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In recent decades, numerous studies have been conducted to develop metal/coating systems that combine the mechanical advantages of bioalloys with the biological compatibility of hydroxyapatite ceramics for use in bone implants. Microwave synthesis addresses issues related to the effective control of pressure and temperature gradients that occur in materials during heat treatment. This work presents the results of preparing and characterizing hydroxyapatite (HA) from sol-gel precursors, which were then consolidated using microwave techniques. The sol-gel was obtained via an aqueous route, using triethyl phosphite and calcium nitrate tetrahydrate as precursors for phosphorus and calcium. After the synthesis, microwave treatments were applied until homogeneous and crystalline powders were obtained. Ti6Al4V alloy served as a metallic substrate on which hydroxyapatite powder coatings were applied. To determine phase formation and morphology, both the synthesized powders and the coatings were characterized using Fourier Transform Infrared Spectroscopy (FTIR), X-ray Diffraction (XRD), and Scanning Electron Microscopy (SEM). FTIR and XRD analyses confirmed the formation of crystalline hydroxyapatite at extremely low temperatures of 175 °C. SEM studies revealed the characteristic morphology associated with hydroxyapatite crystallization. The coatings produced were crystalline, homogeneous, and devoid of cracks. The effectiveness of the microwave technique for consolidating HA powders was demonstrated, resulting in densified coatings achieved at 450 °C, which may be beneficial for orthopedic implants aimed at promoting bone growth and reconstruction.

Keywords: Hydroxyapatite; Sol-Gel; Microwave, Coatings.

Modality of presentation: Oral

MA06/ELECTROCHEMICAL NOISE FOR THE MONITORING OF AN A36 STEEL PROTECTED WITH AN EPOXY COATING ADDED WITH SIO2 NANOPARTICLES

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In this work, an A36 steel protected with an epoxy coating added with SiO_2 nanoparticles at concentrations of 1%, 2% and 3% was evaluated using the electrochemical noise technique. The nanoparticles were synthesized with the Stöber method, while the electrochemical evaluation was carried out using a three-electrode cell, with two nominally identical working electrodes, which consisted of the uncoated, coated and SiO_2-reinforced epoxy-coated steel plates, and an Ag/AgCl electrode as reference. From the synthesis method employed, spherical nanoparticles were obtained, with size less than 100 nm. On the other hand, using methods of analysis in the time domain, with localization index and noise resistance, it was determined that the process in the coating is mixed to localized, where the highest resistance corresponds to the coating with 2% of nanoparticles, which was also shown in the frequency domain. This was also demonstrated in the frequency domain, where the highest noise impedance corresponds to this system, while for shot noise and discrete wavelet transform, a change of the type of process from general to localized was observed in the three coated systems, being the coating without addition the one that presented the greatest change, which indicates more deterioration.

Keywords: Corrosion, epoxy coatings, nano technology, electrochemical noise.

Modality of presentation: Oral

MA07/ACCELERATING CORROSION TEST IN THE PRIMARY SCREENING SELECTION OF STEELS TO BE USED IN HIGH-PARAMETER STEAM GENERATORS SUPERHEATERS CONSTRUCTION

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Renewable energy sources are increasingly being adopted worldwide as a key solution to mitigate the severe environmental impacts of fossil fuels, particularly global warming. Biomass combustion is a widely accessible technology that plays a significant role in transitioning the energy matrix from fossil fuels to renewables. However, corrosion caused by combustion gases and deposits poses a major challenge, negatively affecting boiler efficiency and lifespan. The inorganic composition of biomass, especially in the superheater tubes of boilers, leads to significant corrosion issues. Sugarcane bagasse is one of the most commonly used biomass sources for heat and electricity generation in Cuba's sugar industry. In addition to bagasse, sugarcane tops and leaves are also utilized as biomass. However, these materials contain higher concentrations of chlorine and sulfur, which has limited their use to no more than 10% when mixed with bagasse in Cuba. Several studies have explored ways to increase the proportion of these materials in biomass mixtures. Some researchers have demonstrated the feasibility of assessing, at a laboratory scale, the impact of high-temperature corrosion on steels exposed to synthetic ashes that simulate those produced by biomass combustion. In this study, we propose an accelerated comparative corrosion test to predict the high-temperature corrosion behavior of various steels used in superheater construction. The tests involve exposing the steels to both synthetic ashes, which simulate the combustion of RAC-bagasse mixtures, and real ashes derived from RAC-bagasse mixtures. Additionally, we summarize the different methods used to prepare both real and simulated RAC-bagasse ash mixtures.

Keywords: Biomass combustion, high-temperature corrosion, Renewable energy.

Modality of presentation: Oral

MA08/ATMOSPHERIC CORROSION OF METALS: IN A RURAL-URBAN ENVIRONMENT OF TABASCO

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This work evaluates the behavior of carbon steel, aluminum, copper and galvanized steel exposed for one year in Cunduacán, located in the northwest of Tabasco. The research included the evaluation of the corrosion rate of the materials, using the mass loss technique, and they were also characterized by Scanning Electron Microscopy (SEM) and X-ray diffraction (XRD). Meteorological data on temperature and relative humidity were used to calculate the Time of Wetting (TOW), and the deposition rates of chloride ions and sulfur dioxide were analyzed. It was observed corrosion rates showed a greater impact by the environment on carbon steel and copper specimens with corrosivity categories C_3 and C_5, while aluminum and galvanized steel specimens were assigned a classification of C_1 and C_2 respectively according to ISO 9223. The investigation validated the TdH information obtained in the year of 1300 h under ISO 9223. The depositions of sulfur dioxide and chloride ions obtained were 0.65 and 0.40 mg/m^{2}d, which are low deposition rates according to ISO 9225. In addition, the presence of corrosion products such as lepidocrocite and goethite for carbon steel, and cuprite for copper was validated. The analytical data indicated that both the TdH and the contaminants analyzed exert a low influence on the corrosion process of these metals in the evaluated environment.

Keywords: aluminum, carbon steel, copper, corrosion, galvanized steel.

Modality of presentation: Oral

MA09/ATMOSPHERIC CORROSION STUDIES IN CARIBBEAN AREAS: FIRST EXPERIENCE IN GUADELOUPE

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Atmospheric corrosion level in tropical coastal zones is usually very high. Guadeloupe is a tropical island in the Caribbean Sea with a tropical climate characterized by a high average temperature, high humidity and a coastal environment throughout most of its area. These factors accelerate the atmospheric corrosion rate of infrastructures. No information has been found in the literature on any study of the atmosphere corrosive aggressiveness in this zone. Aim of this work is to evaluate the influence of the atmosphere corrosive aggressiveness on the metallic materials deterioration in three areas of Guadeloupe. The atmosphere aggressivity corrosion was evaluated in accordance with ISO 9223:2012 standard. Three metallic samples for each type of metal were exposed during one-year exposure period at each site (three exposition site (ES) near the coastal): low carbon steel, zinc, aluminum and copper. Based on the results of metals corrosion rate evaluated from mass loss, the atmosphere corrosivity category was High (C4) to Very High (C5) for low carbon steel and copper among the three ES, Medium (C3) for zinc and High (C4) for aluminum in each ES. Only for Zinc an aluminum an agreement is found between the categories obtained for one year and the predicted ones using the dose-response model. A similar study should be carried out in other areas with a shorter distance to the coastline in order to evaluate the influence of emissions from sargassum algae decomposition on the corrosion rate of different metals.

Keywords: atmospheric corrosion, metallic samples, corrosivity category of the atmosphere.

Modality of presentation: Oral

MA10/ELECTROCHEMICAL EVALUATION OF THEOPHYLLINE AS A CORROSION INHIBITOR FOR API 5L X70 STEEL IMMERSED IN CO_2-SATURATED NACL

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The organic inhibitor theophylline, a reactive grade, was evaluated under static conditions on API 5L X70 steel immersed in 3% (w/v) NaCl saturated with CO_2, with the aim of possible use in the oil industry, to determine its effect on corrosion protection. Electrochemical evaluations were performed by measuring open circuit potential (OCP), Electrochemical Impedance Spectroscopy (EIS), and Polarization Curves (PC) techniques. Inhibition kinetics was monitored for a period of 21 days, achieving an acceptable inhibition efficiency of 88.7%. The results showed that the adsorption rate of the compound onto API 5L X70 steel conforms to the fitting model with the Langmuir isotherm.

Keywords: Corrosion inhibition, steel, carbohydrates,

Modality of presentation: Oral

MA11/PLASTIC AGEING UNDER TROPICAL CLIMATES

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Guadeloupe is a tropical island located in the Caribbean Sea and subjected to a tropical climate characterized by a high average temperature, a high irradiance level and a high relative humidity. All these parameters are well known to induce an accelerated degradation of polymers leading to adverse environmental impact and additional economical cost. In our laboratory, artificial and natural ageing of polymers are studied since 2015. We developed ageing protocols as well as original technics allowing a better characterization of ageing processes. In this work, we will present the results obtained on polyolefin samples and mainly polypropylene. Ageing kinetic obtained under 3 artificial ageing protocols are compared with those obtained under natural ageing. Natural sites are either in Guadeloupe island, Campeche (Mexico) or Havana (Cuba). A particular attention will be paid to the meteorological differences of these natural sites to better understand their impacts on the degradation mechanisms. Characterization of the chemical degradation are studied using infra-red spectroscopy in ATR or transmission modes. The evolution of the mechanical properties of the ageing samples are characterized by nanoindentation technics. Comparison between ageing kinetic obtained on samples submitted to artificial and natural ageings allowing us to better understand the role of thermo-oxidation versus photo-oxidation.

Keywords: Polymers, ageing, infra-red

Modality of presentation: Lecture

MA12/AGEING OF A POLYMER COMPOSITE BASED ON CARBON BLACK FROM RECYCLED TIRES

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More than a billion tires are thrown away every year. Millions of tires are dumped in landfills leading to environmental issues even if recycling and recovery are performed in developed nations. In this study, the carbon black contained in tires (25-30%weight) is recovered by pyrolysis. The process is thermo-sufficient and eco-friendly since there is no effluent and the carbon print is low. The pyrolysis carbon black is used as anti-UV in High Density Polyethylene (HDPE). Accelerated aging study is performed on HDPEs with different recycled carbon black contents. Multi-scale mechanical study is performed to study the effect of carbon black with aging time. Evolution of the surface oxidation as well as the oxidation through the thickness of the samples are determined. This work demonstrates that recycled carbon black from tires can be used as anti-UV in polymers.

Keywords: recycling, carbon black, HDPE, anti-UV.

Modality of presentation: Oral

MA13/EVALUATION OF FURANIC DERIVATIVES AS CORROSION INHIBITORS IN AN INDUSTRIAL COOLING SYSTEM WITH FRESH WATER RECIRCULATION

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The corrosion-induced deterioration of the vast array of metallic structures, essential in both industrial and social spheres, causes multimillion-dollar losses worldwide each year and significant environmental impacts due to contamination of the atmosphere, soil, and surface or groundwater. The use of inhibitors is one of the most widely employed methods for preventing and controlling corrosion deterioration in freshwater recirculating cooling systems made of carbon steel, which are widely used in the chemical, food processing, refrigeration, and many other industries. In Cuba, corrosion protection is applied only in some of these systems within the chemical industry, using imported inhibitors. In most other cases, no anticorrosion protection methods are implemented, leading to the rapid deterioration of facilities. This study presents the results of the evaluation of mixtures of furanic derivatives and their combinations with inorganic salts as corrosion inhibitors for carbon steel, both in a model solution and in water from the cooling system of the "Coppelia" ice cream factory. The efficiency and mechanism of action of these mixtures as corrosion inhibitors were determined using gravimetric methods and polarization curve analysis. Finally, an industrial test was conducted with one of the mixtures. All the laboratory-tested mixtures proved highly effective as corrosion inhibitors for steel under the tested conditions. The mixture used in the industrial test achieved efficiencies exceeding 75%.

Keywords: Corrosion inhibitors, cooling system, carbon steel.

Modality of presentation: Oral

MA14/CHARACTERIZATION OF FRESH AND HARDENED STATE PERFORMANCE OF MORTARS MODIFIED WITH COAL FLY ASH

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Coal-based electricity generation produces substantial volumes of fly ash, classified as industrial waste with significant environmental impacts when not properly managed. In the Dominican Republic, this process generates thousands of tons of fly ash annually, yet effective utilization strategies remain notably underdeveloped. Consequently, identifying technically viable and environmentally sustainable applications for these industrial by-products constitutes a strategic imperative, particularly within the construction industry. This research examines the feasibility of incorporating coal fly ash as a partial replacement for cement in rendering mortars. Experimental mortar mixes were prepared with varying replacement percentages, aiming to systematically evaluate their influence on critical technical parameters, such as workability, setting time, mechanical strength, and thermal conductivity. The assessment procedures adhered strictly to international standardized methodologies, enabling comprehensive comparisons between the fly ash-modified mortars and a conventional mortar used as a reference. The incorporation of fly ash seeks to improve the sustainability profile of mortar products by reducing cement usage and mitigating the environmental consequences associated with waste disposal. The study provides technical criteria supporting the valorization of coal fly ash produced in thermoelectric power plants, thereby promoting sustainable construction practices aligned with circular economy principles.

Keywords: Coal fly ash, sustainable mortars, circular economy

Modality of presentation: Oral (Virtual)

MA15/PETROGRAPHIC CHARACTERIZATION OF CONCRETES WITH REPLACEMENT OF COARSE AGGREGATES BY SLAG WASTE PRODUCT OF THE STEEL INDUSTRY

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Replacing aggregates in concrete formulations is a common practice to enhance properties such as strength, durability, impermeability and workability. One of the materials used to replace aggregates in concrete is slag, an undesirable waste product of the steel industry. During the setting and hardening process of concrete, cracks may form, which play a significant role in the penetration of corrosive agents that degrade concrete properties. The objective of this work was to study the transition zone between the cement paste and slag, focusing on the consequences of crack formation on the properties of concrete. The microstructural fractographic study was centered on the aggregate-paste transition zone, which generally represents the weakest link and is considered the phase that limits the strength of concrete. The fractographic study at high magnifications, using a scanning electron microscope, provides valuable information on the properties of materials, particularly their defects. Polished and fractured surfaces of concrete with varying proportions of black slag were characterized. All concrete samples exhibited a good internal structure, with a dense cement matrix and well-bonded paste-slag interfaces. Only isolated microcracks were observed in the cement paste, where new hydrated products are expected to form during concrete aging, contributing to improved strength and durability. Optical microscopy examination of thin samples revealed the dense and compact structure of the concrete. The good compressive strength demonstrated the advantages of incorporating slag. The microscopic focus of this work provides a novel contribution to this field of study.

Keywords: Steel slag, concrete, petrography, optical microscopy, scanning electron microscopy

Modality of presentation: Oral

MA16/WEATHERING TEST ON MORTAR FOR ARCHITECTOICAL RESTORATION ELABORATED WITH TRADICIONAL AND RECYCLED MATERIALS

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Along the time, the technological and cultural development of the ancient cultures in Mesoamerica, left evidences of procedures used for the fabrication of architectonics elements by using local raw. One of these materials is mortar. Fundamental for ancient and modern structures, was developed by different cultures along the word. In Mesoamerica, and in particular the ancient Maya, were capable of elaborate resistant mortars with great structural stability by using calcareous stone derivatives. Nevertheless, due to their long exposure to the extreme tropical rainforests climate in the Maya region, ancient mortars suffers structural damage, caused mainly by the high environmental water availability that leads dissolution and degradation of calcareous materials. Because of that, it is fundamental the recuperation of these traditional technologies, and the use of compatible mortars to be used in conservations works of historic and modern structures, considering also, the use of alternative materials in order to comply with the sustainability, recycling principles and circular economy criteria of the actual environmental tendencies. This contribution shows the results of natural environmental test carried out in seven groups of mortar formulations elaborated with traditional and recycled materials, exposed to the tropical climates in a selected area of the Biosphere Reserve of Calakmul, in Campeche Mexico. Properties such as color, Leeb hardness, ultrasound pulse velocity and water absorption coefficient were monitored in order to measure physic and mechanical changes in the mortar formulations. Results indicate that recycled man-made mortars were more stable under environmental exposure conditions than those elaborated with traditional materials.

Keywords: traditional mortar, environments test, fisicomechanical properties, recycled materials

Modality of presentation: Oral (Virtual)

MA17/ANALYSIS OF THE EFFECT OF MICROBIAL COLONIZATION AND THEIR INTEGRATION ON SASCAB MORTARS

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Biodeterioration is one of the most important problems facing cultural heritage around the word. In the southeastern of Mexico, there are numerous Mayan constructions made of limestone rock and the traditional sascab, a calcareous clay material historically used for the elaboration of mortars since Prehispanic period due to its availability and good construction properties. However, it is also highly bioreceptive and vulnerable to colonization by microorganisms, which can affect both the structure and the appearance of historic buildings. This study evaluated the effect of microbial colonization and their integration in sascab mortars coupons through the inoculation of bacteria and fungi isolated from Mayan archaeological structures of the Peninsula of Yucatán. The inoculated coupons were exposed to controlled degradation into an environmental chamber. Microbiological tests based on carbonic anhydrase production and calcium carbonate precipitation, and physicomechanical measurements such as Leeb hardness, colorimetry and ultrasound propagation velocity were carried out to analyze changes in these properties of sascab. The results showed that microbial activity caused visible color alterations and change of harness in the surface of the samples. Also, significative variations in ultrasonic propagation velocity were registered, suggesting an impact on the internal structure of the mortar as a consequence of degradation test. This indicate that microorganisms play a relevant role in altering the physical properties of the material that depend on the species present during the colonization process and the particular exposure conditions. In consequence they can exert both a degrading and a potentially protective effect.

Keywords: biodeterioration, mortars, colonization, physicomechanical, microorganisms

Modality of presentation: Oral (Virtual)

MA19/DESIGN OF WASTEWATER TREATMENT PLANTS INTEGRATING CIRCULAR ECONOMY PRINCIPLES

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The conference focuses on a new vision of wastewater treatment plant design to improve the integration of circular economy concepts. It begins with a brief history to understand the current situation. Even today, the logic remains linear and focused on improving or adding processes that do not promote the integration of circular economy principles. The conference presents a modification of the purpose of wastewater treatment plants to include circular economy notions in their design. The vision is to design a wastewater treatment plant for the production of energy and marketable products, while respecting the protection of human health and natural ecosystems. This presentation introduces a paradigm shift by employing unitary processes within mesh networks, in contrast to the conventional sequential arrangement of treatment processes. In order to produce more energy and usable materials than those contained in wastewater, the principle is to decompartmentalize wastewater treatment from the management of certain domestic or industrial residual materials. In conclusion, the presentation discusses the links between this vision and the various dimensions of the anthropic system. It outlines the complexity of the system and the obstacles to be overcome in order to apply this new vision, as well as in developing a circularity indicator for wastewater treatment plants.

Keywords: Wastewater, treatment plant design, meshed processes, circular economy.

Modality of presentation: Lecture

MA20/REUSE OF PURIFIED WASTEWATER FROM URBAN WATSTWATER PLANTS AS AN ALTERNATIVE OF DRAUGHT AND WATER SCARCITY

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In the context of water resources shortage that Morocco is experiencing in recent years, the mobilization of non-conventional resources becomes mandatory and essential to reduce the gap between needs and availability. The reuse of purified urban wastewater in a suitable treatment plant is considered an environmentally friendly and economical approach to the management of this significant resource which represent at least 80 % of consumed fresh water. The recycling of treated water in agriculture and watering of green spaces is conditioned by the compliance of parameters to standards (WHO, FAO, NMEDI, etc.) [2,3] and stipulated in 36-15 law promulgated by Moroccan government on 2015. In this work, we have monitored the quality of purified wastewater treated in: one very efficient and modern plant of Mediouna City (40.000 Inhabitants), a second plant of the airport zone (60.000 inhabitants), and a third plant of urban wastewater treatment (120.000 inhabitants) by analyzing all parameters. Samples of treated water were collected weekly throughout 2023. Monitoring of physicochemical, bacteriological, and parasitological analyses has proven that the treatment technologies implemented in the peri-urban area of the City of Casablanca (the first is activated sludge, the second is membrane filters, and the third is natural lagooning) provide a whole range of treated water capable, at varying scales, of being reused for useful purposes such as crop irrigation, watering green spaces, road washing, and fire protection. The work will detail the characteristics of each category of treated water and provide complementary solutions for water that does not fully comply with the required international standards.

Keywords: Wastewater treatment plants; Purified wastewater; Characterization Parameters of Wastewater; Reuse of purified wastewater, Morocco.

Modality of presentation: Lecture

MA21/DEVELOPMENT OF A BIOSURFACTANT-MODIFIED LAYERED DOUBLE HYDROXIDE FOR CARBARYL ADSORPTION FROM WATER

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Water pollution by insecticides represents a major risk for ecosystems, pollinators, and human health. In this study, a layered double hydroxide modified with sodium palmitate (CaAl-PS-LDH) was synthesized using the co-precipitation method and evaluated as an adsorbent for the removal of carbaryl from water. This material consists of Ca and Al in the main layers, with sodium palmitate as the interlayer anion. This combination of cations and a natural, food-grade surfactant ensures environmental compatibility and reduces toxicity risks. The adsorbent was characterized by X-ray diffraction, scanning electron microscopy, energy-dispersive spectroscopy, and Fourier-transform infrared spectroscopy. A structural arrangement of CaAl-PS-LDH, including the possible orientation of sodium palmitate anions within the novel adsorbent structure, was proposed. The modified layered double hydroxide exhibited a significantly higher adsorption capacity, reaching 15.99 mg g^{-1}, in contrast to 1.83 mg g^{-1} for the unmodified inorganic adsorbent, highlighting its improved performance for carbaryl removal. The effects of pH, temperature, initial insecticide concentration, and adsorbent dose on the adsorption of carbaryl by CaAl-PS-LDH were also studied. The adsorption mechanisms were best described by the pseudo-second-order kinetic model, while the adsorption isotherm was best represented by the Freundlich model. The results suggest that CaAl-PS-LDH is a safe and effective option for water treatment applications. Its ease of preparation, low cost, and targeted pollutant removal capacity make layered double hydroxides suitable materials for water treatment in rural, isolated, and vulnerable communities with specific water purification needs.

Keywords: Water treatment, adsorption, pesticides, layered double hydroxides, biosurfactant, carbaryl, sodium palmitate.

Modality of presentation: Oral

MA22/OZONE GENERATION BY VACUUM ULTRAVIOLET RADIATION (Λ = 172 NM) IN A CONTEXT OF DECENTRALIZED DRINKING WATER PRODUCTION

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The main problem with centralized drinking water production is the recontamination of treated water during transport and storage. Several authors have observed a multiplication of total coliforms, *Campylobacter* and *E. coli* in distribution pipes as well as in drinking water storage tanks. This post-treatment recontamination highlights the importance of integrating a disinfection step directly at the point of consumption, i.e. delocalized disinfection on a household scale. The delocalized application of a disinfection process in remote areas is complexified by factors specific to these communities (such as difficulty in sourcing equipment and products, instability of power distribution networks, low population density). To overcome these issues, the conference presents the development of a water ozonation module on a household scale, enabling ozone disinfection to be decentralized. To surmount the constraints of oxygen supply, air drying and high-voltage power supply, the disinfection module integrates a photochemical vacuum ultraviolet ozone generator operating with ambient air and powered by a 24 V source. The conference presents the results of the effect of relative humidity of the gas (ambient air) on the ozone production of the generator, as well as presenting the concept of implementing such system in a context of decentralized drinking water production. The conclusion looks at the potential impact of the widespread application of photochemical ozone generators and discusses prospects for improving photochemical ozone generation.

Keywords: Decentralized water production; ozone; vacuum ultraviolet; water vapor

Modality of presentation: Oral

MA23/OZONE BLEACHING OF CELLULOSIC FIBRES. EXPERIENCE WITH TOWELS

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The bleaching method with hydrogen peroxide is expensive due to the high consumption of products, water and energy, while with ozone it is very advantageous. The objective of this study was to evaluate the use of ozone in the bleaching of towel samples, made of terry fiber fabric, 100% cotton. Raw and pretreated samples (desizing-scouring) were used, at pH 5, with water content of 30%. The experiments were carried out at room temperature, with exposure times: 5 to 30 min; gas flows: 10 and 20 L h^{-1}; concentrations of ozone in the gas: 40 to 80 mg L^{-1}. The degree of whiteness (GB) and degree of polymerization (GP) were measured, comparing them with bleaching with hydrogen peroxide for dyeing. The pretreatment of the fabric indicated a favorable effect, but the increase in gas flow did not. Ozone bleaching was improved by increasing the time and the concentration of ozone in the gas. However, short times are recommended to avoid damage to the fabric. The efficiency of the process improved by increasing the humidity of the reactor inlet gas. Under the experimental conditions evaluated, no effect on hydrophilicity was observed. Applying the wet gas, the ozonized raw fabric (10 min) reached a GB to dye medium to dark tones without affecting the required GP. Bleaching of raw fabrics was recommended under a concentration of 60 mg L^{-1} for 10 min and humidified gas (fabrics with water content: 30% and pH 5). A technological proposal with technical specifications was realized.

Keywords: ozone, textile, bleaching, whiteness and polymerization degree, hydrogen peroxide

Modality of presentation: Oral

MA24/DEVELOPMENT OF DOMESTIC OZONIZERS EQUIPMENT FOR WATER DISINFECTION

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Due to the problems of water distribution in the hydraulic networks, the use of cisterns and elevated tanks, which can generate water contamination, it is necessary a final disinfection of the water before its consumption. For this purpose, domestic ozonizers allow to obtain quality water for human consumption, food washing, and various household utensils. In response to these needs, the CNIC has developed a new production line of equipment with two variants of applicability. The first one, Ozoney-F, is designed to work with in-line water pressure and a flow rate of up to 2 L/min, obtaining in 10 minutes of continuous operation a volume of treated water of up to 20 L. The second one, Ozoney-T, does not require connection to a water line and allows ozonation in 30 minutes of water knobs of up to 20 L. For the development of both models, three ozone generation modules from commercial firms were evaluated and the required adaptations were made to the equipment for their installation. The new equipment was evaluated in terms of ozone concentration in the gas, dissolved ozone concentration in the water, ozone generator tube temperature, gas and liquid flow and continuous operation time. In addition, tests were carried out to eliminate up to 105 CFU/mL of the E. coli microorganism, obtaining a high disinfection efficiency. The most efficient module was identified and the technological documents and plans for the industrial production of both models of equipment were prepared.

Keywords: ozone, domestic ozonizers, disinfection, equipment evaluation

Modality of presentation: Oral

MA25/REMOVAL OF DIFFERENT POLLUTANTS FROM WATER USING HYDROGELS BASED ON SODIUM ALGINATE AND POLYACRYLAMIDE

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Water pollution has become a serious concern for the sustainability of aquatic ecosystems and human health, primarily due to the wastewater discharged by the pharmaceutical and textile dyeing industries. To address this issue, hydrogel adsorbents have gained significant attention because of their beneficial properties. This study focused on creating combined hydrogels using sodium alginate (NaAlg) and polyacrylamide (PAAm). Hydrogels with different compositions were prepared by free radical copolymerization of AAm in the presence of AlgNa and N, N-methyleneacrylamide (MBA) as a crosslinking agent. Fourier-transform infrared spectroscopy (FTIR) confirmed the structural composition of the hydrogels, while scanning electron microscopy (SEM) revealed an irregular morphology with porous and rough areas. Additionally, the swelling properties of the hydrogels, along with their ability to adsorb some polluting agents, including methylene blue, Congo red, ciprofloxacin, and ceftriaxone, were investigated. Hydrogels with a higher content of NaAlg in a pH 8 medium exhibited greater swelling, with values exceeding 12 g H_2O/g hydrogels. This indicates a high adsorption capacity that varies with pH levels. Contaminant adsorption tests were conducted separately in the laboratory, in simulated wastewater treatment, at different pHs and initial concentrations. The adsorption capacity for both dyes and antibiotics varied based on the pH of the medium and the composition of the hydrogels, with values ranging from 5 to 15 mg of contaminant per gram of hydrogel. This research provides a viable, environmentally friendly, and low-cost method for enhancing wastewater treatment and preventing leakage through sewage discharge.

Keywords: Hydrogels, wastewater, sodium alginate, acrylamide, antibiotics, dyes

Modality of presentation: Oral

MA26/PHOTODEGRADATION OF POLLUTANTS IN WATER USING FE_3O_4 NANOPARTICLES SUPPORTED ON BIOPOLYMERS

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Water contamination by industrial, agricultural, and domestic compounds represented a significant environmental challenge in this study. A photocatalytic system based on modified magnetite (Fe3O4) nanoparticles was developed and optimized, evaluating its efficiency in the degradation of organic and inorganic pollutants. The synthesis and characterization of the nanoparticles were carried out using advanced techniques. Laboratory-scale photocatalytic experiments were conducted using Malathion (a pesticide) as a model contaminant at concentrations of 0.3 ml/L under UV-Vis irradiation with a 13W lamp for 3 hours, with absorbance measurements taken every 15 minutes. These samples were analyzed by measuring unique wavelengths in a spectrophotometer. The results showed a removal efficiency greater than approximately 90%, reaching approximately 45% within the first hour of exposure. Subsequently, a slight stabilization in degradation efficiency was observed, suggesting the possible generation of intermediate byproducts. These findings confirm that magnetite nanoparticles supported by biopolymers exhibit significantly higher efficiency than traditional photocatalysts such as TiO_2, highlighting their stability and reusability over multiple cycles. This study contributes to the development of sustainable technologies for wastewater treatment, with potential applications in industrial and agricultural sectors.

Keywords: Photocatalysis, Nanoparticles, Magnetite, Malathion, contaminant degradation

Modality of presentation: Oral

MA27/CHARACTERIZATION OF BIOFILM-FORMING ESCHERICHIA COLI ISOLATED FROM HAVANA RIVERS AND THEIR RELATIONSHIP WITH ANTIMICROBIAL RESISTANCE AND PHYLOGROUP

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The rise in bacterial resistance to antibiotics globally has emphasized the significance of aquatic ecosystems as reservoirs of resistant bacteria. *E. coli* is commonly used as an indicator of fecal contamination in these environments, and its ability to form biofilms has been linked to the antimicrobial resistance of these strains, increasing their pathogenicity and contributing to the dissemination of antimicrobial resistance in natural settings. The objectives of this study were to assess the biofilm-forming capacity of environmental *E. coli* isolates using qualitative and quantitative methods and to examine the correlation between this capacity and the antibiotic resistance exhibited by the isolates. A total of 150 *E. coli* isolates from the Almendares, Quibú, and Luyano rivers in Havana were examined for their resistance to 18 antibiotics (ampicillin, amoxicillin-clavulanic acid, ceftazidime, cefotaxime, aztreonam, ceftriaxone, cefepime, piperacillin-tazobactam, meropenem, imipenem, trimethoprim-sulfamethoxazole, gentamicin, amikacin, chloramphenicol, ciprofloxacin, levofloxacin, azithromycin, and tetracycline). Among the isolates, 45.3% were found to be biofilm producers and resistant to at least one antibiotic. The biofilm-forming strains were categorized as weak producers (51.5%), moderate producers (22%), and strong producers (26.5%), with the latter displaying the highest levels of antibiotic resistance. The ESBL phenotype was detected in 20 isolates, with the $bla_{\text{CTX-M-1}}$ gene present in 12 strains, bla_{TEM} in seven strains, and bla_{OXA} in one strain. These ESBL *E. coli* isolates exhibited co-resistance to tetracycline, quinolones, aminoglycosides, and macrolides. Phylogenetic subgroup A_0 was the most prevalent among the *E. coli* isolates, followed by subgroups A_1 and B_1. These findings underscore the importance of implementing control measures to prevent the spread of these isolates in natural environments and to regulate or eliminate the presence of even trace amounts of antibiotics in water sources.

Keywords: *E. coli*, biofilms, multidrug resistance, aquatic ecosystems.

Modality of presentation: Oral

MA28/SUSTAINABLE GROUNDWATER MANAGEMENT: CASE OF THE SINALOA RIVER AQUIFER

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The water quality analysis of the Sinaloa River aquifer is based on the evaluation of physicochemical and microbiological parameters using conventional methodologies such as the Water Quality Index, multivariate statistical analysis, and hydrogeochemistry to determine its condition and potential risks for human consumption and agricultural use. The study, conducted from 2012 to 2022, considers various factors, such as contamination from agricultural and industrial activities and saline intrusion, which affect groundwater availability and quality. Additionally, significant challenges have been identified, including aquifer overexploitation due to intensive water use without proper management, lack of wastewater treatment infrastructure contributing to water contamination, and inefficient water resource management. The results of this analysis indicate that the Sinaloa River aquifer faces significant challenges, highlighting the need for constant monitoring to detect potential risks in real time. Monitoring is essential to track changes in water quality and ensure the sustainability of water resources for both human and agricultural needs. The study emphasizes the importance of implementing sustainable management strategies to protect the aquifer, as well as the fundamental role of monitoring in preventing the overexploitation of water resources. The use of geospatial analysis tools, such as remote sensing and geographic information systems (GIS), enables informed decision-making and is essential for the conservation of water resources in the region. Given the increasing pressure on the aquifer, the integration of these technologies into water resource management practices is crucial to maintaining the health of the aquifer and ensuring its availability for future generations.

Keywords: Water quality, Sinaloa aquifer, Pollution, Sustainable management

Modality of presentation: Oral

MA29/SUSTAINABILITY 4.0: MERGE INTERNATIONAL STANDARDS AND CUBAN POLICIES WITH THE DIGITAL REVOLUTION

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In the era of digital transformation, sustainability is not just a concept, but a key strategy for the future of organizations. Sustainability 4.0 integrates technologies such as artificial intelligence, the Internet of Things, and Big Data to strengthen environmental resilience and optimize business management. Since 2024, the standards proposed by the International Organization for Standardization for management systems have explicitly incorporated the impact of climate change. This requires organizations to assess risks and opportunities to align with global standards. Furthermore, it reinforces the integration of sustainability into companies' strategic and operational planning. Simultaneously, Cuban environmental legislation is being modernized to adapt to current climate challenges. This reform seeks to guarantee the population's constitutional right to a healthy environment and promote more effective and contextualized management. Socio-environmental resilience thus becomes a key element in addressing the country's challenges. In this scenario, artificial intelligence plays a fundamental role. Its application allows for improved environmental monitoring, optimized implementation of best practices, and strengthened response capacity to new regulatory requirements. The convergence of updated ISO standards, updated Cuban legislation, and the use of advanced technologies mark the step toward Sustainability 4.0, which represents a profound transformation in the management approach implemented in organizations to reduce their environmental and social impact.

Keywords: Industry 4.0 and sustainability; ISO standards and climate change; Socio-environmental resilience

Modality of presentation: Lecture

MA30/REUSE OF PURIFIED WASTEWATER FROM URBAN WATSTWATER PLANTS AS AN ALTERNATIVE OF DRAUGHT AND WATER SCARCITY

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In the context of water resources shortage that Morocco is experiencing in recent years, the mobilization of non-conventional resources becomes mandatory and essential to reduce the gap between needs and availability. The reuse of purified urban wastewater in a suitable treatment plant is considered an environmentally friendly and economical approach to the management of this significant resource which represent at least 80 % of consumed fresh water. The recycling of treated water in agriculture and watering of green spaces is conditioned by the compliance of parameters to standards (WHO, FAO, NMEDI, etc.) [2,3] and stipulated in 36-15 law promulgated by Moroccan government on 2015. In this work, we have monitored the quality of purified wastewater treated in: one very efficient and modern plant of Mediouna City (40.000 Inhabitants), a second plant of the airport zone (60.000 inhabitants), and a third plant of urban wastewater treatment (120.000 inhabitants) by analyzing all parameters. Samples of treated water were collected weekly throughout 2023. Monitoring of physicochemical, bacteriological, and parasitological analyses has proven that the treatment technologies implemented in the peri-urban area of the City of Casablanca (the first is activated sludge, the second is membrane filters, and the third is natural lagooning) provide a whole range of treated water capable, at varying scales, of being reused for useful purposes such as crop irrigation, watering green spaces, road washing, and fire protection. The work will detail the characteristics of each category of treated water and provide complementary solutions for water that does not fully comply with the required international standards.

Keywords: Wastewater treatment plants; Purified wastewater; Characterization Parameters of Wastewater; Reuse of purified wastewater, Morocco.

Modality of presentation: Lecture

MA31/INTEGRATING RENEWABLE ENERGY INTO THE ENERGY MATRIX OF THE NATIONAL CENTER FOR SCIENTIFIC RESEARCH

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The transition to renewable energy sources has become a global priority in the pursuit of sustainable development. In particular, our country faces a complex energy context, where thermal generation using fossil fuels is increasingly challenging. In response to this situation, the management of the National Center for Scientific Research (CNIC) decided to introduce renewable energy sources into the company's energy matrix, ensuring energy independence and contributing to the nation's sustainable future. To materialize this decision, a coordinated and collaborative effort was carried out between specialists from the engineering and commercial departments, guaranteeing an efficient integration of knowledge and strategies for its proper implementation. As a result, several systems utilizing solar thermal and photovoltaic energy were acquired, following various commercial strategies, among which the procurement of 400 kWp through a leasing agreement with a foreign commercial partner. The progressive implementation of these systems has significantly transformed the company's energy management, as it has allowed for a reduction in public grid consumption, the replacement of steam and electricity in production processes, and the contribution of energy to the national electrical system.

Keywords: renewable energy, photovoltaic, sustainable, leasing

Modality of presentation: Oral

MA32/DEVELOPMENT OF A METHOD FOR THE RECOVERY OF SOLID WASTE GENERATED DURING THE SOFT CAPSULE PRODUCTION PROCESS

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Soft capsules are pharmaceutical forms primarily used for the encapsulation of lipid solutions or mixtures with low water solubility. The CNIC soft capsule production plant generates between 35 and 40 kg of waste daily, composed of gelatin shell, active ingredient (AI), and mineral oil, generated during the encapsulation process. Due to this problem, the objective of this work is to develop a method for recovering the gelatin shell waste generated during the soft capsule production process and reintroducing it into the production process; to evaluate the physical, chemical, and microbiological characteristics of the resulting product; and to conduct a long-term stability study. To separate the mineral oil and AI from the gelatin shell, centrifugation was performed for 1 hour at a speed increase from 150 to 1200 rpm. The recovered shell was then heated to a temperature between 70 and 75°C until completely melted. A vacuum was applied for 30 minutes. After this time, the capsule was allowed to rest and heated for 10 minutes. The encapsulation process with the recovered shell performance 90–91%. The resulting capsules exhibited changes in their organoleptic characteristics, although they meet the physical, chemical, and microbiological requirements established for the final product. Recovering this shell reduces waste volumes by 12% and increases raw material performance by 17%. The long-term stability study shows that the organoleptic characteristics and quality specifications of the product do not present variations for up to 12 months.

Keywords: residue, recovery, soft capsules, gelatin shell, centrifugation

Modality of presentation: Oral

MA33/ADSORPTION OF HEAVY METALS FROM AQUEOUS SOLUTIONS USING BACTERIAL BIOMASS-BASED ADSORBENTS: AN INSIGHT INTO KINETICS AND OPTIMIZATION STUDIES

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The presence of heavy metals in domestic and industrial effluents represents a public health and environmental problem worldwide. For their elimination, the currently available conventional methods are expensive and inefficient, which has led to the development of new technologies based on the use of bacterial biomass and the characterization of the bioremoval process. The objective of this work was to determine the influence of adjusted environmental factors on the capture of Pb (II) in *Bacillus subtilis* (AL-25). The biosorption kinetics of the metal was studied by different models and a full factorial experimental design 2^3 was applied, where the main effects and interactions of six factors were evaluated at two levels: pH, initial biomass concentration, initial metal concentration, contact time, stirring speed and immobilizing agent concentration. The experimental data were adjusted more accurately to the pseudo second order kinetic models and intraparticle diffusion, with R^2 values of 0.98. The regression model used to adjust the main effects of the factors was validated, which allowed determining the experimental conditions that favor removal. Under these conditions, the experimental metal removal percentage was approximately 92.9%, which is close to the value predicted by the statistical design (94.4%). These results demonstrate the potential of bacterial biomasses used to be used in the treatment of wastewater with the presence of these compounds. Furthermore, the factorial design proved to be a suitable statistical tool for improving heavy metal removal efficiency and standardizing optimal disposal conditions for these environmental pollutants.

Keywords: removal, lead (ll), *Bacillus subtilis*, adsorption kinetics and standardizing study.

Modality of presentation: Oral

MA34/MICROPLASTICS IN CUBAN FRESHWATERS: DIVERSITY, TEMPORAL CHANGES, AND EFFECTS ON EXTRACELLULAR ENZYMATIC ACTIVITY

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Plastics, as synthetic polymers, are emerging contaminants that can harm organisms and ecosystems. This study investigates the presence of microplastics in sediments of two rivers in western Cuba, assessing their temporal variability, diversity, and characterizing the types of microplastics in these ecosystems. Additionally, the study examines the relationship between microplastic concentrations, the extracellular enzymatic activity of benthic microbial communities, and nutrient levels in sediments. Sediments from two stations, the Paila (urban river) and Baños del San Juan (rural river), were analyzed using micro-FTIR for chemical identification, and nutrients and extracellular enzyme activities were determined by colorimetric methods. The results showed higher microplastic concentrations at the Paila station compared to the Baños del San Juan station. The identified microplastics included polyethylene terephthalate (41.9%), polypropylene (25.8%), acrylic (6.5%), polyvinyl chloride (6.5%), polyethylene (3.2%), polyurethane (3.2%), and polyvinyl alcohol (3.2%), with polyethylene terephthalate being the most abundant in both sampling stations. The highest microplastic diversity was observed at the Paila station in April, with June showing the highest concentrations of microparticles. Redundancy analysis showed that nitrite, polypropylene, ammonium, and precipitation were the variables influencing extracellular enzyme activities at both sampling stations. Higher levels of polypropylene were associated with increased levels of nitrite and ammonium. Additionally, it is suggested that polypropylene inhibits proteolytic and catalase activity in the sediments of the studied stations. This investigation is the first report in Cuba of the presence of microplastics in freshwater ecosystems and one of the few studies in the Latin American and Caribbean region.

Keywords: Freshwater sediments, extracellular enzyme activities, plastic pollution, urban river, rural river

Modality of presentation: Oral

MA35/ ANTAGONISM OF *BACILLUS* STRAINS AGAINST PHYTOPATHOGENIC FUNGI OF CEREALS

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Wheat is one of the basic cereals for human consumption. Cuba has wheat cultivars adapted to the climatic conditions. However, production is insignificant and the wheat consumed is imported. Plant Growth Promoting Bacteria (PGPB) are a powerful tool to inhibit the development of phytopathogens that affect crops, as well as to enhance their growth. In this sense, members of the Bacilli class are recognized for their high metabolic capacity to produce metabolites with antagonistic activity against phytopathogenic fungi. Considering this, and the need to avoid the use of chemical compounds in agriculture to improve the sustainable environmet, the following research aimed to evaluate the antagonistic activity of Bacilli strains against phytopathogenic fungi. Bacilli strains were isolated from Cuban wheat accessions CC-204, I-399 and M-04. Attributes for growth promotion and pathogen antagonism, as well as fungal growth inhibition in dual culture were evaluated. From the results obtained in the qualitative *in vitro* antagonism tests against *Fusarium proliferatum*, 40 isolates were selected and tested against the fungi *Curvularia tuberculata, Curvularia pallescens* and *Bipolaris* sp. Based on the results of these antagonisms and growth promotion attributes, 15 isolates with high activity were selected and evaluated quantitatively. All fifteen isolates showed growth inhibition for the fungi *Curvularia tuberculata*, *Curvularia pallescens* and *Bipolaris* sp. The selection of isolates with potential to eliminate fungal pests may be a viable alternative to improve agricultural production in sustainable agriculture.

Keywords: *Bacillus*, pathogenic fungi

Modality of presentation: Oral

MA36/TRIACONTANOL AND TRIACONTANOL-CONTAINING ADDITIVE “INNOWAX” AS PLANT GROWTH STIMULATORS: APPLICATIONS TO MICROGREENS AND OPEN-FIELD PLANT CULTIVATION

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Triacontanol is an aliphatic alcohol (C30H61OH) widely present in different waxes of plants and animals. Its phytohormone-like properties allow using it as a growth stimulator in agriculture. It increases plant growth, seed germination, flower and fruit number. Pure triacontanol is hard to dissolve in water and alcohols, and usually it's supplied with emulsifiers (detergents) to improve its solubility in water. Other higher alcohols of waxes can suppress the action of triacontanol: octacosanol, C28-alcohol, was shown to be the antagonist of triacontanol acting via the same signaling pathway, adenosine signaling system. Hexacosanol, C26-alcohol, demonstrated the ability to activate adenosine-dependent signaling system in animal cells, so it might participate in the same signaling pathway in plants. The problem of using crude wax hydrolyzates is the balance between growth stimulation by triacontanol and adverse action of other alcohols. The emulsifying activity of fatty acid anions of wax hydrolyzates is very useful for triacontanol solubilization. InnoWax is a mixture of wax hydrolyzates designed for optimal balance of triacontanol and other higher alcohols. It stimulates growth of green biomass of monocots and dicots, and the enhancement of growth varied from 13 to 25%. Being used in low concentrations, it can be added as a component of water for microgreen cultivation or for open plantations. The report will include actual results of examining the growth stimulating action of InnoWax on oat, radish, rice and maize. Economic benefits for InnoWax application in production of microgreens and open-field cultivation of key agricultural plants of Cuba will be discussed.

Keywords: Triacontanol, plant growth stimulation, microgreens, Cuban agriculture

Modality of presentation: Oral

MA37/ EFFECT OF OZONE TREATMENTS ON GERMINATION AND DISINFECTION OF SACHA INCHI (*PLUKENETIA VOLUBILIS* L.) SEEDS

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Sacha inchi (*Plukenetia volubilis* L.) is an Amazon species with an elevated agro-industrial potential. The seeds are oleaginous with a very high percentage of polyunsaturated fatty acids. They have a high content of omega-3 and omega-6, which is important for health and nutrition. Seeds also contain vitamins A and E, which act as antioxidants. The objectives were to evaluate the ozonation effects on germination and disinfection of sashi inchi seeds. Seeds groups were treated applying concentrations of gaseous ozone of 5 and 20 mg/ L for 20 min. Others were immersed in water with dissolved ozone (0.5 and 1.0 mg/L) during 15 min. Ozone treatments did not affect the germination of sacha inchi seeds. Treatments with lower concentration of ozone registered the best results for germination percentage and indicators of vigor. An efficient microbial inactivation of inoculated seeds was obtained in both phases (gaseous and aqueous), these results are important for the propagation of sasha inchi seeds. However, ozone treatments, under the experimental conditions of this study, did not provide a sufficient prophylactic effect to guarantee the emergence process. Only seeds treated with T1 (ozone concentration of 5 mg/L for 20 min) reached greater survival of the seedlings (53%), resisting the fungal attack. Ozone in gaseous phase was most suitable for treatment of the seeds. The results of this study have identified ozone as an alternative treatment of Sacha inchi seeds to improve their agronomic management, specifically their propagation.

Keywords: Disinfectant agent, germination, oleaginous seeds, ozonation, Sacha inchi

Modality of presentation: Oral

MA38/APPLICATION OF REGENERATIVE TECHNIQUES TO REDUCE THE USE OF PRE-EMERGENT HERBICIDES IN INITIAL AGAVE TEQUILANA PLANTINGS

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Given the economic importance of agave, efficient technologies have been generated mainly for the control of pests and diseases. All of them show a great variation of products, doses and moment of application, without the certainty of affecting the yield, nor the quality of the fruit of the crop, pineapple, nor the conditions of preservation of the ecosystems involved. In view of the above, it is necessary to establish a rational and organic management of the products under conditions of regenerative agriculture where emphasis will be placed on the four principles of soil care such as: minimize soil disturbance, maximize soil biodiversity, maximize root growth and Maximize soil cover. Objective: to evaluate the application of regenerative techniques to reduce the use of pre-emergent herbicides in initial plantations of *Agave tequilana* under regenerative agriculture conditions for both nutrition and pest and disease control in the agricultural company Magnocampo. The experimental design was totally randomized, two variants were chosen, one as a regenerative agriculture strategy and the second variant was the traditional one with the traditional technological package, after which pre-emergent herbicides were applied in both. Results: under the application of the regenerative strategy, most of the soil was kept covered in contrast to the traditional, reaching a high diversity of species, contributing to maintain the soil in favorable conditions. The application of regenerative techniques allows reducing the use of pre-emergent herbicides in initial plantations of *Agave tequilana*.

Keywords: regenerative agriculture, traditional technological package

Modality of presentation: Oral (Virtual)

MA39/ANCESTRAL PLANTS IN AMAZON ENVIRONMENT, USEFUL FOR FOOD AND HEALTH

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There is knowledge and connection of native indigenous peoples with the environment and organic agricultural practices, to take care of food and health. In Ecuador, indigenous Amazonian families have reported up to 886 uses of 107 species cultivated in their farming systems or collected in their forests. One way to reinforce ancestral knowledge and sustainable practices is laboratory analysis to confirm the functional properties of species for food and health. The effects of polyphenolic and antioxidant activities in some Amazonian plants, important in indigenous communities, are studied. Six species were chosen for analysis: *Mansoa alliacea, Eryngium foetidum Maytenus macrocarpa, Theobroma cacao, Allium ursinum* and *Ilex guayusa*. They were studied in the laboratory of the Universidad Estatal Amazónica. Hydroalcoholic extracts were performed with ultrasound-assisted extraction. Higher levels of polyphenols and antioxidant activities ($p \leq 0.05$) were observed in cocoa seeds and chuchuhuaso bark. In the rest of the materials, the polyphenol content was lower than in a reference red wine. Antioxidant activity is always related to polyphenolic activity. Universities in Ecuador are working with species used by local populations to increase the exploration of sources of secondary metabolites for the pharmaceutical, cosmetic and functional food sectors, involving the interest of indigenous students to develop local uses and economies.

Keywords: Antioxidants, beneficial species, Amazonian environment, ethnobotany.

Modality of presentation: Oral (Virtual)

MA40/ANALYSIS OF WATER USE IN LEGUMINOUS CROPS PRODUCTION AND POST-HARVEST HANDLING AT LUVHADA IRRIGATION SCHEME, LIMPOPO, SOUTH AFRICA

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Leguminous crops are an alternative food source that significantly contributes to food and nutrition security. Although they are applauded for their low water consumption at the production stage, it is unclear how water is utilized by these leguminous plants during the post-harvest period. During post-harvest processes, water is mostly used in activities such as storing, transportation, marketing, and retail or roadside selling. The study assessed water usage in post-harvest handling activities of leguminous crops at the Luvhada irrigation scheme, South Africa. The study adopted an exploratory mixed-method design and utilized structured and semi-structured interviews to solicit answers from the respondents. Thematic content analysis was used to analyse qualitative data while descriptive statistics were used for quantitative data. At the post-harvest phase, farmers used water mainly for cleaning and cooking. Moreover, farmers did not measure the exact amount of water used in post-harvest activities either due to lack of interest or due to lack of proper water infrastructure that can allow them to record the amount used. More than 52.4% of the farmers relied on river water for post-harvest activities. It is therefore, recommended that observational and participatory studies be conducted to monitor the activities of a farmer over some time to accurately predict the amount of water used in post-harvest activities.

Keywords: Legumes crops, Luvhada irrigation scheme, post-harvesting, water use

Modality of presentation: Oral

MA41/MAJOR FACTORS INFLUENCING WATER SECURITY FOR VEGETABLE CROP FARMING WITHIN THE NWANEDI IRRIGATION SCHEME OF LIMPOPO PROVINCE

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Despite negative factors threatening global water security in arid and semi-arid areas, an estimated 20% of the world's irrigated agriculture remains the largest consumer of freshwater. South Africa is one of the sub-Saharan countries encountering water insecurity mainly due to scarcity and poor management in irrigated agriculture. Nwanedi irrigation scheme, one of the 180 irrigation schemes in Limpopo province faces water challenges. The main objective of the study was to explore the major factors influencing water security for vegetable crop farming within the Nwanedi irrigation scheme. A qualitative research design was used, and the purposive sampling procedure utilised to select 20 respondents from 300 smallholder farmers. Face to face interviews and direct observations were conducted to gather data. The data was analysed using Atlas.ti version 8 software. Irrigation and farming methods used, low temperatures, availability of rainfall and water sources, access to financial capital and infrastructure were the major factors positively influencing water security for vegetable crop farming. In contrast, large sizes of farm fields as a spatial factor in relation to water availability, theft of equipment, malfunctioning equipment, high operational expenditures, high temperatures, drought, water salinity, steep gradient and long distance from the river to the farm fields were the major factors negatively influencing water security for vegetable crop farming. The farmers suggested drilling boreholes, desalination, securing reservoir tanks, renewable and cheaper power supply, electricity subsidization, dam construction and reconstruction of the available dams could ameliorate major factors negatively influencing water security for vegetable crops at the scheme.

Keywords: Agriculture, infrastructure, irrigation, vegetable crop farming, water security.

Modality of presentation: Oral

MA42/NEREA® TECHNOLOGY: ECO-FRIENDLY FERTILIZERS FOR MODERN AGRICULTURE

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NEREA® Technology, developed by the Natural Zeolite Engineering Laboratory (NatZEng®) at the University of Havana, offers a revolutionary and eco-friendly fertilizer based on natural zeolites such as clinoptilolite, heulandite, and mordenite. Since 1985, NEREA® products have been designed to deliver nutrients to plants on demand, ensuring optimal growth while addressing key environmental challenges. Field trials and independent studies conducted in Cuba, Mexico, and Canada have validated its effectiveness, demonstrating its ability to maintain crop yields, improve soil health, and reduce environmental impact. Evidence shows that the use of NEREA® products, as opposed to chemical fertilizers, saves more than 90% of the NPK nutrients typically used in plant nutrition at a production scale. To determine the effective doses of NEREA® Fertilizer for commercially important crops in Cuba, such as tomato, cucumber, garlic, and black beans, trials were conducted under both outdoor and greenhouse production conditions. The results indicate that a dose of 1 tonne/ha of edaphic NEREA® Fertilizer is optimal for less nutrient-demanding crops like black beans. In contrast, a dose of 2 tonne/ha is optimal for crops such as tomato and garlic to achieve average yields. However, for higher yields in cucumber, a dose of up to 5 tonne/ha is required. In other studies, conducted over three rice-growing seasons, the combined use of NEREA® Plus and NEREA® Fertilizer products provided significant savings of NPK nutrients while achieving yields close to those observed under optimal fertilization conditions. NEREA® technology represents a transformative solution for modern agriculture, combining efficiency, sustainability, and environmental protection.

Keywords: NEREA® Technology, Sustainable agriculture, Natural zeolites, Nutrient delivery system, Eco-friendly fertilizers

Modality of presentation: Oral presentation

MA43/MICROSCOPIC EVIDENCE OF THE MODIFICATION OF THE ROOTS OF *EURUCA SATIVA* MILL (ARUGULA) INDUCED BY THE ECOLOGICAL FERTILIZER NEREA®

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The extensive use of conventional agrochemical fertilizers has compromised human and soil health. The shape and architecture of the roots adapt to the state and concentration of nutrients to take those that are soluble or interchangeable in soils and substrates. It is known that plants produce root growth in areas surrounding fertilizer granules and modify their absorbent hairs to increase the absorption surface. NEREA® products are ecological nanostructured zeolitic materials developed in Cuba by the Natural Zeolite Engineering Laboratory (IMRE-UH) that contain all the macro and micronutrients necessary for the optimal development of crops. Due to their physical and chemical properties, NEREA® products constitute a platform for the controlled release of nutrients that plants take in the time and magnitude they need to develop and what is not consumed remains in the NEREA® particles. The objective of this work was to demonstrate the great affinity of the roots for the NEREA® particles. The experiment was carried out with Euruca Sativa Mill arugula seedlings germinated in coconut fibre without fertilization and transplanted to different substrates: NEREA® Substrate (100%); NEREA® Plus in silica sand (25/75%); NEREA® Plus and soil pulverized in silica sand (25/25/75%) and soil pulverized in silica sand (50/50%). Scanning electron microscopy images of arugula roots 43 days after transplanting show that they modify their architecture and morphology to trap and envelop NEREA® particles, ignoring other particles present in the medium, confirming the extremely high nutritional efficiency of these new materials as fertilizers.

Keywords: Fertilizers, plant nutrition, morphology, zeolite

Modality of presentation: Oral

MA44/TRADESCANTIA SPATHACEA AS A CORROSION INHIBITOR IN ACID AND ALKALINE MEDIUM

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In this work, the efficiency of *Tradescantia spathacea* extract to control corrosion of SAE 1010 steel was analyzed in 1M HCl solution and in 3.5% NaCl solution. *Tradescantia spathacea* compounds were extracted by the Soxhlet method using ethanol as solvent and deionized water. The compounds were characterized by UV-Vis and gas chromatography (GC-MS). To evaluate the inhibitor efficiency, the electrochemical impedance (IE) technique was used in a potentiostat-galvanostat equipment and the weight loss technique. Phenolic molecules and heteroatomic molecules were found in the results. The results showed an increase in the inhibitor efficiency, as the concentration increased, up to 93%, while in NaCl solution efficiencies of 91% were obtained.

Keywords: Acid medium, green inhibitor, *Tradescantia spathacea*.

Modality of presentation: Poster

MA45/INHIBITION EFFICIENCY FOR CORROSION CONTROL WITH PLANT EXTRACTS IN AN ACIDIC MEDIA

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To treat steels and eliminate the formation of oxides, chemical pickling is used which is a cleaning process with hydrochloric acid or sulfuric acid leaving satisfactory results, which increases the demand for the use of this cleaning process. As a method of corrosion prevention, natural corrosion inhibitors are used because they are environmentally friendly. Inhibition tests were performed with extracts of banana peel and purple maguey, the extraction of compounds was performed by the Soxhlet method, these were analyzed by gas chromatography (GC-MS). The electrochemical evaluation was carried out with a potentiostat-galvanostat equipment and with a three-electrode cell (platinum electrode, calomel electrode and working electrode with SAE 1010 steel), in an acid solution at room temperature of 298 K. Efficiencies of 76% to 91% were obtained with the banana peel and efficiencies of 90% to 95% with the purple maguey, this extract being the one that showed greater efficiency in the acid solution.

Keywords: Corrosion inhibitor, Banana peel, purple maguey

Modality of presentation: Poster

MA46/IMAGE PROCESSING TO IMPROVE THE IDENTIFICATION OF DEFECTS IN PAINTS: CASE OF WHITE EPOXY PAINTS EXPOSED NEAR POLYMERIC NANOLAMINATES

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The evaluation of degradation of coatings is based on visual inspection to detect changes in the appearance of surface. Common defects like blistering, rusting, cracking, etc., are identified and graded according to the standard family ISO 4628:2016. Processing images of brilliant white coatings presents unique challenges due to their high reflectivity, uniform appearance, and sensitivity to lighting conditions. Experimental data reveal non-standard defects in the coating specimens under examination. The aims of the present investigation were to develop a combination of methods used in image processing that allows to improve the visualization of the defect structures in the exposed coating samples. The images were acquired with a reflex camera of 18 MPx resolution, with variable illumination and magnification, characteristic of working in field conditions. The results of the application of the selected sequence of image processing methods like edge identification, maps of distances, etc., are displayed. This is an essential preprocessing for the successful application of artificial vision methods. Additionally, another confirmation was obtained that the simultaneous degradation of polymeric nanolaminate test specimens in close proximity induces specific coating defects.

Keywords: Paints and varnishes, Evaluation of degradation of coatings, defect evaluation, image processing, edge identification, maps of distances

Modality of presentation: Poster

MA47/ENVIRONMENTAL NOISE LEVELS IN THE MAIN STREETS AND SPACES OF THE CITY OF CIENFUEGOS

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Noise pollution has significant health impacts. Noise can lead to stress, sleep disturbances, and cardiovascular issues. The main source of noise pollution in cities is road traffic. The city of Cienfuegos is no exception. Its industries and port activities are mainly located in two large areas downwind of the city. The regular layout of streets, low height of buildings, the small flow and the absence of large agglomerations of vehicles, compared to large cities, are characteristics of this city, which make the study of its environmental acoustics interesting. The objective of this research was to explore the ambient noise levels in the main streets and spaces of the city. The selection of the quantity and locations of the points to be measured was made based on an estimate of the distribution of vehicles circulating in the city. It was based on high-resolution satellite images and the position of each vehicle was recorded with the use of a Geographic Information System. The noise level (Leq) with frequency weighting A was measured for 20 minutes with a sound meter and also the maximum value during this period. According to the sources present, the noise at each point was classified into: transit, commercial and suburban. The sound pollution was graded in: Acceptable, Moderate and Severe, according to Cuban norm NC 26:2012. Most of the streets with vehicular traffic resulted in severe noise pollution and the spaces with commercial noise, with moderate pollution.

Keywords: Environmental noise, traffic noise, commercial noise, sound pollution, Cienfuegos

Modality of presentation: Poster

MA48/ATMOSPHERIC CORROSION STUDY IN OIL DRILLING AND EXTRACTION COMPANY CENTER OF MATANZAS PROVINCE

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A study on atmospheric corrosion for the most used metallic materials in the building industry, such as carbon steel, zinc, copper and aluminum, was carried out in the outdoor zones of the Oil Drilling and Extraction Company Center of Matanzas province company for a period of one year, as required by the atmospheric corrosion specialty standards. The results allowed concluding the existence of a proposed of higher than extreme (>CX) corrosivity category of the atmosphere for carbon steel and copper. This result was obtained in other coastal zones of high building potential in Cuba's tropical coastal climate. However, very high (C5) and medium corrosivity categories of the atmosphere were obtained for the zinc and aluminum respectively. In general, the corrosivity categories determined for the tested metallic materials corresponded to the typical description of the aggressive coastal atmosphere environment in terms of the monthly behavior of deposition and concentration of aggressive agents, taking into account the atmosphere classification in the study zone, as well as the monthly and cumulative behavior of the atmospheric corrosion rate. The air quality in the study zone is considered good for human health. Therefore, it is recommended that this same important research work would be carried out in other zones close to the company, mainly the Supertanker Base, located a short distance from the coastline, as well as to carry out tests using micro structural analysis techniques on the corrosion product samples obtained from the carbon steel and copper specimens removed during the year of study.

Keywords: metallic materials, corrosivity, atmosphere, atmospheric corrosion, building

Modality of presentation: Poster

MA49/STRUCTURAL STABILITY OF LOW-COST ZEOLITES USED AS CATALYSTS FOR HYDROGENATION OF SUCCINIC ACID

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Zeolitic materials incorporating mono- and bimetallic systems of nickel and cobalt were synthesized from natural zeolite through ion-exchange processes using Ni^{2+} and Co^{2+} chloride solutions. These materials were prepared via two methods: traditional ion exchange (IE) and impregnation (Imp). X-ray diffraction (XRD) studies, conducted as a function of temperature and complemented by other characterization techniques, were used to evaluate the structural stability of the systems and the mutual influence of Co^{2+} and Ni^{2+} in both IE- and Imp-prepared samples. The ion exchange of Ni^{2+} and Co^{2+} primarily replaced Ca^{2+} and Na^{+} cations in the zeolite phases, which consisted of a mixture of clinoptilolite and mordenite. The materials prepared by Imp achieved higher nickel and cobalt contents; however, they also contained significant amounts of chloride. In contrast, the materials prepared by IE exhibited negligible chloride content and larger specific surface areas. Temperature-dependent XRD experiments revealed no deterioration of the zeolite structure. However, significant changes were observed in the intensity of certain diffraction maxima, which were attributed to the nature, quantity, and extra-framework positioning of the cations. Among the prepared materials, the bimetallic NiCo system synthesized by IE emerged as the most promising catalyst for the hydrogenation of citral.

Keywords: zeolite, XRD study, crystal structure

Modality of presentation: Poster

MA50/HEALTHY HOUSING STRATEGY: CHALLENGES AND DILEMMAS IN THE PROVINCE OF BUENOS AIRES, ARGENTINA

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The normal conditions of the domestic microhabitat have a highly significant influence on the sustainable development of the environment and normally generate a strong impact on individual health. One strategy to promote people's health is the Healthy Housing promoted by the World Health Organization (WHO). This strategy aims to protect persons by improving housing conditions. Physical deficiencies in the built environment and families' lack of knowledge about risk factors, contribute to the increase in diseases, especially among the most vulnerable populations. This highlights the needs for all actors involved in the chain production habitat —government, academies, professionals, and users—to have efficient strategies to minimize risk factors and maximize protective factors in housing. The object of this investigation is to identify the role of each player and the indicators related to the Healthy Housing strategy in Buenos Aires (Argentina), throughout a systematic review of the scientific corpus, regulations, and professional strategies in three dimensions of analysis: 1) locally produced scientific articles, 2) current regulations, and 3) building evaluation methodologies. The results suggest the need to promote knowledge about the relationship between housing and health, by updating public policies, developing capacities, and transferring guidelines to users. Facilitating these actions from an intersectoral perspective, considering local conditions, and involving the community, establishes a strategy for the sustainable environmental development of the territory.

Keywords: Healthy Housing, health, Housing, Sustainable development, habitat

Modality of presentation: Poster

MA51/WATER CULTURE AND ACCESS TO DRINKING WATER: AN INTERDISCIPLINARY EXTENSION EXPERIENCE

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According to WHO, health is "a state of complete physical, mental, and social well-being, and not merely the absence of disease." From this perspective, housing conditions have a large impact on people's health. Therefore, access to safe drinking water and adequate sanitation are fundamental factors in quality of life and human health. As part of the "University Extension Program" at the Universidad de Buenos Aires, this project was developed to address the issue from technical, social, and cultural perspectives, in collaboration with various community stakeholders. The interdisciplinary experience responds to the needs identified by a kindergarten in a neighborhood lacking a sewage system and access to safe water in the Metropolitan Area of Buenos Aires, Argentina, where residents faced multiple challenges in accessing drinkable water. Considering that water management has a cultural component, working with the kindergarten children and their families proved to be highly valuable. The results highlighted the need to adapt water for human consumption and food preparation by constructing a community-built filter using common materials. Additionally, a series of recommendations were proposed to improve household facilities, which in many cases were sources of contamination and risk. The intervention was further complemented by an educational initiative on sustainable water management, engaging children as key promoters of good practices. These experiences for students integrate knowledge from various disciplines to solve real community problems. They serve as highly enriching strategies, helping students understand the technical, social, and cultural impacts of their professional actions and the importance of multidisciplinary work.

Keywords: Healthy house, Safe water, University extension program, Treatments of water

Modality of presentation: Poster

MA52/SUSCEPTIBILITY TO ANTIBIOTICS IN BACTERIA ISOLATED FROM THE ALMENDARES RIVER, HAVANA

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Antibiotics are emerging contaminants in aquatic environments with detrimental effects on the microbiota. Among the biochemical mechanisms of bacterial resistance to antibiotics is the synthesis of enzymes that destroy the molecular structure of these compounds, which can favor their biodegradation. The objective of the work was to evaluate the susceptibility to different antibiotics in bacteria isolated from the Almendares River, Havana. Bacterial isolation was carried out from water samples from two points of the river that receive untreated effluents; microbiological methods were used for the taxonomic characterization of the isolates. The Kirby-Bauer method was applied to determine bacterial susceptibility to seven abiotics. Seven bacterial strains of the genera *Pseudomonas, Enterobacter, Staphylococcus and Bacillus* were isolated. The following behavior was evident in them: 85% were resistant to ciprofloxacin, 71% were resistant to Azithromycin, 57% were resistant to Tetracycline, and 42%, 28%, and 14% were resistant to Gentamicin, Ampicillin, and Kanamycin, respectively. Sensitivity to Kanamycin, Ampicillin, Tetracycline, Gentamicin and Ciprofloxacin was detected in a range of 71 to 14% of the strains tested. An intermediate response in terms of susceptibility was identified in 14% of the bacteria against Gentamicin and Kanamycin. The results show the presence of resistant strains in some parts of the river, with environmental and public health impacts.

Keywords: Isolates, antibiotics, resistance, Intermediate, sensitive

Modality of presentation: Poster

MA53/OLEOVET ENVIRONMENTAL IMPACT ASSESSMENT AT THE NATIONAL CENTER FOR SCIENTIFIC RESEARCH

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The biopharmaceutical industry pays special attention to the environmental impact derived from the production of a drug, in the different pharmaceutical forms and even those classified as natural products, which denotes the social responsibility of this type of organization, including from the design. The impact assessment is a very useful tool from a holistic perspective, the potential impacts of a new product. The scientific research center that has endorsed a policy of environmental sustainability performs the impact assessment of all productions. Objective: to assess the environmental impact of OleoVET. The impact assessment is performed using the methodology adapted from the Guide to Environmentally Sustainable Practices in Laboratories. Published in May 2018 in Valencia, Spain. Prior to the application of the methodology, an analysis of its relevance is carried out, in a first step it is analyzed by a group of 5 selected specialists, according to scientific category, experience in the activity. Once endorsed by the criteria of the selected experts, the environmental impact assessment is carried out by means of a risk assessment matrix. Regarding the validity of the methodology to be applied, 80 percent of the selected experts considered it to be quite appropriate and adequate. The assessment concluded that the risks identified do not represent an environmental, ecological, economic or social impact on human health. The impact assessment allows to conclude that all risks have been identified as low, it has been demonstrated that the OLEOVET production process is environmentally satisfactory.

Keywords: Environmental impact, Environmental sustainability

Modality of presentation: Poster

MA54/EVALUATION OF THE PERFORMANCE OF WASTEWATER DISCHARGES OF CNIC COMPANY

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The adequate management of wastewater is universally recognized as an essential measure for the protection of public health and the preservation of the environment; hence the National Center for Scientific Research Company maintains a rigorous control of its discharges. This paper shows the results obtained from the analysis of the Company's wastewater discharges, comparing them not only with the Cuban discharge standard NC:27 (in force since 2012), but also with the baseline preset in 2022 for internal monitoring in the center. For this purpose, the analytical results issued by the Laboratory Management Group of Scientific Technical Services - DECA, (accredited according to NC-ISO/IEC 17025:2017), during the years 2022 to 2024 were taken into account. The results obtained for BOD_5, COD, settleable solids, temperature, pH and electrical conductivity showed that the wastewater generated in the company continues to comply with the requirements of the standard for discharge into the sewage system. In addition, it was found that all parameters showed values lower than those of the established baseline, which in turn are lower than the Average Maximum Permissible Limits required by current regulations.

Keywords: baseline, wastewater, characterization

Modality of presentation: Poster

MA55/INTEGRATION OF ENVIRONMENTAL MANAGEMENT INTO THE QUALITY MANAGEMENT SYSTEM OF THE CENTER FOR MOLECULAR IMMUNOLOGY

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The development of an integrated management system allows companies to save resources, better performance and compliance with the objectives and goals set. However, the complexity of the company determines the magnitude of the steps to be taken to make the integration a reality, which is more feasible in small and medium-sized companies than in large ones. This research addresses the methodological and practical integration of the Environmental Management System to the Quality Management System at the Center for Molecular Immunology, a closed-cycle Cuban biotechnological institution dedicated to the development of products for the treatment of cancer and other autoimmune diseases. In particular, the importance, potentialities, and differences of the management systems are addressed. In general, a Strategic and Operational Plan is proposed for the implementation of the integration of both management systems in the Center for Molecular Immunology. Among the methods and techniques used are documentary review, checklist, Delphi method, cause-effect diagram and SWOT matrix, as tools to analyze the causality of problems. The usefulness of the proposed integration structure is pointed out for the rest of the BioCubaFarma companies, as long as it is adjusted to their own characteristics and processes.

Keywords: Quality Management System, Environmental Management System, documentary system.

Modality of presentation: Poster

MA56/PATHOGENIC FUNGI PRESENT IN THE AIR IN TWO WHEAT CROPS: *ALTERNARIA, CURVULARIA* AND *FUSARIUM*

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Fungi such as *Alternaria*, *Curvularia*, and *Fusarium* are pathogens that affect wheat, causing wilting of leaves and root rot, which negatively impacts growth and productivity. This study analyzed the temporal variation of these fungal genera in the air during two wheat cultivation cycles in Artemisa (2023 and 2024), using viable and non-viable volumetric equipment. Air samples were collected with three replicates, and the identification of fungi was performed using microscopy, calculating density and relative frequency and correlation with meteorological factors. Viable: The results indicated that all three genera were detected in 2023, while only *Fusarium* and *Curvularia* were found in 2024. *Alternaria* was isolated only in April 2023, and *Curvularia* showed the highest contribution that month. Non-viable: *Fusarium* had similar amounts in March and April 2023, and in 2024, *Curvularia* was recovered in January and March, with *Fusarium* predominating in April. In terms of relative density, *Curvularia* exceeded *Fusarium* and *Alternaria* in both years. Meteorological correlations showed significant relationships between temperature and the spores of *Alternaria* and *Fusarium* in 2023, and with *Curvularia* in previous periods. In 2024, only a positive correlation between temperature and *Alternaria* was observed. These findings suggest that environmental conditions influence the proliferation of these fungi, highlighting the need for continuous monitoring to implement integrated pest management strategies in agriculture.

Keywords: Aeromycology, airbone fungi, plague, wheat *(Triticum aestivum*)

Modality of presentation: Poster

MA57/METHODOLOGY FOR ASSESSING PROGRESS IN THE CIRCULAR ECONOMY. SUSTAINABILITY STRATEGY AT CNIC

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The circular economy is a model of productive transformation based on the efficient use of resources, which is built on technological innovation and collaboration between actors in value chains. Its implementation implies a paradigm shift and structural changes in production systems, the latter with benefits in terms of profitability, pollution prevention and positive social impacts. At National Center for Scientific Research (CNIC) the transition to the circular economy is a priority in its strategies. especially in design alternatives and innovation models based on the use of technology that have the potential to extend the useful life of resources. The work objective was to design a methodology to evaluate progress in circular economy in the CNIC, for which a literature review was conducted to support the concept of circular economy, an analysis that presents a picture far beyond just waste management. Indicators were developed to evaluate progress in circularity in the value chain and opportunities were identified that contribute to the decarbonization goals and the Sustainable Development Goals (SDGs). It was shown that there is progress in the transition to the circular economy, industrial symbiosis practices are used, waste is reduced, resources are reintroduced into the production cycle, so that they create value when goods reach the end of their useful life. Opportunities were identified such as the use of renewable energy sources, conservation of water sources, reuse of treated water, improvement in the use of resources, as well as its most important limitations when applying this methodology in Cuban conditions.

Keywords: Circular Economy, Sustainable Development Goals, Value chain

Modality of presentation: Poster

MA58/MICROPLASTICS IN AQUATIC ECOSYSTEMS: RESEARCH PERSPECTIVES FROM ENVIRONMENTAL MICROBIOLOGY

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Microplastic debris (MPs) in ecosystems contribute to the enrichment and distribution of bacterial pathogens, raising significant environmental concerns. MPs create ideal habitats for microbial biofilms, and studies have reported that the presence of drug-resistant bacteria in plastic pieces can be 100 to 5000 times higher than in the surrounding water. This data suggests that plastic could serve as a new ecological habitat in the open ocean. Research on freshwater ecosystems, however, is much more limited. This work takes a preliminary approach from environmental microbiology to explore the role of MPs in freshwater ecosystems, with a particular focus on Cuba. It opens up opportunities to investigate how microbial communities interact with MPs, potentially leading to their degradation or transformation. The research addresses several important points: 1. MPs as a preferred habitat for antibiotic-resistant bacteria in freshwater ecosystems; 2. The mechanism of horizontal gene transfer for antibiotic resistance influencing this process; 3. Plastic as a material for the selection of specific microbial communities; 4. Microorganisms as a part of the solution for mitigating microplastic pollution. This approach could lead to innovative solutions for the bioremediation of contaminated ecosystems. The aim of this study is to lay the groundwork for future research, contributing to the sustainable development and conservation of aquatic resources in Cuba.

Keywords: microplastics, tropical freshwater ecosystems, bacterial pathogens, antibiotics, bioremediation

Modality of presentation: Poster

MA59/NEW FORMULATIONS USING LIQUID WASTE FROM PRODUCTION PROCESSES

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The Palmex and Policosanol productions generate residual oil and residual acetone/ hexane, respectively. The final disposal of these liquid wastes is temporary storage. The objective was to develop and evaluate formulations as nail polish remover and surface remover-cleaner from these wastes. Different proportions of the components and mixing times were tested with a stirring speed of 300 rpm at room temperature. For the nail polish remover, formulations were evaluated with proportions of residual acetone: 65-78% (solvent), residual oil: 5-2% (emollient agent) and ethanol: 20% (solvent). The dependent variable: removal time of nail polish. Laboratory tests and an exploratory proof were carried out with N: 50 women, applying a survey. On the other hand, for the surface remover-cleaner, formulations with proportions of residual acetone: 60-80% (< 20% water), residual hexane: 40-20% (solvents) were evaluated. The dependent variable was the removal time of dirt (greases and oils) on different surfaces. Laboratory and a Pilot Plant tests were carried out, as well as using parts and pieces of cars, recording the effectiveness indicators. The Palmesol (20% ethanol, residual acetone: 78% and residual Palmex oil: 2%) acts as a removing and dispersing agent for difficult-to-remove dirt, mainly greases and oils. It is special for the industrial cleaning of surfaces, parts and pieces of cars. The Limbamez (80% residual acetone (< 20% water) and 20% residual hexane) as a nail polish remover, protective and moisturizing agent. Both products have the Technical Data Sheet with instructions for use. They are in the registration phase for commercialization. The results respond to the Circular Economy application for the CNIC productions.

Keywords: liquid waste, formulation, thinner, nail polish remover, Circular Economy.

Modality of presentation: Poster

MA60/DEVELOPMENT OF A RELEASE AGENT FROM SEMI-SOLID WASTE FROM THE PRODUCTION OF ABEXOL AND POLICOSANOL

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In the manufacture of solid active ingredients (AI) derived from sugar cane wax and beeswax, four semisolid wastes are generated, obtained from the acetone and hexane distillation processes. The patent review revealed the existence of release agents from paraffin waste from the petroleum industry, but not from this type of waste generated by the production of Abexol and Policosanol at the National Center for Scientific Research. The release agents are products that are applied to molds or formwork of reinforced concrete structures to prevent them from adhering to the formwork, avoiding subsequent damages. The objective of this study was to develop a product from these wastes for application as a potential release agent of hydraulic concrete. The wastes were characterized with respect to dry weight, residual solvents, evaporation and drying losses. Ten formulations were developed under selected operating conditions: water/residual proportions, temperature, stirring speed and time, prior heating or not of the components. Four formulations were chosen for their texture and evaluated, in wooden molds, at laboratory. These fulfilled with the technical characteristics of a release agent: compatibility with the mold material, durability, good adhesion, easy application, drying time values were between 15 and 60 min, as well as a performance profile: 7.5-11.4 m^2/L. Consequently, they were evaluated in a Pilot Plant of the Prefabricated Company on folding metal tables. The formulation - G from RDA(P) waste was the most suitable, with less than 45 min of drying and a performance of 6-8 m^2/L. Tests with molds on an industrial scale are being coordinated.

Keywords: Wastes, release agent, solvent, process, hydraulic concrete.

Modality of presentation: Poster

V INTERNATIONAL SYMPOSIUM ON INFECTIOUS DISEASES AND VACCINES

EI02- IMPACT OF HUMAN PAPILLOMAVIRUS INFECTION IN DIFFERENT RISK GROUPS OF CUBAN POPULATION

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Molecular epidemiology studies on high-risk human papillomavirus (HR-HPV) in Cuba provide critical insights for optimizing cervical cancer (CC) screening and prevention strategies. HPV detection and genotyping were performed using qPCR and microarrays. Among women aged 30-59 with cervical lesions (n=322), HPV prevalence was 76.1%, with HPV-16, 18, 31, and 45 being the most prevalent and associated with CC ($p \leq 0.007$). Women diagnosed with CC exhibited high viral loads **(**10^6-10^7 copies/mL**)**. Adolescent females (12-24 years) with precancerous lesions or CC showed even higher positivity rates **(**84-92%**)**, with notable regional variations: HPV-58 (45.5%) predominated in Isla de la Juventud (n=94), while HPV-31 (15.2%) was most frequent in Camagüey (n=166). Among asymptomatic women (n=500) from Havana, Villa Clara, and Holguín, HPV infection was 14.8%, with HPV-16 (23%) as the dominant genotype. A separate study of 559 adolescents (including STI patients and asymptomatic) revealed an overall HPV positivity rate of 42.9%**.** STI patients predominantly harbored HPV-66, 58, 51, and 52, whereas asymptomatic individuals carried HPV-16, 18, 31, and 33. Anal HPV infection was detected in 68.1% of 116 patients, with significantly higher rates in HIV-positive individuals (p=0.000). In colorectal tumors, 23.8% were HPV-positive, exclusively involving HPV-16 (19%) and 33 (4.8%). Head and neck tumors (n=88) featured HPV-58 (84.4%) and 66 (50%)**,** while conjunctival lesions were predominantly associated with HPV-16 (1.6%)**,** particularly in squamous cell carcinomas with high viral loads. These findings may be of importance for local decision makers to improve HPV screening and prevention strategies, including the introduction of HPV vaccine in Cuba.

Keywords: human papillomavirus, Molecular epidemiology; cervical cancer; extragenital HPV; Cuba.

Modality of presentation: Lecture

EI03/EVALUATION OF INDIVIDUAL MIXTURES FOR THE DEVELOPMENT OF A SYSTEM FOR THE IDENTIFICATION OF HIGH-RISK GENOTYPES OF THE HUMAN PAPILLOMAVIRUS

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Human papillomavirus (HPV) is a group of more than 200 viral variants that infect skin and mucous membranes in humans. It causes benign lesions such as genital warts, and persistence can be associated with malignant processes. Cuba does not have its own assay for the identification of high-risk variants (HR). Objective: To evaluate the design of primers for the identification of 15 HPV HR genotypes by real-time PCR and high-resolution melting analysis (HRMA) with SYBR Green. Bioinformatics tools were used to design primers specific to selected HPV variants with a single thermal program. Individual reaction mixtures were normalized and evaluated with serial dilutions of international standards (IS) for HPV (16 and 18) and control samples by real-time PCR and HRMA. In the specific mixtures, a differentiated amplification signal and melting temperature (Tm) values were obtained for each, with no cross-reactivity. The standardized assay conditions allowed the detection of up to 103 copies/µL of IE. Clinical Sensitivity and Specificity were determined for control samples, with a >95% confidence interval. The designed primers are specific for the identification of the 15 RA genotypes. The Tm of the amplified products differ from each other. The Ct and Tm characterization of the normalized reaction products under a single thermal program could be used in the detection of multiple targets.

Keywords: polymerase chain reaction, HPV, high-resolution melt analysis, SYBR Green

Modality of presentation: Oral

EI04/SOLUBLE PRODUCTION OF HUMAN PAPILLOMAVIRUS 16 L1 AND 18 L1 PROTEINS BY *ESCHERICHIA COLI*

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Considering the high incidence of cervical cancer worldwide, preventive vaccines have been developed against persistent Human Papillomavirus (HPV) infection. These vaccines are based on the major capsid protein L1 and particularly, the Chinese vaccine Cecolin® uses *Escherichia coli* as a host system for the production of N-terminal- truncated L1 proteins in the soluble fraction. In order to develop a Cuban alternative, the *E. coli* strains BL21(DE3) transformed with the plasmids pT7F7HPV16L1 or pF0T7HPV18L1 have been obtained at the National Center for Scientific Research. For both genetic constructions, a full-length synthetic HPV L1 gene under the control of the T7*lac* promoter was used. With the aim of obtaining the HPV-16 L1 and HPV-18 L1 proteins in the soluble fraction of *E. coli*, parameters of L1 gene induction and the composition of the culture medium was studied. For the cells lysis an Emulsiflex C3 disrupter was employed. Among the evaluated experimental conditions, induction with 0.2 % lactose at an optical density of three units in Terrific broth stood out. The HPV-16 L1 protein was obtained at levels of 12 % with respect to the total proteins in the soluble fraction; while HPV-18 L1 protein was detected at about 20 % with respect to the total proteins in the same fraction. For both recombinant strains, 12 - 14 units of optical density was obtained at the end of induction. Consequently, the aforementioned condition was selected as a starting point of the scale-up to 5L fermenters at the National Center for Biopreparations.

Keywords: Human Papillomavirus type 16 and 18, *Escherichia coli*; soluble fraction

Modality of presentation: Oral

EI05/PURIFICATION OF HPV16- AND HPV18-L1 PROTEIN PENTAMERS FROM *ESCHERICHIA COLI*

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Human Papilloma Virus (HPV)-16 and -18 are the two most common high-risk HPVs responsible for ~70% of all HPV-related cervical cancers and head and neck cancers. The L1 protein is the majority of the HPV capsid and together with the L2 protein, they make up the 72 pentameric capsomers of the capsid. The L1 protein has the intrinsic capacity to self-assemble into virus-like particles (VLP), without the participation of the L2 protein or the viral genome. These VLP resemble native virions in shape and size, are highly immunogenic and non-oncogenic. For these reasons, they are the active ingredient in all HPV vaccines approved to date. The National Center for Scientific Research is addressing a project aimed at obtaining vaccine preparations against HPV, based on HPV -16 and -18 L1-VLP. The objective of this work was to purify HPV16 (L1-16)/HPV18 (L1-18) L1 proteins from the soluble fraction of *Escherichia coli* BL21(DE3) transformed with the expression plasmids pT7F7HPV16L1/pT7F7HPV18L1, capable of self-assembling into VLPs. The strategy followed for the purification of the pentamers was the combination of a cation exchange chromatography as the capture step followed by a hydrophobic interaction chromatography as a polishing step. In the purification process, the L1-16 and L1-18 proteins reached a purity of 95% and a yield of 58.32 mg/L and 72.35 mg/L for L1-16 and L1-18, respectively. The purified capsomers of both proteins were able to self-assemble into VLPs, according to transmission electron microscopy analysis.

Keywords: Human Papillomavirus type 16 and 18, Virus Like Particles, Purification, L1 Protein, *Escherichia coli*.

Modality of presentation: Oral

EI06/CHARACTERIZATION OF *ESCHERICHIA COLI*-PRODUCED HUMAN PAPILLOMAVIRUS 16 AND 18-L1-VIRUS LIKE PARTICLES

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Vaccination against Human Papilloma Virus is the most cost-effective public health measure against cervical cancer. Cuba will implement HPV vaccination this year, targeting 9-year-old girls. Having a Cuban vaccine will allow to expand vaccination coverage to girls, boys, and young people up to 26 years old. The National Center for Scientific Research in collaboration with the National Center for Biopreparations are developing a prophylactic HPV vaccine candidate. The aim of the present work was to biochemically, structurally and functionally characterize HPV-16- and HPV-18-L1 VLP assembled *in vitro* from HPV-16- and HPV-18-L1 protein pentamers purified from *Escherichia coli*. The biochemical evaluation was carried out by reducing and non-reducing SDS-PAGE electrophoresis. Structural-morphological characterization was made by Transmission Electron Microscopy (TEM) and Dynamic Light Scattering (DLS), and functional characterization by mouse erythrocyte hemagglutination assay (HA). Particle distribution analysis of TEM images showed that 90% of the measured HPV-16-L1 VLP had a diameter of 32–40 nm (average diameter of 36.9 ± 0.72 nm), which was smaller than HPV-18-L1 VLP, where 80% of the particles had diameters between 46–52 nm (average diameter of 50.3 ± 0.6 nm). Hydrodynamic diameters of HPV-16-L1 and HPV-18-L1 VLPs were 50-70 nm and 70-90 nm, respectively; and the particles had polydispersity indexes of 10% to 20%. The VLPs agglutinated mouse erythrocytes in a dose-dependent manner and their hemagglutinations were type-specifically inhibited by polyclonal antibodies directed against pentamers of HPV-16- and HPV-18-L1, demonstrating the presence of type-specific, conformational neutralizing epitopes on the *E. coli*-produced VLP surface.

Keywords: Human Papillomavirus type 16 and 18, vaccine, Virus Like-particles, L1 Protein, *Escherichia coli*.

Modality of presentation: Oral

EI07/IMMUNOGENICITY IN MICE OF *ESCHERICHIA COLI*-PRODUCED HUMAN PAPILLOMAVIRUS 16 AND 18-L1-VIRUS LIKE PARTICLES

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The National Center for Scientific Research, in collaboration with the National Center for Biopreparations, is developing a vaccine candidate against Human Papillomavirus (HPV), whose active ingredient is virus-like particles (VLPs) of the L1 protein of HPV-16 (L1-16) and -18 (L1-18), obtained from the *in vitro* assembly of L1 pentamers purified from *Escherichia coli*. The objective of the present study was to evaluate the immunogenicity in mice of monovalent formulations of L1-16 and L1-18 VLPs administered in two or three doses of 4 or 0.4 µg (VLP-L1-16) and 2 or 0.2 µg (VLP-L1-18) adjuvanted with aluminum hydroxide. As controls, three doses of L1-VLPs at the highest concentration used, without adjuvant, were administered. High titers of specific IgG anti-16- and -18-L1-VLPs were obtained in all experimental groups, with no significant differences among the different schedules and doses of the adjuvanted VLPs. Anti-16-L1-VLP IgG titers in the group of mice immunized two or three times with the highest dose were statistically different from those in the group of mice immunized with non-adjuvanted VLPs; in the case of titers of IgG anti-18-L1-VLP, significant differences were only observed between the group inoculated with the highest dose and the control group. The titers of mouse erythrocyte hemagglutination inhibition mediated by homologous VLPs of the group of mice immunized three times with the highest and lowest doses were statistically different from the control group without adjuvanted VLP. The results demonstrated the induction of a type-specific neutralizing antibody response, which is responsible of protection against viral infection.

Keywords: Human Papillomavirus type 16 and 18, Virus Like Particles, L1 Protein, *Escherichia coli*, immunogenicity.

Modality of presentation: Oral

EI08/GENERATION AND CHARACTERIZATION OF MONOCLONAL ANTIBODIES DIRECTED AGAINST VIRUS LIKE PARTICLES OF HUMAN PAPILLOMA VIRUS 16- L1 PROTEIN. ANALITICAL TOOLS FOR LIBERATION OF A VACCINE CANDIDATE AGAINST HPV-16

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Human Papillomavirus (HPV) is the main cause of cervical cancer, the fifth most frequent cancer in Cuban women. Epidemiological studies have revealed a high circulation of genotypes 16 and 18, even in women with normal cytology, which reinforces the need for prophylactic vaccination. Available vaccines use the L1 protein, the predominant component of the viral capsid, capable of self-assembling into virus-like particles (VLPs). These maintain the structure and antigenicity of the native virus, which makes them highly immunogenic. Given the prevalence of genotypes 16 and 18 in Cuba, the National Center for Scientific Research has developed a bivalent vaccine candidate based on VLPs of these genotypes. This study focused on the generation and characterization of monoclonal antibodies directed against L1-16 VLPs to evaluate their specificity and neutralizing capacity using techniques such as Western Blotting, Dot Blotting, ELISA, and hemagglutination inhibition assay. Six monoclonal antibodies were obtained: five specifically recognized the native VLPs, and one, the denatured ones. Three demonstrated the ability to inhibit hemagglutination, indicating their recognition of key epitopes in viral neutralization. These antibodies could be valuable in the development of quantitative ELISA assays for the quality control of vaccines based on pentamers and L1-16 VLPs.

Keywords: Human Papillomavirus type 16, Virus Like Particles, L1 Protein, monoclonal antibodies, diagnosis, ELISA

Modality of presentation: Oral

EI10/PRELIMINARY STABILITY STUDIES OF HUMAN PAPILLOMAVIRUS 16-L1 PENTAMERS PURIFIED FROM *ESCHERICHIA COLI* FOR FORMULATION PURPOSE

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The development of a vaccine candidate against Human Papillomavirus requires quality assurance assays using reference materials. The objective of this study was to evaluate the stability of HPV16-L1 pentamers purified from *Escherichia coli* to identify potential formulations useful for a reference standard for this antigen. The stability of the pentamers, measured as the amount of soluble L1 after treatment, was assessed by incubation for 30 minutes at different temperatures (37 and 50°C), pH (6.0, 7.0, 8.0), salt concentration (NaCl, 0.25, 0.5, 0.75, 0.8, and 1 M), and glycerol concentration (5 and 10%) in 20 mM phosphate buffer. The amount of L1 in the soluble and insoluble fractions was assessed by reducing SDS-PAGE. Incubation of the pentamers at 50°C had the greatest impact on stability, so this temperature was selected for the evaluations. At pH 8.0, the greatest instability of the L1 protein was observed, in agreement with its theoretical pI of 8.5. The pentamers were most stable at 0.5 M NaCl and pH 6.0 and 7.0. The addition of glycerol had no effect on stability. Based on the results, it is proposed to evaluate the stability of the pentamers in 20 mM sodium phosphate buffer and 0.5 M NaCl at pH 6.0 and 7.0 in an accelerated study at 37°C and 25°C. The methodology followed can be used to evaluate the stability of virus-like particles (VLPs).

Keywords: Stability, pentamers, HPV16-L1, *E. coli*

Modality of presentation: Oral

EI11/ASSEMBLY OF HUMAN PAPILLOMAVIRUS 16- L1-VIRUS LIKE PARTICLES BY TANGENTIAL FILTRATION

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Virus-like particles (VLP) are currently widely used in the manufacture of vaccines against human papillomavirus (HPV). The National Center for Scientific Research (CNIC), in collaboration with the National Center for Biopreparations, is undertaking a project to develop a bivalent vaccine candidate against HPV-16 and -18 genotypes, based on VLP of the major capsid L1 protein. At the laboratory level, VLP have been obtained by *in vitro* assembly of pentamers purified from *Escherichia coli* by dialysis. This process is not efficient for obtaining VLP on a larger or industrial scale due to the long processing times and significant buffer consumption. Therefore, to improve VLP assembly yields, ultrafiltration and tangential diafiltration processes are employed. The aim of the present study was to evaluate the formation of VLP from *Escherichia coli*-purified pentamers using the Sartocon Slice200 tangential filtration system. The better results were achieved when the VLP assembly process was carried out at a constant pressure (0.01 bar), overnight, at a temperature of 10 °C, reaching a VLP yield of 21%. The hydrodynamic diameter of VLP were found between 60-75 nm, according to dynamic light scattering analysis, similar to the diameter obtained for VLP assembled by dialysis. The polydispersity index was found between 10-13 nm, which demonstrated that the VLP preparations were homogenous. VLP were also stable after a month at 4 ^{o}C. The results showed that *E. coli*-purified HPV16-L1 pentamers are able to assemble into VLP by tangential filtration, although the process needs to be optimized to maximize yields.

Keywords: Virus Like Particles, Assembly, L1-16 Protein, Tangential filtration.

Modality of presentation: Poster

EI12/ STABILITY OF HUMAN PAPILLOMAVIRUS 16 AND 18-L1-VIRUS LIKE PARTICLES ASSEMBLED FROM PENTAMERS PURIFIED FROM *ESCHERICHIA COLI*

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Structural integrity preservation of Human Papilloma Virus (HPV)-16 and HPV-18 L1-Virus-Like Particles (VLPs) is critical for vaccine development. The aim of this study was to evaluate the stability of HPV-16 and -18 L1-VLP assembled from L1-pentamers purified from *E. coli* during conservation at -20°C and +2-8°C using three key indicators: soluble protein percentage after centrifugation (FS%), L1 protein purity in the soluble fraction (L1-FS%) and L1 integrity. Initial HPV18-L1-VLP preparations showed poor stability at -20°C, with FS% not exceeding 70% within 22-64 days. Crucially, modifications to the assembly process yielded significantly more stable HPV18-L1-VLPs in both short-term (3 days: FS% ~87-98%, L1-FS% ~89-100%) and long-term (3 months: FS% ~97-99%, L1-FS% ~89-100%) storage at -20°C. Dynamic Light scattering showed stability for one month at +5°C. At +2-8°C, the batches remained stable for 70-79 days (FS% ~85-86%, L1-FS% ~86-98%), though one exhibited L1 fragmentation. For HPV16-L1-VLPs at -20°C for 64-114 days, four preparations in sodium acetate buffer (pH 5.5) and one in sodium phosphate (pH 6.6), with equal salt concentration, remained stable. Conversely, two preparations in 20 mM phosphate buffer (pH 6) with lower salt concentrations (0,5 M NaCl) and two in acetate buffer were unstable by structural damage. Freeze-thaw cycles caused no instability. At +2-8°C for six weeks, HPV16-L1-VLP stability was generally limited to about 2 weeks. In summary, optimizing the assembly process was key to achieve stable HPV18-L1-VLPs, while HPV16-L1-VLPs stability appears to be process-dependent. Acetate buffer was more convenient for assembly and long-term freezing, but refrigeration stability remains a challenge, heavily influenced by buffer composition and salt concentration.

Keywords: Human Papillomavirus type 16 and 18, HPV vaccines, Virus Like Particles, Stability, L1 Protein, *Escherichia coli*.

Modality of presentation: Poster

EI13/ANALYSIS OF HPV-L1 PROTEIN PRODUCTION AND SOLUBILITY IN *ESCHERICHIA COLI* BL21(DE3)

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The National Center for Scientific Research and the National Center for Biopreparations develop a vaccine candidate against Human Papillomavirus (HPV) 16 and 18, based on virus-like particles assembled from L1 pentamers purified from *Escherichia coli*. This bacterium does not assembly VLP, but soluble L1-pentamers are intracellularly produced. During cultivation, it is required to quantify the amount and solubility of L1-protein. The aim of this study was to stablish the conditions for the analysis of these parameters by SDS-PAGE in a reproducible way. For *E. coli* whole- cell samples, the best results for L1 quantification by densitometric analysis were obtained when cell precipitates were suspended at a cellular density at 600 nm of 5 units, in a 0,2 M NaCl-containing buffer, instead of PBS. For evaluating L1-solubility, the best results were obtained when cell paste were suspended at 25 - 50 g (wet weight)/L of lysis buffer and were disrupted by high-pressure homogenization. After centrifugation, soluble and insoluble fractions were diluted 1/5 in water before SDS-PAGE assay. These conditions will be useful for evaluating consistency of L1-production and solubility in a robust way during process development.

Keywords**:** *E. coli*, VLP, HPV, SDS-PAGE

Modality of presentation: Poster

EI14/HIGH PRESSURE HOMOGENIZATION OF AN *E. COLI* BL21 (DE3) STRAIN PRODUCER OF HPV-18 L1 PROTEIN

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The National Center for Scientific Research and the National Center for Biopreparations (BioCen) develop a vaccine candidate against the Human Papillomavirus 16 and 18 using *Escherichia coli* as host. As part of the scale-up at BioCen, an *E. coli* BL21 (DE3) strain, which produces the HPV-18-L1 protein, was grown in 50 L bioreactors, where the soluble L1 protein accumulated intracellularly. For L1-purification at the laboratory level, *E. coli* cells are disrupted by using the high-pressure homogenizer Emulsiflex C3, for five passages at 1000 bar, according to the manufacturer's recommendations. For the scale-up of the purification process, conditions must be established to guarantee maximum efficiency in the rupture and recovery of the HPV18-L1 protein for the subsequent purification step. The aim of this study was to characterize the cell lysis of the *E. coli* BL21 (DE3) strain, producer of the L1-18 protein, grown in 50 L fermentations by high-pressure homogenization. The disruption efficiency, the amount of L1-18 in the soluble fraction, and its purification yield on SP-Sepharose, the first downstream purification step was evaluated at different pressures (500, 700, and 1000 bar) and number of cycles (1–5). The lysis efficiency was similar in the three evaluated pressures in terms of cell disruption and the amount of total protein released. The amount of soluble L1 released and its yield after purification from the soluble fraction were shown to be similar after three and five cycles of homogenization at the three evaluated pressures, indicating that three disruption cycles could be used as standard conditions.

Keywords: High-pressure homogenization, Number of cycles, Pressure, Purification, L1-18 Protein.

Modality of presentation: Poster

EI15/CHARACTERIZATION OF POLYCLONAL ANTIBODIES DIRECTED AGAINST *ESCHERICHIA COLI*-PRODUCED HPV-16/18-L1-VLPs

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All available vaccines against Human Papillomavirus (HPV) use virus-like particles (VLPs) of the L1 protein, the major component of the viral capsid. The National Center for Scientific Research and the National Center for Biopreparations are developing a vaccine candidate against HPV-16 and 18 that uses VLPs assembled from L1 pentamers purified from *Escherichia coli*. While developing a vaccine candidate, its quality must be controlled; polyclonal antibodies (pAbs) are useful for control assays. The objective of this study was to characterize pAbs directed against HPV-16 and -18 L1-VLPs regarding type-specificity and conformational epitope recognition using indirect ELISA; as well as neutralizing activity using the inhibition assay of erythrocyte hemagglutination (IHA) mediated by L1-VLPs. The pAbs specifically recognized L1 pentamers and intact VLPs at high titers, both those obtained from *E. coli* and those commercially-available produced in *Saccharomyces cerevisiae*. Furthermore, the pAbs inhibited VLP-mediated HA in a type-specific manner, both for those obtained in *S. cerevisiae* and *E. coli*, indicating the presence of type-specific neutralizing antibodies directed against conserved conformational epitopes in VLPs obtained from both hosts. These results support the potential of pAbs for the development of ELISA assays sensitive to antigen conformational quality and for the functional monitoring of VLPs produced in *E. coli*.

Keywords**:** Polyclonal antibody, antibody characterization, pentamers, VLP, HPV-18, HPV-16; hemagglutination inhibition, indirect VLP ELISA

Modality of presentation: Poster

EI16/NEW INSIGHTS ON MUCOSAL IMMUNIZATION FOR IMMUNOCOMPROMISED INDIVIDUALS

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Mucosal immunization represents a promising strategy for enhancing immune protection at the body's primary entry points for pathogens. By targeting mucosal surfaces such as the respiratory tract, this approach aims to elicit strong local and systemic immune responses. Recent advances in vaccine platforms, including the development of innovative delivery systems, adjuvants and immunopotentiators, have highlighted the potential of mucosal immunization in preventing infectious diseases. The advantages of mucosal immunization, especially in immunocompromised individuals, become evident with the results of the therapeutic vaccine against chronic hepatitis B, HeberNasvac, and the Mambisa vaccine candidate against COVID-19. The Mambisa vaccine was evaluated in a phase II clinical trial, where volunteers were stratified by age into two groups: those younger than 60 years and those older than 60 years. The vaccine candidate was shown to elicit high levels of specific serum IgA and IgG antibodies. These antibodies, present in both serum and mucosal tissues, inhibit RBD-ACE2 binding and demonstrate neutralizing activity against the D614G variant and the Omicron variant of concern. In an independent proof-of-concept study comparing the nasal vaccine with a systemic vaccine, only Mambisa was capable of inducing mucosal tissue-specific memory cells. Current antiviral therapies fail to control viral replication in the long term in most chronic hepatitis B patients. As HBV persistence has been associated with a defect in the development of HBV-specific cellular immunity, therapeutic vaccination has been extensively studied in CHB. HeberNasvac induced an antiviral effect associated to a Th1 response and surpasses antiviral therapies in terms of safety, treatment duration, and functional response.

Keywords: nasal vaccines, mucosal immunization, Mambisa, HeberNasvac

Modality of presentation: Lecture

EI17/ CONJUGATE VACCINES FOR IMPROVING THE IMMUNE RESPONSE IN CHILDREN: THE CUBAN EXPERIENCE

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Conjugate vaccines have transformed infant immunization by overcoming the limitations of poor immunogenicity associated with polysaccharide antigens in young children. By covalently linking of polysaccharide antigens to protein carriers, these vaccines effectively stimulate T-cell-dependent immune responses, resulting in enhanced antibody production, immunologic memory, and long-term protection. Conjugation enhances antigen recognition and B-cell activation in immature immune systems, promoting higher seroprotection rates and functional antibody levels against bacteria. Cuba has developed the R&D capacity for conjugate vaccines, bringing various projects from the laboratory to market. The first was the *Haemophilus influenzae* type b (Hib) conjugate vaccine, Quimi-Hib, which marked a turning point in vaccinology as the world's first vaccine with a synthetic antigen. This vaccine has significantly reduced the global burden of meningitis, pneumonia, and sepsis in infants. Another example is the pneumococcal conjugate vaccine (PCV) Quimi-Vio, which prevents invasive pneumococcal disease and reduces nasopharyngeal carriage, thereby enhancing herd immunity. Both vaccines are safe and effective in infants and have been implemented in Cuba's National Immunization Program. The most recent example is COVID-19 SOBERANA 02, a unique conjugate vaccine developed during the pandemic that uses protein-protein conjugation to improve the immune response to small viral proteins. These Cuban vaccines exemplify Cuba's control of conjugation technology, supporting the national immunization program and confirming its capacity for innovation in this field.

Keywords: Conjugate vaccines, COVID-19 vaccine, pneumococcal vaccine

Modality of presentation: Lecture

EI18/COVID-19 VACCINE UPDATE STRATEGY BASED ON THE DIMERIC RBD SUBUNIT PLATFORM

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Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) has infected over 777 million people worldwide and resulted in more than 7 million deaths. The vaccines authorized for emergency use or fully approved are safe and highly effective against severe disease. However, it has been reported that vaccine-induced protection against symptomatic SARS-CoV-2 infection wanes over time. Additionally, as COVID-19 pandemic progresses several variants of concern (VOCs) have emerged, including Beta, Delta, Gamma, and Omicron. Omicron lineages have been reported to be more resistant to neutralization by vaccine-elicited antibodies and, in some cases are more transmissible than previous VOCs. Major progress has been made with the COVID-19 vaccination response, and it is critical to continue the progress, particularly for those most at risk of disease. In the context of the continued emergence of SARS-CoV-2 variants of concern (VOCs), the strategy of vaccine manufacturers has been to update existing vaccines under the same platform concept. The IFV, in collaboration with other institutions, has worked on this strategy using the RBD dimer-based subunit vaccine platform with the capacity to respond to the emergence of new variants according to WHO recommendations.

Keywords: Variants of Concern, vaccines

Modality of presentation: Oral

EI19/MAMBISA NON-CLINICAL PROGRAM: NASAL VACCINE FOR SARS-COV-2 PREVENTIVE USE

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The Mambisa nasal vaccine was developed in response to the SARS-CoV-2 epidemiological situation, as well as the need for new administration routes directly related to the site of virus entry. The objective of these studies was to evaluate the non-clinical safety of the Mambisa vaccine. The program included the Irwin test, single and repeated doses, and determination of irritancy in rodents and non-rodents, depending on the objectives of each study. Groups were treated with different doses of Mambisa and its placebo. The following were determined: clinical examinations, body weight, food consumption, body temperature, heart and respiratory rate, behavioral and ophthalmic evaluation, EEG, ECG, visual and brainstem evoked potentials, clinical pathology, immunogenicity, histology, biopsy, and transmission electron microscopy. There was no clinical evidence of an increase in clinical parameters at the nervous level. There were no behavioral alterations, and the ECG and EEG results indicated normal auditory and visual pathway function. Clinical pathology revealed normal physiological values for each species without pathological alterations. The Mambisa intranasal vaccine is a safe product that can increase antibody titers through immunization. This evidence justifies the clinical use of the Mambisa vaccine, as it poses no risk to overall health or the administration site.

Keywords: vaccine, Mambisa, Sars-CoV-2, non-clinical safety, intranasal, rodent, non-rodent.

Modality of presentation: Oral

EI20/ABDALA/MAMBISA PRIME-BOOST SCHEDULES: NON-CLINICAL EVIDENCES OF FUNCTIONAL ANTIVIRAL RESPONSE

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Currently, a high proportion of people have developed anti-SARS CoV-2 neutralizing antibodies, either through vaccination or natural infection. It has been demonstrated the role of booster shots in the improvement of functional antiviral responses against new VOI and VOC. Abdala, one of the Cuban vaccines with 92.28% efficacy in clinical trials and Mambisa, a novel needle-free alternative against SARS CoV-2 were developed by CIGB. Both formulations included the receptor binding domain (RBD) produced in Pichia pastoris yeast. Objective: To test the role of a single intranasal booster dose of Mambisa in rodents and NHP previously immunized with Abdala. Two strengths (50 µg and 100 µg) of Mambisa were assayed in rats and monkeys. In rats, an increase in magnitude (serum IgG titer) and quality (ability to inhibit RBD-receptor interaction) of antibody response was achieved after the booster shot with no differences between both Mambisa strengths. Monkeys treated with 100 µg Mambisa developed the strongest antibody response characterized by the *in vivo* neutralization of parental D614G and omicron BA.1 strains. In addition, monkeys maintained normal hematological and biochemical parameters indicating Mambisa was safe and well tolerated. The Abdala or Mambisa booster effect was compared in Balb/c mice. Both formulations significantly increased anti-RBD IgG antibody titers and functionality compared with the response elicited after Abdala prime. Besides, neutralizing capacity vs D614G, omicron BA1.2, BA 5.2 and XBB1.6 was achieved. All this evidence suggests that a single intranasal administration of Mambisa is enough to recall memory B cell clones to elicit a systemic functional antiviral response.

Keywords: SARS CoV-2, Abdala, Mambisa, vaccination, prime-boost

Modality of presentation: Oral

EI21/IMMUNOLOGICAL EVALUATION IN AFRICAN GREEN MONKEYS OF TWO NASAL VACCINE CANDIDATES TO INDUCE A BROADER IMMUNITY AGAINST CORONAVIRUS

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The COVID-19 pandemic had a devastating impact on the world. Although the disease is currently under control, considering the possibility of emergence of new coronavirus variants with pandemic potential, the development of more universal coronavirus vaccines is essential. In this study the immunogenicity of two broad-scope nasal vaccine candidates against coronavirus, called PanCoV, was evaluated in non-human primates. The vaccine preparations were based on highly conserved regions from SARS-CoV-2 (the nucleocapsid (N) and S2 subunit from Spike protein) that include several relevant T cell epitopes and has the potential to form virus-like structures. PanCoV1 candidate contains the N protein and PanCoV2 candidate a chimeric protein comprising the C-terminal domain from N protein fused to a fragment of the S2. Additionally, both candidates, contains the receptor binding domaing (RBD) protein and the ODN-39M as CpG adjuvant. The obtained results demonstrate the capacity of both nasal vaccine candidates to boost the anti-RBD IgG response and induce anti-N immunity in plasma, showing a cross-reactivity with antigens from SARS-CoV, MERS, and H-CoV and a neutralizing response against SARS-CoV-2 which persisted nearly three months after the last dose. Mucosal specific and cross-reactive IgA response was also demonstrated, mainly in PanCoV2 vaccinated monkeys. Additionally, the specific IFN-γ-secreting cells response measured in PBMC in the vaccinated groups, underscores the capacity of these nasal candidates to stimulate cellular immunity. These PanCoV vaccines emerge as promising candidates for use as a booster alternative, with the potential to amplify and broaden the scope of the immune response against Coronavirus.

Keywords: coronavirus vaccine, SARS-Cov-2, nucleocapsid protein, S2 domain, RBD

Modality of presentation: Oral

EI22/A SYNTHETIC OLIGOSACCHARIDE CONJUGATE PERTUSSIS VACCINE CANDIDATE AGAINST NASOPHARYNGEAL COLONIZATION

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Reemergence of whooping cough has been associated with the community transmission due to asymptomatic carriage as both, cellular and acellular vaccines, have demonstrated little or no effect in eliminating or reducing nasopharyngeal colonization (NPC). On the other hand, *Bordetella pertussis* lipooligosaccharide has demonstrated its importance upper respiratory tract colonization in mice and traditional polysaccharide-conjugate vaccines are capable of reducing NPC. In this sense, the aim of this work is to develop and preclinical testing of a synthetic oligosaccharide conjugate pertussis vaccine against NPC. Conjugates were prepared from synthetic disaccharide and trisaccharide of the terminal *Bordetella pertussis* lipooligosaccharide and adjuvated in aluminum hydroxide for immunization of mice and rabbits. Serum, lungs and nasopharyngeal tissue samples were extracted two weeks after last immunization. Total and functional antibody response against the oligosaccharides and the bacteria were assessed by ELISA and bactericidal assays. Specific memory T cell response was evaluated by FACs in murine lungs and nasopharyngeal tissue samples. Terminal disaccharide and trisaccharide conjugates induced specific IgG antibodies in both animal models. Sera from immunized rabbits had functional response measured by bactericidal, complement deposition and opsonophagocytosis assay. Conjugates induced high frequency of IL-17A and IFN-γ CD4 T helper cells in nasopharyngeal tissue and lungs. Both cytokines have been suggested to play an important role in the clearance of the bacteria from the respiratory tract. Sera from animals immunized with the disaccharide conjugate protected against NPC. These results demonstrated the potential of oligosaccharide-conjugates as a pertussis vaccine candidate against NPC.

Keywords: *Bordetella pertussis*, synthetic oligosaccharides, conjugate, vaccine, immunogenicity

Modality of presentation: Oral

EI23/IMMUNOGENICITY AND PROTECTIVE CAPACITY IN MICE OF A ZIKA VACCINE CANDIDATE BASED ON A RECOMBINANT SUBUNIT

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Zika virus infection continues to be a global health concern. Nowadays, no preventive vaccine is available, and the development of safe and effective vaccines is yet a challenge. Subunit vaccines are attractive as a non-replicating platform, due to their potential safe use in all populations, including pregnant woman and children. This work is focus into development of a zika subunit vaccine that combines two viral regions, the domain III of the envelope and the capsid, directed to induce humoral and cellular immune responses. The chimeric protein was produced in bacteria and characterized using polyclonal anti-ZIKV and anti-DENV antibodies, which confirmed the high specificity of the molecule against the zika virus. Also, blood peripheral mononuclear cells from zika immune donors stimulated with the recombinant antigen showed the capacity to recall and stimulate the memory T cell response previously generated by the natural infection. In addition, based on structural features of chimeric protein, it capacity to self-assemble after combination with nucleotides compounds to form more immunogenic aggregates were tested. After that, animal studies were completed to evaluate the immunogenicity of several formulations. As results, subunit protein was immunogenic in mice, in terms of neutralizing antibodies induction and cell-mediated immunity. Furthermore, aggregated forms of the protein after combination with immunomodulators as oligonucleotide ODN 39M and c-di-AMP, proved more immunogenic. Finally, protective capacity was evaluated in a mice model, as results animals vaccinated with the subunit vaccine candidate were protected to viral challenge, due to a significant reduction of the viral load was detected.

Keywords: vaccine, zika virus, recombinant protein, immunomodulators, neutralizing antibody, cell-mediated immunity

Modality of presentation: Oral

EI24/THE NATURALS PRODUCTS CURMERIC® IN RESPIRATORY DISEASES

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Curmeric® are natural formulations which contains *Curcuma longa* extracts. The Curmeric nasal drops, mouthwash, and oral solution have been registered at the National Institute of Hygiene, Epidemiology and Microbiology (INHEM). They are Curmeric are produced by Medilip, Biocubafarma, in collaboration with the PDL CURMERIC (FARMABANA-CEADEN). *In vitro*, the anti-bacterial effect of Curmeric formulations was investigated against different bacterial strains isolated from patients with respiratory diseases at the Intensive Care Unit of the University Hospital General Calixto García. The anti-coronavirus effect of Curmeric were investigated *in vitro* against the bovine coronavirus BCoV which is phylogenetically very close to SARS-CoV-2. In clinical studies, the prevention of COVID-19 transmission in healthcare workers showed significant differences in COVID-19 positive cases between the study group and the control group. Also, the clinical studies on APS and sanitary interventions during de pandemic in Ciego de Avila and Granma provinces indicate that Curmeric would be safe and capable of preventing the disease transmission. Within these studies was also found that patients who suffered from other non-COVID respiratory infectious diseases, asthma, allergy, improved their clinical symptoms. The natural products Curmeric nasal drops, mouthwash, and oral solution showed preventive effects, as well as for the recovery of symptoms of respiratory infectious and non-infectious diseases. These three products have been included in the Cuban Basic List of Natural Pproducts.

Keywords*:* Curmeric, *Curcuma longa*, respiratory diseases antiviral, antibacterial effects

Modality of presentation: Oral

EI25/EVALUATION OF ANTIVIRAL ACTIVITY AND IMMUNE AND LIPID MODULATORY EFFECTS OF CURMERIC® - ORAL SOLUTION, AGAINST DENGUE 2 VIRUS *IN VITRO*

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Dengue is considered one of the ten greatest threats to global health. Recently, a Cuban nano-formulation derived from the Curcuma longa, known as Curmeric®, was developed and has demonstrated antioxidant, anti-inflammatory, cytotoxic and regulatory effects on cellular lipids. The antiviral activity of Curmeric® against DENV-2 was carried out in the non-tumor mammalian cell line Vero and the human monocyte cell line Thp-1. The regulatory effects on cellular lipids were explored by quantifying the expression of three lipid metabolism genes, RARA, OSBPL10 and PPAR. The immune-modulatory activity was studied through the expression of seven immune response genes, IL-6, IL-10, IL-12, B2M, RIG-1, TNF and MIP-1 α. A selective antiviral effect of on Curmeric® DENV-2 was proven in the cell lines studied. Curmeric® also enhances the expression of PPAR and OSBP10, regulating cellular lipid metabolism, contributing then to limiting the replication of the dengue virus. It was also demonstrated the immune-modulatory effects of Curmeric® by increasing the expression of MIP1α, IL-6 and IL-10 and decreasing the expression of RIG-1. Our results provide new alternatives for the management of dengue disease using natural medicine, in an effective and sustainable way.

Keywords: Dengue, Curmeric, immune-lipid modulatory effects

Modality of presentation: Oral

EI26/ OBSERVATIONAL STUDY ON THE IMMUNOMODULATORY EFFECT OF CURMERIC IN SUBJECTS WITH SUSPECTED OROPUCHE FEVER IN SANTIAGO DE CUBA

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The confirmation of Oropuche fever in Santiago de Cuba occurs in 2024, an unknown disease until then. Taking into account the antiflammatory, antiviral and immunomodeling action of the Turchma Longa Fundamental component of the Curmeric, an observational intervention study was carried out, prospective for the exploration of the immunodulatory effect and the security of the curmeric in suspicious subjects of oropuche in the health area Carlos Juan Finlay, the first territory of the country where the diagnosis of the disease was confirmed by PCR studies for oropuche fever. Results. There were differences in the evaluation of patients after the 5th day of treatment with nasal drops, the variation leaflet with respect to the control group was 50.0%. On the tenth day of evaluation this percentage was 66.6% in the clinical evaluations carried out. The use of the curmeric applied in nasal drops to subjects with clinical suspicion of Oropuche, favored in the improvement of symptoms during the evolution of the disease, not observing the same result in patients who did not use it.

Keywords: oropuche, curmeric, clinical improvement

Modality of presentation: Oral

EI27/*IN VITRO* ANTIOXIDANT EFFECT OF CURMERIC® IN THP-1 LINES INFECTED WITH DENGUE-2 VIRUS

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Dengue is considered a rapidly spreading global health threat. Currently, there are no effective antiviral therapies or safe vaccines available to resolve this disease. Recently, a Cuban formulation derived from locally harvested C. longa, Curmeric®, has been developed, which has demonstrated anti-inflammatory, cytotoxic and other effects in different *in vitro* and *in vivo* studies in infectious diseases. The oxidative imbalance that mediates molecular signaling in these diseases has been associated with viral replication, cell death and inflammation. To evaluate the antioxidant activity of Curmeric® and curcumin (main component of C. longa extract) at different concentrations, their redox effects were evaluated in Vero and THP-1 cell lines with Dengue 2 virus. To determine the redox properties, the activity of catalase (CAT), glutathione (GSH), malondialdehyde (MDA) and hydroperoxides (HPO) were determined. A significant decrease in CAT, MDA and HPO levels ($p < 0.05$) was observed in DENV-2 infection assays treated with Curmeric® depending on the concentration of the products. In contrast, a notable increase in GSH levels was observed ($p < 0.05$). The modulation of antioxidant capacities and cellular oxidative damage observed may be related to the antiviral and immunomodulatory effect in the cell lines studied. The results may constitute the molecular demonstration of the possible benefit in clinical studies and offer new perspectives for the potential application of natural medicine against dengue and other viruses.

Keywords: Redox Biomarkers, Curmeric®, Antioxidant, Dengue

Modality of presentation: Oral

EI28/DIRAMIC-12 SYSTEM. UPDATE AND USE IN ANTIMICROBIAL RESISTANCE SURVEILLANCE

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The DIRAMIC system was awarded the World Intellectual Property Organization (WIPO) Gold Medal in 2007. The most recent version, DIRAMIC-12, includes the updating of antibiotic sets based on antimicrobial resistance behavior. It is also associated with the Microbiological Map web application, which allows for real-time monitoring of antimicrobial resistance in any province of the country by compiling a national statistical scheme for the circulation of different microorganisms and their resistance and susceptibility to different antibiotics. An evaluation of 142 clinical isolates performed with the DIRAMIC-12 system in the microbiology laboratory of the Frank País International Orthopedic Scientific Center is presented. The evaluation was conducted from April to June 2023. Of the total strains analyzed, 29 presented a resistance profile with a tendency toward susceptibility, and the remaining 113 isolates presented different types of resistance. These results demonstrate the practical utility of the DIRAMIC-12, a semi-automated device for microbiological diagnosis that is not only capable of detecting urinary tract infections within a 4-hour period, but is also capable of performing antibiotic susceptibility tests and alerting about possible types of resistance in the isolated microorganism.

Keywords: DIRAMIC-12, antibiogram, microbiological diagnosis, surveillance of antimicrobial resistance.

Modality of presentation: Oral

EI29/ELECTRON MICROSCOPY AS A TOOL TO IDENTIFY ORGANELLE TARGETS FOR ANTIPARASITIC COMPOUNDS

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Parasitic protozoa comprise many species that are pathogenic for humans and animals of veterinary interest. These include diseases such as Chagas disease, highly prevalent in Latin America, Sleepiness disease, prevalent in part of Africa (sub-Saharan region), leishmaniasis, which can be found in all continents, and *Toxoplasma gondii*, the agent of toxoplasmosis, among others. Here, I comment on the application of scanning and transmission electron microscopy to analyze the cell organization of several parasitic protozoa that allowed the identification of several structures and organelles found in the parasitic protozoa. Some of these structures and organelles may represent targets for the action of anti-parasite compounds. As examples of organelles, I will discuss results obtained for glycosomes, kinetoplast - DNA network, mitochondria, apicoplast, acidocalcisome, hydrogenosomes. Among the cytoplasmic structures I will discuss results related to microtubule-containing structures. In our laboratory we have explored the effect of compounds such (a) inhibitors of several enzymes involved in the biosynthesis of sterols, (b) inhibitors of cysteine proteases, (c) inhibitors of topoisomerases, (d) inhibitors of histone acetylases, and (e) phospholipid analogues. Finally, I will present some observations made using cryoelectron microscopy of trypanosomatids. This approach allows the identification of new substructures that may constitute new drug targets.

Keywords: Trypanosoma cruzi, Leishmania amazonensis, Toxoplasma gondii, experimental chemotherapy, electron microscopy

Modality of presentation: Lecture

EI30/*TRICHOMONAS VAGINALIS*: TRICHOMONIASIS, ITS DAMAGE, AND NEW DRUGS FOR CHEMOTHERAPY

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Trichomonas vaginalis is the etiologic agent of trichomoniasis, the most common nonviral sexually transmitted infection worldwide, with an estimated 260 million new cases annually. *T. vaginalis* contains a complex and elaborate cytoskeleton constituting the mastigont system, which is mainly formed by several proteinaceous structures associated with basal bodies, the pelta-axostylar complex made of microtubules, and striated filaments named the costa and the parabasal filaments (PBs). *T. vaginalis* has a simple life cycle consisting only of a trophozoite form, which is characterized by a pear-shaped body, four anterior flagella, and one recurrent flagellum. However, under unfavorable environmental conditions, such as abrupt temperature changes or the presence of drugs, this organism undergoes profound morphological alterations. It forms a pseudocyst, spherical or ellipsoid shape with internalized flagella. When in contact with host cells, the parasite assumes an amoeboid shape. Here, we used a new generation of scanning electron microscopes with a resolution of below 1 nm, which were complemented by electron tomography and Fast-Fourier methods, allowing the discovery of new data. This approach allowed us to characterize an unknown parabasal filament and reveal the ultrastructure of the sigmoid fiber that has not been published before. In addition, we tested new drugs as a possible replacement for the use of metronidazole, the treatment used nowadays, which provokes side effects.

Keywords: IST; sexual disease; parasite; protozoa; metronidazole; chemotheraphy

Modality of presentation: Lecture

EI31/EVALUATION OF METAL-COMPLEXED BENZNIDAZOLE AND FEXINIDAZOLE FOR EFFICACY AND SELECTIVITY AGAINST *TRYPANOSOMA CRUZI*

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Chagas disease, caused by the protozoan *Trypanosoma cruzi*, affects about 8 million people worldwide. In this work, we investigated the potential of new metal complexes formed by benznidazole and fexinidazole associated with gold and platinum (MNDP15 - 18) against *T. cruzi*. Epimastigotes and amastigotes were treated for up to 72 h and counted using flow cytometry and High-Throughput Screening. Trypomastigotes were treated for 24 h and submitted to counting. Ultrastructural changes were assessed by transmission electron microscopy after up to 72 h. LLC-MK2 viability was evaluated by the MTS/PMS method after 96 h. ADMET and molecular docking analysis were performed by specialized software. Our results showed that all compounds inhibited epimastigote proliferation, with IC50 values up to 6 µM after 72 h of treatment. Regarding host cell viability, only MNDP17 reduced the number of viable cells (CC50 = 41 µM). MNDP15 and MNDP16 were able to inhibit amastigote proliferation considerably (IC50 = 2 and 0.7 µM, respectively), while the IC50 value of the other two drugs was higher than 10 µM. These drugs were also effective in reducing the number of trypomastigotes. MNDP15 and MNDP16 caused mitochondrial swelling, kDNA disorganization, intense vacuolization, and membrane profiles that suggest the occurrence of autophagy. The compounds showing the most promising results are currently undergoing investigation through molecular docking analysis. Based on these findings, we believe these compounds might be more selective to the parasite and can be explored as promising drugs in further chemotherapeutic studies against *T. cruzi*.

Keywords: Chagas disease, electron microscopy, flow cytometry, ultrastructure, high throughput screening, molecular docking

Modality of presentation: Oral

EI32/*IN VITRO* EFFECTS OF LDT10 AND LDT119 ON *TRYPANOSOMA CRUZI*

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Chagas disease is a systemic and endemic neglected tropical disease caused by *T. cruzi*, an obligate intracellular parasite. In many countries, benznidazole is the only drug approved for clinical use despite several side effects and the emergence of resistant parasite strains. Thus, the need for more efficient, safe, and accessible drugs is urgent. Phospholipids analogs (PAs) are effective against malignant mammalian cells and some pathogenic protozoa such as *Leishmania*. Here, we analyzed the effects of new saturated cardanol, isolated from the cashew nut shell liquid (*Anacardium occidentale*) on epimastigotes, trypomastigotes, and intracellular amastigotes of *T. cruzi*. LDT10 and LDT119 inhibited the *in vitro* growth of epimastigotes and amastigotes with IC 50 in the nanomolar range. Trypomastigote lysis was seen. Ultrastructural analysis demonstrated that these compounds affected the parasite's membranes. Mitochondrial and Golgi cisternae swelling and the formation of membrane blebs, ultimately leading to parasite death were observed. The Golgi complex of parasites, but not that of the host cells, was affected, suggesting a specific mechanism of action possibly due to interference in two different phospholipid biosynthesis pathways used in the distinct cell types. Our observations show that the trypanocidal activity of the PAs investigated herein is higher than that of previously reported PAs in the literature. In conclusion, this work shows that these compounds are potent and fast-acting inhibitors of the growth of the proliferative developmental forms of *T. cruzi* (associated with several alterations in the parasite structural organization) and cause lysis of the highly infective trypomastigote form. The effects observed support the assertion that interference with the phospholipids of the membranes is relevant as a potential route for developing new therapeutic agents to treat Chagas disease.

Keywords: *Trypanosoma cruzi*, experimental chemotherapy, saturated cardanol, Phospholipid analogs

Modality of presentation: Oral

EI33/THE EFFECTIVENESS OF THE HPV VACCINE IN BRAZIL

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The HPV vaccine has been available through the SUS (Brazilian Unified Health System) since 2014 and is essential for preventing HPV related cancerss, such as cervical, anal and oropharyngeal cancer. In Brazil, the quadrivalent vaccine is used, which protects against four types of HPV. Despite its importance, vaccine uptake remains low, hindering the eradication of the disease in the country. This study carries out a descriptive and qualitative literature review on the effectiveness of the HPV vaccine in Brazil, analyzing articles from 2014 to 2024 in Portuguese and English, excluding systematic reviews and meta-analyses, resulting in 19 selected articles. This study investigated factors contributing to this low uptake and concluded that the main reasons include influence of anti-vaccine groups, incomplete vaccination schedule, and the lack of adequate information, which facilitates the spread of fake news. The PNI (National Immunization Program) 2024 addressed some of these issues by expanding the vaccination age range and simplifying the schedule to a single dose, helping to improve vaccination coverage. However, it is necessary to implement health education campaigns and correct misinformation to combat fake news and increase uptake.

Keywords: HPV, Vaccine, Brazil, Prevention, Efficacy

Modality of presentation: Poster

8TH INTERNATIONAL SYMPOSIUM ON OZONE APPLICATIONS

OZ01/SPECTRUM OF CARE. HOW THIS DIRECTION IN VETERINARY MEDICINE NEEDS TO BE INCLUSIVE IN INTEGRATIVE MEDICINE

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With many options offered in the care of our animals one needs to be able to look at any opportunity that can support our patients. With the high cost of diagnostic and surgical options there can be very successful treatments that should be included when making a decision on care. The spectrum like a prism, has many light directions and colors. Choosing only one spectrum the choices can deny full care and be cost prohibitive. Alternative medicine gives more options to enable an owner to care for their animals instead of euthanasia. It should always be given as an opportunity to help. Educating conventional veterinarians on the many directions of the spectrum of care should be part of Continuing Education and veterinary school curriculums. Learning objective: Understanding the different modalities, and what they can do for an animal. Learning objective: 1. Start to look at all the different directions of the spectrum that can be utilized and acknowledging that these exist and could be very helpful to patients. 2. How Ozone plays a huge part in all of the support for these different modalities.

Keywords: Spectrum of care, alternative and complementary medicine, ozone therapy, Microbiome Restorative therapy, MBRT

Modality of presentation: Lecture

OZ02/VETERINARY MEDICAL OZONE THERAPY IN CANCER TREATMENT

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This presentation examines the integrative use of medical ozone therapy in veterinary cancer treatment. Recognized for its anti-inflammatory, immunomodulatory, and oxidative stress-reducing properties, medical ozone therapy serves as a supportive modality in managing cancer in animals. It enhances the effects of conventional treatments such as chemotherapy and radiation while complementing holistic therapies like IV vitamin C, mistletoe, herbal medicine, acupuncture, and hyperthermia. Additionally, it helps mitigate treatment side effects and improves overall patient well-being. This discussion presents case studies and clinical evidence demonstrating the role of medical ozone therapy in boosting immune function, improving tissue oxygenation, and supporting systemic healing. Practical insights into best practices, dosage guidelines, and protocols for integrating medical ozone into comprehensive cancer care plans will be provided. The findings suggest medical ozone therapy can optimize therapeutic outcomes, improve quality of life, and enhance the body's natural defense mechanisms in veterinary cancer patients. By incorporating this modality into an integrative approach, veterinarians can offer more effective and personalized treatment options including pallative and hospice care for animals facing cancer.

Keywords: Veterinary medical ozone therapy, cancer treatment, immune modulation, holistic veterinary care, integrative oncology, oxidative stress reduction

Modality of presentation: Oral

OZ03/MICRO BIOME RESTORATIVE THERAPY MBRT: FECAL TRANSPLANT, THE IMPORTANCE OF POOP

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With over 100 trillion microbes in a normal human and 85 % of your immune system coming from your gastrointestinal tract, the Micro Biome has become the known to increase health and help re-store the body. *Clostridium difficile* is what is standard treatment in Humans but we are treating giardia, lyme, irritable bowel, pancreatic insufficiency, pancreatitis kidney failure, cancer as well as behavior Biofilms in the Gut and how they can affect The Terrain. Learning Objective the overgrowth of the Microbial Biofilm can prevent the Gastrointestinal tract from returning to a more healthful environment. Learning Objective: 1. Looking at how Ozone therapy can reduce the Biofilm in the gut, destroying Bacteria, Fungi, Yeast and Viruses allowing a new terrain to some. 2. MBRT to have more success because of quality of donors and their legacy care. 3. Cancer, Kidney failure, Behavior, Allergies, precursors for neurotransmitters and endocrine system so many other ailments are supported with MBRT.

Keywords: Microbiome, Microbiome Restorative Therapy MBRT, Fecal Microbiota transplantation, FMT

Modality of presentation: Oral

OZ04/VETERINARY MEDICAL OZONE THERAPY WITH ACUPUNCTURE

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Enhancing Healing through Integrative Medicine for Pets explores the combined use of medical ozone therapy and acupuncture to promote healing and wellness in animals. This integrative approach leverages the antimicrobial, anti-inflammatory, and regenerative properties of medical ozone therapy alongside the pain-relieving and energy-balancing effects of acupuncture. Together, these therapies work synergistically to enhance immune function, improve circulation, and support the body's natural healing processes. This presentation examines how these complementary modalities can be effectively integrated into holistic veterinary practice, offering an expanded toolkit for treating chronic pain, inflammation, immune disorders, and degenerative conditions. Case studies and clinical applications illustrate their synergistic effects on cellular regeneration, immune modulation, and pain management. The findings suggest the combination of medical ozone therapy and acupuncture optimizes therapeutic outcomes, accelerates healing, and improves overall patient well-being. By integrating these modalities, veterinarians can broaden their treatment options and provide a more comprehensive, patient-centered approach to animal healthcare.

Keywords: Veterinary medical ozone therapy, acupuncture, integrative medicine, immune modulation, pain management, holistic veterinary care, cellular regeneration

Modality of presentation: Oral

OZ05/OZONE FOR WOUND MANAGEMENT AND CONTROL IN TRAUMA PATIENTS AS AN ALTERNATIVE TO ANTIBIOTICS

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Currently, the challenge of finding multi-resistant bacteria is being faced, which represents a significant risk to the lives of patients. In patients with trauma, part of the problem is exposure to bacteria during the event that caused the trauma (run over, aggression by a congener, aggression with sharp objects, exposed fractures, among other causes). It is common to use antibiotics without performing isolation and identification of bacteria and antibiograms. In cases of traumatology with extensive wounds or those that penetrate cavities, empirical use of antibiotics is frequently resorted to, which can lead to inappropriate decisions in antibacterial therapy. In the case presented, a large lesion with skin detachment is described in which contamination was observed. It was decided not to use antibiotics, using only ozonized solution, bagged (technique that consists of isolating the area and saturating it with ozone) and ozonized oil. Bacterial isolations and periodic antibiograms were performed to observe the evolution of the possible infectious process, finding effective control of contamination. The results indicate that ozone is a viable alternative for controlling the infectious process, thus reducing the costs and impact of antibiotic use.

Keywords: Ozone, Wound, Trauma, Antibiotic, Infection

Modality of presentation: Oral

OZ06/EXPERIENCES OF RECTAL OZONE THERAPY USE IN ORTHOPAEDIC AFFECTIONS. INTERNATIONAL ORTHOPAEDIC SCIENTIFIC COMPLEX "FRANK PAÍS"

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The Ozone therapy is the treatment that uses the ozone like therapeutic agent in a great number of pathologies. In the field of the Orthopaedics in the assistance plane stand out the positive results in the treatment of herniated disc in lumbar and cervical localizations, being reported a significant relief of the pain and the improvement in the quality of the patients' life. Objectives: to show the experiences of the use of the rectal ozone in the orthopaedic affections in the department of Natural and Traditional medicine in the" Frank País" Hospital. Method: descriptive, longitudinal prospective study. Patient universe that went in the last 2 years (2023-2024) to the Hospital Frank Country with affections of the SOMA, shows of 21000 patients that were remitted by the specialist in Orthopaedics to the Department of Natural and Traditional Medicine for valuation for the specialist. 75% those of the sex feminine bigger 60 years, the hernias dial them so much cervical as lumbar they were the affections more assisted after the second week 70% it experienced improvement, the satisfaction it was achieved in 90% according to scale of Likert. The female bigger than 60 those most suffered ones, the cervical hernias disc consisted those of more incidence. The relief of the pain starting from the 2da week became evident in most of the patients, there was a high degree of the patients' satisfaction the adverse reactions they were not significant.

Keywords: ozone; Ozone therapy; herniated disc; osteoarthritis

Modality of presentation: Oral

OZ07/RECTAL OZONETHERAPY IN ACTIVE IDIOPATHIC ULCERATIVE COLITIS. GASTROENTEROLOGY INSTITUTE. 2022-2024

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Ulcerative colitis (UC) is a chronic inflammatory bowel disease that affects the colonic mucosa. It begins in the rectum and can extend progressively, extending to a variable extent proximally, up to the cecum. Objective: To determine the effect of rectal ozone therapy in patients with active idiopathic ulcerative colitis. Method: A quasi-experimental before-and-after study with a control group was conducted to evaluate the response to rectal ozone treatment in patients with active idiopathic ulcerative colitis. The sample consisted of 46 patients diagnosed with idiopathic ulcerative colitis. Two groups were thus formed, each with 23 patients. The Case Group received ozone therapy. The Control Group received mesalazine and prednisone therapy. The results demonstrated a predominance of male patients aged 50 to 59 years, with a higher incidence of mild colitis, and a predominance of proctosigmoiditis in relation to the extent of the lesion. In the Case Group, both the clinical and endoscopic response were good, suggesting that ozone treatment for colitis is generally favorable and does not generate adverse reactions. Ozone therapy may be a useful and safe therapeutic option in the treatment of mild and moderately active idiopathic ulcerative colitis.

Keywords: Rectal ozone therapy; ulcerative colitis

Modality of presentation: Oral

OZ08/PHARMACOLOGICAL ACTIONS OF OLEOVET, WHICH FAVOR IT AS A CHOICE IN VETERINARY DERMATOLOGY

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Ozonized sunflower oil, commercially called OleoVET for veterinary use, is a drug produced at CNIC, BioCubaFarma, registered for dog demodicosis mange control. The objective of this presentation is to show results that support the secondary pharmacological actions of OleoVET (anti-inflammatory and healing) that make it a treatment of choice for dermatopathies in veterinary medicine. Wistar rats and Balb/c mice were used for granuloma (cotton and carrageenan), AD and healing model, respectively. OleoVET and its formulations were applied topically. The effects of OleoVET and its formulations on granuloma weight, inflammatory infiltrate cells and oxidative stress were determined; while in AD, the effects on local inflammation, splenic response and redox status was determined. In the mouse wound healing model, the efficacy of OleoVET is comparatively evaluated with Hebermin. The diameter of the total epithelialization area was determined in each group at three different times. The results show that OleoVET and its formulations reduced the granuloma weight and infiltrate of inflammatory cells in the granulomas induced by cotton and carrageenan, respectively, which was associated with the stimulation of antioxidant activity together with a reduction in the oxidation of lipids and proteins. Additionally, in AD, OleoVET and its formulations decreased the inflammatory infiltrate (mast cells), modulated the splenic response and increased antioxidant activity both locally (skin) and in plasma samples. The results demonstrate that the wound healing action of AGO at different PIs was comparable to that of Hebermin®. Therefore, it is concluded that OleoVET and the formulations, in both models, evidenced anti-inflammatory action, linked to restoration of the intracellular Redox state. Therefore, OleoVET and the formulations can be used as treatment of choice for the control of dermal diseases linked to inflammation, skin lesions and oxidative stress.

Keywords: OleoVET, inflammation, redox balance, antiinflammatory, antioxidant, epithelialization area

Modality of presentation: Oral

OZ09/STUDY OF CYTOLOGICAL CHARACTERISTICS AND MICROBIOLOGICAL CULTURE OF UTERINE FLUID BEFORE AND AFTER OZONE THERAPY IN FOUR THOROUGHBRED LUSITANO MARES

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In equine reproduction, gestational failure occurs with some frequency, causing great economic and genetic loss to the equine industry. As such, the search for another type of therapy has been increasing, highlighting the use of ozone therapy. This is a low-cost integrative medicine that has been demonstrating therapeutic benefits since the First World War to the present day. Currently, there is literature stating that the use of intrauterine lavages with ozone has been a very beneficial option for the treatment of reproductive pathologies in both women and animals. The present study aimed to evaluate the effects of uterine lavage with ozonated saline solution on the cytological characteristics and microbiological culture of uterine fluid in mares over 15 years of age. Materials and Methods: For this purpose, 0.9% ozonated NaCl saline solution was administered at a concentration of 52 µg of O_3/mL of oxygen via the uterus, and the administered liquid was subsequently collected by gravity, thus observing the cytological characteristics and the microbial agents present in the microbiological culture. A momentary increase in inflammation was observed during the ozone treatment in most mares, however, two weeks after the procedure, there was an improvement in the degree of inflammation as well as a decrease in microbial agents in the microbiological culture. Thus, it is concluded that ozone therapy can have a beneficial therapeutic effect in reducing uterine inflammation, as well as in controlling microbial agents, minimizing possible bacterial resistance, thus playing an important role in improving reproductive indices.

Keywords: Equine reproduction, Ozone therapy, Uterine lavage, Cytological characteristics, Microbiological culture

Modality of presentation: Oral (Virtual)

OZ10/OZONATION-INDUCED CHANGES IN OILS WITH VARYING DEGREES OF SATURATION

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Ozone is a powerful oxidizing agent that reacts with olefins to produce ozonides and a variety of biologically active compounds. In this regard the ozonation of seed oils, often characterized by high degrees of unsaturation, has attracted significant attention as a way of producing peroxide active drugs from an edible base. This study investigates the physicochemical changes induced by ozonation in sunflower oils with modified fatty acid compositions—namely high oleic, high stearic, and high palmitic lines—as well as common sunflower oil. Ozonation kinetics were analyzed alongside peroxide formation and the triacylglycerols (TAGs) most affected by the treatment. Notably, changes in TAG aggregation states were observed, with a tendency toward polymerization, resulting in altered melting profiles and increased viscosity. Castor oil, rich in hydroxylated fatty acids, was also examined for comparison. Additionally, the formation and composition of carbonyl volatile compounds were studied throughout the ozonation process, providing insights into the oxidation mechanisms linked to oil composition. This work was funded by Spanish Ministerio de Ciencia e Innovación through the grant PID2023-148125OB-I00.

Keywords: sunflower oil, ozonation, oligomers, castor oil, volatiles

Modality of presentation: Oral

OZ12/OLEOVET-95 AS TREATMENT OF CANINE DEMODESIC MANGE, CLINICAL TRIAL

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Canine demodicosis, caused by demodex canis mite. The disease occurs in animals with immunological deficiencies, is difficult to control and has high treatment costs. It is considered one of the main causes of veterinary dermatology care. The objective of this phase II clinical trial was to investigate the safety and efficacy of OleoVET-95 for control of demodicosis in dogs. Dogs of different breeds, older than 6 months and both sexes, with clinical and parasitological diagnosis of canine demodicosis, attending to "José Luis Callejas" affective animal clinic, Havana, Cuba, were included. The animals included were recorded general and epidemiological data and other characteristic signs of the disease such as skin lesion index (ILP), alopecia (Alop) and mite count (CA), also complementary analysis (hematology and blood biochemistry) and oxidative stress indicators in plasma were performed. Treatment with OleoVET-95 was applied twice a day and clinical check-ups were performed every 7 days until the dermatosis was cured. The results showed that OloVET-95 significantly reduced the ILP (53%), Alopecia (46%) and CA (88%) variables after 28 days of treatment, reaching 71 and 94% of reduction respectively after 56 days of treatment; pruritus was significantly reduced after the 7th day of treatment. No significant hematological changes were evidenced in the animals after 56 days of treatment, demonstrating the safety of the treatment. 100% of the animals reached total cure after 56 days of treatment. The safety and effectiveness of OleoVET-95 for control of localized and generalized demodicosis in canines was demonstrated.

Keywords: Demodesic mange, OleoVet-95, dogs, counter mite, oxidative stress, pruritus

Modality of presentation: Oral

OZ13/OZONE THERAPY IN THE TREATMENT OF OPEN WOUNDS OF A LLAMA (*LAMA GLAMA*) – CASE REPORT

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Ozone therapy is an integrative medicine technique used in veterinary practice for its antioxidant, healing, immunomodulatory, antimicrobial and tissue oxygenation properties, and is useful in several conditions, including problematic lesions recovery. The objective of this study is to report the use of ozone in the treatment of dermatological lesions in a llama (*Lama glama*). A llama presents at the Large Animal Veterinary Hospital of the Federal University of Lavras, in the city of Lavras - Brazil, developed crusted and ulcerated dermatological lesions on the upper right ear, at the base and on the inner surface of the ears and in the middle region of the neck on both sides, after an enucleation procedure. Due to the lesions observed, a patient underwent treatment with different modalities of ozone therapy three times a week, which consisted of cleaning the site with ozonated saline solution at a concentration of 72 µg/ml, application of ozone gas via a "bag" at a concentration of 40 µg/ml for 10 minutes, progressively reducing the concentration by 5 µg/ml each week until the last session performed, and topical administration of ozonated sunflower oil (OLEOZON®). In total, 14 sessions were performed over a 43-day period, with complete recovery of the patient's lesions at the end of the ozone therapy protocol, followed by discharge of the animal. Based on the results obtained, it is concluded that ozone therapy is a viable and necessary therapeutic technique in the treatment of consultations.

Keywords: Healing; Ozone; Skin; Llama

Modality of presentation: Poster

OZ14/OLEOVET- 95 FORMULATION, NATURAL ACARIDAE, CONTROL REPRODUCTION IN *RHIPYCEPHALUS SANGUINEOUS* AND MICROPLUS

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Rhipicephalus microplus is considered the most important tick of cattle worldwide and a vector of numerous hemoparasitic diseases. Ozonated sunflower oil, called OleoVET for veterinary use, showed a larvicidal action against cultures of *R. sanguineus*. Therefore, the objective of this study is to evaluate the influence of OleoVET and its formulations on reproductive indicators of replete ticks (*Rhipicephalus microplus*). The Teleogins were divided into six groups of 20 each and exposed to following test substances (drinking water, sunflower oil, placebo, OleoVET, 45% and 60% formulations), using the immersion method. The evoo weight, ovoposition inhibition percentage (O.I.), hatching percentage, estimated reproduction (ER) and control percentage, were determined. The results showed a significant reduction in evoo weight of theologines exposed to OleoVET, 45% and 60 % formulations, accompanied by a significant increase in O.I., with respect to the control groups. The OleoVET and formulations 45 and 60 %, significantly reduced hatching percentage and estimated reproduction, compared to controls groups, reaching a reproductive control percentage (57, 55 and 63 %), respectively. It was concluded that OleoVET and the 45 and 60 % formulations were effective in controlling the reproduction of *Rhipicephalus microplus* ticks.

Keywords: *Rhipicephalus microplus*, tick, Ozonated sunflower oil, Teleogins, formulations

Modality of presentation: Poster

OZ15/ASSOCIATION OF OZONE THERAPY AND LASER THERAPY ON DERMATOLOGICAL LESIONS IN A MANED WOLF (*CHRYSOCYON BRACHYURUS*)

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Animals are frequently affected by skin wounds and the choice of appropriate therapeutic approaches is essential for the healing of dermatological lesions. The objective of this work is to report the use of ozone associated with laser therapy in the treatment of dermatological lesions in a maned wolf (*Chrysocyon brachyurus*). In October 2024, in support of the Wild Animal Outpatient Clinic, the Nucleus for Studies in Integrative Veterinary Medicine associated with the case of a young female maned wolf, with evidence of fracture and skin lacerations in the left pelvic limb, the most evident being an 8.1 cm x 5 cm lesion in the caudal region of the knee joint. The dermatological lesion was treated using a protocol consisting of two weekly sessions consisting of cleaning with saline solution and chlorhexidine, and then submitted to infrared laser biophotomodulation (904 nm) using the Portable Laserpulse device (Ibramed®) at a protocol of 4 J/cm2 on the edges of the wounds. The wound bed was then anointed with ozonated sunflower oil (Oleozon®) and covered with an occlusive dressing with sterile gauze and bandages. After two months of treatment, the lesion had regressed to 0.4 cm x 0.2 cm, associated with an improvement in the bed with the absence of secretions, odor and hair growth, and the patient was discharged. It is concluded from the results that the association of ozone therapy and laser therapy was an efficient and viable therapeutic combination for the treatment of dermatopathy.

Keywords: Healing, Ozone, Skin, Laser

Modality of presentation: Poster

OZ16/OLEOVET, CONTROL OF TRICHOPHYTOSIS IN CALVES

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Trichophytosis in calves is a skin infection caused by *Trichophyton verrucosum*, which negatively affects animal development. OleoVET is a product with proven fungicidal action against dermatophytes. The objective of this study was to evaluate the effectiveness of OleoVET and High Peroxide Index (HPI) for controlling trichophytosis in calves. Calves of both sexes, between 3 and 10 months old, of different breeds, belonging to the "Niña Bonita" Genetic Livestock Company, with a clinical and microbiological diagnosis of trichophytosis, were selected. They were randomly distributed into five groups of 10 animals each. Group A (Placebo Control (AG)), Group B (treated with OleoVET), Group C, treated with HPI and Group D, treated with Terbinafine 2% cream, an apparently healthy group E of animals was added. The products were applied every 24 hours, for 15 consecutive days. Each group was divided into two subgroups, the first evaluated after 7 days of treatment and the second after 14 days. Initial and final microbiological diagnosis (direct examination and culture) was performed using skin scraping, a clinical signs scale, and complementary analysis of hematology, biochemistry, and feces, at the beginning, 7 days, and 14 days after completing the treatments. The results showed a significant reduction in clinical signs starting 7 days after application of the OleoVET and HPI products, similar to those achieved with terbinafine. Result corresponding to 100% of animal's negative for *Trichophyton verrucosum* culture in OleoVet and HP groups. No adverse reactions or influence on complementary variables were reported The safety and efficacy of OleoVET were demonstrated as a product of choice for the control of calf trichophytosis, caused by *Trichophyton spp.*

Keywords: OleVET, terbinafine, Trichophytosis, *Trichophyton verrucosum*

Modality of presentation: Poster

OZ17/OZONE THERAPY ASSOCIATED WITH PHOTOBIOMODULATION THERAPY IN LACERATING WOUND HEALING: CASE REPORT

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Accidents involving smooth wire on properties with horses are common, with resulting wounds ranging from superficial cuts to tendon ruptures and bone exposure. The objective of this study is to report the healing of a wound by second intention through the use of Ozone Therapy and Laser Therapy, due to a deep laceration caused by trauma from smooth wire. The patient, a Mangalarga Marchador filly, was admitted to the Large Animal Veterinary Hospital at the Federal University of Lavras (HVGA/UFLA), presenting a deep laceration caused by trauma from smooth wire in the metatarsal region of the left pelvic limb, with rupture of the digital extensor tendon. After 49 days of hospitalization with medical management, Ozone Therapy and Laser Therapy were initiated, involving procedures such as debridement to remove devitalized tissues from the wound, cleaning with degerming chlorhexidine, moistening with ozonized saline solution, use of a plastic "bagging" containing ozone gas positioned over the wound area, topical application of ozonized sunflower oil, and using the portable laserpulse device (Ibramed®) at a protocol of 4 J/cm2 on the edges of the wounds. At the end of 17 sessions of integrative treatment, performed twice a week, the wound, initially measuring 8 cm in length and 7 cm in width, was reduced to 1.2 cm in length and 1.0 cm in width, showing edge reepithelialization. The patient was discharged 70 days after the start of Ozone Therapy and Laser Therapy treatments, with satisfactory wound healing and no secondary infections during the treatment.

Keywords: Horses, Integrative Veterinary Medicine, Lacerative Wound

Modality of presentation: Poster

OZ18/EVALUATION OF THE DERMAL REPEATED-DOSE TOXICITY (90 DAYS) OF OZONATED SUNFLOWER OIL IN DOGS CENP: BEAG

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Ozonated sunflower oil (AGO), commercially called OLEOZON® topical, is a nationally registered drug for the treatment of dermatophytosis (fungal skin infection) and impetigo (bacterial skin infection). After obtaining previous information in several toxicological studies in mainly rodent species, our aim was to assess the possible toxic effects of repeated dermal application (90 days) of OLEOZON® in Beagle dogs. Fourteen female and 14 male Beagles dogs were used, distributed in Control, Vehicle, Low (4 mg/kg), Medium (20 mg/kg) and High (100 mg/kg) doses. The study included 13 weeks of administration and 5 weeks of recovery period. Daily clinical observations were performed; body weight and vital signs (rectal temperature, respiratory rate, and heart rate) were evaluated. Hematology, blood biochemistry, electrocardiographic and ophthalmologic examinations were also performed. The assay concluded with a 92.9 % survival, due to deaths associated with an event unrelated to the application of the drug. There were no clinical signs of toxicity at the site of administration and no alterations in body weight gain attributable to the test substance. No alterations were detected in the hematological or biochemical parameters associated with the application of OLEOZON®, and no ophthalmological effects were observed. Cardiac ischemia of the lower face was detected in 4 of 17 animals applied with the test substance. It was possible to conclude that the repeated dermal application of Ozonized Sunflower Oil was well tolerated in Beagle dogs at the doses evaluated.

Keywords: repeated dose toxicity, ozonated sunflower oil, Beagle dogs

Modality of presentation: Poster

OZ19/INFECTIONS ASSOCIATED WITH CHRONIC HEMODIALYSIS CATHETERS WITH THE APPLICATION OF OLEOZÓN IN HIV PATIENTS. IPK 2022-2026. INSTITUTIONAL PROJECT

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The most frequent morbidity in hemodialysis is infection, which is closely related to the type of vascular access. The solutions applied to disinfect the area can contribute to reducing this complication. The objective is to determine the frequency of hemodialysis catheter-related infections based on the application of different disinfectant solutions to the surrounding skin in HIV-positive patients on chronic hemodialysis at the Pedro Kourí Institute of Tropical Medicine (IPK) from 2022 to 2026. This is an ambispective, exploratory, monocentric study. All willing patients with chronic kidney disease undergoing hemodialysis, of any gender and age, with catheters as a vascular access route, and who are not allergic to the product will participate. If a septic episode related to the hemodialysis catheter is suspected, three blood cultures will be taken, and the frequency of catheter-related infections will be compared. A comparison will also be made between alcoholic povidone-iodine solutions and 2% chlorhexidine solutions in terms of the frequency of infectious episodes per 1,000 catheter days. The use of Oleozón is expected to reduce the number of infectious episodes associated with hemodialysis catheters and therefore the admissions generated by this cause, increase the useful life of the catheter, and contribute to the saving of antimicrobials.

Keywords: hemodialysis catheters; infection, Oleozón

Modality of presentation: Poster

OZ20/PROVEN BENEFITS OF OZONE THERAPY IN DERMATOLOGY

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The skin (the body's largest organ) and its derivatives (hair, nails, and sebaceous and sweat glands) make up the integumentary system, protecting it and helping to maintain the integrity of its structures. The use of ozone therapy for skin diseases is a topic not always well understood by medical professionals. Medical ozone preparations were primarily classified as ozone hydrotherapy, ozonized oil for external use, and ozone autohemotherapy (OAHT). The objective is to demonstrate the potential of ozone therapy for dermatological diseases. This study aims to demonstrate the potential of using ozone therapy in dermatological diseases. The search terms used were: ozone therapy, ozonized oil, skin, mycosis, germicide, and antiviral, all of which were used interchangeably. Publications from international databases were selected and could be accessed in full format to enhance their methodological quality. Twenty-eight articles with variable evidence were found related to the effectiveness of ozone therapy on the skin. Ozone therapy has shown great promise in clinical applications, presenting anti-infective properties, improving microcirculation, and relieving pain. Furthermore, ozone therapy has great potential to improve cutaneous microecology, combat aging, and treat viral diseases. There is documented evidence that allows for a positive assessment of the use of ozone therapy in skin diseases. It is recommended to continue providing results that support its extensive use.

Keywords: ozonetherapy, dermatology, germicide, anti-inflammatory

Modality of presentation: Poster

OZ21/OZONE APPLICATIONS IN AGRICULTURE AND FOOD PROCESSING: FROM FARM TO FORK

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Ozone is increasingly recognized as a valuable tool in agriculture and food processing due to its strong oxidizing properties and its ability to decompose into oxygen without leaving harmful residues. This presentation will explore the various applications of ozone throughout the food production chain, from crop protection to post-harvest treatment and food processing. In agriculture, ozone can be used to reduce the reliance on chemical pesticides by enhancing plant resistance and controlling pathogens. It is also applied in post-harvest stages for the decontamination of fruits, vegetables, and grains, helping to extend shelf life by reducing microbial load and oxidative degradation. Additionally, ozone plays a crucial role in food processing, where it is used for surface decontamination of fresh produce, meat, seafood, and even packaged food products. Beyond its effectiveness in microbial control, ozone contributes to sustainability by reducing the need for chemical treatments and improving food safety without introducing harmful by-products. The presentation will also address regulatory considerations and recent scientific developments supporting the integration of ozone into modern agricultural and food production systems. By examining both the scientific principles and practical applications, this discussion aims to provide a comprehensive understanding of how ozone can contribute to safer, more sustainable food production.

Keywords: Ozone, Food safety, Crop protection, Post-harvest treatment, Microbial decontamination, Sustainable agriculture

Modality of presentation: Oral

OZ22/POST-HARVEST OZONE TREATMENT TO IMPROVE FRUITS PRESERVATION

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Microbial contamination of fruits during storage can lead to significant economic losses, affecting both producers and industries, and contributing to food waste. Consequently, there is a growing need for sustainable solutions that effectively reduce pathogenic microorganisms while leaving minimal or no residues on the products. These studies investigate the potential of gaseous ozone treatment as a non-persistent alternative to chemicals for fruit preservation. We assessed the effects of ozonated atmosphere during cold storage on plums, melons, and apples under varying ozone concentrations and storage conditions (normal cold or controlled atmosphere). The experiments were conducted in downscaled chambers of 12m^3 and airtight modules of 600 L, at temperatures ranging from 1.5°C to 8°C. Results showed a significant reduction in fungal and bacterial contamination, with up to 90% decrease in fungal flora, particularly in melons and apples. However, exceeding certain ozone levels led to phytotoxicity symptoms. In addition, no adverse effects on the physicochemical properties of the fruits such as firmness and sugar were observed, and sensory analysis revealed that ozone-treated fruits maintained organoleptic qualities of the samples. These findings suggest that ozone treatment could be a promising method for improving fruit preservation by reducing microbial contamination without compromising quality, offering a viable alternative to traditional chemical treatments.

Keywords: Fruits preservation, Ozone, Controlled atmosphere

Modality of presentation: Oral

OZ23/OZONATED OILS AS AN INNOVATIVE APPROACH TO CONTROL GRAPEVINE AND APPLE TREE PATHOGENS

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Plant diseases caused by fungal pathogens significantly impact agricultural production, necessitating alternative sustainable control strategies. This study investigates the antimicrobial properties of ozonated oils against pathogens affecting grapevines and apple trees. *In vitro* assays were conducted on *Phaeomoniella chlamydospora*, *Phaeoacremonium aleophilum*, *Neofusicoccum parvum, Diplodia seriata* (grapevine trunk diseases), and *Venturia inaequalis* (apple scab). Results demonstrated a strong sporicidal and fungicidal effect of ozonated oil, with a significant reduction in spore germination and fungal development at specific concentrations. Greenhouse trials on apple seedlings confirmed the efficacy of ozonated oil in reducing fungal infections while maintaining plant health. Field tests conducted in collaboration with an industry partner further validated these findings, highlighting the potential of ozonated oils as an environmentally friendly alternative to conventional fungicides. The study emphasizes the need for further research on formulation optimization and active compound identification to enhance application feasibility. Ozonated oils represent a promising solution for viticulture and orchard management, aligning with the demand for sustainable plant protection strategies.

Keywords: Ozonated oils, Fungal pathogens, *In vitro* and field trials, Grapevine trunk diseases, Apple scab
Modality of presentation: Oral

OZ24/THE OZONE MOLECULE AT THE SERVICE OF THE GRAPEVINE: FROM THE NURSERY TO THE VINEYARD

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The ozone molecule has proven its biocide properties over a wide range of microorganisms and applications. These biocide properties and the low remanence of the ozone molecule make it a promising candidate to substitute controversial plant protection products used in agriculture. The present study aims to review several applications of ozone in the gaseous state or in aqueous solution for its use in viticulture. From the nursery to the vineyard, different experimentations have been performed and have showed promising results: i) ozone gas application during 34h to 25 days on grafted grapevines in nursery has led to the reduction of fungal developments on the plants. ii) Ozonated water has also been tested in nursery. Irrigation with ozonated water have stimulated the roots growth in number and weight and have reduced the time needed for buds to break. Plants soaked in ozonated water have a similar recovery rate than the plant treated with fungicide treatment. iii) Another study investigated whether ozonated water could be used to control conidia dispersal of the esca-associated fungus *Phaeoacremonium aleophilum*. Fungal development after artificial inoculation was significantly reduced by 50% in planta with ozone treatment. iv) Finally, ozonated water can be interesting for the control of downy mildew in the vineyard. For all these applications, the ozone molecule has proved its usefulness to produce healthy grapevines and replace or reduce the use of conventional plant protection products.

Keywords: Grapevine, Ozone, Disinfection, nursery

Modality of presentation: Oral

OZ25/CLINICAL TRIALS WITH OZONE THERAPY IN POSITIVE, PERSISTENT AND CONVALESCENTS OF COVID-19 PATIENTS

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COVID-19, a respiratory infection caused by SARS-CoV-2, causes a systemic inflammatory response, accompanied by a redox imbalance, disseminated intravascular coagulation, and the death of a high percentage of patients worldwide, classified by the WHO as a pandemic. Three clinical trials were conducted to evaluate the potential of rectal ozone therapy in COVID-19 positive, persistent, and convalescent patients. Rectal ozone therapy (ROT) was administered to COVID-19 positive, persistent, and convalescent patients, in combination with conventional treatments (CT) in each case, complying with the biosafety protocol described for the management of the disease. All patients remained hospitalized for the execution of the studies. Patients with RT-PCR positive (PCR+) for SARS-CoV2 received ROT every 12 hours for 10 days, and persistent patients with PCR+ received ROT every 9 days for 10 days. Efficacy variables included PCR negativization, evaluation of clinical signs, redox status markers, and hematological and hemochemical parameters. In the CT of convalescent patients, OTR was applied every 24 h, five days a week, for a total of 20 sessions. OTR in symptomatic SARS-CoV-2-positive patients resulted in PCR negativization by day 5 of treatment in 81% versus 43% in the CT group, accompanied by a significant reduction in clinical symptoms, restoration of redox status, and a shorter hospital stay. In persistent OTR patients, 56% of these patients had PCR negativization between the 5th and 8th applications. In interventions on convalescent patients, modulation of the redox status was evident in more than 80% of patients in the OTR+Biopla groups, as well as a 78% reduction in symptoms. This was associated with the patient's physical recovery, determined in part by the increase in body mass index. No adverse reactions inherent to OTR were observed during the period evaluated in the studies. The results obtained in the three clinical trials demonstrate that OTR is a beneficial and safe therapy for the management of COVID-19 at different stages of the disease. These results led to the inclusion of OTR in the National Action Protocol for COVID-19 as a treatment option to be considered.

Keywords: COVID 19, Ozone rectal insufflation, PCR, Glutation

Modality of presentation: Oral

OZ26/ COMBINED OZONE THERAPY WITH MESENCHYMAL STEM CELLS IN RHEUMATOID ARTHRITIS. PRELIMINARY STUDY

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Rheumatoid arthritis (RA) is one of the most common autoimmune diseases. Although several treatment regimens modify the course of the disease, this pathological entity continues to impair the quality of life of the patients. The beneficial effects of mesenchymal stem cells in improving this disease are scientifically documented, and the beneficial effects of ozone therapy in RA have also been reported. However, to date, there are no reports combining both therapies in therapeutic management. The objective of this work is to evaluate the use of mesenchymal stem cells with ozone therapy in the therapeutic management of RA. Seventeen patients diagnosed with RA who were receiving methotrexate (7.5 milligrams per week), were included. They were randomly divided into three groups of five patients: a control group that received methotrexate only, group 1 received methotrexate plus 20 sessions of rectal ozone therapy, group 2 received ozone therapy as group 1 plus a cycle of 21 million mesenchymal stem cells intravenously. All groups underwent the DAS 28 scale, C-reactive protein, rheumatoid factor, anti-cyclic citrullinated peptide antibodies (ACPCC), erythrocyte sedimentation rate and the Oviedo sleep questionnaire (COS) at the beginning, at 1 and 6 months of treatment. Significant improvement in DAS 28, C-reactive protein, rheumatoid factor, ACPCC and COS was obtained in group 2 at 1 and 6 months of observation compared to control group and group 1. This result is due to the combination of the immunomodulatory effects of both therapies, since by combining them these effects are probably potentiated. Ozone therapy combined simultaneously with mesenchymal stem cells showed short- and long-term improvement in the quality of life of patients with RA.

Keywords: Rheumatoid arthritis, ozone therapy, mesenchymal stem cells

Modality of presentation: Oral (Virtual)

OZ27/CLINICAL-EPIDEMIOLOGICAL CHARACTERIZATION AND PHARMACOVIGILANCE IN THE OZONE THERAPY CLINIC OF THE DR. ANTONIO LUACES IRAOLA HOSPITAL

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There is currently an increase in the consumption of natural medicines and the application of these therapies. These can modify biological processes that produce beneficial and therapeutic actions, but they also cause adverse reactions. However, research on their safety and efficacy is still scarce. A descriptive and prospective observational study (use of medications) was carried out in the ozone therapy consultation of the Dr. Antonio Luaces Iraola Provincial Hospital of Ciego de Ávila, with the objective of carrying out the clinical-epidemiological characterization and pharmacovigilance of patients who attended for the application of ozone rectally, in the period from January 2021 to May 2024. The sample consisted of 204 patients who met the inclusion and exclusion criteria. A total of 204 patients were seen in the rectal ozone therapy clinic, predominantly female, with a predominance in the 50-59 age group. Twelve patients presented with adverse reactions, most notably abdominal cramps and hypertension, in addition to other symptoms such as dizziness, bleeding, localized warmth, and headache. Mild adverse reactions predominated, occurring primarily in the first cycle of treatment and within the first week, and at low doses. Ozone therapy, despite being a very noble natural therapy, produces adverse reactions that are generally mild and sometimes go unnoticed.

Keywords: ozone therapy, ozone, pharmacovigilance, adverse reactions

Modality of presentation: Oral

OZ28/OLEOZÓN® AND OZONIZED WATER, THEIR USE IN DENTISTRY. 28 YEARS OF EXPERIENCE IN CUBA

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Ozone therapy has shown beneficial effects in the treatment of oral diseases. Oleozón®, a product manufactured in Cuba, combined with ozonated water can be used in dentistry. Objective: To establish the therapeutic effects of Oleozón and ozonated water in the prevention and treatment of oral diseases. A systematic review was conducted based on documentary review and content analysis of scientific articles, theses, books, and other documents to evaluate the experiences of Cuban researchers in the prevention and treatment of oral diseases with the use of Oleozón® and ozonated water. A search strategy was conducted according to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) methodology in MEDLINE, Scopus, Web of Science, the Cochrane Library, and Lilacs. Observational studies and clinical trials were selected according to inclusion and exclusion criteria. The keywords were: efficacy, effectiveness, therapeutic effects, Oleozón®, ozonated water, and oral diseases. Seventeen experts were consulted. Informed consent and ethical principles were observed. 223 potentially relevant studies were identified, 41 of which were included, according to design: 25 cross-sectional studies, 10 prospective studies, and 6 randomized clinical trials. Eighty-six percent used Oleozón® and the remainder ozonated water, of which 3% used a combination. The most reported therapeutic effects were: analgesic (52%), hemostatic (32%), anti-inflammatory (92%), wound healing (87%), and immune system regulation (62%). Most researchers reported evidence of the therapeutic effects of Oleozón® rather than ozonated water or their combination. Efficacy and effectiveness were rated as good. It is considered a safe and cost-effective treatment alternative in Dentistry.

Keywords: Oleozón, ozonized oil, ozonized water, prevention, treatment, oral diseases, efficacy, effectiveness

Modality of presentation: Oral

OZ29/REPORTING BEHAVIOR OF OZONE THERAPY USE IN CUBA

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Ozone therapy has been developed in Cuba with a scientific approach, and significant contributions have been made to the application of this modality, which has given the country a recognized worldwide prestige in this field of medicine. Objective: To characterize the use of ozone therapy in Cuba. Method: A statistical summary of the use of ozone therapy at different levels of health and of the ozone therapy network in the country was compiled. A search of national scientific production was conducted through BD Scielo, PubMed, Google Scholar, and Cochrane. Results: Multiple advances have been made since its approval in the country. The founding of CENIC, scientific journals, approval by the Ministry of Public Health (MINSAP), distribution of equipment at all levels of care, and staff training are all evidence of this. Conclusions: Each year, the number of patients treated with this modality, the inclusion of treatments in different specialties, and the scientific production on this topic increase.

Keywords: ozone therapy, scientific production, healthcare system

Modality of presentation: Oral

OZ30/ EFFICACY OF TOPICAL OLEOZON®, KETOCONAZOLE AND TERBINAFINE IN PATIENTS WITH EPIDERMOPHYTOSIS

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Epidermophytosis or *tinea pedis* of the feet is a fungal infection of the superficial layers of the skin. These mycoses are a 28.5% of dermatology consultations. Objectives: To compare the efficacy and safety of Topical OLEOZON® versus Ketoconazole and Terbinafine in the treatment of Epidermophytosis for six weeks, as well as evaluate its safety and tolerability. Multicenter Phase III study, it had an open, randomized, comparative design, with three parallel group to which Topical OLEOZON® was apply, or Ketaconazole, or Terbinafine, twice a day for 6 weeks. The effect on the clinical and mycological cure rate was prefix as the primary efficacy variable and the effect on treatment time to achieve cure as a secondary efficacy variable. The study included 300 patients of both sexes with a diagnosis of Epidermophytosis, who were randomly distribute into three groups that received Topical OLEOZON®, or Ketoconazole, or Terbinafine, respectively. Treatment with Topical OLEOZON® produced a total clinical and mycological cure rate in 78% of patients, similar to Ketoconazole (78%) and Terbinafine (77%) treatment. Complete mycological cure was achieved in 87% of patients treated with Topical OLEOZON®, similar to Ketoconazole (88%) and Terbinafine (89%) treatments. Regarding the healing time, of the 233 patients with complete clinical cure, 10 patients (4.3%) were completely cure after 2 weeks of treatment, 58 patients (24.9%) after 4 weeks and 164 patients (70.4%) after 6 weeks. At the end of six weeks, all treatments significantly reduced all skin lesions and the presence of dermatophytes. The treatments were safe and well tolerated. Topical OLEOZON® applied for six weeks showed comparable efficacy and safety with Ketoconazole and Terbinafine in patients with Epidermophytosis.

Keywords: Topical OLEOZON®, Ketoconazole, Terbinafine, epidermophytosis, dermatophytes

Modality of presentation: Oral

OZ31/EFFECT AND SAFETY EVALUATION OF OZONE THERAPY COMBINED WITH ANTIRETROVIRALS IN HIV PATIENTS

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Human immunodeficiency virus (HIV) and antiretroviral therapy produce oxidative stress, conditioning the use of bioxidative alternatives. Indeed, the objective was to evaluate the effect and safety of ozone therapy as a potential redox modulator in Cuban HIV patients. A quasiexperimental study was carried out with 20 HIV patients with antiretroviral therapy (ART) and medical ozone application due to rectal insufflation (150-300 mL volumes in a staggered way) in 12 sessions for one month in two cycles. The initial and final evaluation of patients included hemochemical, hematological tests, absolute T-CD4+lymphocytes, viral load, and plasma redox balance indicators. The values of the final variables were compared to the initial values and with a group of supposedly healthy individuals (ISS). The adverse reactions were compiled during the period. The ART was effective in 100 % of patients without modification of the evaluated hematological and hemochemical variables ($p > 0.05$). Significant differences ($p<0.05$) were observed in the average value of the concentration of malondialdehyde, reduced glutathione, hydroperoxide, advanced oxidized proteins products, nitric oxide and superoxide dismutase enzymes at the end of the study and compared to the healthy supposed individuals group in addition to 74 % beneficial simultaneous modification. The combination of medical ozone with antiretrovirals produces biomolecular oxidation reduction, increased antioxidant activity and immune cellularity, without hematological or blood influence, nor adverse events, or medication interaction during study.

Keywords: Redox Biomarkers, HIV, Antiretrovirals, Ozone therapy

Modality of presentation: Oral

OZ32/OZOMED PLUS® FOR MEDICAL APPLICATIONS, MORE THAN 30 YEARS OF DEVELOPMENT

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The National Center for Scientific Research has developed the OZOMED line of ozone generating equipment since 1986, registering it in 1990. The OZOMED PLUS and PRO devices are designs that combine the accumulated experience of specialists, physicians, and scientists. They employ the same generation system as previous models, utilizing high frequency as the basis for generation. This creates resonance between the secondary of the high-voltage transformer and the generating cell, achieving greater ozone production performance, preventing temperature increases in the generating cell, and preventing an increase in the ozone destruction process. The OZOMED is a versatile device that allows for the application of virtually all forms of ozone therapy administration, such as: major and minor autohemotherapy, rectal and vaginal insufflation, intramuscular, paravertebral, intradiscal, bag, subcutaneous, intratonsillar, intra-articular, urethral, among others. We aim to present the evolution of OZOMED, the specialties where they are applied, medical applications, national and international use, and achievements.

Keywords: ozone, ozone therapy, OZOMED

Modality of presentation: Poster

OZ33/APPLICATION OF INTRAUTERINE GASEOUS OZONE FOR THE TREATMENT OF BACTERIAL INFECTION IN THE MARES

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The main goal in horse breeding is to obtain the maximum number of healthy, live foals from mares mated/inseminated during the previous breeding season. Often the veterinary obstetrician is faced with obstacles, mainly represented by infertile mares or mares with reproductive problems. Irrespective of the initiating agents of infertility, both infectious and non-infectious causes frequently lead to the onset of an inflammatory process that makes the uterine environment unsuitable for conceptus development. This is a process that if untreated, most often evolves into a true pathological process, such as endometritis. In recent years, the lack of response to traditional therapy and the increasing prevalence of antimicrobial-resistant pathogens have led to the development of alternative therapies. Considering the antimicrobial characteristics, immune-stimulating ability, and low cost of ozone therapy (O_3), the aim of the study was to evaluate the efficacy of this therapy in uterus. Five sub fertile mares were included in the present study; inflammation was assessed by cytological, bacteriological, and uterine biopsy examinations before and after ozone treatment. Uteruses were insufflated with an O_2 -O_3 gas mixture for 3 consecutive days, and endometrial samples were collected before the first treatment and at the subsequent heat. Intrauterine administration of O_3 was well tolerated and effective in reducing both uterine inflammation and infection, restoring a physiological environment compatible with pregnancy.

Keywords: intra-uterine ozone therapy, mares

Modality of presentation: Oral (Virtual)

1ST INTERNATIONAL SYMPOSIUM ON INDUSTRIAL MANUFACTURING OF NATURAL PRODUCTS AND REGULATORY AFFAIRS

PAR01/SUSTAINABLE PRODUCTION AND COMPLIANCE WITH GOOD PRACTICES AT BIOCUBAFARMA

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This paper presents the close link between good manufacturing practices (GMPs) in the biopharmaceutical industry and sustainable production principles. It argues that the implementation of GMPs not only ensures the quality and safety of medicines but can also contribute to environmental and social sustainability. It presents elements that demonstrate that the adoption of GMPs can be aligned with sustainable production goals. It concludes that the integration of GMPs with sustainable production principles not only benefits the pharmaceutical industry in complying with increasingly stringent regulations but also has a positive impact on public health and the environment. Finally, the companies comprising the BioCubaFarma business group are recommended to adopt an integrative approach in their management that considers both the quality, safety, and efficacy of products, as well as long-term sustainability.

Keywords: Quality, environment, sustainability, good manufacturing practices

Modality of presentation: Lecture

PAR02/TENDENCY OF QUALITY PARAMETERS IN THE PRODUCTION OF NUTRITIONAL SUPPLEMENTS AL CNIC

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The significant health benefits demonstrated by the nutritional supplements from the National Center for Scientific Research (CNIC) have led to high demand in the domestic market and a significant interest in other countries, with established customers who rely on our products. Therefore, maintaining high quality in the production of these active ingredients (AI), ensuring compliance with GMPs and with the recent implementation of the Integrated Management System, has been a premise of our center. The objective of this work is to analyze the trend in the results obtained over the last five years in the production of the AIs policosanol and Beeswax Alcohols. The study shows compliance with quality parameters in the initial saponification stage, in the solvents used in the extraction and purification processes, in the suitable sub-batches that make up the batches, and the yield obtained for each source wax. In the five years analyzed, the trend in compliance with the quality specifications of these products remained stable, except for the alcohol content in policosanol saponifications, due to the quality of the processed raw material wax, with a total alcohol content close to the specification limit, which, once processed, gave rise to sublots with lower 1-octacosanol and total content. In conclusion, analyzing the trend of quality parameters in the production of policosanol and EPCA over the last five years, allowed the company to be alerted to the difficulties caused by the processing of low-quality refined sugarcane waxes in the production of policosanol.

Keywords: policosanol, Beeswax Alcohols, sub-batches

Modality of presentation: Oral

PAR03/IMPROVEMENTS IMPLEMENTED IN THE CNIC IS ACTIVE INGREDIENT BATCH MANUFACTURING PROTOCOL

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The Manufacturing Protocol document for the Policosanol Batch (active ingredient produced at the CNIC under licenses granted by the Cuban regulatory entity, CECMED), had a very simple design, referencing only the primary records folio for the stages of the production process. Auditors repeatedly stated that adequate traceability was lacking and that little information was provided on the production process, as the primary records were filed in other folders, separate from this governing document. With this in mind, the objective of this work was to improve the structure and design of the Batch Manufacturing Protocol, not only for policosanol but also for all active ingredients produced at the center. One of the improvements was to present, through individual diagrams, the production process for each final product (sub-batch) that makes up the batch and to attach the official primary records for each stage of the production process. The addition of records reporting the analytical and inspection results for each sub-batch was also implemented. Additionally, all information related to the approval of the various raw materials involved and the primary packaging material was incorporated. The result was a more comprehensive document, allowing the traceability of the processes and operations carried out to be verified by directly consulting the primary record issued in each case. In conclusion, with the improvements implemented in the Batch Manufacturing Protocol, it was possible to overcome the non-conformity reported by CECMED and visualize from start to finish each stage of the process for obtaining CNIC is natural origin AIs.

Keywords: policosanol, sub-batch

Modality of presentation: Oral

PAR04/MANUFACTURING OF POLICOSANOL TABLETS: CHANGES AND CHALLENGES

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Policosanol, recognized for its cholesterol-lowering effects, is a natural compound derived from sugarcane wax and the active pharmaceutical ingredient in Ateromixol® tablets (5, 10, and 20 mg), registered by the National Center for Scientific Research and produced by Medsol Laboratories. Historical production data from Medsol Laboratories (2015–2024) were analyzed, assessing the batch approval rate according to standards from the Center for State Control of Drugs, Equipment, and Medical Devices. Statistics confirm that its pharmaceutical composition has remained unchanged, with consistent dissolution and potency profiles even under stressful conditions, supporting its long-term quality. Analysis of production data (2015-2024) reveals that Medsol produced batches with a pass rate exceeding 99% (only one batch was rejected due to minor deviations), demonstrating not only operational efficiency but also the robustness of an original formulation maintained for three decades. In Latin America, Cuba is consolidating its position as a strategic producer thanks to its patented extraction technology and the long-standing stability of its formulations, with exports to Asian markets that validate the product's international competitiveness. This track record of success is underpinned by the technological stability of the process, with no critical modifications in 30 years. Ateromixol® tablets represent a paradigmatic case of sustainable pharmaceutical innovation, where consistency in quality and formulation has been key to maintaining clinical and commercial relevance in a dynamic global market.

Keywords: manufacturing, policosanol, tablets

Modality of presentation: Oral

PAR05/PERFORMANCE OF CNIC IS NUTRITIONAL SUPPLEMENT (VASACTOL, PREVENOX, ABEXOL) PRODUCTION OVER THE PAST FIVE YEARS

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The National Center for Scientific Research (CNIC) produces active ingredients (AI) of natural origin, which it markets as nutritional supplements in tablet form, produced jointly with the Solid Medicines Company (MEDSOL) through a cooperative production contract. These include Vasoactol (to increase physical efficiency), Abexol (as a gastroprotector and anti-inflammatory), and Prevenox (as an antioxidant). These active ingredients, with no reported adverse effects and no prescription required, enjoy high demand and acceptance in the domestic market. Therefore, the objective of this work is to analyze the production behavior of these nutritional supplements for the domestic market over the last five years, using different statistical tools and graphs using MINITAB. The results show that Vasoactol and Prevenox production reached higher levels in 2020 and 2021, which subsequently decreased for various reasons, mainly related to internal organizations of both companies, evidencing a downward trend. However, despite not reaching the production levels of previous supplements, Abexol shows an upward trend in 2023 and 2024, given the recovery of AI production capacities and the finished form. In conclusion, the CNIC has managed to maintain an adequate level of these supplements in the domestic market over the last five years, although without satisfying demand. Vasoactol showed the most stable performance, with annual production exceeding 10 million tablets.

Keywords: Abexol, Vasoactol, Prevenox, Production

Modality of presentation: Oral

PAR06/FIRST RESULTS ON NEW PREVENOX´S AI IN THE CNIC´S PRODUCTIONS SINCE A TECHNOLOGICAL POINT OF VIEW

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The significant health benefits demonstrated by Prevenox have led a very high demand, which remains unmet due to the low production volumes of its Active Ingredient (AI). It should also be noted that, in the 19 years that Prevenox has been on the market, no improvements have been made to its AI or its finished form. Taking these aspects into account, a series of improvements were designed and introduced into the technological processes for obtaining its AI. The possibility of using saponified sugarcane wax, subjected to the extraction of its fatty alcohols, as a starting material for obtaining the AI was included. The step of liberation of the fatty acids (FAs) with sulfuric acid was eliminated; and the FAs were left in the form of potassium salts. Optional purification was added for sub-batches that did not meet the FAs content described in the quality specification. The results of the sub-batches of the new Prevenox AI produced were compared with data from previous years for AI obtained using the traditional method, revealing a 6% to 9% increase in production yield and greater use of installed capacity. In conclusion, the modifications made guarantee a more economical and efficient production of this AI, while maintaining the same quality and antioxidant efficacy as the previous AI.

Keywords: policosanol, Prevenox, sub-batches.

Modality of presentation: Oral

PAR07/ DEVELOPMENT OF PREVENOX FORMULATION AND COATING

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In Cuba, the proportion of people aged 60 and over is progressively increasing. The Ministry of Public Health's goal is to contribute to improving the health and quality of life of older adults. One way to achieve this is to prevent disease through the use of natural and traditional medicine. Prevenox 5 mg coated tablets have been shown to increase the body's antioxidant response, lower cholesterol and triglyceride levels, and prevent the development of osteoporosis. Objetive to develop a new formulation and coating for Prevenox 5 mg tablets. A formulation was developed using the active ingredient High Molecular Weight Acid Mixture (in the form of potassium salts) (MAAPMK) as its initials, using a wet process. The excipients used were analyzed using the corresponding official techniques to verify compliance with the requirements for each excipient. The experimental batches prepared showed excellent physical, chemical, technological, and microbiological properties. The coating of the experimental batches was carried out satisfactorily

Keywords: Prevenox, excipients, coating, industrial, batches

Modality of presentation: Oral

PAR08/EFFECTIVE AND SELECTIVE METHODS FOR THE EXTRACTION AND ISOLATION OF BIOACTIVE NATURAL PRODUCTS

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Today, natural drugs or food supplements not only provide the primary health-care needs for the majority of the population in developing countries but have attracted more and more attention in developed countries due to soaring health-care costs and universal financial austerity. For example, in the USA, approximately 49% of the population has tried natural medicines for the prevention and treatment of diseases. Chemicals known to have medicinal benefits are considered to be “active ingredients” or “active principles” of natural medicines. Natural products have provided the primary sources for new drug development. Natural products offer more drug-like features to molecules from combinatorial chemistry in terms of functional groups, chirality, and structural complexity. The amounts of active ingredients in natural medicines are always fairly low. The lab-intensive and time-consuming extraction and isolation process has been the bottle neck of the application of natural products in drug development. There is an urgent need to develop effective and selective methods for the extraction and isolation of bioactive natural products. This review intends to provide a comprehensive view of a variety of methods used in the extraction and isolation of natural products. A description of the main current´s methods employed on natural products extraction its presented. A great diversity of methods has been employed, like: Pulsed electric field extraction (PEF), Microarray assisted extraction method (MAE), Ultrasound assisted extraction method (EAU), Supercritical fluid extraction (SFE), Pressurized liquid extraction (PLE), Soxhlet extraction, and Ionic liquids extraction.

Keywords: Natural products, Extraction, Isolation, Natural medicine, Chromatography

Modality of presentation: Lecture

PAR10/EXTRACTION OF POLICOSANOL FROM SUGAR CANE WAX WITH SOXHLET TECHNOLOGY

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Sugar cane has been used over the years as a source of wax. The chemical processing of waxes has been studied due to the interest of the products obtained from it, divided into two groups, saponifiable and unsaponifiable. Since 1991, the National Center for Scientific Research of Cuba has begun studies on policosanols (a mixture of high molecular weight alcohols) and the different extraction methods. Policosanol is a mixture of high molecular weight alcohols that is used for the treatment of cardiovascular diseases, due to its action in increasing high-density lipoproteins, in addition to being an antiplatelet agent, it is beneficial against hypercholesterolemia. Refined cane wax currently does not have the appropriate characteristics to achieve policosanol with the specifications required for export, because of this the general objective is to extract high molecular weight alcohols with higher purity from refined sugarcane waxes with lower quality using Soxhlet-type technology, maintaining the saponification process. The results are evident using this technology for extraction as they met the quality requirements, and the performance of this technology is higher than that of the conventional extraction used in Group 3 of the CNIC.

Keywords: sugar cane, refined cane wax, high molecular weight alcohols, policosanol.

Modality of presentation: Oral

PAR11/EVALUATION OF A SOLAR-ELECTRIC HYBRID DRYER IN THE PRODUCTION OF ANAMU CAPSULES AT THE CNIC

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In recent years, there has been increasing interest among researchers and producers in the use of natural products due to their availability in the environment around us. Natural products developed for therapeutic purposes respond to the health needs of the vast majority of the population in developing countries and constitute one of the most interesting areas of scientific creation in the contemporary world. This study aims to evaluate the energy consumption of a new hybrid solar-electric dryer, developed by the Research and Development Group of the National Center for Scientific Research, and compare it with the energy consumption of traditional ovens for drying plant material for the production of anamu capsules. These capsules have great social value as they contain minerals for the proper functioning of the human body, especially trace elements that, despite being required in very low concentrations, play fundamental roles in human metabolism. Measurements were made of the temperature behavior of the traditional ovens and the hybrid solar-electric dryer during a week of drying the plant material. The moisture content of the ground product was determined, and it was observed that in both cases it met the established specification (≤ 6%). The study determined that the hybrid solar dryer was the oven that consumed the least electricity, and the energy savings in the drying process were calculated at 19.74%.

Keywords: anamu, hybrid solar-electric dryer

Modality of presentation: Oral

PAR12/INNOVATION IN SOAP MAKING: INTEGRATION OF NATURAL PRODUCTS

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Growing concerns about health and the environment have led to a resurgence in the use of natural products in soapmaking. This approach not only responds to consumer demand for more sustainable options but also offers significant benefits for the skin. Among the most notable natural ingredients are moringa cake, honey, and propolis extracts, rich in antioxidants, carbohydrates, amino acids, and minerals, making them excellent moisturizers, wound healers, and anti-inflammatories. In Cuba, research conducted by the Institute of Pharmacy and Food at the University of Havana (IFAL-UH) in collaboration with the National Center for Scientific Research (CNIC) has focused on the inclusion of these natural active ingredients in soapmaking. This effort has led to the development of soaps with greater stability that promote cell regeneration and hydration, being especially beneficial for people with dermatological conditions. The integration of these natural ingredients into soap formulations represents an innovative trend that combines efficacy, sustainability, and health, positioning natural soap as a viable alternative in today's cosmetics market.

Keywords: soap, moringa, propolis, honey, cosmetics, natural products

Modality of presentation: Oral

PAR13/IMPROVEMENT OF THE RAW MATERIAL SAMPLING PROCESS SOAP SHAVINGS BASED ON THE ASSOCIATED RISKS

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The sampling process at the CNIC, for the raw materials of the process of obtaining Soap for therapeutic purposes, is planned to obtain a representative sample of the batch of Vegetable Soap Shavings that allows its suitability to be evaluated. Based on the results of the visual inspection and quantitative analysis, the batch is approved or declared Non-compliant. However, in 2024, it was detected during the soap production process that the shavings used presented foreign particles and lumps, which were not detected during the sampling process. It is evident that the supplier is new, initially evaluated, from a sample that once analyzed meets the quality specifications for the established parameters, so the contracting of this supplier is approved for the use of raw materials in production. Analysis of the root cause of the deficiency in the sampling and acceptance process helps prevent recurring problems by addressing the ineffective procedures that cause them. The objective of this work is to carry out a risk analysis taking into account the possible sources of failure that may affect deviations in the chip sampling process. This will allow us to assess, control and review the risks of the quality of the Raw Material. In this way, defects can be prevented, security increased and the sampling process for new suppliers improved. During the analysis the risks are considered acceptable, however, new control measures were applied to minimize risks that could be classified as unacceptable and a re-evaluation of the residual risks was carried out.

Keywords: sampling, raw materials, visual inspection, risks, process

Modality of presentation: Oral

PAR14/ OZONIZED SOAP: STABILITY AND PROCESS ANALYSIS

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Ozonated soap has germicidal and skin-revitalizing properties, and is used in medical, podiatric, dermatological, and cosmetic treatments, or simply as a common soap to maintain healthy and hydrated skin. Stability studies in cosmetics are of great importance because they allow for continuous monitoring of product quality. The objective of this study was to study the stability of ozonated soap and apply statistical process control to its manufacturing. Three industrial batches of soap, packaged in cardboard boxes and with personalized wrapping in cardboard boxes stored at room temperature (30 ± 2 ºC), were studied. The organoleptic properties, fatty acid content, alcohol insolubles, drying losses, softening wear, foaming power, cracking index and caustic free alkalinity were determined for three years. Process control was performed on batches produced between January 2022 and August 2023, determining control charts and process capability indices for fatty acid content, alcohol insolubles, and drying losses. Of the two types of study, the soap presented in a cardboard box only fulfilled its organoleptic properties up to 18 months, while this was not the case for the other case study, which maintained its organoleptic properties, without the presence of cracks or fissures during the time evaluated. All parameters remained within quality specifications, except that drying losses and foaming power were only stable for 18 months in the case of soaps packaged in cardboard boxes, but not in the other case. The ozonized soap production process is under statistical control, meeting quality specifications for alcohol insolubles, fatty acids, and drying losses. The processes were capable of handling alcohol insolubles, fatty acids, and drying losses, with high Cp and Cpk values.

Keywords: ozonized soap, statistical process control, stability

Modality of presentation: Oral

PAR15/DEVELOPMENT OF HONEY AND MORINGA RESIDUE SOAP AS A NATURAL EXFOLIANT

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Dermocosmetics based on natural products are designed to beautify and protect the appearance of the skin. Today, these products represent a commendable option covering a variety of applications. The present work focuses on the development of a new formulation of dermocosmetic soap with bee honey as an active pharmaceutical ingredient and moringa oil residue as an exfoliant, for later incorporation into the cosmetics line of the National Center for Scientific Research (CNIC). This product has a positive impact on the health and well-being of the population due to its moisturizing, antibacterial, nutritional properties and removal of dead skin cells. A formulation with honey was developed for reference study. Two formulations were tested with different concentrations of API and exfoliant. The physical-chemical characteristics of the formulations were determined and they were subjected to a stability study in three conditions (I) shelf, (II) sunlight and (III) oven at 47°C, evaluated in terms of their psychophysiological properties. In the stability study, the variant (5% honey, 1% exfoliant, 1% TiO_2, 1% EDTA) was determined as the best formulation. At the end of accelerated aging, the physical-chemical characteristics of the best formulation were similar to the reference ones.

Keywords: soap, honey, moringa oil residue, exfoliant

Modality of presentation: Oral

PAR16/REGULATORY FRAMEWORK AND GOOD MANUFACTURING PRACTICES FOR NATURAL PRODUCTS

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The Center for State Control of Medicines, Equipment and Medical Devices (CECMED) has the mission to guarantee public health protection by ensuring, through a system of regulation and sanitary control, that the medicines, diagnostic tools, equipment and medical devices available for human use, whether imported or domestically produced, meet the required safety, efficacy, and quality standards. Natural products are part of CECMED's regulatory scope as the Regulatory Authority of Medicines. In the exercise of its functions, it has established the regulatory framework for this type of product. It includes the requirements for sanitary registration and Good Manufacturing Practices. These are an essential part of the Quality Management System that manufacturers must establish to obtain medicines with the appropriate quality, safety, and efficacy, ensuring that products are consistently produced and controlled according to the quality standards suitable for their intended use and according to the conditions required for their marketing. This document summarizes the regulatory requirements that allow for the establishment of an appropriate quality assurance system that ensures that a natural product can meet the premise of quality, safety, and efficacy to reach Sanitary Registration, production, and use in humans.

Keywords: Regulatory framework, Sanitary Registration, Good Manufacturing Practices

Modality of presentation: Lecture

PAR17/CURRENT REGULATORY TRENDS IN THE CUBAN BIOTECHNOLOGY INDUSTRY

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Significant advancements in the global biotechnology industry, including gene therapy, artificial intelligence, nanotechnology, 3D bioprinting, and environmental biotechnology, establish challenges in complying with current regulations. Cuban biotechnology, as a leader in innovation and sustainability, must adopt current regulatory trends in order to access international markets with products of high added value. This approach contributes to the country's economy and allow raising the health levels of the Cuban population. This paper highlights how the Center for Genetic Engineering and Biotechnology (CIGB) updated its regulatory management to align with trends set by national regulatory authorities: regulatory flexibility, greater transparency in decision-making and global harmonization. These effort focus on addressing health emergencies, enhancing quality of life and developing agricultural projects for food production. Methods including reviewing regulatory agency guidelines for biomedical and veterinary medicines, analyzing recent scientific publications and conducing gap analyses. The results identified challenges in the biotechnology product approval process and outlined actions to achieving new registrations for biopharmaceuticals and certifications for agricultural biotech products. The CIGB demonstrated its alignment with current trends, showcasing its commitment to innovation and sustainability.

Keywords: biotechnology, regulatory management, gap analysis

Modality of presentation: Oral

PAR18/REGULATORY SYNERGIES: PROMOTING BIOMEDICAL AND VETERINARY BIOTECHNOLOGY IN CUBA

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In biotechnology, regulations play a key role in ensuring the quality and efficacy of its products in harmony with the environment. In Cuba, regulations related to biomedical and veterinary use are essential to support the development of the pharmaceutical industry. The Center for Genetic Engineering and Biotechnology (CIGB) focusses on researching, developing, producing and marketing innovative biomedical and veterinary products, adhering to the current regulatory framework-including guidelines for the Sanitary Registry and the Sanitary License for Pharmaceutical Operations (LSOF). The objective of this work is to analyze the interrelation of the two regulatory institutions CECMED (biomedical) and CENASA (veterinary), regarding the sanitary registration of biomedical and veterinary products. It also proposes improvements to the veterinary medicine dossier compilation methodology. The approach included reviewing national and international regulatory standards, checklists, teamwork, and brainstorming sessions. The study elevated the batch file submission standards for veterinary product certification, highlighting their close relationship with biomedical applications. This synergy strengthened critical aspects of veterinary product regulation. Additionally, it enhanced the scientific justification and regulatory consistency of manufacturing processes and stability studies for veterinary products. Leveraging prior expertise from CECMED, applied methodology ensures robust regulatory approval for novel drugs, fostering a more sustainable industry and a healthier future.

Keywords: biomedical, veterinary regulations, biotechnological.

Modality of presentation: Oral

PAR19/IMPORTANCE OF THE IMPROVEMENT OF THE CNIC'S METROLOGICAL ASSURANCE LABORATORY FOR ITS PRODUCTION PROCESSES

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Metrology focuses on the selection, reception, use and calibration procedures of measuring instruments used in production processes. More specifically, technical metrology is defined as "part of metrology relating to the study of measurements made to ensure dimensional compatibility, conformity with the design specifications necessary for the correct operation of instruments, as well as to ensure the adequacy of a product in relation to its intended use." Within Technical Metrology, two objectives are pursued, the first of them is the control of measurements and their results, which are involved in quality studies of production processes, raw materials, materials, equipment and measuring instruments used to control and define the requirements related to guaranteeing the quality of productions. The other objective is to determine properties of a process in order to keep it under control; these properties can be, among others, thermodynamic, physical, chemical, etc. With the certified and properly equipped Metrology Laboratory, the results of measurements and calibrations can be obtained, which are valid at the national level. From a technical point of view, the equipment of the Metrology Laboratory is totally Feasible, since it is established that the equipment necessary to provide metrology services can be acquired without difficulty. The benefits for the center are to strengthen the technological infrastructure in the field of quality, allowing a positive impact on production processes, raising their quality.

Keywords: metrology, production processes, control, quality.

Modality of presentation: Oral

PAR20/VALIDATION OF THE PURIFICATION, STORAGE AND DISTRIBUTION PROCESS OF PURIFIED WATER IN THE NATIONAL CENTER FOR SCIENTIFIC RESEARCH

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The National Center for Scientific Research (CNIC) has a system to obtain purified water through a combination of reverse osmosis (OSM) and electrodeionization (EDI) with an integrated degasser. This water is used in cleaning equipment (final rinse) and as raw material in the production of medicines, which is why CECMED requires the qualification of the installed system and the validation of the process that occurs. The objective of this work is to show the results of the validation of the purification, storage and distribution process of purified water in the CNIC facilities. After the successful qualification of the system, from the Design, the process was validated in 3 phases. Upon completion of the first phase, sodium hypochlorite dosing was added to the drinking water collection tank and the frequency of loop sanitization was increased to improve water quality at some points. In the second phase, compliance with the critical process parameters (determined in the first phase) was verified; as well as the water quality specified for each stage of the process and at the points of use. The successful completion of Phase 2 allowed Phase 3 to be undertaken, operating according to updated procedures for 1 year to take into account possible seasonal variations in the quality of the source water. By evaluating the physical, chemical and microbiological quality of the water at the outlet, it was proven that the System consistently produces purified water with a quality that meets the specifications established in USP 44.

Keywords: validation, purified water

Modality of presentation: Oral

PAR22/INTEGRATED QUALITY MANAGEMENT SYSTEM, ENVIRONMENT AND THE HAZARD ANALYSIS SYSTEM AND CRITICAL CONTROL POINTS IN THE COMPANY CNIC- BIOCUBAFARMA

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The company National Center for Scientific Research (CNIC) has as its social objective: Research, produce and market products developed in the field of science and execute foreign trade operations related to the export of goods and services, being a producer of a varied range. of products designed within the framework of the pharmaceutical industry. To comply with regulatory requirements, it was necessary to design a quality system that was capable of integrating several standards such as ISO: NC 9001:2015, ISO:NC 14001:2015 and NC 136:2017 Hazard Analysis System and Critical Safety Points. control, the objective of this work being to show how it was possible to design this integrated system. To do this, brainstorming was used as a fundamental tool and the tasks planned in an institutional Project were taken into account, as well as the common requirements of the standards involved in the integration were analyzed and applied, and the specific requirements of each were implemented one of them. The work carried out culminated satisfactorily, achieving the implementation with the scope "Research, Production, and Marketing of active ingredients, finished products of natural origin, and medicinal soaps; determined compliance with quality, environmental, and hazard analysis and critical control point requirements NC 136: 2017; the latter only for the active ingredient product of the nutritional supplements of the CNIC company" which allowed maintaining sales to countries with high regulatory standards in the world, as a conclusion the Integrated Management System for quality, environment and the safety system was obtained. hazard analysis and critical control points of the CNIC-BioCubaFarma company issued by the National Standardization Office of Cuba.

Keywords: Integrated Management System, quality, environment, safety system hazard analysis and critical control points

Modality of presentation: Oral

PAR23/EFFICACY OF THE INTEGRATED MANAGEMENT SYSTEM AT NATIONAL CENTER FOR SCIENTIFIC RESEARCH

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The efficacy of Integrated Management Systems (GIS) allows, quickly and proactively, to manage the company and make possible the comparison of results with the proposed goals, which is why their correct identification and measurement are essential premises for all companies. The National Scientific Research Center belonging to the Higher Organization of Business Management (OSDE) Group of Biotechnological and Pharmaceutical Industries (BioCubaFarma) of the Republic of Cuba, dedicated to scientific research, with a high development in the areas of natural, biomedical and technological sciences, has implemented a GIS of Quality, Environmental and Hazard Analysis and Critical Control Points (APCC), as well as its fundamental processes to organize and manage in an efficacy solution to problems, where the satisfaction of customers and other interested parties is the maximum expression of success. The objective of this work is based on evaluating the efficacy of the GIS and process in the CNIC company. To meet the proposed objective, the company's twelve processes are taken, the indicators with their method of calculation, evaluation criteria and the frequency at which efficacy is measured, in order to determine their control, if they are meeting the objectives established and if the GIS is efficacy. The efficacy evaluation guaranteed that the controls are adequate, that the established objectives are being met and that the GIS is efficacy, which led to the granting of the Certification.

Keywords: Efficacy, Integrated Management System, Evaluation

Modality of presentation: Oral

PAR24/ENVIRONMENTAL IMPACT ASSESSMENT OF THE EFFECTS OF CLIMATE CHANGE ON THE CNIC. ISO 9001:2015 REQUIREMENT

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Today, the effects of climate change have become central to the actions of all organizations. Rising temperatures, more frequent storms, rising ocean levels and warming waters, species extinction, food shortages, increased health risks, poverty and displacement are the most notable effects posed by the UN as a consequence of climate change. In this context, the ISO standards system establishes its evaluation as a requirement for the implementation of quality systems and environmental management systems. To assess the environmental impact of the effects described for climate change in the CNIC as a requirement 9001:2015. The double-entry matrix method is used, with calculation of the impact index to evaluate the behavior of the effects described, which includes probability, frequency and control measures implemented. no significant impacts are identified for the entity's performance; the organization has an environmental strategy that enhances the mitigation of potential risks arising from climate change. An environmental impact assessment of climate effects on the CNIC has been performed. The effects of climate change described by the United Nations conventions on climate change do not have a significant impact on the institution's performance,

Keywords: climate change, environmental impact

Modality of presentation: Oral

PAR25/HAZARD ANALYSIS AND CRITICAL CONTROL POINTS (HACCP). IMPLEMENTATION IN THE MANUFACTURING OF NUTRITIONAL SUPPLEMENTS

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Hazard Analysis and Critical Control Points (HACCP) is a process oriented food safety system that systematically identifies specific hazards and measures to control them, ensuring the safety of the final product. Considering that this tool controls risks or hazards at acceptable levels or eliminates them throughout the production chain, its use has become widespread in the pharmaceutical industry. The National Center for Scientific Research (CNIC) certifies the NC 136:2023 standard within the SGC, becoming a pioneer within the country's pharmaceutical industry in applying this standard. The objective of the work was to design a HACCP system, establishing guidelines for its implementation in the production processes of nutritional supplements manufactured at the CNIC. The methodology used was based on the application of the Seven Basic Principles of the HACCP System, resulting in its design. In the first stage, the prerequisites established to facilitate the effective implementation of the system were analyzed, a HACCP plan was developed, and the seven principles of the system were applied in the different stages of the manufacturing process. Critical control points (CCP) were determined and their critical limits (CL) were established according to the requirements of standard NC 136:2023. The results of the HACCP system were implemented within the Management Review for analysis, the establishment of corrective measures, and verification of the system's effectiveness and updating to ensure its suitability. The establishment of the HACCP system has strengthened national and international competitiveness, providing greater product quality and safety, and thus providing greater customer confidence.

Keywords: HACCP, safety, nutritional supplements

Modality of presentation: Oral

PAR26/IMPLEMENTATION OF THE HAZARD ANALYSIS AND CRITICAL CONTROL POINTS (HACCP) SYSTEM AT THE SOFT CAPSULE FINISHED PRODUCT PRODUCTION PLANT

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Hazard Analysis and Critical Control Points (HACCP) represents a systematic, proactive, and preventive tool, essential for ensuring quality, reliability, and safety in the pharmaceutical industry. This structured approach, based on technical and scientific principles, allows for the analysis, evaluation, prevention, and control of adverse risks or hazards that arise during the different stages of the production process, thereby ensuring product safety, compliance with international regulations, and improving consumer confidence. The objective of the work was the implementation of the HACCP system in the production plant for finished forms of soft capsules. First, the HACCP team was formed, the scope of the study was defined, a complete description of the product was created, including its intended use and consumers, and flow diagrams were constructed and verified on-site. Once approved by the HACCP team, the potential physical, chemical, and biological hazards were defined and classified as significant or not based on their likelihood of occurrence and severity of harm. Critical Control Points were identified, and the critical limits to be met to mitigate the identified risks were subsequently established. Finally, monitoring, verification, and validation systems were designed for the identified risks, as well as preventive or corrective actions. Documentation systems, procedures and records, were created to support all actions and decisions taken throughout the process. The implementation, monitoring, and certification of a HACCP system increases accountability and control in any industry, as well as reducing costs such as quality laboratory analysis, sanitation programs, reduced complaints or claims, and reprocessing and raw material costs. This is a fundamental and crucial tool for product quality, sustainability, and safety.

Keywords: HACCP, risk, safety, nutritional supplements

Modality of presentation: Oral

PAR27/INTEGRATION OF THE PHARMACOVIGILANCE SYSTEM TO THE INTEGRATED MANAGEMENT SYSTEM AT THE CNIC

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The Integrated Management System (IMS) is a single system designed to manage multiple aspects of an organization's operations in accordance with multiple standards, such as quality management, ISO 9001(2015) that seeks to improve productivity, control and reduce risks, and promote continuous improvement in products and services, environment ISO 14001 (2015) and health and safety 45001(2023). Objective: to describe the results of the integration of the Pharmacovigilance System (SF) to the GIS at the National Center for Scientific Research (CNIC). A documentary review of the SF is carried out, identifying all those aspects that contribute to the robustness of the SIG, certified in the year 2024. On the other hand, training actions on the principles and requirements of the ISO series standards were carried out for all personnel, and Pharmacovigilance requirements were identified that harmonized with the MIS implemented in the organization, a discipline included in the process of review, monitoring and continuous improvement of the MIS. It was verified the existence of integration to the MIS of the FS implemented in the center; on the other hand, procedures were prepared, reviewed and approved in the customer satisfaction MIS according to the ISO standards, considering the quality, environmental and specific requirements of Pharmacovigilance. At the end of the work, it was found that there is an integration of systems that has strengthened the CNIC's capacity to manage the quality and safety of its products and services, in accordance with the MIS certified by the ONN.

Keywords: Pharmacovigilance, Integrated Management System

Modality of presentation: Oral

PAR28/DEMONSTRATING THE CONSISTENCY OF THE MANUFACTURING PROCESS OF SACHA INCHI OIL SOFT CAPSULES

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Sacha inchi oil is rich in antioxidants and polyunsaturated fatty acids, from which a formulation of soft capsules as a nutritional suplement was developed at the National Center for Scientific Research of Cuba. Drug Regulatory Bodies require evidence from manufacturers of pharmaceutical products that they are consistently produced to meet predefined quality specifications. The objective of the work was to evaluate the quality of the industrial batches of soft capsules of Sacha inchi oil and to apply the statistical control of processes in its manufacture. Batches of oil were analyzed, including organoleptic characteristics, acidity index, peroxide, fatty acid content and microbiological count. In the Soft Capsule Production Plant, 41 industrial batches were produced, evaluating their organoleptic characteristics, loss due to drying, weight variation, disintegration time, fatty acid content and microbiological count. Control graphs for weight variation, loss on drying, disintegration time and fatty acid content were obtained from batches produced in 2023. Compliance with the quality parameters of the oil batches was demonstrated, proving the feasibility of the production method. All batches of soft capsules showed satisfactory values in the evaluated parameters, confirming the reproducibility of the developed technology. The manufacturing process of Sacha inchi oil soft capsules is under statistical control for fatty acid content and weight variation, but not for disintegration time and drying losses.

Keywords: Sacha inchi oil, soft capsules, quality control, statistical process control

Modality of presentation: Poster

PAR29/STUDY OF THE STABILITY BEHAVIOR OF THE INTERMEDIATE PRODUCT SAPONIFIED WAX IN THE PRODUCTION OF POLICOSANOL

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The production of the active ingredient (AI), Policosanol, consists primarily of a mixture of aliphatic primary alcohols isolated from refined sugarcane wax. Saponification represents the initial stage of the policosanol production process, with the alcohol content of the saponified wax being a critical step in the subsequent production of policosanol. Saponified wax represents an intermediate product (IP) in the process, and is stored for use in polyethylene bags at ambient temperature and humidity (30 ± 2°C / 75% RH), necessitating continuous quality monitoring. The objective of this study was to determine the influence of moisture content in saponified wax samples on the resulting alcohol content. Representative samples of the IPs were taken, and their total alcohol and moisture content were determined over a 60-day study period. During the study period, the appearance of the saponified products was evaluated, and no significant changes in their physical appearance were observed. The alcohol content in the wax did not present any critical effects, maintaining values within the quality specifications established for this type of intermediate product. The data were fitted to a linear regression model, and statistical analysis showed no significant difference in the slope of the line. The results obtained for the moisture content were approximately 4%, showing no significant influence on the result of the alcohol content in the saponified wax during the study period. PI saponified wax can be stored under the ambient and packaging conditions studied for 60 days without affecting the alcohol content.

Keywords: saponified wax, polyoxyethanol, alcohol content, moisture content

Modality of presentation: Poster

PAR30/ASSESSMENT OF TECHNOLOGICAL EDUCATION FOR AN ECOLOGICAL AND EFFICIENT PRODUCTION OF OZONIZED SUNFLOWER OIL AT THE CNIC

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Technological education is presented as a fundamental process in the field of ecological and efficient production of ozonated sunflower oil. This educational approach is designed to train operators involved in the production process, enabling them to acquire the technological knowledge necessary to make informed decisions and become creators of high quality products. Training is focused on responding to society's needs and motivations, as well as complying with environmental regulations and promoting economic development. Objective: to assess the impact of technological education for ecological production. A preliminary study is conducted analyzing methods and tools in this process, highlighting the urgency of implementing a system of educational workshops considering environmental training received and work performance, these workshops not only strengthen the competencies of operators, but will also promote more sustainable and efficient productive practices as part of the acquired environmental culture. The relevance of technological education in optimizing the use of technologies in the production of ozonated sunflower oil is highlighted. By integrating technological education in the production process, the aim is not only to improve the quality of the final product, but also to contribute to a production model that respects the environment and responds to market demands.

Keywords: technology education, organic production, ozonated sunflower oil, production efficiency, sustainable development.

Modality of presentation: Poster

PAR31/NEW DESIGN OF A SUPPORT FOR PROPOLIS SOLID-LIQUID EXTRACTION

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Propolis has different therapeutic uses such as antiparasitic, anti-inflammatory, healing agent, anesthetic, tissue regenerative, antipsoriatic, analgesic, antioxidant, hepatoprotective, etc. In the cosmetic industry, it is also used in the preparation of high quality products, which are demanded among the population. In the National Center for Scientific Research, propolis tinctures are obtained at 5 %, 10 %, 15 % and 50 % or as a soft propolis extract at 85 % total solids. Taking into account the limited capacity of the propolis manufacturing plant of the National Center for Scientific Research, the objective of this work was to design a new model to carry out the solid-liquid extraction process in order to satisfy the high demand for propolis. The designed support allowed a safe solid-liquid extraction process in bags, without contamination, thus guaranteeing the quality of the product. It has a capacity of up to 75 kg, obtaining similar performance to the previous 50 kg support. This new design could be applied to the production of other natural products.

Keywords: propolis, solid-liquid extraction, new design, support

Modality of presentation: Poster

PAR32/PROPOSAL FOR THE STORAGE AND SUSTAINABLE MANAGEMENT OF WASTE GENERATED IN THE PHYSICOCHEMICAL LABORATORY

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The pharmaceutical industry is a production sector subject to high standards of regulation which guarantees product safety conditions for the population and where the environmental impact of the processes and substances used in the different quality control tests is minimized, being a global problem the treatment of waste generated and the management of hazardous chemicals. The CNIC has endorsed an environmental policy of commitment with the care of the environment, in such sense the present work has as objective to carry out a proposal for the management of reagents storage and the handling of waste generated in the Laboratory**.** A review of the spatial conditions and flows of materials and personnel in the storage and handling of hazardous substances, to identify areas for improvement to minimize the risk of accidents with environmental impact, from the review of the volumes of waste generated a proposal is made for the identification of its components by chromatographic methods, from which to suggest other uses, contributing to the principles of circular economy at the laboratory level, taking advantage of technological resources and expertise of laboratory personnel. An analysis was carried out to improve the storage and handling conditions of chemical substances in the laboratory, and by analyzing the volumes generated, information collected in the RIGA 11 register, a proposal was made for their characterization by chromatography methods, to obtain more precise information on components and purity that can define other uses, thus contributing to environmental sustainability. A proposal was developed for the storage and sustainable management of waste generated in the physicochemical laboratory.

Keywords: waste, chromatographic methods

Modality of presentation: Poster

PAR33/DETERMINATION OF THE CHARACTERISTICS OF THE GELATIN RAW MATERIAL TO IMPROVE THE PALMEX ENCAPSULATION PROCESS

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The Lipid Extract of Palm Fruit (ELFP) is an oily liquid formed by the set of several fatty acids. The action of this product for the treatment of Benign Prostatic Hyperplasia was compared with that of Saw Palmetto, with satisfactory results. The most suitable pharmaceutical form for this product is softgels. These are oral pharmaceutical forms, composed of a gelatin shell that covers the active pharmaceutical ingredient (API) in order to improve the bioavailability of drugs that are poorly soluble in water. In 2019, the production of this finished form began in our country in a production plant at the National Center for Scientific Research, with the aim of meeting the needs of this product in Cuba. The productions that have been achieved in the plant have been difficult, due to the physical-chemical characteristics of the API. Taking this situation into account, the objective of this work is to determine the characteristics of the raw material gelatin that allows improving the performance of the palmex encapsulation process. For this analysis, tests were carried out with 2 different types of gelatin. The gelatin shell was prepared using the same proportions and similar parameters for the tests. Of the types of gelatin used, the best performance was obtained with the 165.67 g Bloom bovine origin type B gelatin. The capsules obtained complied with the physical-chemical and microbiological characteristics established for the final product.

Keywords: softgels, ELFP, gelatin, performance

Modality of presentation: Poster

PAR34/DEVELOPMENT OF FORMULATIONS IN SOFT CAPSULES WITH DIFFERENT ACTIVE INGREDIENTS

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Among the most commonly used solid oral dosage forms are capsules, which are the second most commonly used finished form after tablets. The raw materials used in their manufacture are gelatin, glycerin, and purified water, and the active ingredient(s) (AIs) are contained within. Due to the current drug shortage in the country, solutions are being sought to introduce naturally derived medications to the market that can address this shortage. These oils have various applications: sacha inchi is a seed whose oil prevents cardiovascular disease and helps eliminate cholesterol, triglycerides, and accumulated fats from the body. Oral OLEOZON® is a medication with antibacterial and antifungal action and is successfully used in the treatment of giardiasis. Pumpkin seed oil is considered an appropriate ingredient for the prevention of health problems, especially for the treatment of enlarged prostates (benign prostatic hyperplasia). The objective of this study was to develop softgel formulations with different gelatin preparations for the encapsulation of sacha inchi seed oil, OLEOZON® Oral, and pumpkin seed oil. The proportions of purified water and glycerin, as well as the vacuum time applied to the shell for preparation, were varied, resulting in softgels with a specific solution that meets quality requirements and yields exceeding 90%. This result has a significant impact on increasing softgel production for application in various pathologies and to meet public demands. It also contributes to the utilization of the softgel plant's capacity, which was designed for an annual production of 200 million capsules and currently falls below that figure.

Keywords: soft capsules, sacha inchi, OLEOZON®, pumpkin seed, trials.

Modality of presentation: Poster

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