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Presentation of the content

In the first article we present *Lippia alba: an aromatic plant with recognized value in traditional medicine*, by PEREA-DOMÍNGUEZ, Xiomara Patricia, SEGOVIANO-LEÓN, Juan Paulino, LEYVA-MORALES, José Belisario and SOTO-ALCALÁ, Jorge, with adscription in the Universidad Autónoma de Occidente, in the next article *Effect of malathion on AChE activity, humoral and cellular response in juvenile shrimp Litopenaeus vannamei (Bonne, 1931),* by HERNÁNDEZ-MENDOZA, Edgar Gabriel, ROJAS-MÉNDEZ, Carmen Araceli, PÉREZ-MEDINA, Luis Gerardo and ZAMORANO-MACHUCA, José Alfredo, with adscription in the Universidad Autónoma de Nayarit, in the next article *Decision-making in a family microenterprise in La Estancia, San Juan del Rio, Qro.,* CORTÉS-ALVAREZ, Yolanda, CORTES-ALVAREZ, Alfredo, GONZALEZ-NERI, Aarón Iván and QUEZADA-MORENO, Maribel, with adscription in the Universidad Autónoma de Querétaro, in the next article *Fractal fuzzy logic using Kelly plots,* by RAMOS-ESCAMILLA, María, with adscription in RINOE-Mexico.

Content

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Lippia alba: an aromatic plant with recognized value in traditional medicine

Lippia alba: una planta aromática con reconocido valor en la medicina tradicional

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Abstract

Lippia alba is an aromatic shrub with recognized medicinal properties attributed mainly to the phytochemical content of its essential oils. It is widely valued in traditional medicine in several South American countries, while in Mexico, despite being widely used, its use and traditional value for local communities has been poorly documented and little is known about its metabolite profile. Due to the remarkable importance of *L. alba*, a documentary review was conducted on its uses in traditional medicine, its bioactive capacity and its relationship with its metabolite profile, for which information was collected through a detailed search in different scientific databases. It was found that *L. alba* has an interesting profile of metabolites, which have been evaluated mainly in its essential oils. Among the most important volatile metabolites are nerol, geraniol, citral, limonellum, -pinene, -myrcene, among others. Regarding non-volatile secondary metabolites, coumarins, quinones, terpene lactones, flavonoids, tannins, etc. have been found. In Latin America, a wide variety of chemotypes have been reported, whose phytochemical composition is a function of genetic variation, geographic distribution and exposure to different soils and climatic conditions. In addition, *L. alba* has bioactive properties such as antioxidant antivity, antiproliferative activity against different cancer cell lines (human lung adenocarcinoma, murine melanoma and leukemia tumor cells), antibacterial properties, decreased anxiety and vasorelaxant effect, among others. In Mexico, it is necessary to make greater efforts in scientific research to characterize the different chemotypes, evaluate their phytochemical profile and biological activity, as well as to document and safeguard the empirical knowledge that has been transmitted from generation to generation about the traditional use of *L. alba*.

***Lippia alba*, Essential oils, Verbenaceae, Medicinal Plants**

Resumen

Lippia alba es un arbusto aromático que posee reconocidas propiedades medicinales atribuidas principalmente al contenido de fitoquímicos de sus aceites esenciales. Es ampliamente valorada en la medicina tradicional en varios países de Sudamérica, mientras que en México, a pesar de ser extensamente utilizada, se ha documentado poco su uso y valor tradicional para las comunidades locales y poco se conoce de su perfil de metabolitos. Debido a la notable importancia de *L. alba,* se realizó una revisión documental sobre sus usos en la medicina tradicional, su capacidad bioactiva y su relación con el perfil de metabolitos, para la cuál se recopiló información mediante una búsqueda detallada en diferentes bases de datos científicas. Se encontró que *L. alba* posee un interesante perfil de metabolitos, los cuales han sido evaluados principalmente en sus aceites esenciales. Dentro de los metabolitos volátiles más importantes destacan el nerol, geraniol, citral, limonelo, α-pineno, β-mirceno, entre otros. En relación a los metabolitos secundarios no volátiles se han encontrado cumarinas, quinonas, lactonas terpénicas, flavonoides, taninos, etc. En América Latina se reporta una amplia variedad de quimiotipos, cuya composición de fitoquímicos está en función de la variación genética, la distribución geográfica y la exposición a diferentes suelos y condiciones climáticas. Adicionalmente, se destaca que *L. alba* posee propiedades bioactivas como antividad antioxidante, actividad antiproliferativa frente a diferentes líneas celulares de cáncer (adenocarcinoma pulmonar humano, melanoma murino y células tumorales de leucemia), propiedades antibacterianas, disminución de la ansiedad y efecto vasorrelajante, entre otras. En México, es necesario realizar mayores esfuerzos en investigación científica para caracterizar los diferentes quimiotipos, evaluar su perfil de fitoquímicos y actividad biológica, así como documentar y resguardar los conocimientos empíricos que se han transmitido de generación en generación sobre el uso tradicional de *L. alba*.

***Lippia alba*, aceites esenciales, Verbenaceae, Plantas medicinales**

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Introduction

Traditional knowledge is considered as "a set of wisdoms and routines that date back to the origin of humanity, preserved and transmitted by generations orally" (Arrazola-Guendulay *et al*., 2018, p. 56). As described by Arrazola-Guendulay *et al*. (2018), traditional knowledge results from an integration into social processes, cultural and ecological conditions and is transmitted through legends, myths, dogmas, field practices, etc. (p. 56).

For several centuries, in what is now known as Mexico, medicinal plants have formed an important part of the cultural background of the pre-Columbian indigenous peoples, continuing through the independent period and reaching the ethnic groups that populate modern Mexico. The knowledge of this flora and its use to treat various diseases affecting the population are part of the knowledge that is empirically transmitted from generation to generation (Palma-Tenango *et al*., 2017, p. 134).

Culturally created biodiversity is the product of a long process of exchange and systematic natural selection. To this are added medicinal plants, which can belong to primary, secondary, semi-cultivated and cultivated vegetation. This extraordinary wealth is not found in other parts of the world. Without the knowledge of the people, this civilizing experience would be lost for Mexico and humanity (Boege, 2008, p. 20).

"*Lippia alba*, belonging to the Verbenaceae family, is an aromatic shrub native to Latin America, from Mexico to the Caribbean and South America, with recognized medicinal properties." (Garcia *et al*., 2017, p. 140). Its phytochemical content and bioactivity have been studied in different Latin American countries, while in Mexico there are very few scientific studies on the subject; however, its value for the treatment of some ailments, such as gastrointestinal ailments, is traditionally recognized.

Currently, in the northwest of the country, particularly at the Universidad Autónoma de Occidente, efforts are being made to evaluate the phytochemical content of extracts and essential oils of *L. alba*, as well as to study the traditional uses of this plant and its medicinal value for local communities, which is expected to be very high. Due to the remarkable importance of *L. alba* in the region, it is relevant to conduct a detailed review of the main research related to the bioactive compound profile and biological activity of *L. alba* in order to compile, synthesise, update and disseminate knowledge about this valuable medicinal plant.

Theoretical framework

"In Mexico, the use of herbs with healing properties is very old" (Heinrich et al., 1998, pp. 1859-1871; Palma-Tenango *et al*., 2017, p. 134) and "until today it has become a common practice. Generally, the leaves or flowers are used, and sporadically, the stem and root, consumed directly, in infusions or other presentations" (Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias, 2020). The National Biodiversity Commission (CONABIO, 1998) "lists between 3500 and 4000 species of medicinal plants regularly used by the Mexican population". "Indigenous peoples use between 5,000 and 7,000 plant species in various cultural activities" (Boege, 2008, p. 21). "Despite the research that has been carried out, in many cases, the active chemical principle related to the beneficial effects attributed to these plants is unknown" (Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias, 2020).

According to McChesney *et al*. (2007), "there is a growing interest in conducting phytochemical, ethnobotanical or biodiversity assessment research on medicinal plants, which has made it possible to exploit their potential and support their traditional use" (p. 2015). "Natural phytochemicals isolated from plants used in traditional medicine are considered a good alternative to synthetic chemicals" (Juiz *et al*., 2015, p. 214). "Plants function as a laboratory for the production of not only primary metabolites that are used as food by humans, but also secondary metabolites of great pharmaceutical importance such as: glycosides, alkaloids, flavonoids, volatile oils, among others" (Kumar *et al*., 2020, p. 3).

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"Globally, 70% of anticancer compounds (Jacobo-Herrera et al., 2016, p. 391) and 75% of drugs to treat infectious diseases come from natural products" (McChesney *et al*., 2007, p. 2015).

Talking about L. alba and its medicinal properties means talking about the essential oils it contains. "Essential oils and plant extracts have been used for centuries in traditional medicine" (Ferraz, *et al*., 2021, p. 1).

Essential oils are defined as products obtained from a natural raw material of plant origin, by steam distillation, by mechanical processes from the epicarp of citrus fruits, or by dry distillation, after separation of the aqueous phase (if any) by physical processes (ISO, 2013).

Method and tools

This research is a documentary review of the uses of *L. alba* in traditional medicine, its bioactive capacity and its relationship with the phytochemical profile. For the compilation of information, a detailed search of scientific articles was carried out in different databases such as Web of Science, PubMed, Science Direct, Elsevier, among others. The search was carried out in English and Spanish using keywords such as *Lippia alba*, essential oil, medicinal plants, traditional medicine, phytochemicals, among others, including publications from 1998 to 2021. Subsequently, relevant scientific articles were selected for detailed analysis.

Results

L. alba has been widely used in traditional medicine in some South American countries (Juiz et al., 2015, p. 214).

The species is consumed fresh, prepared as teas, sweets, extracts, syrups and among other forms. Tea preparations of its leaves, for example, are popularly used as respiratory remedies and in the treatment of gastrointestinal disorders, diarrhea and dysentery and for having tranquilizing, sedative, analgesic and spasmolytic actions (da Silva *et al*., 2018, p. 792; Gimenes *et al*., 2021, p. 1).

"Due to genetic variation, geographical distribution and exposure to different soils and climatic conditions, *L. alba* can produce essential oils with different chemical composition, which generates a classification by chemotypes" (Souza *et al*. 2017, p. 2). The chemical composition and bioactivity of L. alba essential oils have been extensively studied in different regions (Celis *et al*., 2007, pp. 103-105; Santos *et al*., 2016, pp. 1-9; Gimenes *et al*., 2021, pp. 1-14; Juiz *et al*., 2015, pp. 211-217; Reyes-Solano *et al*., 2017, pp. 962-970; Stashenko *et al*., 2013, pp. 192-202). Garcia *et al*. (2017) determined the relative chemical composition of essential oils produced under various environmental conditions and extraction parameters, highlighting among the main components neral, geraniol, geranial, caryophyllene, caryophyllene oxide (pp. 140-148).

Recently, Gimenes *et al*. (2021) determined the chemical composition of the essential oils of eight genotypes of *L. alba*, finding a total of 73 metabolites, of which -pinene, -myrcene, 1,8-cineole, linalool, neral, geranial and caryophyllene oxide were the most abundant compounds among the accessions (p. 1). Nogueira *et al*. (2021) reported the identification of 15 sesquiterpenes representing 95.45% of the extracted *L. alba* essential oil. The main components reported were β-caryophyllene, β-elemene, D-germacrene and δ-cadinene (p. 3). Moreover, "different non-volatile secondary metabolites such as coumarins, quinones, terpene lactones, flavonoids, biflavonoids, tannins, iridoids, phenylethanoid glycosides, phenylpropanoids and triterpene saponins have been quantified in the chemical composition of *L. alba*" (Acero-Godoy *et al*., 2019, p.6). The secondary metabolites of *L. alba* include phenolic compounds. There are few reports on the determination of phenolic compounds and antioxidant activity in *L. alba*. Among them is the work by Chies *et al*. (2013), who reported significant contents of phenolic compounds and antioxidant activity in extracts of *L. alba* collected in Brazil (p. 194). Gomes et al. (2019) reported a seasonal variation in the flavonoid concentration of two chemotypes of *L. alba* collected in Brazil, being predominant in the summer season (pp. 186, 189-191).

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In Mexico, there are very few studies that evaluate the content of phenolic compounds in *L. alba*; among them is the work by Reyes-Solano *et al*. (2017) who investigated the presence of phenolic compounds in the essential oil in terms of antioxidant activity (pp. 962).

The biological activity of *L. alba* extracts, mainly the essential oils, has been studied in countries such as Brazil and Colombia, standing out for its antioxidant, antifungal, antiparasitic and antimicrobial activity, among other properties (Celis *et al*. 2007, pp. 103-105; Santos *et al*., 2016, pp. 1-9). The antiproliferative effect on K562 leukaemia cells of *L. alba* (colombiana) essential oils produced under different growth, collection and extraction conditions has been evaluated, observing that environmental factors significantly affected the concentrations of secondary metabolites, as well as the biological activity of the different oils obtained from the same chemotype. Furthermore, it was shown that the best antiproliferative effect against the tested cells was obtained from the citral chemotype (Garcia *et al*., 2017, pp. 140-148). Junior et al. (2018) evaluated the anxiolytic effect of *L. alba* essential oils in fish, with satisfactory results (p. 49). Table 1 presents some of the studies evaluating the compound profile and biological activity of L. alba essential oils.

In the northern region of the state of Sinaloa, particularly in the municipality of Guasave, *L. alba* is known by the common name of "salvavidas" and is distributed wild and domestically (Figure 1). In this region, the use of *L. alba* in traditional medicine has been observed, mainly for the treatment of gastrointestinal diseases. Local communities have specific knowledge of the medicinal properties of *L. alba*, which is passed on from generation to generation. Considering the above, it is relevant to study in depth the medicinal uses that *L. alba* mexicana has had over time in the municipality of Guasave, mainly used by local people, in order to generate information that will allow, in the future, the use of the plant on a larger scale.

Sample	Type of extract	Metabolites identified	Biological activity/therapeutic effect	Reference
Leaves of L. alba	Essential oil obtained by hydrodistillation	Monoterpenes nerol/geraniol and citral (constitutes 50% of the crude essential oil)	Cytotoxic activity against B16F10Nex2 (murine melanoma) and A549 (human lung adenocarcinoma) cell lines. IC50 values between 45 and 64 g/mL.	Santos et al. (2016), pp. 1-9.
Leaves and inflorescences of L. alba	Essential oil obtained by microwave-assisted hydrodistillation.	Neral, geraniol, geranial, caryophyllene, caryophyllene oxide.	Essential oils of the citral chemotype showed a cytotoxic effect on K562 (leukaemia) tumour cells ranging from 54-95% and IC50 between 13 and 38.8 g/mL and differences in anti-proliferative activity correlated significantly with variations in caryophyllene oxide concentration.	García et al. (2017), pp. 140-148.
Inflorescences, young leaves and mature leaves of L. alba	Essential oil obtained by microwave-assisted hydrodistillation.	Neral, geraniol, geranial, caryophyllene, caryophyllene oxide.	Induction of programmed cell death in Trypanosoma cruzi (haemoflagellate protozoan causing Chagas disease).)	(Moreno et al. (2018), pp. 1-16
Aerial part of L. alba	Essential oil obtained by hydrodistillation	Geranial, p-cymene, neral, geranic acid, carvone, limonene	Antibacterial potential and anti-biofilm against Staphylococcus aureus, a species of recognised clinical interest.	Porfírio et al. (2017), pp. 1-7.
Leaf of L. alba	Essential oil obtained by hydrodistillation	Carvona as the main constituent	They determined that aromatherapy with L. alba essential oils may be useful as a means of counteracting anxiety in a normal population.	Soto-Vásquez y Alvarado-García (2018), pp. 101-107.
L. alba (part of the plant not specified))	Essential oil	Citral	L. alba essential oil and its main constituent, citral, demonstrated a vasorelaxant effect on isolated rat aorta..	da Silva et al. (2018), pp. 792-798.
L. alba (part of the plant not specified))	Essential oil	Citral, geranial, neral, limonene, carvone, gamma terpinene, among others.	Tocolytic activity of L. alba essential oil and its major constituents, citral and limonene, in the isolated rat uterus.	Pereira-de-Morais et al. (2019), pp. 155-159.
Aerial part of L. al (inflorescences, leaves and stems))	Essential oil obtained by hydrodistillation	β-caryophyllene, β-elemene, D-germacrene and δ-cadinene	Antiviral effect against Zika virus and low cytotoxicity. Larvicidal tests showed action of the essential oil against Aedes albopictus larvae.	Nogueira et al. (2021), pp. 1-8.

Table 1 Studies evaluating the profile of compounds and biological activity of *L. alba* essential oils

Figure 1 Aerial part (stem, leaf and flower) of *L. alba* collected in the municipality of Guasave, Sinaloa

Discussion and conclusions

Plants have been used since ancient times for the treatment of diseases. The use of plant metabolite extracts is an alternative for the design of new medicinal and therapeutic products. *L. alba* has an interesting phytochemical profile that has been related to different beneficial effects on human health. Although it is widely used and studied in several South American countries, little research has been done in Mexico regarding its bioactive compounds profile and evaluation of the biological activity of plant extracts.

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However, it is popular knowledge that it has been used traditionally for the treatment of diseases. Its traditional use by local communities in northwestern Mexico is well recognised. Different varieties, chemotypes and genotypes of L. alba have shown great bioactive potential and a wide range of applications. Therefore, it is important to carry out scientific research that provides support and safeguards the empirical knowledge that has been passed down from generation to generation. Ethnobotanical studies are an essential tool in this work. In addition, the determination of phytochemical profiles and biological activity are indispensable for the understanding of the medicinal properties of plants.

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Effect of malathion on AChE activity, humoral and cellular response in juvenile shrimp *Litopenaeus vannamei* (Bonne, 1931)

Efecto del malatión sobre actividad de AChE, respuesta humoral y celular en juveniles de camarón *Litopenaeus vannamei* (Bonne, 1931)

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Abstract

Malathion is an organophosphate pesticide used in agricultural fields in the northwestern part of the state of Nayarit. Shrimp production systems are located near the fields, and it could be thought that chemical residues could be present in the shrimp fattening ponds. Due to the environmental risk of pesticides and the economic risk they represent in the shrimp farming area, the present work consisted of knowing the effect of three sublethal concentrations of malathion, by means of a 96-hour toxicity bioassay, with the purpose of evaluating the humoral, enzymatic, total protein and cellular response of shrimp (*Litopenaeus vannamei*). Initially, a batch of unexposed shrimp (time 0) was analyzed, after the application of sublethal doses of malathion and at 96 hours, another batch of shrimp was analyzed. Coagulation time was not altered by exposure to malathion, acetylcholinesterase (AChE) activity was inhibited 75.5 % at the highest malathion concentration, and a decrease in protein ($p<0.05$) was recorded in the shrimp from the different treatments and at the two times analyzed (0 hours and 96 hours). The total number of hemocytes was higher when the concentration of malathion was increased, which demonstrates with the results obtained that the effect of malathion on the variables analyzed was evident in spite of having used sublethal concentrations.

Shrimp, Enzyme, Hemocytes, Pesticide, Toxicity, Shrimp, Toxicity

Resumen

El malatión es un plaguicida organofosforado que se usa en campos agrícolas del Noroeste del Estado de Nayarit, los sistemas de producción de camarón se encuentran cerca de los campos de cultivo, y se podría pensar que los residuos de sustancias químicas pudieran estar presentes en los estanques de engorde de camarón. Debido al riesgo ambiental de los plaguicidas y al riesgo económico que representa en la zona camaronícola, el presente trabajo consistió en conocer el efecto de tres concentraciones subletales de malatión, mediante un bioensayo de toxicidad de 96 horas, con la finalidad de evaluar la respuesta humoral, enzimática, proteína total y la respuesta celular del camarón (*Litopenaeus vannamei*). Inicialmente un lote de camarones no expuestos (tiempo 0) fueron analizados, posterior a la aplicación de dosis subletales de malatión y al tiempo de 96 horas, otro lote de camarones fue analizados. El tiempo de coagulación no fue alterado por la exposición a malatión, la actividad de acetilcolinesterasa (AChE) fue inhibida 75.5 % en la mayor concentración de malatión, además fue registrado una disminución de proteína ($p<0.05$) en los camarones de los diferentes tratamientos y en los dos tiempos analizados (0 horas y 96 horas). El número total de hemocitos fueron mayores cuando se incrementó la concentración del malatión, lo que se demuestra con los resultados obtenidos, que el efecto del malatión sobre las variables analizadas fue evidente a pesar de haber utilizado concentraciones subletales.

Camarón, Enzima, Hemocitos, Plaguicida, Toxicidad

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Introduction

Malathion ($C_{10}H_{19}O_6PS_2$) is an organophosphate pesticide used to control pests affecting agricultural crops, the constant use of the pesticide in crop fields can lead to high-risk residues that may be moved by rainfall or agricultural drains and incorporated into water bodies. Residues in water can cause toxicity and mortality of sensitive organisms. Malathion is derived from phosphoric acid and has phosphorus and sulphur atoms (US EPA, 2013), the main effect is the inhibition of the enzyme acetylcholinesterase, which, by not carrying out the hydrolysis of the neurotransmitter (acetylcholine), accumulates in the post-synaptic membranes and affects the nervous system (García-de la Parra et al., 2006). Pacific shrimp (*Litopenaeus vannamei*) is a sensitive species when exposed to organophosphate pesticides, requiring only 0.078 mg L^{-1} of malathion to cause mortality in 50% of exposed organisms (LC50-96 hours) (Bautista, 1996). Organophosphate pesticides; malathion, chlorpyrifos, diazinon and parathion among others, are considered immunotoxic because they alter humoral and cellular responses even when present in sub-lethal concentrations (Yeh et al., 2005; Jose et al., 2011). They also have an effect on acetylcholinesterase (AChE) activity which causes loss of balance and erratic swimming in crustaceans (Mwila et al., 2013). Among the adverse effects of malathion, genotoxicity of haemocytes in Penaeus monodon (Jose et al., 2011) and effects on growth, decreased food consumption and altered respiration process in the crustacean *Macrobrachium nipponense* (Yuan et al., 2004) have been recognised. In the present study, the objective was to evaluate the effect of three sublethal concentrations of malathion on haemolymph coagulation, acetylcholinesterase (AChE) activity, total protein and haemocyte number in shrimp (*L. vannamei*), before and 96 hours after the application of the pesticide, in order to identify the dose at which an effect on the defence response, enzymatic alteration and effect on total protein of the experimental organisms could be observed.

Theoretical framework

The continuous use of chemical substances in the world is something that is carried out in a normal way, with the intention of improving and protecting investments in agricultural fields in order to have sustainable productions ensuring food for the population, in such a way that this has led to the excessive use of chemical substances. In Mexico, the use of pesticides is currently unregulated and is a source of pollution that has a negative impact on the environment and causes a decline in sensitive species. In the last 20 years, agrochemicals applied in the environment of northwestern Mexico (Sonora, Sinaloa and Nayarit) have been studied and it has been concluded that residues are present in sediments and aquatic organisms (Hernández et al., 2018). White shrimp is one of the main products for consumption and export; production is in second place in Mexico as a result of its high demand (CONAPESCA, 2015). However, gas chromatography has determined residues (0.00035 mg g-1) of malathion and chlorpyrifos (0.000013 mg g-1) in shrimp from farms in the state of Sonora, Mexico (Burgos-Hernández et al., 2006). Due to the presence of residues, experiments with white shrimp L. vannamei exposed to chlorpyrifos (0.00036 mg L-1 and 0.00018 mg L-1) and after 21 days of exposure, slow growth and gill cell damage were observed (Pawar et al., 2019). Other effects caused by organophosphorus pesticides are the decrease in glycogen, triglycerides and total protein, in addition to causing mortality of experimental organisms even at sublethal concentrations (Osuna-Flores et al., 2019).

Method and tools

The juvenile shrimp used were donated by the farm "Los Sauces" located in the municipality of San Blas Nayarit, Mexico. They were transported to the Laboratory of Biological Indicators of Environmental Stress (LIBEA) of the National School of Fisheries Engineering of the Autonomous University of Nayarit. The organisms were acclimatised to 25 practical salt units (PSUs) for 72 hours. The shrimp (40 in total) were placed in 60-litre glass tanks (60 cm x 40 cm x 35 cm). The conditions of the experiment were; ambient temperature of 25 °C and 24 °C in the water of the tanks, pH 7.5 and oxygen concentration was 7.45 mg L-1.

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The organisms were fed with the commercial feed Api-shrimp at 8 % of the biomass. Dilutions of malathion were prepared based on the LC50-96 hours obtained by Bautista (1996), which were; 0 %, 1 %, 10 % and 50 %. Ten organisms taken at random were placed in each aquarium, including a control group (0 %). Before the application of the different malathion concentrations, three shrimp were analysed (clotting time, acetylcholinesterase activity, total protein and total haemocyte count). After the corresponding percentage concentration was applied (0.0, 0.00078 mg L-1, 0.0078 mg L-1 and 0.039 mg L-1), at the end of 96 hours of exposure the same variables were evaluated in seven organisms for each treatment.

Haemolymph extraction was performed with the aid of a 1 mL insulin syringe, which was inserted at the base of the first abdominal segment between the pereiopods. The clotting time of the haemolymph was counted with a standard digital stopwatch (H56-70), a 1.55 mm capillary haematocrit microtube (brandSD) was used (Jussila et al., 2001). To quantify acetylcholinesterase activity, the methodology described by Ellman et al. (1961), adapted to microplate (Herbert et al., 1995), which is based on a colorimetric method, was used. Protein concentration was determined by the method of Bradford (1976), adapted to microplate (Herbert et al., 1995). Bio-Rad reagent was used as reaction solution. Total haemocyte count (THC) was performed with an optical microscope; 17 µL of haemolymph mixed with formalin according to Costa et al. (2009) was used. Haemocyte counts were performed in a Neubauer chamber at 400X, placing the total number of cells in the four corner quadrants and one additional quadrant randomly selected for each case (Arredondo & Voltolina, 2007).

Statistical analysis of the data was by normality, homoscedasticity, one-way ANOVA and two-way ANOVA tests, and when differences were identified, mean comparison tests (Holm-Sidak) were applied. All statistical analyses were performed with a significance level α= 0.05.

Results

The highest haemolymph coagulation time occurred before applying the malathion concentration (at the concentration 0.00078 mg L-1, corresponding to 1 % of the LC50) while the lowest value occurred 96 hours after applying the pesticide concentration (Table 1). The two-way ANOVA analysis showed significant differences (p=0.05) as a function of time, concentration and the interaction between the two sources of variation. On the other hand, the coagulation time of the control group shrimp showed no significant difference between their mean values.

		Malathion concentrations (mg L^{-1})			
Variable	Time	0	0.00078	0.0078	0.039
Coagulation (seconds)	0 hours	73.33±10.21a	167.33±13.31d	101.66±25.42bc	118.33±30.61c
	96 hours	70.85±17.08a	85.57±15.76a	67.20±11.09a	113.00±19.13b

Table 1 Mean values (seconds ± standard deviation) of coagulation of L. vannamei haemolymph exposed to three sub-lethal concentrations of La LC50-96 hours of malathion

Two-way Anova and Holm-Sidak method

The acetylcholinesterase (AChE) activity present in shrimp at the time (0 hours) before pesticide application did not show significant differences in their mean values. However, once the pesticide was applied and at the time of 96 hours, AChE decreased in the presence of the highest concentration of malathion, which corresponded to half the value of the LC50-96 hours, reflecting the effect caused by the pesticide used in the experiment.

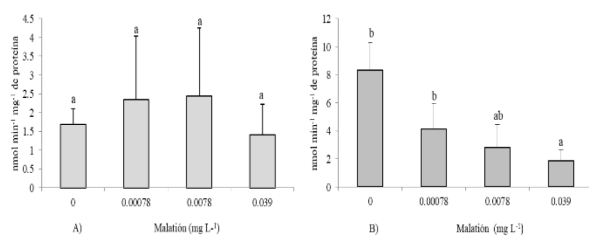

Figure 1 Mean values of AChE activity (± standard deviation), A) time 0 hours, before malathion application, B) 96 hours of exposure to the pesticide.

The total protein concentration was variable at the beginning of the experiment, the highest average value was presented in treatment 0 (control), and before the application of the pesticide (A), significant differences were determined between the treatments with respect to shrimp from the control group. Once the pesticide was applied and after 96 hours of exposure, the trend of total protein *in L. vannamei* muscle was to decrease in shrimp exposed to the highest concentration (Figure 2), with significant differences (p=0.05) with respect to the average values of total protein of shrimp in the control group. However, the mean values of total protein in shrimp exposed to the 0.039 concentration did not represent significant differences (p>0.05) with respect to the mean values of total protein of shrimp from the two pesticide treatments (0.00078 mg L^{-1} and 0.0078 mg L^{-1}).

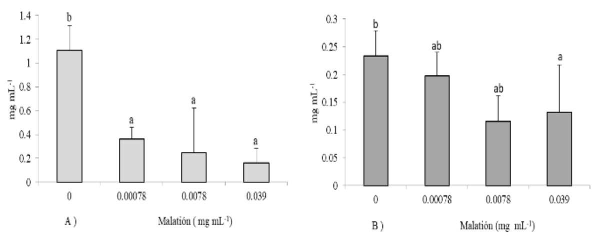

Figure 2 Mean values of total protein (± standard deviation) in *L. vannamei* muscle. A) not exposed, B) exposed 96 hours to malathion

The mean values of total haemocytes of shrimp in the three treatments tended to decrease with respect to shrimp in the control group. The decrease occurred even though the shrimp were not exposed to the pesticide (time 0), the trend determined was significantly different (p=0.05) and the lowest mean value was 1.060±0.440 X 106 cells mL-1 (Figure 3). Once the pesticide concentrations were applied, the total haemocytes of the exposed shrimp showed a tendency to increase in number (B), which were higher in the 0.0078 mg L-1 malathion treatment (10 % of the LC50), than the average values of haemocytes of shrimp in the control group, and there were only significant differences (p<0.05) between the averages of the malathion treatment with respect to the average values of the control group.

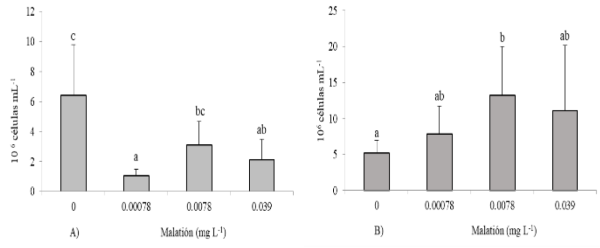

Figure 3 Mean haemocyte values (± standard deviation) of *L. vannamei*. A) not exposed, B) exposed 96 hours to malathion.

Discussion and conclusions

Malathion is a widely used and broad-spectrum pesticide in pest control, and it is possible that residues may reach shrimp production systems. Some of its effects are reported in several studies focused on evaluating the effect on the gill system, as well as on immunological and neurotoxic processes. Clotting time is an important response and is considered a defence response to different viruses (Song et al., 2003). In addition, increased clotting time may be indicative of stress conditions (Jussila et al., 2001). In this work the clotting time showed increase in time and according to the different sublethal concentrations of malathion, the increase happened at the sublethal concentration of malathion (0.039 mg L-1). This result coincides with that reported for Fenneropenaeus indicus species exposed to 0.00005 mg L-1 malathion, the coagulation time was altered (Sabu & Gopal, 2016) reflecting that for Litopenaeus vannamei a higher concentration of malathion is required to cause an effect on haemolymph coagulation time. AChE activity was inhibited by sublethal concentrations of malathion, the inhibition value was approximately 4.4 times lower than the value obtained in control shrimp, while Tassanee Eamkamon et al. (2012). in the study of exposure to sublethal concentrations of chlorpyrifos, determined an effect on AChE that was 1.9 times less than the activity of control shrimp. Studies show that the pesticides malathion and paraquat affect the feeding rate in Macrobrachium nipponense and cause a decrease in body weight and consequently the loss of total protein (Yuan et al., 2004), which also with Litopenaeus vannamei, malathion caused a decrease in total protein. On the other hand, haemocytes are important in the innate defence mechanism, both humoral and cellular responses represent the immune defence to the presence of pathogenic microorganisms and exogenous particles (Jose et al., 2011).

A decrease in the number of haemocytes has been shown to occur in the presence of metals, viruses and bacteria (Lorenzon et al., 2001; Abad-Rosales et al., 2019). In this experiment and in the presence of malathion, haemocytes tended to increase in the treatment (0.0078 mg L-1), perhaps due to the low concentration of malathion used, which is described as induction by the stress caused by the pesticide used. In addition, the present work also corroborates that malathion alters AChE activity and total protein concentration in the presence of sublethal concentrations of malathion.

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Decision-making in a family microenterprise in La Estancia, San Juan del Rio, Qro.

La toma de decisiones en una microempresa familiar en la estancia, San Juan del Rio, Qro.

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Abstract

This research project shows how a family in the community of La Estancia, San Juan del Río, Qro. with a small food business, with decisions made by the owner have been a livelihood for many years and this can be considered by all people who wish to start a business.

Decision making, Family business, Business owner, Business Owner

Resumen

Este proyecto de investigación da a conocer la forma en la que una familia en la comunidad de la Estancia, San Juan del Río, Qro. con un negocio pequeño de comida, con decisiones que ha tomado la dueña han sido un sustento durante muchos años y esto pueden considerarlo todas las personas que deseen emprender un negocio.

Toma de decisiones, Negocio familiar, Dueña del negocio

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Introduction

The state of Querétaro is among the states with the greatest economic development at the national level. And this is not just for a year or two towards 2023. It has been working to achieve it. Part of this work has been to ensure that family businesses survive with their owners from the 80's to today.

With the above mentioned, the objective was to know the history of a family business as if it were a process, since it is not easy to continue with a small family business for more than 40 years and that it is the sustenance of families composed of mother, children and grandchildren. Therefore, this research is considered a case study. And because the process of continuing the business has been carried out, it has had to face very significant changes.

Literature review

Business process

Management process is the set of parts - planning, organising, directing and controlling - in order to achieve the objectives of a business which will be the family business to be run in the most efficient way possible. It is in the management stage that the business owner can intervene in any conflict that may arise. López (2021) https://economipedia.com/definiciones/proceso-administrativo.html

According to the author Luna (2015:118) for a business to function within the framework of rules set by the internal and external environment it is necessary to have or carry out control within the microenterprise and/or business. Classification (2020) because in this way the administrative process defined above is consolidated.

A micro enterprise can be called a business, as mentioned by the authors Calleja (2021:19) and Luna (2015:126) indicate that in the management phase it would be for a small business the owner who must carry out this management phase by efficiently and effectively applying leadership, since the owner must be a leader who supervises, communicates, motivates and makes decisions.

The author Luna (2015:12) mentions that businesses can be considered micro enterprises, which belong to the service sector and can have up to a maximum of 20 employees.

Blandez (2016:7) indicates that entrepreneurs and/or business owners present similar characteristics in order to have a successful business. The following are mentioned:

- They create a business in order to grow it.
- They focus on satisfying consumers' needs as well as their own.
- They establish plans and strategies such as innovation of new products and/or services.
- They come up with new ways of managing the business and/or company.
- Anticipate the demands of their customers.
- Zavala (2022:16) mentions that knowledge of people and events is important. That for a job a portion of money is earned and is allocated to various actions.

If within the company it is the owner and/or leader who makes the decisions, actions are taken that lead to a change in the business over time.

For the author Jeffcut (1994:241), decision making is the process of narrative analysis, interpreting actions and identifying meanings for the business to function better.

Decision making, for author Monllor (1994:96) indicates that the use of the information obtained by the business to select actions that produce fruitful results for the growth of the business. This process of converting information into action is referred to as decision making.

In addition to the business owner making decisions, he or she also ensures that the organisation does so in the best possible way.

Simon (1982). Sfez (1984). Ivancevich, et al. (1997). Frank Harrisson (1999). Robbins (2004). Drucker (2006). Hammond, Keeney and Raiffa (2006). Etzioni (2006). Aviño and Maella (2010) the previous authors agree that in order to continue in a market, it is necessary that the owners of microenterprises must carry out a decision-making process composed of phases, premises, steps, elements, rules, stages or principles.

Author Mapcal (1995:8) made a classification of important decisions depending on the hierarchical level at which they are made: General decisions: affect the whole business or company.

Functional decisions: those into which the company is divided, the sales function, the purchasing function, the production function, the merger of production, accounting, customer service, etc.

Departmental decisions: those related to the activities of the various departments, such as accounting records activities, quality control, supervisors, etc.

Operational decisions: are those that have a direct relationship with the activities carried out on a daily basis by the operational levels of the business or company, such as messengers, receptionists, workers, external salesmen, drivers, administrative staff, etc.

Computer science or information technologies, studies the techniques and automated processes that act on data and information (Suarez, R. 2007).

Work

For the author Rieznik , P. (2009:19) work is the driving force of human evolution. The author Cañigueral (2020:82) mentions that all changes in jobs, families and workers have occurred with absolute normality, tolerance and development of one's own social, ideological and moral environment. For the majority of the population, going to work meant leaving the house, arriving at the same place, staying there for at least eight hours a day for twenty, thirty or forty years. Moreover, teamwork is an investment.

A complex structure of coordinated actions, carried out by a group of people and a fundamental pillar of social progress and human development. Ballenato, P. (2009: 120).

Authors Lara & García (2022:3) point out that the work carried out in a business can be considered a process of adaptation, where the members obtain recognition from their clients for the service they provide and can continue in this way for several generations. González (2022:128-133) indicates that the historical reconstruction aims to present three aspects: the origins and motivations, the presence of leaders and the changes and continuities present.

Methodology

In relation to the authors (Hernández, et al. 2018) the hypothesis was established for this project: the decision making of the business owner is carried out according to the work that he performs within the business.

With which the following variables were set: dependent. Decision-making by the owner: independent. Work he does within the business. With a focus on reality, laws and interconnections, it was deduced that there is a relationship between:

a) Decision-making

b) Work he does within the business.

c) Food business

d) Administrative process

By going through the municipal, national and food business contexts, it was possible to determine the dimensions, known as variables, which intervened in this project and which were indicated at the beginning of this aspect, with the following characteristics:

Dependent variable: owner's decision making.

This variable mentions that for the case study considered in this research it is a business and/or microenterprise, indicating that it has an owner. A second characteristic is: the owner makes decisions in the business in order to move forward under any circumstance.

Even dealing with family businesses, where according to the authors Benitez, Benitez & Botero (2021:45) the values that were managed to strengthen are solidarity, respect and communication.

Independent variable: Work that he performs within the business.

A case study of a family food business was carried out in this project, which is exclusively for breakfast or lunch time. a plan of action was drawn up in the field with the purpose of collecting information by devising a strategy for approaching the business (observation or immersion in the field). The approach strategies to understand the phenomenon in the environment of the food sector in the Estancia, within the municipality of San Juan del Río, Querétaro, were executed in the following way:

To describe and understand how the business owner has made decisions and to know how his basic structure of experience has been created. We attended the place where the business is located, which is a family home, to taste the tacos, gorditas and sopes of the stews they offer, for approximately half a year, we tried to continue being a customer, to get to know the owner and the business to provide them with the following results.

Results

Description of the business

The business started approximately 39 years ago. It offers food for lunch.

The customer arrives at the family home where the business is located. The door is open and there is a sign on the pavement indicating the name of the business and what is offered.

Figure 1
Source: Taken with date October, 2022

Figure 2
Source: Taken with date October, 2022

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Figure 3
Source: Taken with date October, 2022

In the photo above, when you enter the house, you can see some tables to sit at. And in the background, the customer can also see people making tortillas, gorditas and sopes on a comal. On the wall there is even a picture of a football team, where one of the sons of the family was playing.

Figure 4
Source: Taken with date october, 2022

As can be seen in the photo above, the stews are in plastic containers already prepared by the owner. A daughter-in-law fills the gorditas, tacos or sopes with them. And a daughter is the one who makes the gorditas, sopes or tortillas. A granddaughter is the one who serves what was ordered. And she also charges you for what you eat.

The owner, you can never see her in the shop, as she is in the kitchen preparing the various stews, you can only hear the blender when you need a sauce.

Figure 5
Source: Taken with date October 2022

The comal is large, gas-powered. And they even offer water for coffee

In 1984, the owner of the business divided the work among her children in solidarity because her husband died and so she said to herself: what should I do to support my 11 children? So she started making tacos and her children took them to the homes of the customers who bought them from her.

The children grew up and some of them started working on their own and others are still in the business to this day. The lady soon had more customers and then it was no longer possible to continue making all the deliveries and so, some started to go to the family home for the orders. A table was set up for those who wanted to have lunch there.

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The shared goal of the owner was to continue with the source of employment and this led the owner to make decisions regarding the change in her process of how the business will and has to change with actions for a better functioning, this led the owner to share her experiences and situations that she had and this as mentioned by the author Nava Murcia (2022:25) because when she started it personally, she considered that it was very important to stay at home, without having to leave, because she had 11 children and the family would stay together most of the time. Therefore, she agrees with the author Jeffcut (1994). And with radical changes that have affected the modus vivendi this is mentioned by the authors Rico and De la Torre (2021).

The decisions that have been taken in the family business were not programmed, because for more than 35 years, there was an accumulation of adverse circumstances to the operation, they were not structured because there was no clear procedure on how to handle each situation. Simon, (1982).

In business at the time, a course of actions or a process composed of decisions made by phases, steps, premises, elements, stages, rules or principles had to be carried out. With adherence to the authors Simon (1982). Sfez (1984). Ivancevich, et al. (1997). Frank Harrisson (1999). Robbins (2004). Drucker (2006). Hammond, Keeney and Raiffa (2006). Etzioni (2006). Aviño and Maella (2010).

Thanks to this family microenterprise, the owner was able to provide for her 11 children and still has a daughter, a daughter-in-law who is the widow of one of her sons and a granddaughter who helps her serve customers and two of her sons continue to go to deliver orders placed over the phone.

The following is the administrative process made up of decisions that the owner needed to make in order to move forward, not to close down and to face the various situations that have arisen in the business during her time at the Estancia, which is a community in the municipality of San Juan del Río, Qro.

Decision-making process

1. The owner made the decision to sell tacos and deliver them to the homes of those who bought from her.

2. The owner made the decision to have her children help her with the business. Once they were old enough to do so.

3. The owner made the division of labour for her children, depending on their age and experience.

4. The owner indicated to the children that they needed to go and make the delivery of the tacos.

5. She also made the decision to indicate to the daughters that they would help her to cook and make tortillas.

6. Thus 35 years have passed in which the family has a home-based business and does not need to incur any additional expenses to commute to work outside the home. They only have to carry out their assigned activities.

7. The number of customers continues to increase as the tortillas and stews have a very familiar, special flavour, and as many years have passed, it is necessary to fix up the place in the house that has been set up for the business. The wall of the house needs to be flattened and painted on the outside.

Description of the owner:

The owner is 70 years old and looks very strong, you can't even tell how old she is. She was born in 1953. And as in those years, women only dedicated themselves to the home and to taking care of the children, that is why she had 11 children. She was widowed very young at the age of 31. And having taken the decision to start a family business is considered to be what keeps her still very active in the.

Discussion

With the authors Simon (1982). Sfez (1984). Ivancevich, et al. (1997). Frank Harrisson (1999). Robbins (2004). Drucker (2006). Hammond, Keeney and Raiffa (2006). Etzioni (2006). Aviño and Maella (2010) be it phases, premises, steps, elements, norms, stages or principles, the owner of the family food business has had to make a series of decisions that led her to form a process of them to continue selling at her home. what is relevant is that this family business or microenterprise has had a very positive impact of growth for 35 years that has been a source of income for a family, which has not required going out to work outside the home, but in hers is done in the community of La Estancia, in the municipality of San Juan del Río.

Conclusions

With this project, it became clear that the owner of a family food business, under any circumstance, unwittingly carried out a decision-making process to continue in the food market from the time she started it, until now. That is, for more than thirty-five years.

Every business, however small, can automatically establish an administrative process that includes decision making according to its needs.

Businesses, even if there are family members within them, are a source of income.

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Fractal fuzzy logic using Kelly plots

Lógica difusa de fractales utilizando parcelas de Kelly

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Abstract

Strictly defined, the concept of self-similarity or self-similarity applies only to mathematical fractals - which arise from the iteration of simple formulae but lead to very complex structures, Cantor Dust, Peano Curve, Koch Snowflake, whereas in natural or physical fractals - those found in nature, such as a fern leaf, an arborisation, capillaries - the concept of self-similarity applies, since their fractality is only statistical and they possess, consequently, an anisotropic scaling,(not having the same properties in all dimensions of analysis), which does not allow an amplified part of a figure to maintain exactly the characteristics of the figure as a whole, is where we find Kelly plots.

Fuzzy logic, Fractal, Kelly plots

Resumen

En estricto rigor, el concepto de autosemejanza o autosimilitud se aplica sólo en fractales matemáticos - que surgen de la iteración de fórmulas sencillas pero que llevan a estructuras muy complejas, Polvo de Cantor, Curva de Peano, Copo de Nieve de Koch, mientras que en los fractales naturales o físicos - aquellos que se encuentran en la naturaleza: una hoja de helecho, una arborización , capilares y se aplica el concepto de autoafinidad, ya que su fractalidad es solamente estadística y poseen, en consecuencia, un escalamiento anisotrópico (que no tiene las mismas propiedades en todas dimensiones de análisis), lo que no permite que una parte amplificada de una figura mantenga exactamente las características de la figura como un todo, es donde encontramos las parcelas de Kelly.

Lógica difusa, Fractal, Parcelas de Kelly

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Introduction

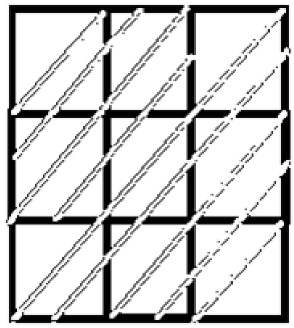
It is interesting to note that the irregularity of fractal objects becomes a particular characteristic of the object and accounts for the similarity of its parts with respect to the whole, regardless of the scale of analysis used.

There are mathematical fractals that arise thanks to the iteration of their mathematical formulae, as well as natural fractals or those that are found spontaneously in nature. Several scientific disciplines have had a progressive approach to fractal geometry, linked to its mathematical, scientific and technological applicability, which stimulates the dedication to the observation and study of fractal structures. Fractals seem to be a suitable tool for the deep mathematical study of, for example, the quantitative analysis of singularities that naturally appear in dynamical systems.

The contribution of fractals to the understanding of the world results in a kind of natural philosophy, an integrated view of the world, an organising element. However, it is recognised that fractal models are currently descriptive rather than explanatory, which in no way reduces their usefulness and potency for use in science. Mandelbrot explains that all the natural objects alluded to in the fractal geometry of nature are "systems", in the sense that they are made up of many different parts articulated among themselves, and the fractal dimension would describe this rule of articulation. Indeed, it would seem that fractal geometry would be, in a sense, the geometry of complex systems.

A fractal object has a fractal dimension expressed by a decimal number that exceeds its original topological dimension, which allows us to think that, depending on the irregularity of the shape, it becomes more complex and occupies a progressively larger place in space. In this way, we are faced with a tool that describes the shape or pattern (quality) in a complex system through a mathematical formalisation. The fractal dimension, in this understanding, accounts for the dialogue between quantity and quality in an object of nature with fractal characteristics.

Let's start with the negative diffusion in ¾= is the fractal mean.



$$DN = \frac{1}{2}\pi \cdot \left[\frac{lim}{ln}\right]^{\frac{3}{4}}$$

$$lI(DN) = \left[\frac{\partial\left[\frac{1}{2}\right]}{\partial\pi} \cdot \frac{dlim}{dln(\alpha)}\right]^{\frac{3}{4}}$$

π = It is the diffusion factor (α)

$$lI(D)^{N,p,b}\int_{Pd\to Pcc}^{Pi\to Pcr}\left[\frac{log\frac{1}{2}}{ln\pi}\cdot\frac{\frac{1}{\alpha}lim}{\frac{1}{\alpha}ln(\alpha)}\right]^{\frac{3}{4}} + \left[\frac{log\frac{1}{2}}{ln\left(\frac{\pi}{d}\right)}\cdot\frac{\frac{1}{\alpha}lim}{\frac{1}{\alpha}ln\left(-\frac{1}{\alpha}\right)}\right]^{\frac{3}{4}} + \left[\frac{log\frac{1}{2}\cdot\frac{1}{2}}{ln\left[\frac{1}{\pi}\right]^{\frac{1}{3}}}\right]\cdot \left[\frac{\frac{1}{\alpha}lim}{ln\frac{1}{3}}\right]\cdot lim(-4) + \left[\frac{\frac{1}{\alpha}}{ln\left(\frac{3}{4}\right)}\right]\cdot\left[\frac{log\pi}{ln(-1)}\right] + \left[\frac{\frac{1}{\alpha}}{ln\frac{1}{3}}\right]\cdot\left[\frac{\frac{1}{\alpha}}{ln\frac{1}{3}}\right] + lim(-4) + \left\{\left[\frac{\frac{1}{\alpha}}{ln\frac{3}{4}}\right]\cdot\left[\frac{log3}{ln4}\right].lim\left(\frac{1}{\alpha}\right)\right\} \quad (1)$$

$$lI(D)^{N,p,b}_{\dots}\int_{Pd/_{-Pcr}}^{Pi/_{Pcc}} = \left[\frac{log\frac{1}{2}d^{IV}}{ln(\pi)}\cdot\frac{\frac{1}{\propto}^{IX}}{-\frac{1}{\propto}^{II}}\right]^{\left[\frac{d(3)\propto}{d(4)-\propto}\right]^{II}} + lim\left\{\left[\frac{log(\alpha)^{III}}{ln(-\alpha)}\right] - lim\left[\frac{\partial log(-\alpha)}{\partial ln(\propto)^{III}}\right]\right\}^{\left[-\frac{1}{4}+\frac{3}{(-4)}\right]} \quad (2)$$

An ensemble that has a fine structure, i.e., that has detail at whatever scale it is observed:

$$lI(D)^{N,p,b}_{\dots}\int_{Pd/_{Pcr}}^{Pi/_{Pcc}} = \left[\frac{log\frac{1}{2}}{ln\pi}\right]^{d-IV}\cdot\left[\frac{1}{\alpha}\right]^{VII\ d(-1)^{II}} + lim(\alpha^{n}) - lim(log-\alpha+ln\alpha)^{II} \quad (3)$$

$$lI(D)^{N,p,b}_{\dots}\int_{Pcc}^{Pi} + \int_{-Pcr}^{Pd} = \frac{antilog(2)}{d^{IV}} + \left[\frac{1}{\alpha}\right]^{VII} + lim\left[-\frac{1}{\alpha}\right]\alpha$$

$$lI(D)^{N,p,b}_{\dots}\int_{Pcc}^{Pi} + \int_{-Pcr}^{Pd} = \frac{\frac{1}{\alpha}\left(\frac{1}{2}\right)}{4} + \frac{\frac{1}{\alpha}}{7}lim\left[-\frac{1}{\alpha}\right]\alpha$$

$$lI(D)^{N,p,b}_{\dots}\int\frac{Pi-Pcr}{Pcr+pd} = \frac{1(2\alpha)}{4} + \frac{7}{\alpha} + lim\left[-\frac{1}{(2\alpha)}\right]$$

$$lI(D) = \frac{N\to P}{b}\dots\int\frac{P^{II}(1,c,r)}{P^{II}(d)} = \frac{2\alpha}{4} + \alpha - 7 + \frac{1}{\alpha} - 2\alpha$$

The fractal dimension (defined in some way) is larger than its topological dimension, and does not have to be integer:

$$lI(D) = \frac{N \to P}{b} \ldots \int^{IV} \begin{Bmatrix} 1(2\alpha) \\ c(-7\alpha) \\ -d(\alpha) \end{Bmatrix} .2\alpha \quad (4)$$

$$lI(D) = \frac{N \to P}{b} \ldots \int \frac{P}{\frac{1}{4}} \begin{Bmatrix} \frac{\frac{1+c}{r-d}}{\frac{-4}{\alpha}} \end{Bmatrix} \Big/ \frac{1}{2}\alpha$$

$$lI(D) = (N+b)^{-P} \ldots \int^{\frac{P}{4}} \left(\frac{r \to c}{\frac{d}{\left[\frac{1}{-4}\right]}} \right) 0.5\alpha$$

$$lI(D) = \frac{(N+b)}{P} \left(\frac{P}{-4}\right) + \left(\frac{r+c}{\frac{d}{-4}}\right) 0.5\alpha$$

$$lI(D) = \frac{(N+b)}{(r-c)} 0.5\alpha$$

$$lI(D) = \frac{0.5}{(N+b)+(r-c)} - \alpha \quad (5)$$

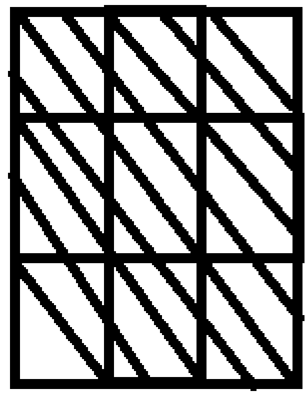
An L-system is basically a set of rules that are applied sequentially to an initial sentence. Starting from a string of symbols, successively longer and longer strings are generated.

$$lI(D) = \left[\frac{(N+b)}{(r-c)}\right] - \alpha$$

The interpretation is that reality is non-mechanical and non-linear, or in other words, the inability of man and science to predict and control reality, and that there is an order to seemingly random events.

$$DP = \left[\frac{1}{2}\right]^{\pi} \cdot \left[\frac{limI^{\frac{3}{4}}}{\frac{1}{ln}}\right]$$

$$lI(DP) = \frac{\partial\left[\frac{1}{2}\right]}{\frac{\partial\pi}{\partial d}} \cdot \left[\frac{[dlim]}{dln\left[\frac{1}{\propto}\right]}\right]^{\frac{3}{4}}$$



In this plot we can see the positive margins in the fractal elasticity. We are also interested in periodic points, or states of the system that are repeated over and over again. Periodic points can also be attractors. Sarkovskii's theorem describes the number of periodic points in a one-dimensional discrete dynamical system. Any deterministic system that is sensitive to the initial conditions is called chaotic:

I_F = Iteration finite

C= Call

P = Put

L_I = Itto´s Lemma

L= Lagragian

H_r= Recursive heteroscedasticity

H_R= Recursive homoscedasticity

$$\text{If} = \int_{n\alpha_l}^{C_a} \overset{C_m}{\underset{n\alpha_{ll}}{}} \overset{C_\beta}{\underset{n\alpha_{lll}}{}} \left[\frac{(C_a+C_m+C_\beta)^{\frac{3}{4}}}{\left(\left[\frac{n}{\alpha_l}\right]+\left|\frac{n}{\alpha_{ll}}\right|+\left|\frac{n}{\alpha_{lll}}\right|\right)^{\frac{1}{2}}}\right]^2 + \frac{(C_a + C_m + C_\beta)}{\frac{\frac{n}{\alpha_l}}{\to} + \frac{\lambda_0}{\to} + \frac{\lambda_l}{\to}}{\frac{\frac{\lambda_0}{\Rightarrow}}{\frac{\lambda_0}{\lambda_l}} + \frac{\frac{n}{\alpha_{ll}}}{\frac{\Longrightarrow}{\frac{\lambda_l}{\lambda_0}}} + \frac{\frac{\lambda_0}{\lambda_l}}{\frac{\Rightarrow}{\frac{n}{\alpha_{lll}}}}} \quad (6)$$

$$C = \frac{\frac{dM_3+dM_4}{d\lambda_l \to d\lambda_{ll}}}{\frac{dM_1+dM_2}{\lambda_{lll} \to \lambda_{lV}}} \quad (7)$$

$$P = \frac{M_1(M_4)}{M_3(M_2)} \int_{M_3}^{M_1} + 1 \frac{d(M_4)}{d\lambda_l} + \frac{d(M_2)}{d\lambda_{ll}} + \alpha \to \int_{M_3\left[\frac{d(M_2)}{d\lambda_{ll}}\right]^{\frac{1}{2}}}^{M_1\left[\frac{d(M_4)}{d\lambda_l}\right]^{\frac{3}{4}}} + \alpha \quad (8)$$

Its definition is very simple: take a segment of a certain length (for example, the interval [M1; M4] of the real line) and divide it into three sub-segments of equal length, remove the central segment and repeat the process with the two new segments.

$$\mathrm{L_I} = \left[\frac{d(\pi)^{\frac{1}{2}} + d(\pi)^2}{1+\frac{1}{2}} + \frac{d\lambda_l}{d\lambda_{ll}}\right]^2 \cdot \left[\frac{d(\pi)^{\frac{1}{2}}}{d(\pi)^2}\right]^1 + \frac{d\lambda_l}{d\lambda_{ll}} \left[\frac{d(\pi)^{\frac{1}{2}} + d\lambda_{ll}}{d(T.C)^2 + d\lambda_1}\right]^{\frac{3}{4}-\frac{1}{2}}$$

$$L = \int_{[T.C]}^{(\pi)^{\frac{1}{2}}} + 1 \; \frac{d(\pi)}{d\lambda_l} + \frac{d(T.C)^2}{d\lambda_{ll}} + \alpha$$

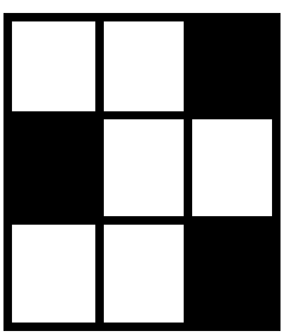
$$\mathrm{H_r} = \left[\frac{(C_a+C_m+C_\beta)^{\frac{3}{4}}}{\left(\left[\frac{n}{\alpha_l}\right]+\left[\frac{n}{\alpha_{ll}}\right]+\left[\frac{n}{\alpha_{lll}}\right]\right)^{\frac{1}{2}}}\right]^2$$

$$\mathrm{H_R} = \frac{(C_a + C_m + C_\beta)}{\begin{array}{c} \overset{\frac{n}{\alpha_l}}{\rightarrow} + \overset{\lambda_0}{\rightarrow} + \overset{\lambda_l}{\rightarrow} \\ \dfrac{\overset{\lambda_0}{\Rightarrow}}{\frac{\lambda_0}{\lambda_l}} + \dfrac{\overset{\frac{n}{\alpha_{ll}}}{\Longrightarrow}}{\frac{\lambda_l}{\lambda_0}} + \dfrac{\overset{\frac{\lambda_0}{\lambda_l}}{\Rightarrow}}{\frac{n}{\alpha_{lll}}} \end{array}} \qquad (9)$$

We determine the Brownian diffusion:

$$DB = \left[\frac{1}{2}\right]^{\pi} \cdot \left[\frac{lim}{\frac{1-4}{ln3}}\right]$$

$$lI(DB) = \frac{\partial\left[\frac{1}{2}\right]}{\frac{\partial\pi}{\partial d}} \cdot \left[\frac{dlim}{\frac{dlog1}{dlog4}}\right]^3$$



Structural equations:

Short-term: RC = [(π+T.C.)/(1/2)]

$$\mathrm{M_1} = \left[\frac{M+\pi}{\frac{1}{2}}\right]^{3/4}$$

Long-term: RL = [(π-T.C.+ 〚(π)〛^2)/(1/2+1)]

$$\mathrm{M_2} = \left[\frac{M1+M2}{\pi+\frac{1}{2}}\right]^{3/4}$$

$$\mathrm{M_3} = \left[\frac{M1+M2+M3}{\pi+\frac{1}{2}}\right]^{3/4}$$

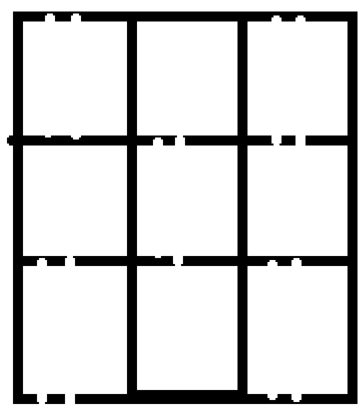
Medium-term: RM = [(π + T.C.)/(1/2-1)]^2

$$\mathrm{M_4} = \left[\frac{(M1+M2)^{1/2}}{(M3+M4)^{3/4}}\right]^{\pi}$$

We determine the diffusion with inelastic plot for the entire >1

$$DPi = \left[\frac{1}{2}\right] \cdot \left[\frac{\pi}{\frac{1}{3}}\right]^{lim-4}$$

$$lI(DPi) = \left[\frac{\partial\frac{1}{2}}{\frac{\partial\pi}{\partial\frac{1}{3}}}\right] \cdot \left[\frac{lim}{4}\right]$$



However, the set is small when its length is considered: the initial interval [0,1] measures 1, and at each step, one third is taken away, which makes its length multiply by 2/3 and in the geometric sequence a = (2/3)n tends towards zero.

$$\int \left[\frac{d\ (2.48)}{\frac{d(2.50)}{x}}\right]^{\frac{1}{2}} = \left(\frac{2.48}{2.50}\right)^{\frac{1}{2}}$$

Integral with fractional numbers.

$$\int\left[\frac{\frac{d\ (8)}{sin}}{\frac{d(14)}{cos}}\right]^{1/2} = \frac{\sin(14)}{\cos(8)}$$

Integral with entire numbers.

$$\int\left[\frac{d\ (7)}{\frac{d(2.48)}{x}}\right]^{3/4} = (7)^{3/4} - (2.48)^{3/4}$$

Integral with entire number and fractional numbers

We determine the fractal iteration:

$$\int\left[\frac{\frac{d\ (2.47)}{d\ (2.47)}}{x}\right]^{1/2} + \int\left[\frac{\frac{d\ (2.47)}{d\ (2.47)}}{x}\right]^{1/2} + \int\left[\frac{\frac{d\ (2.47)}{d\ (2.47)}}{x}\right]^{1/2} + \int\left[\frac{\frac{d\ (2.47)}{d\ (2.47)}}{x}\right]^{1/2} + \int\left[\frac{\frac{d\ (2.42)}{d\ (2.47)}}{x}\right]^{1/2} + \int\left[\frac{\frac{d\ (2.40)}{d\ (2.47)}}{x}\right]^{1/2} +$$

$$\int\left[\frac{\frac{d\ (2.38)}{d\ (2.47)}}{x}\right]^{1/2} + \int\left[\frac{\frac{d\ (2.47)}{d\ (2.47)}}{x}\right]^{1/2} + \int\left[\frac{\frac{d\ (2.47)}{d\ (2.47)}}{x}\right]^{1/2} + \int\left[\frac{\frac{d\ (2.47)}{d\ (2.47)}}{x}\right]^{1/2} + \int\left[\frac{\frac{d\ (2.40)}{d\ (2.47)}}{x}\right]^{1/2} + \int\left[\frac{\frac{d\ (2.47)}{d\ (2.47)}}{x}\right]^{1/2} +$$

$$\int\left[\frac{\frac{d\ (2.47)}{d\ (2.47)}}{x}\right]^{1/2} + \int\left[\frac{\frac{d\ (2.47)}{d\ (2.47)}}{x}\right]^{1/2} + \int\left[\frac{\frac{d\ (2.48)}{d\ (2.48)}}{x}\right]^{1/2} + \int\left[\frac{\frac{d\ (2.47)}{d\ (2.48)}}{x}\right]^{1/2} + \int\left[\frac{\frac{d\ (2.47)}{d\ (2.47)}}{x}\right]^{1/2} + \int\left[\frac{\frac{d\ (2.47)}{d\ (2.47)}}{x}\right]^{1/2} +$$

$$\int\left[\frac{\frac{d\ (2.47)}{d\ (2.47)}}{x}\right]^{1/2} + \int\left[\frac{\frac{d\ (2.48)}{d\ (2.48)}}{x}\right]^{1/2} + \int\left[\frac{\frac{d\ (2.40)}{d\ (2.47)}}{x}\right]^{1/2} + \int\left[\frac{\frac{d\ (2.47)}{d\ (2.47)}}{x}\right]^{1/2} + \int\left[\frac{\frac{d\ (2.47)}{d\ (2.47)}}{x}\right]^{1/2} + \int\left[\frac{\frac{d\ (2.47)}{d\ (2.47)}}{x}\right]^{1/2} +$$

$$\int\left[\frac{\frac{d\ (2.47)}{d\ (2.47)}}{x}\right]^{1/2} + \int\left[\frac{\frac{d\ (2.47)}{d\ (2.47)}}{x}\right]^{1/2} + \int\left[\frac{\frac{d\ (2.47)}{d\ (2.47)}}{x}\right]^{1/2} + \int\left[\frac{\frac{d\ (2.47)}{d\ (2.47)}}{x}\right]^{1/2} + \int\left[\frac{\frac{d\ (2.47)}{d\ (2.47)}}{x}\right]^{1/2} + \int\left[\frac{\frac{d\ (2.47)}{d\ (2.47)}}{x}\right]^{1/2} +$$

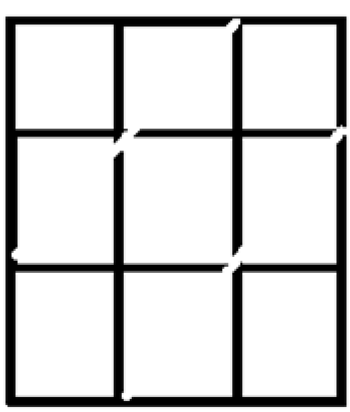
$$\int\left[\frac{\frac{d\ (2.47)}{d\ (2.47)}}{x}\right]^{1/2} + \int\left[\frac{\frac{d\ (2.47)}{d\ (2.47)}}{x}\right]^{1/2} + \int\left[\frac{\frac{d\ (2.47)}{d\ (2.47)}}{x}\right]^{1/2} + \int\left[\frac{\frac{d\ (2.47)}{d\ (2.47)}}{x}\right]^{1/2} + \int\left[\frac{\frac{d\ (2.47)}{d\ (2.47)}}{x}\right]^{1/2} + \int\left[\frac{\frac{d\ (2.47)}{d\ (2.47)}}{x}\right]^{1/2} +$$

$$\int\left[\frac{\frac{d\ (2.47)}{d\ (2.47)}}{x}\right]^{1/2} + \int\left[\frac{\frac{d\ (2.47)}{d\ (2.47)}}{x}\right]^{1/2} + \int\left[\frac{\frac{d\ (2.47)}{d\ (2.47)}}{x}\right]^{1/2} + \int\left[\frac{\frac{d\ (2.47)}{d\ (2.47)}}{x}\right]^{1/2} + \int\left[\frac{\frac{d\ (2.47)}{d\ (2.47)}}{x}\right]^{1/2}$$

We determine the diffusion with increasing plot for all =1

$$DPcr = \frac{\left[\frac{1}{2}\right]\cdot\left[\frac{3}{4}\right]}{\pi - lim}$$

$$lI(DPcr) = \left[\frac{\partial\,\frac{1}{2}}{\partial\,\frac{3}{4}}\right]\cdot\left[\frac{log\pi}{ln\,\frac{1}{lim}}\right]$$



We adjust the value of each equivalent iterated dimension:

$$\left(\frac{2.47}{2.47}\right)^{\frac{1}{2}} + \left(\frac{2.47}{2.47}\right)^{\frac{1}{2}} + \left(\frac{2.47}{2.47}\right)^{\frac{1}{2}} + \left(\frac{2.47}{2.47}\right)^{\frac{1}{2}} + \left(\frac{2.42}{2.47}\right)^{\frac{1}{2}} + \left(\frac{2.40}{2.47}\right)^{\frac{1}{2}} + \left(\frac{2.38}{2.47}\right)^{\frac{1}{2}} + \left(\frac{2.47}{2.47}\right)^{\frac{1}{2}} + \left(\frac{2.47}{2.47}\right)^{\frac{1}{2}} + \left(\frac{2.47}{2.47}\right)^{\frac{1}{2}} +$$

$$\left(\frac{2.40}{2.47}\right)^{\frac{1}{2}} + \left(\frac{2.47}{2.47}\right)^{\frac{1}{2}} + \left(\frac{2.47}{2.47}\right)^{\frac{1}{2}} + \left(\frac{2.47}{2.47}\right)^{\frac{1}{2}} + \left(\frac{2.48}{2.48}\right)^{\frac{1}{2}} + \left(\frac{2.47}{2.48}\right)^{\frac{1}{2}} + \left(\frac{2.47}{2.47}\right)^{\frac{1}{2}} + \left(\frac{2.47}{2.47}\right)^{\frac{1}{2}} + \left(\frac{2.47}{2.47}\right)^{\frac{1}{2}} + \left(\frac{2.47}{2.47}\right)^{\frac{1}{2}} +$$

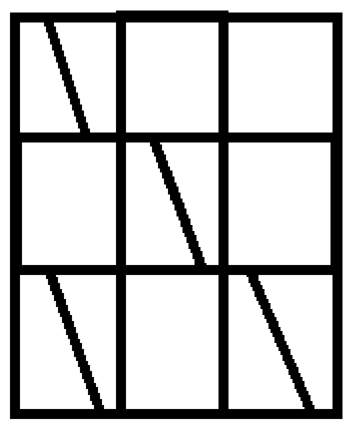
$$\left(\frac{2.40}{2.47}\right)^{\frac{1}{2}} + \left(\frac{2.47}{2.47}\right)^{\frac{1}{2}} + \left(\frac{2.47}{2.47}\right)^{\frac{1}{2}} + \left(\frac{2.47}{2.47}\right)^{\frac{1}{2}} + \left(\frac{2.47}{2.47}\right)^{\frac{1}{2}} + \left(\frac{2.47}{2.47}\right)^{\frac{1}{2}} + \left(\frac{2.47}{2.47}\right)^{\frac{1}{2}} + \left(\frac{2.47}{2.47}\right)^{\frac{1}{2}} + \left(\frac{2.47}{2.47}\right)^{\frac{1}{2}} + \left(\frac{2.47}{2.47}\right)^{\frac{1}{2}} +$$

$$\left(\frac{2.47}{2.47}\right)^{\frac{1}{2}} + \left(\frac{2.47}{2.47}\right)^{\frac{1}{2}} + \left(\frac{2.47}{2.47}\right)^{\frac{1}{2}} + \left(\frac{2.47}{2.47}\right)^{\frac{1}{2}} + \left(\frac{2.47}{2.47}\right)^{\frac{1}{2}} + \left(\frac{2.47}{2.47}\right)^{\frac{1}{2}} + \left(\frac{2.47}{2.47}\right)^{\frac{1}{2}} + \left(\frac{2.47}{2.47}\right)^{\frac{1}{2}} + \left(\frac{2.47}{2.47}\right)^{\frac{1}{2}} + \left(\frac{2.47}{2.47}\right)^{\frac{1}{2}} + \left(\frac{2.47}{2.47}\right)^{\frac{1}{2}} =$$

We determine the diffusion with decreasing plot for all <1

$$DPd = \left[\frac{1}{2}\right]\cdot\left[\frac{\pi}{\frac{1}{3}}\right]^{lim4}$$

$$lI(DPd) = \left[\frac{\partial\left[\frac{1}{2}\right]}{\partial\left[\frac{1}{3}\right]}\right]\cdot\left[\frac{d\pi}{d\left[\frac{1}{3}\right]}\right]\cdot\left[\frac{lim}{4}\right]$$



Finally, we represent the diffusion with constant plot = 0

$$DPcc = \left[\frac{1}{2}\right] - lim\left[\frac{3}{4}\right]^{\pi}$$

$$lI(DPcc) = \left\{\frac{\partial\left[\frac{1}{2}\right]}{\partial\left[\frac{3}{4}\right]}\right\}\cdot\left[\frac{log3}{ln4}\right]^{lim\pi}$$

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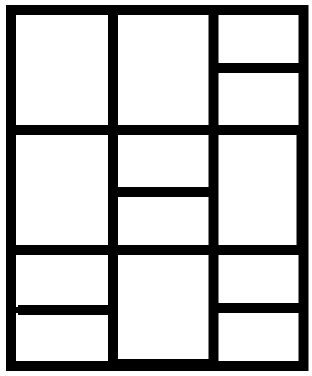

Conclusions

The more times the formula is iterated, the larger the complex number should become, but this is not always the case. The parameter that determines its growth is the modulus of the complex. If the modulus (which is not imaginary, but real) is 2 or greater, it is proven that it will continue to grow infinitely. However, there are complexes that, no matter how much we square them, will never give us a complex number whose modulus is greater than 2.

Under this new form of analysis, initially described by Hausdorff, it is possible to calculate the dimension of those "monstrous structures", for example, the number of parts can be expressed as a function of the scale factor according to the law a = sD.

By subtracting D we obtain: D = log a / log s. It can be seen that, for example, the Koch curve can be constructed by putting together four equal portions, the total curve being three times larger than each of the individual parts.

Thus, it is seen that some mathematical objects and probably many natural objects often lie in a non-integer dimension in space, i.e., their dimension is one decimal number larger than the topological dimension of origin (integer) of the same.

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Introduction

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General explanation of the subject and explain why it is important.

What is your added value with respect to other techniques?

Clearly focus each of its features

Clearly explain the problem to be solved and the central hypothesis.

Explanation of sections Article.

Development of headings and subheadings of the article with subsequent numbers

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Including graphs, figures and tables-Editable

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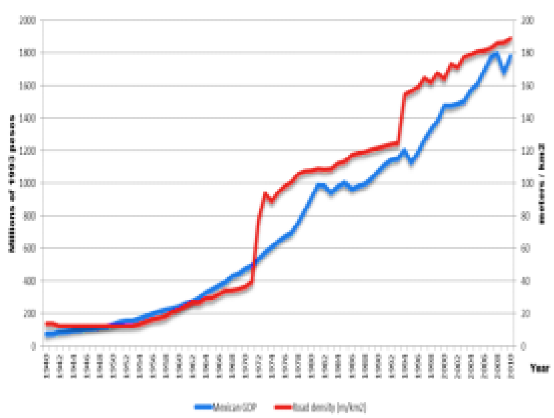

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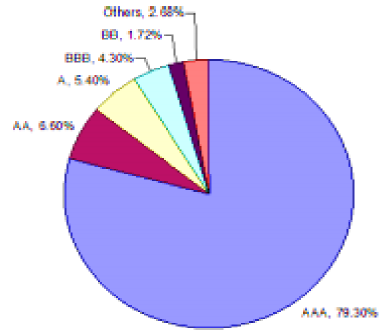

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	favourable economic conditions to meet its commitments
CC	Borrower is highly vulnerable
C	Borrower may be in bankruptcy but is still paying its obligations
D	Borrower has defaulted on obligations and CRA believes that it will generally default on most or all obligations
MOODY'S scale varies slightly	
Investment Grade	From AAA to BAA3
Speculative Grade	From Ba1 to C, (C being in default)

Table 1 Title and Source (in italics**).**

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For the use of equations, noted as follows:

$$Y_{ij} = \alpha + \sum_{h=1}^{r} \beta_h X_{hij} + u_j + e_{ij} \quad (1)$$

They must be editable and number aligned on the right side.

Methodology

Develop give the meaning of the variables in linear writing and important is the comparison of the used criteria.

Results

The results shall be by section of the Article.

Annexes

Tables and adequate sources

Thanks

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Conclusions

Explain clearly the results and possibilities of improvement.

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