Best Uses of PLA Plastic Type and Agricultural Environmental Alternatives

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Better uses for organic waste and the plastic made from them, creating is not everything when we first learn to reduce.

BEST USES OF PLA TYPE PLASTIC WITH ENVIRONMENTAL AND AGRICULTURAL ALTERNATIVES

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Best uses of PLA type plastic with environmental and agricultural alternatives

SUMMARY: In Ecuador, PLA fiber for 3D printers is not produced on a large scale or in an industrial way since its production is somewhat expensive and great research is needed to generate it with organic sources or wastes in addition to certain reagents in the mix that help to generate the polymer completely. The plastic type PLA or polylactic acid is one of the most used materials as raw material for 3D printing, characterized for being made from renewable raw materials such as corn starch and sugar cane cellulose, which means that it is practically a biodegradable material. In the present investigation, a PLA type material with organic waste is created, the most important being corn starch, cane cellulose, lactic acid among other reagents, all in order to contribute to the reduction of plastic waste on the planet that this material has a degradation time of up to 1 year, as an additional value of the product, once it reaches its useful life, it can be discarded incorporated into the soil through composting so that it can be broken down into macronutrients that will enrich this natural resource helping in this way to fertilize the soil prior to established crops.

Keywords: Biodegradable Fiber PLA, Ecuador, Compostaje

INTRODUCTION: Plastic type (PLA) or polylactic acid is one of the materials most commonly used as raw material for 3D printing, characterized by being prepared from renewable materials such as corn starch and cellulose sugar cane, which means that is a substantially biodegradable material, temperatures suitable for working with the PLA range from 190 ° C to 230 ° C that is, it can be used in extrusion processes to create filament, which is used by 3D printers or processes injection generating single-use products such as plastic cups, sorbets or coated, in addition would find a wide range of colors, it seems that today's 3D printing applications have gained ground, ranging from the medical branch prostheses for patients without limbs to matters of taste and aesthetics as characters or objects designed according to the preferences of the user.

The outlook for materials this is pretty good, but it is made competent in the market is necessary to mix natural sources with other sources that come from hydrocarbons such as polypropylene (PP) in order to create a product much more resistant, rigid and reliable to human health; But when do good marketing, these products are classified as eco-friendly as they come from some plants and environmental awareness of society would increase the purchasing trying to promote sustainable development and once again save the world large impacts caused by man, only to meet the needs of the market.

In Ecuador, the PLA fiber 3D printers are not produced on a large scale or industrially, since the production is somewhat expensive and need large research to generate sources or organic waste also exist in certain mixing reagents to help generate completely polymer, however, it is committed to products made based on this material for its good thermal and mechanical properties with good formability to work in any industrial process without having tasted that can be biodegradable and its compostable time. In the absence of any company producing this material must done import as in the case of the reels or full rolls of filament PLA where the cost is approximately $ 50 to $ 70 and the best of up to $ 35,

That is why it has been investigated how to generate a compostable biopolymer type PLA without adding any other material containing hydrocarbons with the objective that the final product has been achieved close its life cycle, giving a totally different approach to the industry, favoring the agricultural sector and essentially prioritizing care environment as well as ensuring that the development of any product made of these materials does not affect food sovereignty.

The polymer or plastic PLA type to be discussed in this article promises to be highly compostable to time to integrate to the ground, given that the procedure must have specific parameters both appropriate temperature and humidity so that the plastic product is degraded with large ease and be transformed into macronutrients to enrich the soil. In turn giving an effective solution to one of the biggest environmental problems facing the city of Quito and the world in general, which, at present has decided to name him as the "age of plastic".

State of the art

International research

Organic production of the PLA as an alternative to traditional plastic

Nunez Salinas, M. (2019). Production plant polylactic acid (PLA) from lactic acid. (End of Grade Inédito). Universidad de Sevilla, Seville. Spain

Objective: This project develops and describes a PLA production plant with a capacity of 20 000 tonnes a year. The main objective is to obtain a high molecular weight polymer suitable for plastic processing. For this purpose, a study of the polymer is performed to choose the suitable production method.

Production of PLA

90% of the lactic acid production is by biotechnologically, ie based fermentation by bacteria of carbohydrate-rich substrates, whether pure carbonaceous substrates such as lactose, sucrose or glucose; or impure carbon substrates such as starch, molasses or whey. The choice of the substrate to choose depends, among other things, its cost, the type of bacteria used and the characteristics of the final product

Degradation and transformation of organic PLA

PLA degradation in the composting occurs in two stages. In the first hydrolytic degradation and the second enzymatic degradation occurs. Degradation begins when the water attacks the hydrolysable groups of the polymer. Subsequently, the attack of water diffuses within the polymer chain ester cleavages causing randomly. Thus, the high molecular weight chains are hydrolyzed to other lower molecular weight of about 50,000 Daltons. This step can be accelerated by acids or bases and is affected by temperature and humidity levels. The process is continued until it reaches a PLA 10000 Daltons, suitable for it to be assimilated by microorganisms, being obtained carbon dioxide, water and humus

Conclusion

The production plant polylactic acid has been calculated for a capacity of 20000 tons year, using as raw material lactic acid and 85% tin octoate as catalyst. Ultimately, it is a good substitute today, but it is not sufficiently investigated, so that your prospect in the future could change.

Local investigations

Optimization of the mechanical properties of synthesized from starch bioplastics

Maria Alejandra Guerrero Narvaez. Optimization of the mechanical properties of synthesized bioplastics from starch, San Francisco de Quito University, College of Science and Engineering, Quito, Ecuador, 2016

Summary: In this investigation a biopolymer was produced from corn starch. Corn starch was mixed with water, chemical modifiers such as sodium hydroxide (NaOH) and hydrochloric acid (HCl) and glycerol which acts as plasticizer. a design of experiments was used with varying fifteen wherein the amount of glycerol and the pH is manipulated, performing five repetitions of each experiment. Subsequently, the influence of these variables were studied on the mechanical properties of biopolymers made

Mechanical properties of biopolymers

Most materials are subjected to forces or loads. The mechanical properties of a material reflecting the relationship between the applied force and the response of the material to it. The most important mechanical properties are resistance [N / m2] and elongation [m]. The bioplastic starch derivatives are materials having low mechanical properties: it is soluble in water, the bioplastic can have softening properties and deformation when in contact with moisture, resulting in a brittle product. This type of bioplastic uses have limitations because they could not create flexible and resilient films.

Materials and methods

The bioplastic studied made from cornstarch commercial corn, " Iris', glycerin, distilled water, sodium hydroxide (NaOH) and hydrochloric acid (HCl). For the drying process of the bioplastic a manual drying was used with mesh drying. Finally, the mechanical tests were performed in a universal mechanical testing machine brand Tinus Oisen.

It took into account the pH of each solution used in the preparation of bioplastic which was adjusted with different amounts of sodium hydroxide NaOH in the case of obtaining a basic bioplastic (7, 9, 11), and amounts of hydrochloric acid HCl to obtain a bioplastic with acid pH (3.5). Each aqueous solution was heated with manual stirring in a burner at an average temperature of 70 ° C (max. 90 ° C) for approximately 15 min.

Conclusion:

The mechanical properties of the bioplastic depends the amount of glycerin and the pH level, the modulus of elasticity varies for all bioplastic with glycerin concentrations and different pH values. The highest value is shown by the bioplastic with glycerin level of 15% and pH 7. Conversely, the bioplastic having elastic modulus lower value is one that was prepared under conditions of pH 7 and a glycerol concentration of 35 %.

Study of organic additives to make starch-based PLA canna (Canna edulis)

Pamela Molina; Myrian Silva; Lauro Valley. Preliminary study of compatibilizers in mixtures PLA-canna starch (Canna edulis), Journal CUMBRES. 3 (1), Quito, Ecuador, 2017: pp. 33 - 40

Objective: Both PLA and starch biopolymers are widely studied in mixtures; however, the interfacial interaction between these still is deficient and is a limiting factor in the preparation of these mixtures. In order to overcome this drawback, the present study aims to assess the influence of citric acid, linoleic acid, cetyl alcohol, and carnauba wax as compatibilizers in the blending of PLA canna starch (Canna edulis).

Materials: mixtures were prepared in 40% PLA, 1% compatibilizer, 58.5% starch and glycerol in the same proportion and 0.5% zinc stearate

Formulation of mixtures for PLA based biopolymer and starch achira

Removed the impurities present in the starch through the sieve ASTM E - 11/95 No. 200. Next, a study was conducted of the influence of each of the compatibilizing with native starch in order to evaluate the miscibility of the glycerol 1: 1 with 58.5% of the total content, the effect of the different assayed mixture PLA-starch-glycerol, for which the amount of PLA in 40% of the mixture and starch ratio was set constant compatibilizers in a ratio of 1%. To facilitate the process ability of the mixture, he was added zinc stearate at a constant level corresponding to 0.5%.

Results: additives for PLA binding with natural starches

It can be established that there was a better miscibility between the components and carnauba wax. Compared to the use of other compatibilizantes, this presents a better interaction. The mixture reached a state of uniform mixing and a time constant torque, materials interacted and melted up to that point. In this sense, it is possible that the interaction of the PLA and starch originates by ester groups, free acids, resins, alcohols and hydrocarbons

Description of the study

To emphasize what is the "era of plastic" investigations date back to the year 1909 when the chemist Leo Baekeland created the first synthetic plastic thermostable (Garcia 2008)which it was created in order to give the supplement manufacture of use for humans such as wood, stone and the resin. It is not until the year 1915 in which the advancement of research and the high demand that had the synthetic plastic analysis began to be the same, discovering new ways to get different types of plastic. The increasing demand from an increasingly consumerist society continues to stimulate mass production of plastic objects(Garcia 2008) resulting, more than 111 years after its creation, the problem causing the "era of the plastic" which especially emphasizes the large accumulation of plastic waste from all over the planet considering this, to the being of industrial origin at the time degrade toxic substances that emit different large-scale environmental deterioration and ecological factors that owns the land being the most affected resources such as soil, air and water.

¿How we produce plastic?

Today almost 90% of materials occupying humans to meet their needs are made from plastic, especially because it is a material with great industrial power to be resistant, moldable, genetically modified and easy to produce. A recent report by the British organization Verisk Maplecroft, which warns about plastic waste, revealed that globally more than 2,100 million produced tons of waste each year, of which more than half were produced in the last 13 years being these fully plastic products(World 2019).

In the case of Ecuador, according to these studies by the Economic Commission for Latin America and the Caribbean (ECLAC) reports that the per capita production of the country regarding urban waste remained a figure of 0.686 km / inhabitant per day of which only 14.91% of these are landfilled for subsequent degradation, and the remaining of the total are deposited opencast in different underground areas such as streams, water bodies or vacant land (Almeida, 2014). In the case of Quito, according to data provided by the Metropolitan Sanitation Company (Emaseo) in the capital occur daily 2 227.69 tons of solid waste, of this amount, 277.35 tonnes are you carrying cases and other types of plastic (Medina 2018).

The present figures mentioned above were provided in the past 9 years making the boom currently on the plastic and how easy it is discarded in the environment deteriorated since its scenic part to its chemical structure. The same as were those who detonated the bomb that many countries seek to approve environmental laws in order to reduce the amount of solid waste generated (Almeida, 2014), as well as take measures to ensure that the production of the plastic will generally decaying or rather regulated, some ideas, which are emphasized are made to the city of Quito, which are: encourage the use of containers and returnable containers and recyclable processes, consume less plastic from hydrocarbons and eco-friendly plastic or biodegradable,

A new alternative for producing plastic

Known as fiber or PLA polylactic acid, aliphatic polyester is a thermoplastic made with organic products especially corn starch feature that gives high biodegradation[1] in the environment under suitable conditions unlike other thermoplastic[2] (Alberto Sierra Dr. Ing. 2016), Thereby reducing the time spent on earth product. Today it is becoming the focus of companies producing plastic items and that the being of plant origin and having thermoplastic characteristics makes it easier production of biodegradable products, in turn making companies comply with environmental laws of the countries mentioned as we seek to protect the planet for present and future damages.

One of the reasons most effective for biopolymers or bioplastics are integrated into the production matrix of the country, it is that these biopolymers have mentioned aqueous high solubility (Aguillón 2016)which makes integrate faster in the environment by reducing the integration time, compared to 500 to 600 years it takes to decompose a regular plastic to a range of 6 months to 1 year is the time it takes the PLA integrated into the environment. Now the PLA has a wide application of products and that being a material with good strength and stiffness makes it suitable for any industrial process, the best known is the casting process where it can be molded easily. That is why the industry 3D printing make the PLA fiber as a base or raw materials for their products, so that other types of plastics pass into the background in the industry taking into account also that the PLA has better features other plastics (see table 1).

[1] Degradation means that can break or decompose easily but biodegradation gives another essential feature of this concept, which is that the biodegradable product can be decomposed by the metabolic action of microorganisms causing the carbon atoms of polymers breaking and included in the environment easily

[2] Thermoplastics are those in which plastic materials during the production process can increase the temperature to get a viscous solution and malleable, and to the time of subjecting to drying becomes a completely solid.

Table 1. Characteristics of the PLA compared to other types of plastics

	PLA	PS	i-PP	PET
Densidad relativa	1.24	1.04-1.06	0.91	1.37
Claridad	Transparente	Transparente	Transparente	Transparente
PROPIEDADES MECÁNICAS				
Resistencia a la tracción (MPa)	48-110	34-36	21-37	47
Módulo de tracción (GPa)	3.5-3.8	2.9-3.5	1.1-1.5	3.1
Elongación (%)	2.5-100	3-4	20-800	50-300
Impacto Izod 23 °C (J/m)	13		72	79
PROPIEDADES TÉRMICAS				
Temperatura de transición vítrea (°C)	60	95	0	75
Temperatura de fusión (°C)	153		163	250
Temperatura de Vicat (°C)	55-60	84-106	80-140	74-200
Temperatura de procesamiento (°C)	210	230	225	255

Mentioning now the 3D industry, the PLA can be used for any product you may have a previous design computer and printed on this machine. This wide range of products ranging from small plastic pots to dishes and human prostheses or any design the user wishes to obtain (see Figure 1).

Figure 1. Design and printing of a product based PLA fiber using 3D printer.

As mentioned above, the PLA fiber is especially composed of corn starch and cellulose cane, but what is sought in the present investigation is to make a material with a variety of starches from organic waste dealing more often in the city of Quito being the most important potato starch (*Solamun tuberosum*) variety chaucha, bagasse and corn starch. Thereof that will give the large materials biodegradable properties in the soil as the plant molecules that were incorporated into the formula to pass after being part of the floor providing macronutrients help enrich the soil for use in the production of any agricultural crop.

Ending the age of plastic

One of the most important you reason why the industrial plastic became a problem for the entire planet is their great degradation time and what causes the break down therein, the first causes the remaining plastic in the environment more than 500 600 years visually intactly it is resistant to sun, wind, water, humidity and other weather conditions, which leads to the second symptom which is the breakdown of the material, although it is true we have mentioned that it is very resistant to different conditions but this only from the visual part since from the chemical field, small particles of plastic are integrated into the environment depending on the surface in which water is in contact (ground, plants) so that these particles begin changing its structure and reach conceive a severe environmental pollution, the same particles in the case of the soil can reach erode or to acidify depending on the material being decomposed.

An alternative to mitigate this problem, taking into account the PLA fiber, is that the products made with this material can again be reintegrated into the environment through composting, ie they could be included in agricultural soils so that they biodegrade by action of microorganisms present in the same macronutrients detaching far from changing the chemical composition of the soil, to be loaded with a lot of them, mitigating two problems at once: the first and most important is to eliminate the synthetic plastic product planet to recover the landscape parts that deteriorate with these materials and the second is to help supplement with nutrients to the soil to enrich and thereby grow therein.

MATERIALS AND METHODS

Materials

As source of corn starch was used (*Zea mays*) of synthetic indentata type, ie Cornstarch industrialized to the bulk containing 0.9 grams of fiber per 100 g cornstarch plus minerals such as phosphorus, sodium, etc. and starch potato (*Solamun tuberosum*) chaucha variety.

As for the cellulose, is obtained from sugar cane (unknown strain) as residue from the extraction process for juices in a small shop, the rod should be dried to the point of becoming brittle to subsequently pulverizing it in a grinder, thereby obtaining a finely powdered particulate material contains not too large as to affect the mixture.

As fine powder addition factor eggshell, which must provide the final product calcium without altering the chemical composition of the mixture was used.

In addition, some reagents were used as acetic acid, glycerol and lactic acid type of the chemical in the mixing process to optimize the thermal conditions and mechanical polymer.

The proportions of each material were measured based on the amount of desired product which was five kilos bioplastic. They will be used to perform different tests subsequently ground with crops both establish and machinery extruder type which give final product as a fiber 3D printer which will be detailed later.

Methods

Active ingredient mixture. To determine the equivalent weight factors was a conversion of grams for each kilogram solid powder respectively each addition ratio of reactants used in the laboratory. We worked with a dilution of 1:10 lactic acid to lower its concentration to 50%. All active ingredients were placed in a beaker with a capacity of 1000 ml, repeating the process until five kilos and then integrated to obtain a homogeneous mixture, the same that was exposed to heat indirectly while rocking the solution, in after the temperature was measured with a mercury thermometer, when the mixture reached 50 ° C 15 ml of acetic acid was added to improve the hardness property in the material when solidified.

Once all the elements of the mixture are reached its doneness a viscous mixture pale cream was obtained, turned away from the heat when it reached a temperature range between 80 ° C - 85 ° C.

Process form (granulate) and drying. It is noteworthy that this process was conducted in the laboratory purely empirically, ie an industrial machinery (pelletizer) was not used. Before the temperature drops mixture, the put it in piping bags previously sterilized and disinfected in order to maintain as hygienic as possible on a flat surface sheets long he stretched foil which served as a basis for drying of the material. Was subsequently shaping grain to each projecting portion of said sleeve, the process was repeated until finishing the obtained mixture.

For the drying process was the left at room temperature in a fully sterile and non-contact dust or any trace of dirt area in the atmosphere, the drying time of the product took between 72 to 120 hours depending on the diameter of the grain. It past said drying time is proceeded to collect and weigh the final product for verification.

Mechanical properties test. Among the mechanical properties they were made for verification bioplastic mentioned: elongation, density and thermal resistance which will discuss them further.

- Elongation mechanical testing the biopolymer. - To calculate the elongation of the sample according to ASTM D-638 three sheets were produced with the following dimensions: thickness 1mm, width 1 cm and 12cm long. Elongation is calculated in Newton's so for this test was required dynamometer which was placed on one end of the sheet, at the same time at the other end a clamp was placed with support for the material not moving, pulls the dynamometer until the material breaks, the exact break point was marked in the apparatus of measurement, the process in the three laminas noting the number of marked break in each and an average was made to take repeated standard value.

- Density bioplastic. For this test it was performed with the usual way to calculate the density of a solid. In a beaker was placed 100 ml of bioplastic the weight and calculated with the following formula.

$$d = \frac{m}{v}$$

- Thermal and mechanical strength testing. These analyzes were performed on an industrial extruder, 3 kilos bioplastic placed in the funnel of the machine, about 10 seconds wait the material started to melt at a temperature of 216 ° k, to the time it was pushed by a worm which caused the material to mix and cover linearly, on reaching the other end of the screw, the fully melted material, passed through a small molder gave as result a thread with a diameter of 1.75mm the same that passed through a cooling system by water and then fulfill the function of performing a thermal shock of both the temperature at which the material exits and the temperature at which the water is, thereby providing solidification of the final product.

Degradability test and composting. A obtaining the dry material was necessary to degradability test on the ground, then through composting verify that provides some type of nutrients on land for agricultural use and this study put it as follows:

Installation and assessment: Day 0

- A hole was made in the ground with 45 cm depth study considered a lot.
- In a wooden box they were placed
    - 10 cm Ground
    - 5cm rotten lettuce
    - 5 cm manure
    - 5cm dry leaves moisturized
    - He was placed back 5 cm soil
    - 2 kilos of bioplastic
    - 2 ml of Bacillus spp. (Liquid formulation) / 200 ml water

Second Assessment: Day 30

- 2 ml of Bacillus spp./ were added 200 ml of water

Observations: The lettuce was 80% decomposition and the study material changed its physical properties:

Table 2. Deformation of the bioplastic composted

ITEM	FIRST EVALUATION	SECOND EVALUATION
COLOR	YELLOWISH	WHITE
STATE	SOLID (RIGID)	SOLID (VERY SOFT)

- the soil was removed to improve the conditions of aeration

Third Assessment: Day 120

The study material has been completely degraded without any waste. It showed good soil incorporation, there was no loss of organic matter or control non-target organisms (worms, beetles, etc.).

Study external conditions

- Temperature
- RH

Soil sampling. After the third evaluation, a spot sample of the batch in which the study of degradability was made of the material and a sample from another batch was also taken without the study material, 3 meters away where they had applied certain agrochemicals took to eliminate pests in the total test area 6 months ago, this in order to improve agricultural production set in place of experimentation.

Each sample was placed in a sealed type plastic bag properly labeled with the amount of a kilo each to assess certain parameters at the laboratory level as pH, organic matter, plus some macronutrients such as nitrogen (N), Phosphorus (P) and potassium (K).

Using compost obtained in agricultural crops. To verify that the material of the polymer obtained does not cause damage on some established culture or by delimiting necessary to establish was a small area of 1.10 meters long by 0.45 meters wide where 8 lettuce (*Lactuca sativa*) were sown oak leaf on a variety of phenological state of emergency, in order not to affect production in large proportions. Complete removal of soil and the area was divided into two lots, homogenized and proceeded to make small holes with 5 cm deep to subsequently place the lettuce.

The division of the area was:

LOTE 1		LOTE 2	
M1	M1	M1	M1
M2	M2	M2	M2

- M1: Sign with study material
- M2: Sample without study material

A dividing the area of experimental comparison between M1 and M2 sample was performed to verify that there was any deficit or accelerating growth in lettuce crops and in turn if it caused any damage. For evaluation of growth took time of 40 days with two evaluations, one every 20 days.

RESULTS:

Physical properties of the biopolymer

Regarding the physical properties of the biopolymer in color a pale cream product is obtained since no organic dye was not adhered, to make it more natural, characteristic odor when being extruded emanated an aroma sweet as cane the same as it maintained throughout the process, with respect to the rigidity extremely compact material is achieved and hard to the touch, kept a small sweet flavor while keeping the hot product, cool when you lose this feature.

Mechanical properties test.

Elongation mechanical testing bioplastic.

Having performed the tests elongation in the material detailed results obtained in Table 3, which indicates that the first sample had a breakpoint of 9 N, the second sample had a breakpoint of 6N because the material was somewhat brittle in the sample, which caused it to break more easily, the third and final sample kept an extremely flat surface and compacted giving as result a breakpoint of 10 N, thus an average obtained 8.33 N elongation in the evaluated material.

Table 3. Elongation tests biopolymer

Test No.	Breaking point
Sample 1	9 N
sample 2	6N
sample 3	10N
Average	8.33 N

Density bioplastic

As a result of calculating the density of the biopolymer the following final measurements were obtained:

$$peso\ del\ vaso\ de\ precipitación: 105{,}9\ g$$
$$volumen\ de\ la\ muestra: 100\ ml$$
$$peso\ del\ sistema: 167\ g$$

$$157g - 105{,}9\ g = 61{,}1g(masa\ de\ la\ muestra)$$

$$d = \frac{m}{v}$$

$$d = \frac{61{,}1g}{100ml} = 0{,}0611\ {}^{g}/_{ml}$$

Thermal resistance and mechanical strength

A mentioning the thermal resistance of the biopolymer, by the extrusion tests, it was found that the melting temperature of the material was 216 ° k, making medium suitable for use industrially in various machinery being the most important extruder, followed 3D printer, the material could also be used in industrial injectors.

Degradability test and composting.

In the test of Degradability external conditions the study were exposed in Table 4. Indicating the temperature varies from 1 to 3 degrees while the relative humidity remained in the last two evaluations.

Table 4. Conditions external measures in the field of study

Evaluation	Temperature ° C	RH %	degradation%	Degradation time
first	20.2	30	0	0
Second	24.6	twenty	25	30
Third	23.7	twenty	100	120

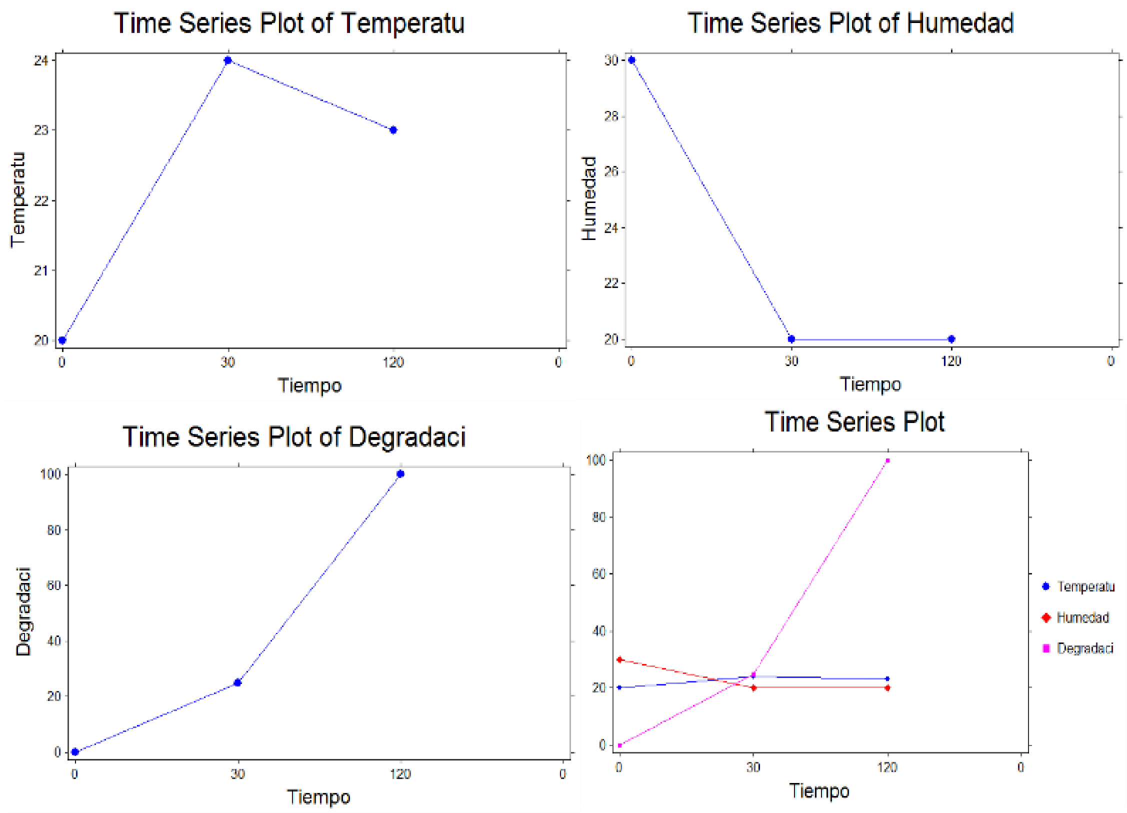

Figure 2. Graphic parameter measured in the field concerning time degradability study material (biopolymer).

Soil sampling

Samples sent to the laboratory showed no such differential comparison, however, it can be seen in Table 5 that Sample 1 that contained the study material contributed significantly macronutrients to the soil, which would qualify as suitable for agricultural production, although it is preferable to conduct more tests for a much more thorough monitoring large scale.

Table 5. Sample 1 with study

Sample code LABORATORY	Field identification	parameter analyzed	METHOD	UNIT	OUTCOME
SFA-20-0198	Sample 1	pH at 25 ° C	Electrometric PEE / SFA / 06 EPA 9045D	-----	6,29
		Organic material	Volumetric PEE / SFA / 09	%	5.19
		Nitrogen (N)	Volumetric PEE / SFA / 09	%	0,26

		Phosphorus (P)	Colorimetric PEE / SFA / 11	mg / kg	116.1
		Potassium (K)	Atomic absorption PEE / SFA / 12	cmol / kg	1.27

A comparison of the results obtained in sample 1, Table 6 shows results not so far in sample 2 but is believed to have affected can use some commercial agrochemical pest control.

Table 6. Sample 2 No study material

Sample code LABORATORY	Field identification	parameter analyzed	METHOD	UNIT	OUTCOME
SFA-20-0199	sample 2	pH at 25 ° C	Electrometric PEE / SFA / 06 EPA 9045D	-----	7, 19
		Organic material	Volumetric PEE / SFA / 09	%	2.76
		Nitrogen (N)	Volumetric PEE / SFA / 09	%	0.14
		Phosphorus (P)	Colorimetric PEE / SFA / 11	mg / kg	81.3
		Potassium (K)	Atomic absorption PEE / SFA / 12	cmol / kg	1,84

Using compost obtained in agricultural crops.

The field data and detailed in Table 7 after dividing the area of study in both lots resulted in a good utilization of nutrients in plants by both samples, however, it was more effective in the sample 1 to the own better properties.

Table 7. Data collected based on the growth of plants in two evaluations

DAY	LOT	SHOWS	INCREASE
0	one	M1	one
0	one	M2	1.34
0	one	M1	two
0	one	M2	1.31
40	two	M1	5.12
40	two	M2	4.4
40	two	M1	5.40

40	two	M2	4.88

Statistix 9.0

Randomized Complete Block AOV Table for Plant growth

Source DF SS MS FP
SAMPLE 1 0.3160 0.3160
LOT 1 25.0278 25.0278 166.00 0.0001
Error 5 0.7539 0.1508
Total 7 26.0977

Grand Mean CV 3.1812 12.21

Relative Efficiency, RCB 1,14

Means of Plant growth for LOT

LOT Mean
1 1.4125
2 4.9500
Observations Mean per 4
Standard Error of Mean 0.1941 to
Std Error (Diff of Means 2) 0.2746

The program used to run data was statistically Statistix, where a coefficient of variation of 12.21 was obtained with an average growth of 3 centimeters 1812 8 floors evaluated.

Lot 2 was eminently better 40-day evaluation because the nutrients present in the samples were much better assimilated by plants during that time.

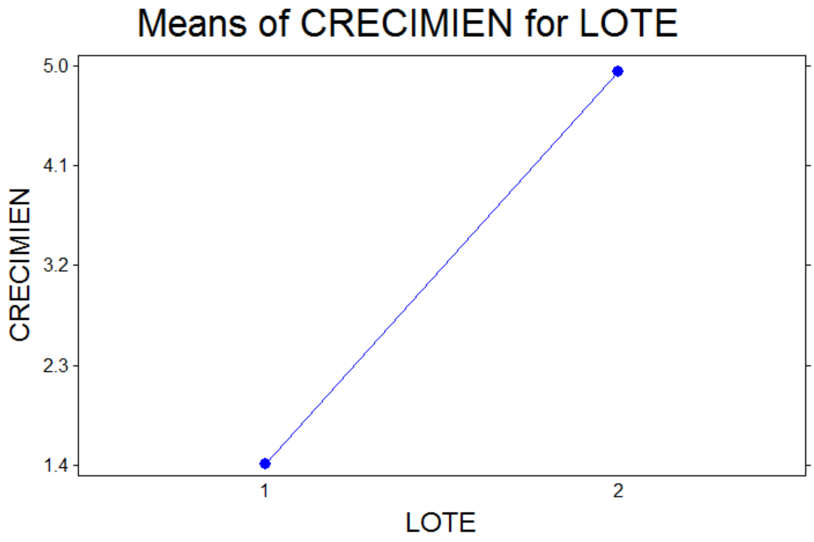

Figure 3. Linear growth curve between the two batches of study

The average growth for (Lot 1) was 1.4125 while for him (Lot 2) was 4.95, the graph of Figure 3 shows a linear curve having no further evaluation and lots of study, however shows results no significant difference between the two lots.

CONCLUSIONS:

It has been shown that it can create a biopolymer based on organic wastes such as bagasse from sugar cane, eggshells, crushed corn, among others, biodegradable and compostable capacity provides macronutrients essential in small amounts for agricultural crops helping small-scale production, in growth or plant height is about, showed positive results without affecting negatively to the ground or the time degradability estimated for the study material established cultures was 120 days without residues that may affect the properties of the soil. As mentioned before, in Ecuador no raw material is produced PLA type machine as extruders or injection as research for these has not depth of the whole, It is generating the forced importation of this material without proposing a competition within the country. Furthermore, it is believed that the biopolymer must be mixed with some additives to help produce more resistant materials when placing them in the machines, since they are adapted to work with synthetic plastic materials containing other properties in addition to lower production costs. In short, to better uses any biopolymer through an industrial stage to fulfill a need in society for a certain time that solutions to environmental problems much more palpable every day, proposals for such projects are suggesting closing the loop by reusing resources that may no longer have a choice but to be discarded more untapped at the maximum especially in homes however circular economy gives us the guidelines to go further and provide with ideas that continue to contribute to sustainable development. End the "age of plastic" will remain a challenge for issues of comfort, social cultural and even economic issues, but improving what already exists or create new prototypes will make the world a better place to live.

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