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Potential of Potato Starch (Solanum Tuberosum) in The Development of Products in The Food Industry

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Abstract

Potato starch (Solanum tuberosum) has great potential in the food industry due to its versatile and beneficial properties. Its ability to form gels, thicken, and stabilize foods makes it a valuable ingredient in a wide variety of products. In the bakery, potato starch can improve texture and retain moisture in baked goods, such as bread and cookies. In the dairy industry, it is used in the production of yogurt and ice cream to impart creaminess and stability. In addition, its resistance to freezing makes it ideal for frozen products, such as French fries and pre-cooked products. Potato starch is also used in the creation of gluten-free foods, providing a safe alternative for people with gluten intolerance. Its ability to form edible films can be applied in biodegradable packaging and protective coatings. In summary, potato starch offers innumerable possibilities for innovation in the food industry, improving the quality, texture and stability of products, as well as contributing to sustainable and gluten-free solutions.

Keywords: *Potato Starch, Food Industry, Versatile Properties, Gluten-Free.*

1. Introduction

Chronic In most Andean countries, such as Ecuador, it is characterized by the cultivation of a great diversity of foods, including tubers, which, thanks to their low cost and high nutritional value, constitute one of the main sources of food for Ecuadorian families (Costa Neto, y otros, 2017)

One of the main components of roots and tubers is starch, which is the main source of energy for plants. Starch is a raw material with a wide spectrum of applications ranging from (Bravo, 2020) in from imparting texture and consistency in food to manufacturing biodegradable paper, adhesives and packaging. Because starch is the most widely used polysaccharide as a functional ingredient (thickener, stabilizer and gelling agent) in the food industry, it is necessary to look for new sources of extraction. (Hernandez Medina, Torruco Uco, Chel Guerrero, & Betancur Ancona, 2018) (Polanco, 2014)

The potentiality of starch the Potato lies in its ability to improve the texture, stability, and sensory properties of a wide variety of food products. However, according to the country (which one?) around 46000 tons of roots and tubers are lost per year, which is of great concern for the agro-industrial field since limiting factors such as: poor post-harvest practices, high moisture content and metabolism of these foods (WON, y otros, 217), and the lack of knowledge of producers for the development of new products, has led to little consideration of this raw material from the point of view of food and nutrition.

At the molecular level, starch has large particles with cracks, it has an obvious shine, it is a soft white powder, odorless and with an unpleasant taste, which can be used to influence the physical properties of many foods due to the benefits it offers, starch represents an excellent raw material for the production of novel products with good characteristics Mentioned (Zárate-Polanco, y otros, 2013).

Research and development in the food industry continues to harness the potential of potato starch to create products that meet the changing needs and requirements of consumers in terms of taste, nutrition and application. Potato starch, coming from a widely available crop in the world, represents a significant opportunity to drive innovation, development and sustainability in the food industry, opening the door to a world of culinary and nutritional possibilities.

Potato starch

In potatoes, starch is their main source of energy storage and their content varies between 15% to 20% of their weight, it has a high phosphorus content (0.08%) compared to starches from other sources. The physicochemical composition of both the potato and the (Pardo C, Castañeda, & Ortiz, 2013) l Its starch changes according to several factors such as: the variety grown, the growing zone, fertilization, and the state of the plant's growth cycle among the main. The starch granule has a diameter of (Gutierrez, 2019) of between 10 and 100, in turn it is composed of two types of molecules, amylose and amylopectin, the latter being μmThe latter is between 70% and 80% by weight, regardless of the size of the starch granules. These characteristics make potato starch a valuable source for obtaining functional biopolymers for food and materials science. (Vargas G. A., 2015)

Technology and extraction of potato starch.

For potato starch extraction, you start by choosing high-quality potatoes, which are generally high in starch and low in sugar. The potatoes are disintegrated and crushed, cut into pieces and crushed to release the starch-containing cells. Washes (Checa, 2014)do Repeatedly add water to remove water-soluble components, such as sugars and proteins. Starch and water are separated, the resulting aqueous suspension is subjected to separation processes to recover Starch in water, This can be achieved by filtration or centrifugation. Wet starch is dried to reduce its moisture content to levels suitable for storage and later use. The dry starch is ground into a fine powder and sifted to standardize the particle size. (Cruz, 2016)

Potentialities of potato starch in the food industry:

Potato starch is commonly used as a thickener and gelling agent in sauces, soups, dairy products, and desserts chiefly, can improve the texture of products such as processed meats, baked goods, and baked goods, providing a soft and fluffy texture. (Dergal, 2006)

Potato starch is naturally gluten-free, making it a valuable option for gluten-free product formulation. Potato starch can improve the shelf life of some food products and help maintain freshness. It can be used in the preparation of functional foods with specific health benefits, such as low-fat, low-calorie foods. Potato starch has a neutral taste, making it suitable for a wide variety of applications without affecting the taste of the final products. (Lasluisa, 2011)(Almidón de Papa, 2020)

Raw material:

To obtain the starch, potato (*Solanum tuberosum*) of the white Leona variety was used, which was purchased in the local market of the city of Calceta-Manabí-Ecuador. This tuber variety had an oblong shape, white flesh color, medium size and good texture.

Physicochemical properties:

The physicochemical and functional properties of native starches are influenced by their granular and molecular structure, which allows them to act in different systems such as: thickeners, stabilizers, gelling agents, water retention agents, among the main and They can be used as food additives (Hernández Ramíreza, Castro Rosas, Rodríguez Marín, & Falfán Cortés, 2020)**.** Starch is a biological substance found in plants and tubers such as potatoes. It is a source of energy storage that plants use to store glucose, which they can later use for their growth and development. In addition, the biological characteristics of potato starch depend on the polysaccharides amylose and amylopectin. (Azuara Nieto & Jiménez Fernández, 2016)

Starch Treatment Process

The potato starch treatment process is a series of stages that aim to extract starch from potatoes and purify it for use in various industrial or culinary applications.

Starch extraction:

The starch in the varieties is extracted according to According to the proposed methodology, the raw material is selected, washed with soap and water to remove excess soil and impurities. The potato is then cut with a paring knife into even pieces of about 8 cm x 2 cm, scooped out potato juice by means of a commercial extractor for domestic use model Rudo, brand Turmix. To obtain the juice of the potato containing the starch, a container with a capacity of 20 liters is placed and over the container a blanket of 40 x 40 cm tied with a rubber band. Once the starch has settled for 30 minutes, remove the excess water, put the starch in 20 cm x 25 cm aluminum trays, on the stove at 50ºC for a period of 4 hours or at room temperature for 12 hours. Once the dry starch is obtained, the particle size is reduced and the crushed powder is passed through a series of meshes to determine granulometry, the starch obtained is stored in a poly bags. (Pardo C, Castañeda, & Ortiz, 2013)

Physicochemical characterization of potato starch:

According to , the content (Bravo, 2020)The percentage moisture content of the starch is determined by the gravimetric method of drying by stove, where 3 g of sample is weighed on a SARTORIUS brand digital scale in a petri dish with a lid (previously weighed after having it for 2 hours at 130°C) and subjected to drying in the oven for 2 hours at 135°C. Then, when the dry sample is removed from the stove, the Petri dish is covered and left to cool in the desiccator for 30 minutes, and then weighed and the percentage of humidity calculated using the following formula:

$$\%\,Humedad = \frac{Peso\ de\ la\ muestra - Peso\ de\ muestra\ despues\ de\ estufa}{Peso\ de\ las\ muestras} \times 100\%$$

The percentage ash content is determined according to the dry calcination method, using a FURNACE brand muffle. 3g of sample is weighed in the crucible (previously placed for 2 hours in the muffle at 600°C and weighed) and calcined with the help of the Bunsen burner inside the bell for 25 minutes, then it is taken to the muffle for 2 hours at 600°C to obtain white or slightly grey and homogeneous ashes. Let it cool in the desiccator for 25 minutes, take the weight and calculate it with the following formula:

$$\%Cenizas = \frac{Peso\ de\ Muestra\ despues\ de\ mufla}{Peso\ de\ la\ muestra} \times 100\%$$

The percentage fat content is determined by the gravimetric Soxhlet method. 3 grams of sample is weighed on filter paper, the sample is sealed and introduced into the previously tared balloon to which 150mL of hexane is added and the extraction is carried out in the Soxhlet equipment with a temperature in the heating plate of 75°C for 4 hours. The residue is placed on the stove for 1 hour at 105°C, cooled in the desiccator for 25 minutes, weighed and calculated using the following formula:

$$\%Grasa = \frac{Peso\ de\ Muestra\ despues\ de\ estufa}{Peso\ de\ la\ muestra} * 100\%$$

The percentage protein content is determined using the Kjeldahl method. 3 grams of sample is weighed on filter paper and transferred in the form of a packet to the balloon, then the Kjeldahl tablet and 25 ml of concentrated H2SO4 are added, the balloon is placed in the digester reverberatory to heat until it carbonizes and, when it comes to a boil and when a clear liquid is obtained, it is kept boiling for 30 minutes. It is then allowed to cool to add 150mL of distilled water and leave to rest. 40 grams of paraffin, 80mL of Kjeldahl soda and 7 zinc grits are added to the balloon and it is distilled in the same Kjeldahl equipment, having placed at the end of the detachment tube an Erlenmeyer with 50 ml of 0.1N H2SO4 and 2 drops of red methyl indicator solution, for 20 minutes. The distillate obtained is titrated with 0.1N NaOH until a yellow turn is obtained, and the calculations were made with the following formula:

$$\%P = \frac{[(Consumo\ de\ H_2SO_4 * N) - (Consumo\ de\ NoOH * N)] * 0.014 * E_c}{Peso\ de\ la\ muestra} * 100\%$$

The percentage fiber content is determined by the Standard method (AOAC 962.09). 3 grams of sample is weighed in a beaker and 200mL of 97% H2SO4 is added, placed in the fiber digester to boil for 30 minutes, and allowed to cool to room temperature. It is then filtered through a linen cloth placed in a funnel and the beaker is washed with distilled water and the residue is filtered. The resulting residue is placed in another beaker, 200mL of 0.1N NaOH is added, placed back into the fiber digester to boil for 30 minutes, and then cooled to room temperature. It is then filtered through the linen cloth placed in the funnel by washing the beaker with distilled water and alcohol. The residue obtained is transferred to the crucible and then placed in the oven for 2 hours at 130°C, cooled in the desiccator and the weight is taken. Finally, the crucible and its contents were placed in the muffle for 30 minutes at 600°C, the sample was then allowed to cool in the desiccator and the weight was taken to perform the respective calculations using the following formula:

$$\%Fibra = \frac{Peso\ de\ la\ muestra\ de\ la\ estufa - Peso\ de\ la\ muestra\ despues\ de\ la\ mufla}{Peso\ de\ la\ muestra} * 100\%$$

The pH value is performed by the potentiometric method. 10 grams of starch were weighed in a beaker, encased with distilled water up to 60mL, placed a magnetic bullet inside the solution and subjected to stirring for 30 minutes at 300 rpm. The magnetic bullet is removed and the potentiometer is inserted to directly measure the pH of the sample. 5 grams of sample were weighed on filter paper and carefully dropped into a test tube, then 50mL of neutral alcohol was added, stirred with a glass rod and left to sit for 24 hours. After this time, an aliquot (10mL) of the supernatant liquid is taken with a volumetric pipette, passed to a fiola and 3 drops of phenolphthalein are added where it is titrated with 0.1N NaOH until a pink color appears. The consumption was noted and the calculations were made using the following formula:

$$\% = \frac{Consumo\ de\ NaOH * N * mlq.ac}{Peso\ de\ la\ muestra} * 100\%$$

The study focused on analyzing the starch of the white Leona potato variety and the results of the tests carried out are presented:

Table 1. Results of the physicochemical characterization of potato starch.

Parameters		D.E
Humidity	12.660%	0,001
Ashes	0.853%	0,001
Fats	0.120%	0
Protein	0.350%	0,001
Fibre	0.140%	0
Carbohydrates	86.010%	0,001
pH	634	0,005
Acidity	0.0027 MEQ of AC. LAC/g starch	5x10-05

Source: Bravo 2020.

The starch moisture content of this variety was found to be 12.66%, a value similar to that of other native and commercial potato varieties reported in previous studies. The amount of ash in the starch was higher (0.853%) compared to other varieties, which may indicate the presence of minerals and salts left over from the extraction. The fat content was low (0.12%), which can affect the viscosity and strength of the starch gel. The amount of protein in starch (0.350%) is within the ranges reported for various potato varieties. The fiber in starch was 0.14%, higher than in some varieties, but still within acceptable ranges. The starch pH was 6.34, which is consistent with the expected values for native starches. The acidity of the starch was also within the proper ranges. (Bravo, 2020)

Table 2. Applications of Potato Enzyme in Industry Application.

Application in the Food Industry	**Description of Potentiality**
1. Thickener & Stabilizer	Potato starch is used as a thickening and stabilizing agent in products such as sauces, soups, and creams, improving texture and consistency.
2. Substitute for Fats and Oils	It can be used to reduce the amount of fats and oils in products such as biscuits and bread, providing a healthier option without compromising quality.
3. Gluten-Free	Being gluten-free, potato starch is an important alternative in the production of gluten-free foods, such as gluten-free bread, pasta, and snacks.
4. Bakery Products	It is used in the making of baked goods, such as cakes, cookies, and baked goods, to improve texture and prolong freshness.
5. Frying Products	Potato starch is used in the preparation of frying coatings, which provides a crispy exterior in foods such as French fries and chicken nuggets.

In conclusion, potato starch, derived from the *Solanum tuberosum plant*, is a valuable component in the food industry due to its functional properties and versatility. In addition to being a thickener, stabilizer, and gelling agent in various food products, potato starch also exhibits nutritional properties. It can enrich foods with additional dietary fiber content, suggesting its potential in creating healthy, functional foods.

Potato starch plays a crucial role in the food industry as an ingredient that improves the texture, consistency, and quality of various products. Its ability to gel at lower temperatures than other starches make it an ideal choice for food production that requires low-temperature processes, preserving the integrity of the ingredients. In addition, its nature of being a natural and readily available ingredient, derived from a widely grown crop, makes it an economical and sustainable option for manufacturers.

4. Conclusion

As interest in healthy and functional foods grows, there is growing research surrounding potato starch and its applications. The physicochemical characterization of the starch of the White Leona variety demonstrates that its properties are consistent with the expected standards, which opens the door to innovation in the creation of food products and materials. Future research could further explore its applications in the food industry and other fields, as well as optimize its extraction and use processes

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