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Obtaining Vegetable Oil from Sacha-Inchi (*Plukenetia volubilis*) by the Cold Pressing Method for Industrial Processing

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Abstract

For the production of sacha-inchi oil, in Ecuador, specifically in the city of Riobamba located in the province of Chimborazo, several unitary operations techniques were used, it was done in a filter press that works with a power of 6, 28 KW generating a temperature of 35 ° C. In the first stage of the process, a weighing was carried out in which a mass of 1.2 kg was obtained, which goes through the peeling and pickling process and immediately reweighs the raw material, obtaining a mass of 0.63 Kg, the same as enter directly to the filter press. The pressing and filtering process lasts about one hour, from which a volume of oil of 120 ml is obtained directly in which viscosity, density and organoleptic properties were measured, from which 35.4 MPa / s were obtained and 0, 9187 gr / cm³ respectively and its organoleptic characteristics were a yellowish color, a slightly spicy flavor, a greasy texture and a woody aroma.

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Keywords

Oil, Peanut, Sacha, Production, Unit operations.

Introduction

The Amazon is one of the potentially richest and most biodiverse areas in the world, within its plant varieties we find the Sacha Inchi, a seed native to this area that presents the highest contents of Omega 3 in relation to foods already known. There, and in the relative ease with which this plant adapts to new conditions, lies the importance and value of this plant (Flores, 2016).

As an oil, it is the best for domestic, industrial, cosmetic and medicinal human consumption, since it exceeds all the oils currently used, such as olive, sunflower, soy, palm, peanut, etc. The adequate consumption of Omega 3 allows to improve the cerebral irrigation, the memory and the nervous system. It also prevents arthritis, the formation of plaques in the arteries, thrombosis, high

blood pressure, diabetes, psoriasis, difficulty concentrating and memory disorders. It also allows to prevent and reduce cholesterol and cardiovascular problems (Manzaneda, 2016).

Sacha Inchi oil is obtained through a real process of extraction of cold pressing, using selected virgin seeds. This means that it is pressed manually and mechanically without using heat or chemical solvents to retain all its nutritional value, however, the friction between the worm mill and the raw material and the representative application of pressure in the press generate small amounts of heat. Subsequently a filtration process is carried out to eliminate any impurity and achieve the final product. The result is an extra virgin non-refined, organic oil, with a clear color and a pleasant

nutty flavor, very rich in nutrients and an excellent source of essential fatty acids (Ganoza, 2010).

Nowadays the knowledge that one has regarding the sacha is still precarious, but already they are beginning to take big steps in the fields of the production, transformation and commercialization; which have been the result of a little more than ten years of work and research with this crop. In this way, it is a relatively new crop option but it already has certain established bases so that it can begin to grow reliably (Kisuna, 2011).

Materials and Methods

Consideration is given to the handling of solid materials from peeling to pressing following the following operations:

Preparation of raw material

Decapsulated and dehusked

Perform with the purpose of eliminating the capsules and the husks that contain the seeds. Remove the shell of the Sacha Inchi by means of a nutcracker.

Balance of mass in the descapsulado and dehusked

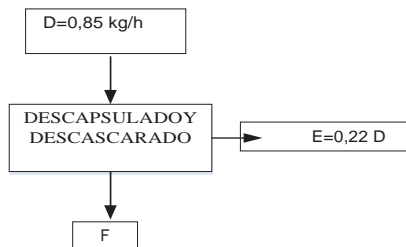


Figura.1 Diagram of the balance of mass in the descapsulado and dehusked

Capsules and shells of Sacha Inchi:

$$E = 0,85 * 0,22 = 0$$

$$F = D - E$$

Sacha Inchi peeled: $F = 0,85 - 0,19 = 0$

Selection of seeds

Eliminate the seeds from the process that may affect the quality of the final product, a discoloration of the seeds indicates the presence of microorganisms, which

accelerates the process of deterioration of a vegetable oil (Peri, 2014, p.115).

Mass balance in the selection

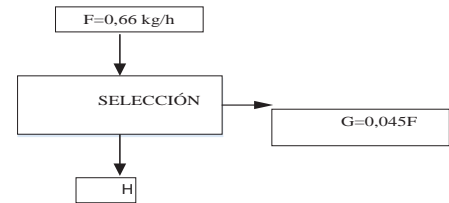


Figura.2 Diagram of the balance of mass in the selection of seeds

Unsuitable seeds (rotten, etc.):

$$G = 0,66 * 0,045 = 0$$

Seeds that continue in the process:

$$H = 0,66 - 0,03 = 0$$

Pesaje

Weigh the raw material, which is the Sacha Inchi capsules, which is processed in the oil extraction plant. To obtain 120 ml of Inchi sacha oil, approximately 635 g of already dehusked seed should be weighed.

Balance of mass at weighing

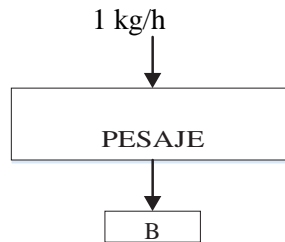


Figura.3 Diagram of mass balance in weighing

Raw material (sacha inchi): $A = B$:

Mass balance in cleaning

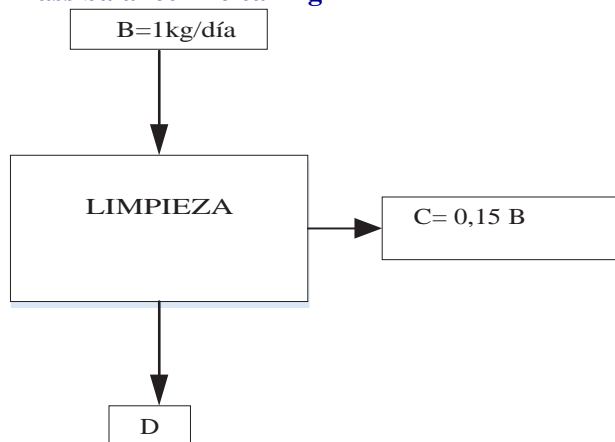


Figura.4 Diagram of mass balance in cleaning

Impurities (stems, leaves, earth, others):

$$C = 1 * 0,15 = 0$$

Sacha Inchi without impurities $D = 1 - 0,15 = 0$

Obtaining vegetable oil from Sacha Inchi

Mechanical pressing of the seeds

Use a continuous filter press made of stainless steel with 75 RPM and 240 W of power. Enter the seeds to the mouth of the press per unit and with a time difference of approximately 5 seconds for each seed

Mass balance in the pressing

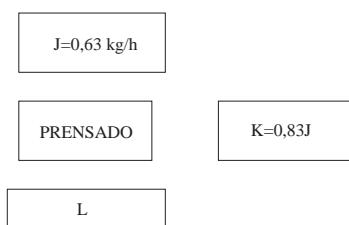


Figura.5 Diagram of mass balance in pressing

Cake: $K = 0,63 * 0,83 = 0$

Filtered oil: $0,63 * 0,52 = 0$

Filtration

After the filtration of the continuous filter press, remove the bagasse from the Sacha Inchi and wrap with a textile cloth filter media to avoid product loss.

Bottling

The bottling is done to store the oil before the final product is dispatched and to lengthen its useful life by reducing the contact of the oil with the air (Saravacos and Kostaropoulos, 2016, page 572). By means of a syringe, transport the obtained oil to plastic bottles and ensure the correct sealing.

Results and Discussions

In the first instance a survey was carried out that allowed us to carry out a survey on the product, therefore for the present project a total population of 225 741 inhabitants was obtained, from which a sample of 109 people was calculated through the formula described in The methodology. Then a series of questions were presented which were part of the survey, which have been analyzed later. Regarding the question about whether he has heard about Sacha Inchi or bush peanuts, 22% of respondents answered yes, while 78% answered no. As for the question about the consumption of a naturally extracted oil, 66% would consume the product and 34% would not consume it according to the physical characteristics of the Sacha Inchi. Average data were obtained such as: the weight of 45g, the central diameter of 3cm, the length of 2cm, the color of the pulp was green and the color of the green skin also. In addition, the organoleptic characteristics of Sacha Inchi oil as final product were: yellow color, light and pleasant smell and dry fruit flavor.

An economic study determines the monetary resources that are needed for the execution of the project, which will be the total cost of the activity (extraction and packaging); as well as indicators that will be the basis for the completion of the project, which is the evaluation of the price of the final product.

For the calculation of Costs of Execution and Preparation of the Budget several analyzes were carried out which were: the variable Costs in which direct raw material intervenes (seeds of Sacha Inchi, glass containers and labels) giving a value of \$ 2.06 and the hand of direct work giving a value of \$ 1.05, obtaining a final value of the unit variable cost of \$ 3.11. In the fixed costs, monthly values were obtained in which the indirect raw material (boxes, cartons, distribution and fuel) took part, giving a value of \$ 23, in the indirect labor (accountant, quality controller and marketing agent) giving a value of \$ 1514 and other fixed expenses (basic services, advertising, repairs, preventive maintenance and office

supplies) giving a value of \$ 240. Obtaining a total cost of \$ 4.30 of the product for which the margin of contributions was obtained with the 33% profit in which the sale price of the Sacha Inchi bottle was estimated in

the market giving a final value of \$ 5.71. In addition, the market rate of return was 7.53%, the net present value (NPV) was \$ 714.95 and the Internal Rate of Return (IRR) was 70%.

Tabla.1 Results of the mass balance in the process of obtaining Sacha Inchi oil

Components		Unit kg / day	Percentage by weight (%)	
Weighing: 1 kg / h (sacha inchi capsules)				
		1	100	
Cleaning: 1 kg / h Sacha inchi				
Impurities (leaves, stems, earth)		0,15	15	
Sacha inchi without impurities		0,85	85	
	Total	1		100
Decapsulated and dehusked: 0.85 kg / h sachu inchi without impurities				
Capsules and shells		0,19	22,35	
Sacha inchi peeled		0,66	77,65	
Total		0,85	100	100
Selection: 0.66 kg / h sachu inchi peeled				
Unsuitable seeds		0,03	4,55	
Seeds that continue in the process		0,63	95,45	
	Total	0,66	100	100
Pressed: 0.63 kg / h of seeds to be pressed				
Cake		0,52	82,54	
Filtered oil		0,11	17,46	
Total		0,63	100	100

SOURCE: Samaniego, Ashlyn. ESPOCH, 2019

According to (MAGAP, 2017), a kilo of Sancha Inchi seed costs approximately \$ 2.40 in the city of Napo while the cost of raw material obtained in the province of Pastaza is \$ 1.25 per kilo, reducing considerably the direct costs. In addition, the prices of packaging and labels were included, a unit sale cost of \$ 2.06 was obtained.

The monthly production that has been visualized to produce is that 1500 bottles of 200 ml being the monthly production cost of 3090.00 \$, unlike the project carried out in the National Polytechnic School where 6860 monthly units of 250 ml were produced obtaining a cost

of 4722.34 \$ since an extraction plant was used by means of cold pressing of greater dimension and that maintains the adequate temperature of 45 ° C although it is not necessary to use the cold pressing because it is not conditioned to a legal precept, it is say, oils can be marketed without having been subjected to this process. (Berrones, 2017).

Conclusion

Sacha Inchi edible vegetable oil was obtained by using a press-filter equipment that uses the unit operation of pressure filtration.

The mass and energy balance in the respective equipment for the extraction of oil was carried out, where it is indicated that there is an input of raw material and output, respectively where there is a cake of 0.45 Kg / h with a total filtered oil as final product of 150 ml.

The best conditions that allowed obtaining the highest yield in Sacha Inchi oil extraction were at temperatures below 50 ° C to comply with the acidity established in the NTE INEN 2688: 2014 Standard.

From the amount of raw material to be processed and the final quantity of oil obtained, the yield is 17.46%.

The oil obtained was characterized by applying the ball method and the pycnometer to determine the density and viscosity respectively of 35.4 MPa.s and 0.9187 g / cm³.

Recommendations

Perform a research and analysis on the product obtained to determine the amount of polyunsaturated fatty acids and bioactive components present.

Characterize and give some added value to the vegetable oil obtained, since this extracted product has a large number of beneficial properties for the living being.

Perform the study in which the unit operation filtered by pressure of the oil replaces the decanting of the oil by means of gravity, because this process considerably reduces the processing time.

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