

YIELD OF TOCOSH FLOUR IN TWO POTATO VARIETIES (SOLANUM TUBEROSUM) AND THEIR CHARACTERISTICS

Jorge Jave Nakayo

Universidad Nacional Mayor de San Marcos - UNMSM, Lima, (Perú).

E-mail: jorge.jave@unmsm.edu.pe ORCID: <https://orcid.org/0000-0003-3536-881X>

Verónica Espinel Pino

Universidad Técnica de Manabí, Manabí, (Ecuador)

E-mail: vespinel@utm.edu.ec ORCID: <https://orcid.org/0000-0002-7604-7599>

Jorge Luis López Bulnes

Universidad Nacional Mayor de San Marcos - UNMSM, Lima, (Perú).

E-mail: jlopezb@unmsm.edu.pe ORCID: <https://orcid.org/0000-0002-9583-1143>

Violeta Vega Ventosilla

Universidad Nacional Federico Villarreal – UNFV, Lima, (Perú).

E-mail: vvega@unfv.edu.pe ORCID: <https://orcid.org/0000-0002-7763-6993>

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ABSTRACT

In the present investigation it allows to demonstrate the yield of the flour of tocosh of two varieties of potato (*solanum tuberosum*) canchán and native variety of “calamarca The raw material was acquired in the district of Paucartambo province of Pasco department of Pasco, to 2880 msnm. For the experimental study the two varieties of potatoes were placed using as technique a pool with a water current with varied times, where the microorganisms act and increase their activity related to the acidity. The evaluation was made using the tukey trial to compare the two varieties, obtaining results for the native variety “calamarca” which had a fermentation time of 45 days to have all the conditions to be tocosh with a flour yield of 59.6% compared to the variety of canchán whose fermentation time was 31 days with a yield of 45%.

KEYWORDS

Tocosh, Yield, *Solanum tuberosum*, Potato, Calamarca, Flour.

1. INTRODUCTION

Potato is undoubtedly one of the most important crops in the country Peru has more than 5,000 potato varieties in terms of area planted (260,000 ha/year), number of producers who depend on it (600,000), contribution to the national economy (11.3% of agricultural GDP) and to the human diet (average consumption of 68.4 kg/inhabitant/year). Potato tocosh is a naturally processed potato for nutritional and healing purposes of traditional Peruvian medicine (Velasco-Chong, *et al.*, 2020). The potato is produced in 19 of Peru's 24 departments, which demonstrates its plasticity in terms of adaptation. As the centre of origin of the potato, Peru maintains a culture of diversity; for this reason, in the mountains, it is common today to find mixed agriculture with native and improved varieties (Velasco-Chong, *et al.*, 2020).

Straw or "ichu" and pressed mechanically with stones under a stream of water from a spring. This treatment gives products nutritional and therapeutic properties used only by those who know and consume them and which could be a natural alternative to alleviate, prevent or cure some diseases (Sandoval *et al.*, 2015), a product obtained thanks to butyric fermentation, while this product has an unpleasant smell, which is a limitation for its consumption in most of the population, this product offers a diversity of health benefits, which is why it is reason to study to find the solution for which this limitation should be a problem in consumer acceptance (Quispe *et al.*, 2020).

We will use two varieties, which will be placed, in a well with a stream of water in a varied time, in which microorganisms act that in turn will increase the activity related to acidity. It seeks to extend the life of a product, transforming it into another as is tocosh flour; evaluate the sensory and physicochemical properties. To make the comparison between two varieties that will produce results that can show us which of them has better properties; better yield and that ferments in less time (Carranza *et al.*, 2020).

We will determine the results based on tocosh in the varieties of potatoes Yungay and Conchán that come from the district of Paucartambo (Agricultural and Hydroelectric Valley) with an altitude of 2880 meters above sea level, province of Pasco in the department of Pasco.

2. METHODOLOGY

The raw material for this study was acquired from the district of Paucartambo province of Pasco department of Pasco, at 2880 meters above sea level the varieties of potato *solanum tuberosum* used are Canchan and native Calamarca.

For the experimental study were placed the two varieties of potatoes in a pool with a water current with varied times in order that the microorganisms act and increase their activity related to the acidity.

The parameters considered for the elaboration of the tocosh were: ambient temperature between 10 and 18 °C Water temperature between 5 and 15 °C average storage time 30 days H 6.0 ± 2.0 (Alvarado *et al.*, 2020).

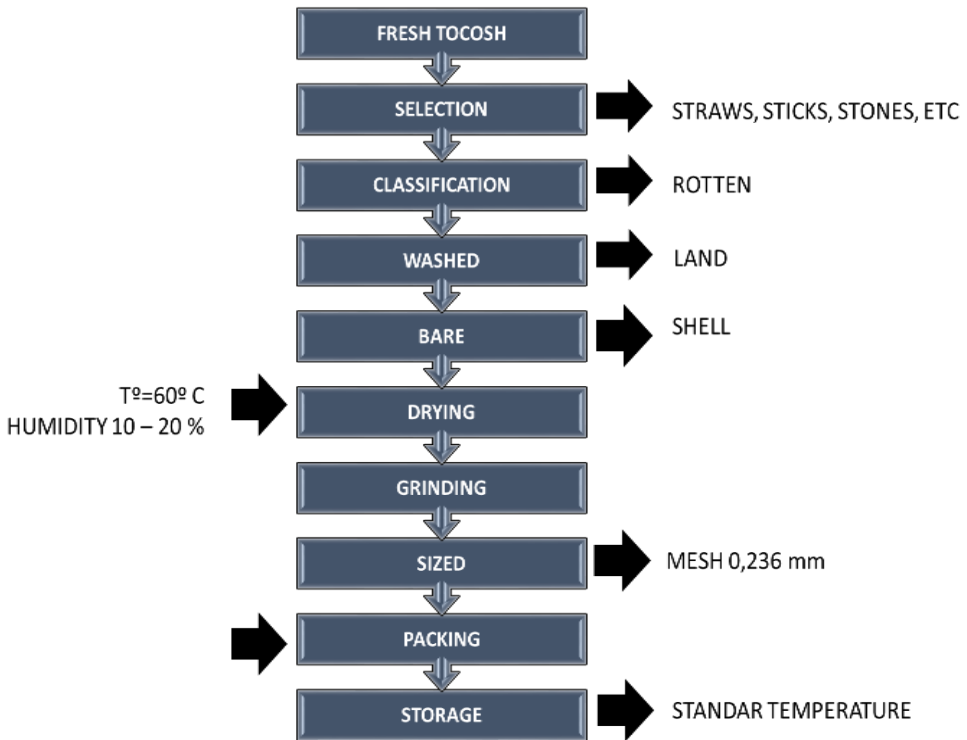


Figure 1. Flowchart of tocosh flour processing (self-made source).

Figure 1 shows the unit operations for the processing of tocosh of the two varieties under study by which the results for the present study will be obtained.

3. RESULTS

The yield in the production of tocosh flour obtained with the flow of tocosh flour processing figure 1 for each variety of potato in the study was: 59.60%, for the native variety 45%, variety of canchan.

The fermentation time for the native variety was 45 days and for the canchan variety was 45 days.

Table 1. Evaluation of physicochemical characteristics during fermentation (Canchan variety).

Control		General appearance	Smell	Ph	T
1	14/04/2019	Smooth shell with hard consistency, characteristic of the potato.	Characteristic of the potato	6.56	9°C
2	21/04/2019	Soft shell of soft consistency	Strong fermentation odor	6.40	9°C
3	28/04/2019	Soft shell with soft consistency	Strong fermentation odor	80	9°C
4	05/05/2019	Soft shell with soft consistency	Strong fermentation odor	5.20	9°C
5	12/05/2019	Robust housing with soft consistency, tocosh feature	Tocosh feature	4.70	9°C

Table 1 shows the evaluation of the physicochemical characteristics during fermentation (Canchan variety), the dates of the controls of its structural changes and its odours, the pH and the temperatures of each sample.

The fermentation of the Canchan potato variety in the production of tocosh flour begins at a pH of 6.56 and ends at a pH of 4.70.

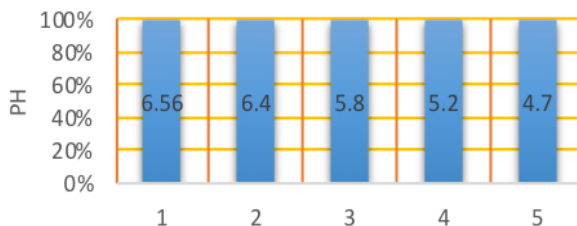


Figure 2. PH variation at 9°C - PAPA CANCHAN.

In Figure 2, the general appearance and smell of the potato changes during the fermentation process; starting the fermentation of the potato in study with smooth skin, hard consistency and characteristic smell of fresh and finished potato.

Table 2. Evaluation of physicochemical characteristics during fermentation (native variety).

Control		General appearance	Smell	Ph	T
1	14/04/2019	Smooth shell with hard consistency, characteristic of the potato	Characteristic of the potato	6.88	9oC
2	21/04/2019	Characteristic of the smooth potato peel of soft consistency	Strong fermentation odor	6.30	9oC
3	28/04/2019	Smooth, hard consistency shell	Strong fermentation odor	6.15	9oC
4	05/05/2019	Smooth, hard consistency shell	Strong fermentation odor	5.90	9oC
5	12/05/2019	Soft rough skin.	Strong fermentation odor	5.60	9oC
6	19/05/2019	Rough shell with a soft consistency.	Strong fermentation odor	5.00	9oC
7	25/05/2019	Rough shell of soft consistency.	Strong fermentation odor	4.50	9oC
8	01/06/2019	Roughened shell of soft consistency.	Tocosh feature	4.15	9oC

Table 2 shows the evaluation of the physicochemical characteristics during fermentation (Nativa variety), the dates of controls of its structural changes and odours, the pH and temperatures of each sample.

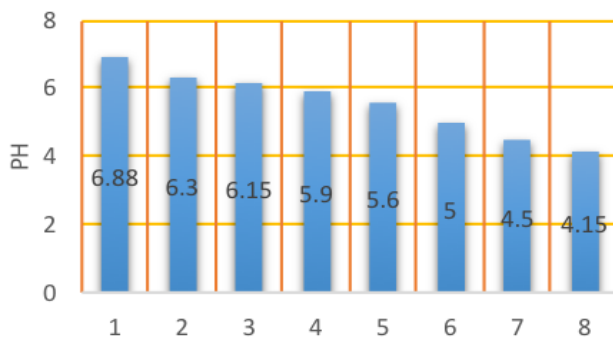


Figure 3. PH variation at 9°C - NATIVE POTATO.

Figure 3 shows that the general appearance and odour of the potato changes during the fermentation process; the two varieties of potatoes under study with smooth skin, hard consistency and odour characteristic of fresh and finished potatoes start to ferment.

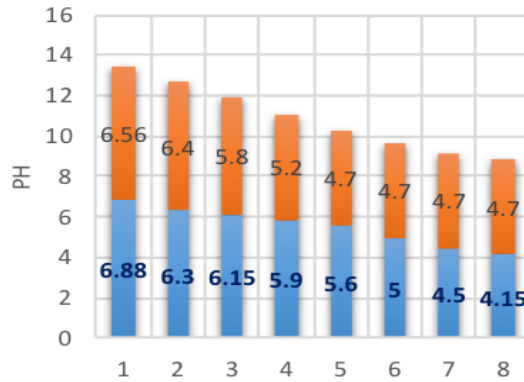


Figure 4. PH comparison PAPA NATIVA vs. CANCHAN.

In Figure 4 we can see the comparison of the two varieties of parasites used in the experiment, also seeing the values between the two varieties there is a significant difference.

Table 3. Analysis of variance, Tukey “flavour attribute”.

SOURCE	GI	SC AJUST.	MC AJUST.	VALUE F	PROBABILITY VALUE	VALUE P
Factor	1	3.125	3.1250	4.52	7,1043E-19	0.042
Error	30	20.750	0.6917			
Total	31	23.875				

In Table 3, the comparison of the treatments of the two potato varieties by Tukey’s taste attribute test, it is observed that the T2 treatment (tocosh - made from the native potato) statistically has a difference with the T1 treatment (tocosh made from the canchan potato), which means that the T2 treatment has better organoleptic attributes on average than the T1 treatment.

Table 4. Analysis of Variance, Tukey “consistency attribute.

SOURCE	GI	SC AJUST.	MC AJUST.	VALUE F	PROBABILITY VALUE	VALUE P
Factor	1	6.125	6.1250	7.86	7,1043E-19	0.009
Error	30	23.375	0.7792			
Total	31	29.500				

Table 4 shows the comparison of the treatments of the two potato varieties by Tukey’s consistency attribute test. It is observed that the T2 treatment (tocosh made from native

potato) has a statistical difference with the T1 treatment (tocosh made from canchan potato). This means that the T2 treatment has better organoleptic attributes on average than the T1 treatment.

Table 5. Analysis of Variance, Tukey "appearance attribute.

SOURCE	GI	SC AJUST.	MC AJUST.	VALUE F	PROBABILITY VALUE	VALUE P
Factor	1	2.531	2.5312	4.48	7,1043E-19	0.043
Error	30	16.938	0.5646			
Total	31	19.469				

In Table 5 the comparison of the treatments of the two varieties of potatoes by Tukey's test of the general appearance attribute, it can be seen that the T2 treatment (tocosh made from native potato) has a statistical difference with the T1 treatment (tocosh made from canchan potato), which means that the T2 treatment has better organoleptic attributes on average than the T1 treatment.

The result obtained from the organoleptic attributes of the two potato varieties applying the tukey test statistic found that the T2 treatment corresponding to the native potato variety presents on average better organoleptic attributes than the T1 treatment (tocosh made from canchan potato).

4. DISCUSSION

4.1. FROM THE STUDY OF THE FERMENTATION OF EACH POTATO

Variety of physicochemical characteristics. In this sense, the potato experiences a decrease in pH until it obtains the tocosh and therefore an increase in acidity (Machaca & Mamani, 2020). Tocosh comes from a fermentation process (Andean technique), which is suitable for distribution and consumption in the different markets of Peru as flour or in its raw form. On the other hand, the amount of glycoalkaloids are related to the cultivation method, storage and temperature, depending overall on the Andean techniques destined for its production and can be distributed in different rates in *Solanum tuberosum* tubers, they have been found in the tuber (smaller quantity), leaves and peel (greater quantity), and some

analysis showed quantities such as 300–600 mg/kg in peel, 2000–4000 mg/kg in buds, and 3000–5000 mg/kg in flowers.

As for changes during the fermentation process of the general appearance and smell of the potato. The phenomenon of transformation of the potato Tocosh loses water and its volume is reduced by about half with the exception of the skin, therefore the Tocosh skin is rough “wrinkled” and the consistency soft; on the other hand, after the fermentation process, it achieves a very peculiar smell that is unpleasant, being less pronounced at the end of fermentation (Velasco-Chong, *et al.*, 2020).

4.2. FERMENTATION TIME FOR EACH POTATO VARIETY

The fermentation of the potato in the production of tocosh should last from 30 to 90 days depending on the variety, size of the potato and the temperature of the water (Bustos, 2018).

Considering that the potatoes of each variety studied had uniform sizes and fermented in continuous pools with the same conditions in terms of water temperature. You could “make sure that the difference in fermentation time is due to the particular characteristics of each potato variety used in the study (Barrera *et al.*, 2018).

4.3. YIELD OF FRESH TOCOSH AND TOCOSH FLOUR BY POTATO VARIETIES UNDER STUDY

Machaca and Mamani (2020) mentions that the yield in tocosh production is 30 to 45%, depending on these values of the potato variety used. The variety with the highest solids, including the highest amount of starch, will have a higher yield in obtaining tocosh.

On the other hand, indicates that the yield per process in obtaining tocosh flour is 35 to 60% depending on the humidity of the flour desired. Tocosh flour, like other flours, must contain a maximum of 12% humidity to guarantee its conservation.

According to the above, we can say that the yield of the process in the production of tocosh for each variety of potato in study is 33.80 to 53.00%. While the yield per process in the

production of tocosh flour is 42.80 to 60.00%; which are within the range established by the mentioned authors (Sandoval *et al.*, 2015).

The tocosh flour did not present toxicity at the repeated dose for 28 days in the highest dose corresponding to 1000 mg/kg BW. There were no deaths at up to 5000 mg/kg BW, therefore, the oral LD50 was greater than 5000 mg/kg (Velasco-Chong, *et al.*, 2020).

5. CONCLUSIONS

The fermentation time of each variety of potato was: in the court 30, native 45 days. And the tocosh obtained from the native potato variety has better sensory characteristics than the other treatments under study (taste, smell, consistency and overall appearance), obtaining the qualitative qualifier I am very pleased according to the qualification of the panelists.

The potato variety with the highest process yield in obtaining tocosh is the native variety with 53.3%, followed by the canchan variety with 50.1%

The potato variety with the highest process yield in the production of tocosh flour is the native variety with 59.6%, followed by the variety Canchan 45.00%.

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