



Instant milk drink based on green plantain (*Musa paradisiaca* L.) and milk

Bebida láctea instantánea a base de plátano verde (*Musa paradisiaca* L.) y leche

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RESUMEN

El plátano verde (*Musa paradisiaca* L.) es una fruta, que se cultiva en diversas regiones del Perú, representa una fuente de alimento diario delicioso, nutritivo y muy solicitado en las regiones de la selva. Por tal motivo, se propuso aumentar su vida útil y valor nutricional elaborando una bebida instantánea y enriquecida con azúcar y leche fresca. Se hicieron tres formulaciones: F₁ (P_{liof} = 0,045 mbar, T_{cong} = -20 °C y t_{liof} = 20 h), F₂ (P_{liof} = 0,120 mbar, T_{cong} = -25 °C y t_{liof} = 10 h) y F₃ (P_{liof} = 0,200 mbar, T_{cong} = -32 °C y t_{liof} = 30 h) con 13,53%, 11,11% y 9,09% de materia prima respectivamente; se evaluó sus propiedades sensoriales y finalmente la composición fisicoquímica de la mejor formulación. Los resultados indicaron que para obtener la bebida instantánea liofilizadas se debe efectuar a una temperatura de congelación de -20 °C, presión de liofilización de 0,045 mbar y tiempo de liofilización de 20 horas y con una formulación de 13,53% de plátano verde variedad inguiri, 54,66% de leche, 18,15% de azúcar y 13,66% de agua. La bebida instantánea liofilizada presenta un 3% de humedad, 4,71% de proteínas; 87,98% de carbohidratos; 0,29% de fibra; 2,39% de grasa y 1,3% de cenizas. En conclusión, la formulación permitió obtener un producto con propiedades químicas, físicas y sensoriales de buena calidad para el consumo humano.

Palabras clave: *Musa paradisiaca* L.; bebida instantánea; harina liofilizada.

ABSTRACT

The green banana (*Musa paradisiaca* L.) is a fruit, which is grown in several regions of Peru, it represents a delicious, nutritious and very satisfying daily food source in the jungle regions. For this reason, it was proposed to increase its shelf life and nutritional value by making an instant drink and enriched with sugar and fresh milk. Three formulations were made: F₁ (P_{liof} = 0.045 mbar, T_{cong} = -20 °C and t_{liof} = 20 h), F₂ (P_{liof} = 0.120 mbar, T_{cong} = -25 °C and t_{liof} = 10 h) and F₃ (P_{liof} = 0.200) mbar, T_{cong} = -32 °C and t_{liof} = 30 h) with 13.53%, 11.11% and 9.09% of raw material respectively; its sensory properties were evaluated and finally the physicochemical composition of the best formulation. The results indicated that for obtaining the lyophilized instant drink should be carried out at a freezing temperature of -20 °C, lyophilization pressure of 0.045 mbar and lyophilization time of 20 hours and with a formulation of 13.53% green banana inguiri variety, 54.66% milk, 18.15% sugar and 13.66% water. The freeze-dried instant drink presents 3% moisture, 4.71% protein; 87.98% carbohydrates; 0.29% fiber; 2.39% fat and 1.3% ash. In conclusion, the formulation of obtaining a product with chemical, physical and sensory properties of good quality for human consumption.

Keywords: *Musa paradisiaca* L.; instant drink; freeze-dried flour.

1. Introduction

The banana is considered within the world's most important crop. Consumed in many countries of the Caribbean, Central America, and South America. In Peru, it is cultivated mainly in the eastern zone, 71.5% of the cultivated areas are located in the jungle region, 22% in the northern coast (Piura and Tumbes) and 6.5% in different

departments of the country. This fruit has an excellent combination of minerals, vitamins and energy, with almost no fat and a low protein content. Among the numerous minerals contained in bananas, we can highlight potassium, iron, phosphorus and calcium, these minerals being present in a higher amount than other minerals contained in the fruit. In addition to this,

we can also name the most representative vitamins, these being vitamin B1, B2, B6 and C (La Rosa, 2016).

Currently, the pace imposed by modern life has allowed the development of new food trends that require products easy to prepare, mainly, instant type, however it is requested that these must provide a nutritional value and a beneficial contribution to human health. The elaboration of some of these products is carried out through the lyophilization process, a drying process through sublimation that allows to prolong the time of the useful life of the food conserving the physical properties related to the quality (Abdelwahed et al., 2006), reduces the losses of the compounds responsible for flavor and aroma in foods, which are lost during conventional drying processes (Orrego, 2008).

The lyophilization process consists mainly of two steps; the first consists of freezing the product and in the second step the product is dried by direct sublimation of the ice under reduced pressure. Sublimation occurs when the vapor pressure and the ice surface temperature are below the triple point of the water (Song et al., 2005).

Among the products obtained through lyophilization are instant milk drinks, which are powdered or granulated dehydrated mixtures, made with a minimum ratio of 30% milk in the final product (Pérez and Pacheco, 2005). It may contain aggregates of other permitted food use ingredients, including cereals, sugars, fruit flavorings, chocolate, vanilla, sweeteners, fruits or dehydrated vegetables.

In previous research, Pacheco et al. (2008) elaborated powdered mixtures for instant milk drinks from unconventional flours such as pre-gelatinized banana flour (*Musa* sp) and rice bran (*Oryza sativa* L.), resulting in good sensory acceptance, attributed according to the authors to the balanced ratio of the mixture of these flours (25 and 12.8% respectively), which was qualified as a food with nutritional and caloric potential, by the moderately high content of proteins (7.25%), dietary fiber (12.8%) and the proportions of total sugars (49.5%), rather than total starch (23.7%), respectively, and the presence of the rest of the constituents, such as fat (1.56%), ash (3.80%) and particularly resistant starch (2.05%).

Based on the above, the objective of this work was to make a freeze-dried instant drink based on plantain, enriched with sugar and fresh milk, evaluating the chemical, physical and sensorial

characteristics. Allowing the development of a food easy to prepare for those people who have little time and need to prepare their products quickly.

2. Material and methods

Place of work execution

The experiments were carried out in the laboratories of Food Analysis and Composition and Research Laboratory of the Faculty of Agroindustrial Engineering of the National University of San Martín - Tarapoto.

Raw material and supplies

The following ingredients were used as raw material. Green banana Variety inguiri (*Musa paradisiaca* L.) from the district of Cacatachi province of San Martín Department of San Martín, better known as the common green banana because it is the most consumed by the population for the lowest price and this one is found in greater quantity in the markets, warehouses, etc., the green state of the raw material is fundamental for this type of drink since when combined with fresh milk a pleasant and characteristic flavor is obtained.

Fresh milk from the district of Cuñumbuque belonging to the province of Lamas department of San Martín. Milk commonly has a yellowish white color, but when water has been added or skimmed, the color is bluish white. The intensity of the color is due to the greater or lesser content of fat, casein (milk protein), carotenes (dyes that are found in green herb). In the milk can be observed accidental colorations, such as: a pink coloration due to the presence of blood and others due to the contamination of microorganisms, the smell is characteristic and reminiscent of the predominant food that is given to cows, this smell is appreciated in freshly milked milk.

Preparation of a lyophilized instant drink based on green banana and milk

Reception of the Raw Material: It is done with the objective of controlling the weight and to examine that raw materials are healthy, clean and in good condition to process them. It is very important that all products showing signs of decomposition be discarded at that time.

Selection and classification: After receiving the green banana, a careful selection is made of the best bananas that meet the necessary quality characteristics, such as the state of green maturity and without any damage or deterioration of the product.

Washing and Peeling: proceeded to wash the

bananas in abundant water by submerging and rubbing them manually in order to remove any impurity that has been impregnated in the banana peel, then with the help of a knife the whole shell is removed.

Cut: Once obtained the banana without shell and pure pulp we cut it into slices to facilitate liquefying.

Liquefied and Mixed of Inputs: liquefy the green banana with a little water, later we mix with the fresh milk and the sugar and we return to liquefy to obtain a homogenous mixture.

Cooking: The purpose and importance of cooking is to eliminate any type of microorganisms that may alter the quality of the product and that the drink can be assimilated by consumers.

Sifting 1: The first sifting is done with the purpose of separating lumps or particles that have not completely dissolved.

Chilled: The beverage is cooled so that it can be handled at the moment of placing in the lyophilizer containers as they are immediately introduced to the freezer

Frozen: The frozen is made with the purpose of immobilizing the free water of the food so that it can pass to the process of sublimation.

Lyophilized: The product was lyophilized with the purpose of making this drink a quick preparation food as well as giving it a longer shelf life while preserving its organoleptic and nutritional properties.

Crushing: After lyophilizing the drink, the resulting dry beverage layers are obtained, which is then crushed to powder.

Sifting 2: The second sifting is done with the dry and crushed product in order to homogenize the particles for a quick dissolution and rehydration of the drink and thus avoid lumps in the drink at the time of consumption.

Packaging and Sealing: The packaging and sealing is done immediately after sifting to prevent the product from gaining moisture, it is very important to seal the product well and in the appropriate packaging in this case we use aluminized paper in such a way to avoid any kind of contamination or hole that could damage the quality of the final product.

Storage: It is very important to store the final product in a cool and dry place to avoid rapid deterioration.

Physical-chemical determinations of the raw material

The chemical physical analyzes of the green banana of the variety "ingui" (*Musa paradisiaca* L.) were carried out as the main raw material of this product.

Determination of banana yield

It was made in the representative raw material as is the green banana of the variety ingui (*Musa paradisiaca* L), by the balance of matter taking into account the weight of the shell, based on 1 cluster of green banana, composed of 8 segments, and each segment composed of 8 average units, corresponding to 140 g, the approximate weight of each unit.

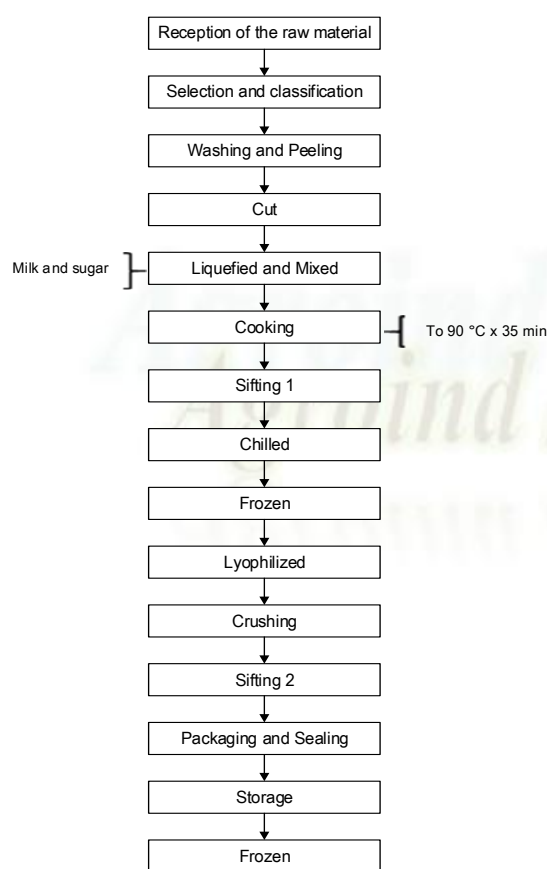


Figure 1. Preparation of a lyophilized instant drink based on green banana and milk.

Physico-chemical analysis

In the raw material green banana ingui variety (*Musa paradisiaca* L.) were determined the percentage of protein, fiber, moisture, ash, total fat and carbohydrates, using the following methods.

- Determination of total proteins: The kjeldahl method was used.
- Determination of fiber: It was carried out by the Henneberg method by Acid-Alkaline hydrolysis.

- Determination of humidity: By the method of drying in an oven at 105 °C until constant weight.
- Ashes determination: By incineration of the sample in muffle at 550 °C for 24 hours.
- Determination of total fat: It was performed by the Soxhlet method using petroleum ether as solvent.
- Determination of carbohydrates.

Sensory, physicochemical and microbiological analysis of the final product

The lyophilized instant drink based on green banana with milk and sugar was sensory evaluated to find the ideal formulation for this product, in addition to the physical chemical and microbiological analyzes performed.

Sensory analysis

The sensory evaluation was carried out with the participation of a control panel of 10 semi-trained people. Using the ordering and preference test to choose the sample most accepted by consumers.

Sorting Test: This test was used to evaluate the quality attributes of color, smell and taste of the 6 samples (F1, F2, F3, F4, F5 and F6) using 10 semi-trained judges and the rating scale was 1 - 6 (best sample - worst sample). To establish the best sample for the instant drink as a result, they were subjected to analysis of variance (ANVA) and Tukey test at a significance level of 5%.

Preference Test: The 3 formulas selected by the ordering test were evaluated in terms of the degree of preference using 10 semi-trained judges and the rating scale of 1 - 3 from highest to lowest preference respectively. To determine the ideal formula of the drink with greater preference, the results were subjected to ANVA and Tukey test at a level of significance of 5%.

Physical - Chemical Analysis

Like the raw material, the physical-chemical evaluation of the lyophilized instant drink was carried out, carbohydrates, proteins, fiber, humidity, ash and total fat were determined.

Microbiological analysis

The lyophilized instant drink as a final product was subject to microbiological control to determine the presence of any undesirable microorganism that could alter the quality of the product, thus performing the analysis of *Escherichia coli*, *Bacillus cereus*, *Staphylococcus aureus* (CFU/g), Mesophilic Aerobios (CFU/g), *Salmonella* sp (in 25 g), according to

what is established for lyophilized products. According to NTS No. 071 MINSA / DIGESA-V.01 RM. N° 591-2008 / Minsa for dehydrated products (freeze dried, concentrates, mixtures) for instant use, which do not require cooking.

Experimental design

The procedures followed for the determination of technological parameters for the preparation of the instant drink were the lyophilization pressure, the freezing temperature and the lyophilization time, for which 3 formulations were made for each raw material in order to find the formula that gathers all the necessary characteristics for this drink and that is pleasing to the consumer.

Table 1

Definitive formulations for the elaboration of the instant drink based on green banana, milk and sugar

Raw materials and supplies	Formulations		
	F1 (%)	F2 (%)	F3 (%)
	$P_{liof} = 0.045$	$P_{liof} = 0.120$	$P_{liof} = 0.045$
	mbar	mbar	mbar
	$T_{liof} = -20\text{ °C}$	$T_{liof} = -25\text{ °C}$	$T_{liof} = -32\text{ °C}$
	$T_{liof} = 20\text{ h}$	$T_{liof} = 10\text{ h}$	$T_{liof} = 30\text{ h}$
Banana	13.53	11.11	9.09
Sugar	18.15	13.66	13.73
Water	13.66	37.61	38.59
Fresh milk	54.66	37.61	38.59
Total	100	100	100

Statistical design

The completely randomized design was completed with 3 treatments and 10 repetitions for each of the treatments. Two sensory tests were designed to objectively describe the organoleptic quality, as well as to obtain a satisfactory and constant level of quality made by the group of semi-trained panelists:

1. In the first test, the attributes of organoleptic quality of the lyophilized instant drink based on green plantain, milk and sugar more or less standardized were evaluated comparatively, considering the existence of 3 treatments for a type of product.

2. In the second test, the attributes of organoleptic quality of the lyophilized instant drink based on banana flour, milk and sugar, also more or less standardized, were evaluated comparatively, considering the existence of 3 treatments for a type of product.

As a result of the 2 designs, various analysis of variance between the treatments have been carried out, which indicate whether the discrepancies recorded between the treatments for both tests are significant or are due to chance. These analyzes were made based on

the score given by the panelists when evaluating the color, smell and taste, for each product. Similarly, in order to achieve a detailed analysis of these results, the Tukey significance limit test was carried out.

3. Results and discussion

Physicochemical analysis of raw materials and supplies

In Table 2, the results of the physical chemical analysis carried out on the banana in the green state of the inguiri variety (*Musa paradisiaca* L.) are shown.

Table 2

Chemical composition of the green banana variety "inguiri" (*Musa paradisiaca* L.)

Components	Quantity
Energy (kcal/100g)	129.00
Carbohydrates (%)	27.68
Proteins (%)	2.42
Fiber (%)	9.52
Humidity (%)	58.34
Ashes (%)	1.09
Total fat (%)	0.95
Soluble solids (%)	3.00

According to the physical and chemical analysis performed on the green banana variety inguiri, it obtained a caloric value of 129 kcal / 100 g; 2.42% of proteins; 9.52% fiber, unlike that reported by Agapito (2010) who considered 152 kcal / 100 g, 4% protein; 0.8 fiber, this difference is possibly due to the variety of green banana that this author considers. For the present work *Musa paradisiaca* L. variety inguiri was used while the author used Cavendish variety.

Likewise, for milk the physicochemical analyzes are observed in Table 3.

Table 3

Chemical composition of fresh milk

Components	Quantity
Humidity (%)	88.0
Proteins (%)	3.6
Fat (%)	3.0
Carbohydrate (%)	4.9
Fiber (%)	0.0

Sensory analysis of lyophilized drink

The three formulations (F1, F2 and F3) were subjected to a sensory evaluation of preference, in order to obtain the ideal formulation for the elaboration of this instant drink, obtaining the highest acceptance values for F3.

Table 4

Sensory evaluation of instant milk drink preference

Judge	F1	F2	F3
1	1	2	3
2	2	1	3
3	1	3	2
4	1	3	2
5	1	2	3
6	1	2	3
7	1	2	3
8	1	2	3
9	1	2	3
10	2	1	3
TOTAL	12	20	28
N° observ.	10	10	10

Of which it is possible to be emphasized that the formulation F3, obtained a qualification of 2.8 points (1st position), attributed to a better presentation and preference by the panelists at the end of the evaluation of each one of the attributes of quality of the instantaneous drink.

Physical-chemical analysis of the instant milk drink

In Table 5 the results of the physical chemical analysis of the instant drink based on green banana variety inguiri (*Musa paradisiaca* L.) with milk and sugar, corresponding to the formulation F3, can be observed.

Table 5

Physical - Chemical Analysis of the lyophilized instant drink based on green banana with milk and sugar

Components	Quantity
Carbohydrates (%)	87.98
Proteins (%)	2.39
Fiber (%)	0.29
Humidity (%)	3.0
Ashes (%)	1.63
Total Fat (%)	2.39

Table 5 shows the physicochemical characteristics of the most preferred beverage selected, which was characterized by having a moisture content of 3.0%, which was found within the maximum limit of 5% specified for instant powdered drink mixes. Indicated in the Covenin norm n° 2125 (3) (García and Pacheco-Delahaye, 2010). Additionally, this result tends to the average interval reported by Pacheco et al. (2004) from 3.10 to 3.24% in beverages based on unconventional green plantain flours, although it was lower than the humidity range of 6.80 at 7.00%, determined in a milk drink with the incorporation of the extruded flour of yam (*Dioscorea alata*) expressed by Pacheco et al. (2008), and by the indicated up to 3.5% in a milk

drink based on cereals fortified with vitamins and minerals, referred to by Vera et al. (2009). The low moisture content was considered ideal for powdered products to maintain the high capacity of rehydration and hygroscopicity of the mixture, as reported by the aforementioned authors; Although from the operational point of view, this condition can cause problems during the mixing of the ingredients and maintain the proper dispersion of the same for packaging, as a consequence of the ease of the material to absorb water from the environment and quickly clumping as explained by Marin et al. (2006).

Microbiological analysis

The microbiological analysis was carried out in order to determine the presence of groups and concentrations of microorganisms that could damage or alter the quality of the product. The results can be seen in Table 6.

Table 6

Microbiological analysis of the lyophilized instant drink based on green banana with milk and sugar

Determinations	Permissible	Results
<i>E. Coli</i> numbering (CFU/g)	102	<100
Mold numbering (CFU/g)	102	<100
<i>Staphylococcus</i> (CFU/g)	102	<100
<i>Bacillus cereus</i> (CFU/g)	103	<100
<i>Salmonella</i> sp en 25 g	---	Absence

According to the results obtained in the microbiological analysis of the final product, it can be observed that the product is within the permissible limits acceptable for consumption according to NTS No. 071 MINSA / DIGESA-V.01 RM. N° 591-2008/Minsa for dehydrated products (lyophilized, concentrates, mixtures) for instant use, which do not require cooking.

Results of the sensory tests formulated by the completely randomized design

As a final product, the lyophilized beverage was obtained instantaneously to be rehydrated immediately, with the following measures for its preparation: 6 small teaspoons equivalent to 42 grams in 250 ml of boiled water.

From the ordering test the three (03) formulations (F1, F2 and F3), obtained the lowest points this indicates that they obtained the first three places, as far as preference of the panelists were the best samples in the 1st place the F1; in the 2nd place = F2 and in the 3rd place = F3, in the three parameters were the best samples.

Table 7

Analysis variance test of preference for the instant lyophilized beverage based on green banana with milk and sugar

Source of variation	S.C.	G.L.	C.M.	F _{cal.}	F _{tab.}
Treatments	12.8	2	6.4	5.33	5.14
Error experimental	7.2	6	1.2		
Total	20.0	8			

As for the color, smell and taste, of the freeze-dried instant drink based on green banana, milk and sugar, they show superiority and preference in terms of their quality attributes compared to the formulations F4, F5 and F6 followed by a very low preference.

This difference is highly significant as corroborated by the respective analysis of variance, where the value of F_c is greater than the values of F_t, which is verified by the test of tuckey, that the treatments F1 vs F2; F2 vs F3, are significant.

On the other hand, when comparing the average of treatments F3 vs F2; F2 vs F1 are not significant. As the difference between the averages of the experiment is greater than the A.L.S (W), it can be said with statistical certainty that there is superiority of preference of one treatment over the other; what does not happen when comparing the average of treatments; showing us that they are not significant.

There is not much difference in relation to parameter 01 and 02 regarding the degree of preference of the panelists since the F4, F5 and F6 maintain their position in the last positions as the worst samples in terms of taste, color and smell due to preference of The panelists being very clear the results can be appreciated that the samples made with fresh mass of green plantain were the most preferred by the panelists thus giving them the first three places of preference with the three parameters.

Regarding the color, smell and taste, the instant drink based on banana flour, milk and sugar, show a nice cream color, but with respect to the smell is very unpleasant in dry sample, due to these characteristics was not preferred by the public consumer.

4. Conclusions

The technological parameters for obtaining the lyophilized instant drink based on green banana variety inguri with milk and sugar with freezing temperature (-20 °C), lyophilization pressure (0.045 mbar) and lyophilization time (20 hours). This drink has 3% humidity, 4.71% protein,

87.98% carbohydrate, 0.29% fiber, 2.39% fat and 1.3% ash.

Likewise, according to the results of the physico-chemical and microbiological analyzes, it can be confirmed that the product is reliable and of good quality for human consumption. Therefore, it can be affirmed that they are feasible to be industrialized and commercialized.

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