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# Licuri Milk Production and Conservation Treatments

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***Keywords*** *— **Almonds, Pasteurization, Licuri, Vegetable milk, Vitamins.***

***Abstract*** *— The licuri milk is obtained from the almonds of the palm tree, which is widely distributed in the Caatinga biome, occurring mainly to the east of the São Francisco River. The objective of the research was to identify the main parameters for the conservation of vegetable milk from licuri and the most suitable method to increase the shelf life of the milk. Quality control analysis were carried out in order to determine purity, pH, acidity and colorimetric index using methods from the IAL Food Manual. The results obtained showed that the treatment in sample B (pasteurization at 90ºC for 30 minutes) was significant compared to the other treated samples. From a chemical point of view, it was observed that treatment B prevented major changes in the milk, demonstrating that pasteurization is a viable treatment for increasing the shelf life of vegetable milk.*

## I. INTRODUCTION

The licuri tree is a natural palm from the Brazilian territory, its fruits are almonds that belongs to the *Arecaceae* family known botanically as *Syagrus coronata* (Martius) Beccari, the plant has 115 genera and 1550 species [1]. It occurs as spontaneous vegetation in the semiarid of the states of Pernambuco, Alagoas, Bahia and in the northern region of Minas Gerais [1]. In different regions of Brazil, the almonds of the licuri tree are also known as Alicuri, Aricuri, Nicuri and Ouricuri. The size of the plant can change according to the conditions of the region and the present nutrients in the soil, reaching up to 8 meters in height per 1 meter of crown [2].

The fruit of this species has a drupe with abundant endoderm, ovoid and fleshy, before ripening, its endosperm is made up of a liquid that becomes solid throughout the ripening process. At the end of this stage, the fruit presents a color that varies from light yellow to orange and, as a characteristic, ripe fruits have a yellow, sticky and sweetish pulp [3]. Inside the fruits, the dry seeds have a dark color and a hard tegument, which coats the almond rich in oil. Fruiting occurs throughout the year; however, May and August are the best in terms of quantity and quality. At the same time, the fruiting phenomenon of licuri occurs during a long period of the year and is correlated with rainfall, which varies from place to place, constituting an important factor to ensure the supply of fruits throughout the year [4].

The milk from licuri almonds is obtained in an artisanal and extractive way, mostly by residents and cooperatives in the Caatinga region of northeastern Brazil [1]. This raw material contains 83.2% of saturated fatty acids, a value higher than the saturated fatty acids of coconut milk (*Cocos nucifera*) and palm (*Elais guinensis*), which presents, respectively, on average, 80% and 50%; and compared to other vegetable milks, they revealed an average percentage of saturated fatty acids below 25% [5]. According to Queiroga et al. [6], in addition to saturated fatty acids, almonds have a high lipid content, around 49% (11.5% of the almond consists of lipids) and 13.2% of total carbohydrates in the fruit pulp. According to Ramalho [5], the pulp of licuri milk can be consumed *"in natura"*, or

even used in the preparation of typical dishes from the Northeast region, it is also common to use licuri oil as an alternative to soy oil and milk for the preparation of beverages.

With great importance to the country people, this palm supports the intense and prolonged drought, in addition to flowering and fruiting throughout most of the year, presenting itself as a source of food for sheep and goats, wild animals, birds and human beings. The entire plant can be (re)used for making brooms, hats, bags, handicrafts, etc., as well as for the extraction of wax from the leaves of the licuri tree, which has the same purpose compared to the wax from the leaves of carnauba (*Copernicia prunifera*) [4], its use is highly defended, not only for its cultural appeal and a whole history of use, but also for its perfume and flavor that is much desired and appreciated by consumers. In industrial terms, there are some private initiatives for the processing of oil and milk destined only for the production of soap, cosmetics and food [5].

As it is a recent product, few studies have been done and there is no efficient technology for the conservation of licuri vegetable milk [3]. In this context, the present work aimed to study the application of heat both in the cooking process and in pasteurization and the associations of conventional industrial methods such as pasteurization, the use of preservatives and the association of these two methods to evaluate their efficiency in increasing the shelf life of licuri milk through physicochemical analysis and identify the best conservation method.

## II. MATERIAL AND METHODS

The raw material was obtained from a cultivated area of the Escola Técnica Família Agrícola under an agroecological system in the municipality of Monte Santo (Bahia), approximately 296 km from the capital of Bahia. The analysis were carried out in the analytical chemistry laboratory of the Instituto Federal de Educação, Ciências e Tecnologia do Sertão Pernambucano, Petrolina campus, in partnership with the Centro de Agroecologia e Energias Renováveis e Desenvolvimento Sustentável (CAERDES), of the Science and Technology Department of Campus III from the State University of Bahia, from December/2019 to January/2020 in a period of 28 days.

In the present work, the production with variations in a factorial experiment was adopted. The fruits selected for analysis were kept at low storage temperature (approximately 10º C) and isolated from light and humidity with a non-toxic plastic cover. The methodologies used to obtain the vegetable milk from licuri were through the extraction *"in natura"* by processing with crushing in an industrial blender for 05 minutes at a maximum power of 900 watts, and thus, subjected to two distinct cooking processes (without and with a pressure of 1.44 atm equivalent to 1487.52 kg.cm-²). Prior to the process, filtration of the crushed mass of the licuri almonds occurred in a mesh of 0.5mm at different times, specific for each method (at the beginning of the cooking, in the middle of the cooking process of the licuri almonds and at the end of the cooking process) [8].

The pre-analysis procedure was applied to all 07 treatments and their 03 repetitions, they were identified from A to G (Treatment A – control; B – pasteurization at 90ºC/30 min.; C – pasteurization at 69ºC/30 min.; D - pasteurization at 64°C/30 min. and addition of 0.12g of vitamin C and E; E - pasteurization at 64°C/30 min. and addition of 0.06g of sodium benzoate; F - 1.2001g of sodium benzoate sodium; G - 0.012g of vitamin C and E). Since, at this stage, initial mass values were obtained for the determination of purity through weighing, that is, the licuri milk was extracted from the almonds and the pre-analysis for the purity test was carried out before applying it to the [9]. The weighings were made on an analytical balance brand Shimadzu - Model BL 320 H. The filtration was made with cotton fabric and subjected to torsion to release the fluid. A Phoenix autoclave model AV-75 was used for the pasteurization process.

The analysis were carried out according to methods adapted from the Adolfo Lutz Institute Food Manual [9] at room temperature of 30ºC, applicable to crude and refined vegetable oils and milk. The pH analysis were performed at time 0 (on the 1st day of analysis) and repeated on the 7th, 14th and 21st day. Acidity analysis were performed at time 0 (on the 1st day of analysis) and repeated on the 7th, 14th, 21st and 28th day. Color analysis using the calorimetry test were performed at time 0 (on the 1st day of analysis) and repeated on the 14th and 28th day. The results were treated according to Reginato D'Arce et al. [10], the results for the construction of the graphs were obtained from the average of the 03 repetitions of each Treatment with the respective periods (1st day to 28th day) of analysis [11].

Treatment A consisted of 50 mL of *"in natura"* milk, only with the process of crushing, filtering and cooking, and classified as a witness (control), necessary to know the efficiency of the other treatments tested, or even to test the effectiveness of treatments known but not consistent under all test conditions. Treatment B consisted of 50 mL of pasteurized milk at 90ºC for 30 minutes; Treatment C consisted of 50 mL of pasteurized milk at 69ºC for 30 minutes; Treatment D consisted of 45 mL of pasteurized milk at 64°C for 30 minutes, subsequently with the addition of 0.12g of vitamin C and vitamin E, then adding more pasteurized milk according to Treatment D until

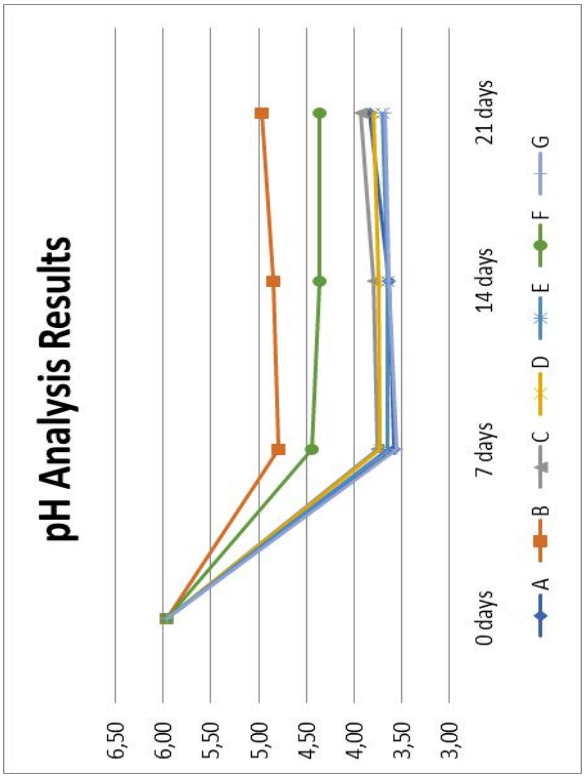
reaching the volume of 50 ml; Treatment E consisted of 45 mL of pasteurized milk at 64ºC for 30 minutes with the addition of 0.06g of sodium benzoate, then adding more pasteurized milk according to Treatment E until reaching a volume of 50 mL; Treatment F consisted of 1.2001g of sodium benzoate plus addition of milk according to Treatment A until reaching a volume of 50 mL; Treatment G consisted of 0.012g of vitamin C and vitamin E plus addition of milk according to Treatment A until reaching a volume of 50 mL [8].

The acidity index was determined by titration with NaOH 0.01 N and 1% phenolphthalein as indicator. The pH indices by immersion in an electrode of the TECNOPON brand digital pHmeter and the colorimetric index using the DeltaE brand colorimeter to measure only LAB values (L*= Luminosity; a*= red/green coordinate; b*= yellow coordinate/blue) according to the Commission Internationale de l'Eclairage [1][12].

## III. RESULTS AND DISCUSSION

Based on the average efficiency data of 20% of the milk by pressing [13], it is possible to identify that the simplified crushing and filtration process surpassed this data, presenting 24.9% efficiency using the cooking technique. After this procedure, it can be identified that Treatments A, B and C had 100% purity, Treatments D, E and G had 99% purity and Treatments F had 98% purity, due to the addition of preservatives in the Treatments D to G the purity content of the samples were reduced by 1% to 2% according to the method applied in each treatment, that is, the addition of preservatives reduces the purity of the milk [10][11].

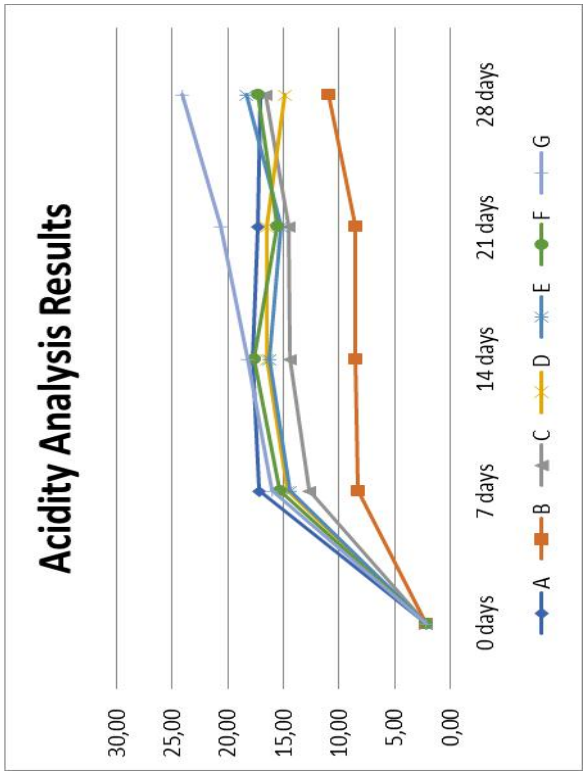
*Graph.1: Results of pH analysis of licuri milk samples.*




*Treatment A – witness; B – pasteurization at 90°C/30 min.; C – pasteurization at 69ºC/30 min.; D – pasteurization at 64°C/30 min. and addition of 0.12g of vitamin C and E; E – pasteurization at 64°C/30 min. and adding 0.06g of sodium benzoate; F - 1.2001g of sodium benzoate; G – 0.012g of vitamin C and E. Source: Developed by the authors of this work.

It was observed that Treatment B presented a pH conservation curve compared to the samples of the initial analysis at time 0 (T0) (1st day of analysis), in this way, and according to the ICMSF (International Commission Of Microbiological Specifications For Foods) which characterizes the proliferation of microorganisms in vegetable milk as a very variable behavior in relation to the time interval, in which the growth takes place, that is, the bacteria grow faster (optimal pH) in the range above 7.0 at 8.0; yeasts between 4.5 and 6.0 and fungi between 3.5 and 4.0 [14]. Therefore, the average results of Treatment B, presented itself as the best conservation method for the pH characteristic.

*Graph 2: Results of the titratable acidity analysis of licuri milk samples.*




**Treatment A – witness; B – pasteurization at 90°C/30 min.; C – pasteurization at 69ºC/30 min.; D – pasteurization at 64°C/30 min. and addition of 0.12g of vitamin C and E; E – pasteurization at 64°C/30 min. and adding 0.06g of sodium benzoate; F - 1.2001g of sodium benzoate; G – 0.012g of vitamin C and E.

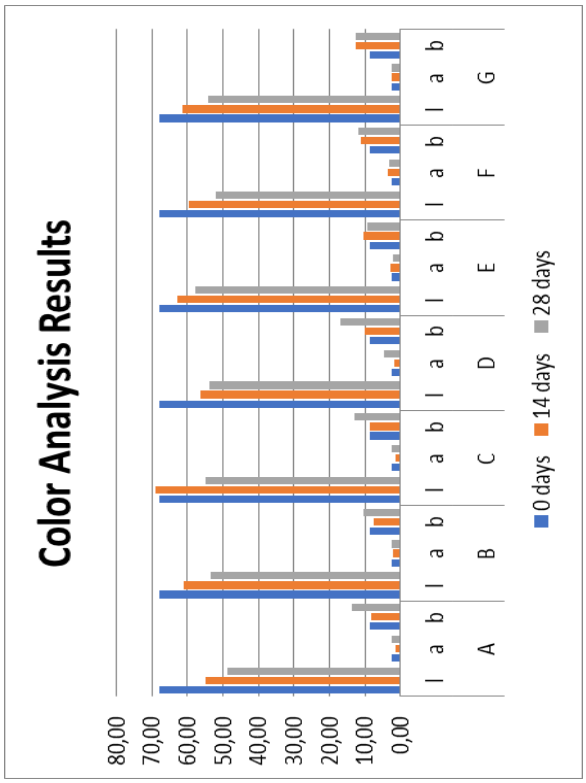
Source: Developed by the authors of this work.

Milk rancidity is usually accompanied by the formation of free fatty acids [15], which may be the main characteristic to determine and to determine its shelf life. The titratable acidity in Treatment A started with low acidity, peaking on the 7th (seventh) day of storage and growing exponentially. In Treatment B, the initial values were the lowest due to the combination of thermal conservation; proportional behavior to the pH analysis, keeping characteristics similar to the initial time 0 (1st day of analysis), that is, the acidity values remained stable for 28 days.

Observing the curves of Treatments C, D, E, F and G it was found that there is a certain coincidence in the behaviors, with a marked increase in acidity from the 7th day and with correlation to the values of the pH analysis during the 28th days of analysis.

There was no advantage in using treatments with additives (vitamins), as shown in the data presented for acidity and pH. According to the work by Zambazi et al. [16] whose titratable acidity values for the product with preservatives ranged from 30% to 50% more than the initial time (1st day) of the analysis, that is, the maximum and minimum acidity ranges never exacerbated in relation to the conservation of the product, however, the existence of methods that manage to keep the growth range for the acidity characteristic to a minimum, presents itself as the best choice in conservation.

*Graf.3: Results of colorimetric analysis of licuri milk samples.*




L* indicates luminosity and a* and b* are the chromatic coordinates. (L* = Luminosity; a* = red/green coordinate (+a indicates red and –a indicates green) b* = yellow/blue coordinate (+b indicates yellow and –b indicates blue).

Source: Developed by the authors of this work.

Another feature that provides information about the conservation status of milk, since the concentration of hydrogen ions can be altered during milk decomposition from phenomena such as hydrolysis, fermentation and oxidation, leading to milk deterioration, making it the more acidic, however, this decomposition of glycerides can also be accelerated by factors such as the action of light and temperature. Thus, using calorimetry analysis, with the L*a*b* color space, according to the theory of

opposite colors, where two colors cannot be green and red at the same time, or yellow and blue at the same time [16 ].

The colorimetric measuring instrument was able to easily quantify these color attributes (L*a*b*), thus identifying Treatments B and G as those that presented colorimetrically in spectral data conservation in the object's color coordinates in the color space L*a*b*.

## IV. CONCLUSION

Licury milk can have its shelf life extended with the use of pasteurization at 90ºC for 30 minutes (Treatment B), without the addition of preservatives for up to 28 days.

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