DEVELOPMENT OF SOAPS WITH AGROINDUSTRIAL WASTE FROM PINEAPPLE (*Ananas comosus* (L.) Merril) AS A SUSTAINABLE SOLUTION TO REUSE EXCESS VEGETABLE OILS

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ABSTRACT

The objective of this work is reuse of residual vegetable oil and pineapple (*Ananas comosus* (L.) Merril) residues in the manufacture of ecological soaps, in order to diversify the mechanisms for reusing these residues, in order to transform them back into raw material. For this, the methodology was based on the reuse of residual vegetable oil that was subjected to adaptation through filtration and purification. Furthermore, it was used pineapple waste as an additive, extracts of the peel and pulp were prepared for the soap formulation. The results obtained from the evaluated properties: alkalinity, pH and fatty acids showed that it is possible to use treated residual frying oils as a source for the production of ecological soap. The reuse of these raw materials makes soaps sustainable and natural, which can also be useful for waste management and can support the development of community projects with an ecological approach.

Keywords: Residual frying oil. Waste. Saponification. Ecological.

1 INTRODUCTION

In Brazil, the juice industry is very prominent, producing a large amount of waste daily, which requires adequate disposal. Thus, *Ananas comosus* (L.) Merril stands out, which is an herbaceous and perennial plant that is found practically in all tropical and subtropical regions and despite the fruit having a high nutritional value due to the presence of mineral salts, most of the fruit is treated as waste. Only 22.5% of the pineapple is used and the remaining 77.5% is waste (shells, leaves, stems, crowns and even discarded fruits), that is, practically 3/4 of the fruit [1]. Another environmentally worrying issue is oils of vegetable origin, whose production and consumption have increased throughout the world, replacing the production of oils of animal origin, in response to the high demand in human and animal food [2]. This increase has generated great concern regarding the environment, as it causes damage if they are disposed of incorrectly, that is, disposed directly down sink drains [3]. Reusing oil for soap production has been one of the simplest alternatives for recycling, as it has some advantages, such as requiring little technology for production and producing less foam, consequently saving more water.

Soaps are cosmetics whose basic function is to clean the skin and are obtained by saponification, a reaction that occurs by adding alkali to fatty matter, resulting in salts of organic acids with surfactant and detergency properties [4]. Various compounds based on nature, such as vegetable oils and fruit extracts, have been reported to have antimicrobial, antifungal and antioxidant properties. Therefore, this work aimed to obtain a useful, cheap and good quality soap, using waste as the main raw material. And such studies are of great importance for community projects that aim to improve recycling in an ecological approach: on the one hand contributing to the family economy, and on the other hand reducing the environmental impact of this waste and encouraging the use of healthier products, which may be a relevant issue from a public health perspective.

2 MATERIAL & METHODS

For research purposes, it was used fresh pineapple (*Ananas comosus* L. Merril) waste of the Pérola type, provided by the pulp company in the city of Mossoro, Rio Grande do Norte. The material was initially separated from the pulp and peels manually, both used in the soap formulation.

The pulp extracts were obtained using distilled water and grain alcohol to obtain the aqueous and hydroalcoholic extract [5]. To prepare the hydroalcoholic extracts, 100 g of fruit pulp and the extracting solvent were used in a solution composed of 160 mL of distilled water. and 40 mL of grain alcohol. The mixture was homogenized for 1 hour using a magnetic stirrer and finally filtered. For the peel extracts, fresh pineapple peel was used, which was separated from the pulp and dried in an oven with air circulation at an average temperature of 105 °C. 50g of the peels and the hydroalcoholic extract composed of a solution with 150 mL of distilled water and 100 mL of grain alcohol were used. The mixture was soaked for 24h and finally filtered.

Based on the procedure described by Vissoso [6], the residual frying oil was filtered to remove solid residues (such as food residues, seasonings, etc.). For each 1L of filtered residual vegetable oil, 1L of distilled water and 125 mL of 2.5% sodium hypochlorite solution were used, both were heated to 60°C and stirred continuously for 30 min. The mixture was then left to separate and subsequently this step was repeated twice for secondary decolorization to obtain clear residual frying oil.

The soap was produced through the adaptation of Cheng's methodology [7], where a 40% NaOH solution was needed to saponify the 40g of treated oil. The 40% NaOH solution and pineapple residue were both carefully added to the oil mixture. The final mixture was then stirred continuously until a significantly thick mixture was formed, was added to molds and remained for 72 hours before being removed from the mold.

To evaluate the properties of the soaps produced, the hydrogen potential (pH) was determined, 100 mL of distilled water was mixed with 1g of soap until completely dissolved using a magnetic stirrer and readings were taken on the pH meter. The free alkali concentration of the soaps was also determined based on the procedure described by Prates [8].

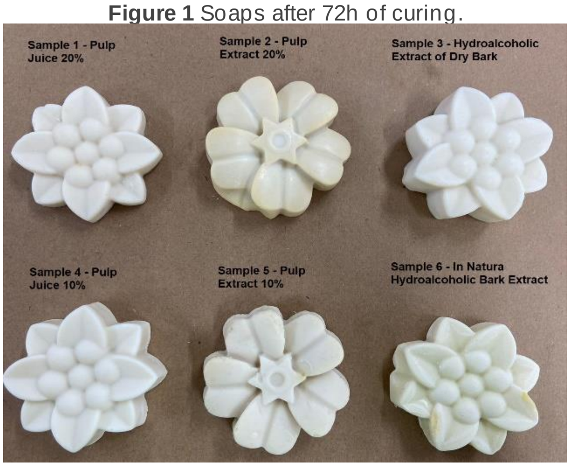
Still following the methodology of Prates [8], but with the purpose of determining fatty and resinous acids, the AGT (Total Fatty Acids) test was carried out. Finally, the ether phase obtained was left to evaporate the ether in a water bath, then dried in an oven at 100°C for 1 hour.

3 RESULTS & DISCUSSION

Samples of residual frying oil were collected in the university restaurant of the Federal Rural University of the Semi-Arido. It was possible to observe that after the oil cleaning procedure it had a significant difference in the color and odor of the treated oil due to the reduction in the amount of impurities and substances that are responsible for the saturated color of the residual vegetable oil.

After the production process, the soaps were cured for 72 hours and then subjected to analysis of their properties. Six soaps were produced that had different aromas and colors due to variation in methodology and concentrations, shown in Figure 1.

Figure 1 Soaps after 72h of curing.



The Brazilian Health Surveillance Agency (ANVISA) determines that bar soaps must have a pH of around 10.4 [9]. According to Gomes et al. [10], the pH of soaps can vary according to their purpose and cleaning soaps require a pH above 8.0. Therefore, evaluating the pH in cosmetic products is extremely important, considering their direct contact with the skin. Another relevant point is the determination of the alkalinity content, which when controlled contributes significantly to increasing the foaming, emulsifying and wetting power of the final product [11]. The main function of alkali in the soap production process is to emulsify and saponify dirt, in addition to increasing the detergency capacity of the finished soap. Table 1 contains the results measured and calculated by the procedures submitted to soaps produced by treated vegetable oil.

Table 1 Results of analyses carried out on the soaps produced.

Soaps	pH	Alkalinity (% p/p)
Samples 1	9,59	0,1641
Samples 2	9,64	0,1823
Samples 3	9,76	0,2917
Samples 4	9,61	0,2734
Samples 5	9,60	0,1458
Samples 6	9,74	0,2369

When analyzing the pH results obtained, all soap samples presented values within those recommended by ANVISA. As for alkalinity, all soap samples were titrated with 0.1 M HCl, as the turning point did not occur after the addition of the indicator, therefore, they did not show free alkalinity. This occurred because during the production of the samples, the solutions reacted completely with the alkali so that they did not present acidity and it was necessary to add NaOH to form free alkalis. Legislation [12] allows a maximum of 2% acidity in oleic acid for most crude vegetable oils and a maximum of 5% for crude coconut oil or fat, so it is possible to observe that in the present work all samples are permitted by law.

The fatty acid content (FAC) was also analyzed, with this type of analysis being carried out on cosmetics that contain some type of oil, in order to determine the amount of fatty and resinous acids, as well as saponified and unsaponifiable fats. Table 2 shows the results obtained expressed in % p/p.

Table 2 Results of fatty acid analyses.

Soap	Mass of the beaker plus TFA (g)	Mass of the beaker (g)	Sample mass (g)	FAC (% p/p)
Samples 1	46,6645	46,2609	1,0650	37,8967
Samples 2	48,2482	47,8695	1,0082	37,5619
Samples 3	51,0129	50,6116	1,0091	39,7681
Samples 4	48,7506	48,3799	1,0374	35,7336
Samples 5	48,7917	48,3917	1,0297	38,8463
Samples 6	45,0452	44,6599	1,0583	36,4074

The values found are in agreement, as high values tend to reduce the quality of the product, from the sensorial part (color, odor, appearance) to the functional parts [12].

4 CONCLUSION

Analyzing the determination of physical-chemical properties, they guaranteed quality control of all soaps produced, where alkalinity met values in an allowed range of 0.16 - 0.24, which guarantees emulsification and saponification of soaps. The pH was within the specifications for commercialization and predicted by ANVISA, with values in a range of 9.59 – 9.76. Therefore, a sustainable and natural product was produced that promotes the improvement of ecological knowledge by using all the waste mentioned for the manufacture of soap for daily use.

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ACKNOWLEDGEMENTS

The Federal Rural University of Semi-Arid for providing the necessary means for the development of this study.