Development, chemical and technological characterization of dry pasta noodles with wheat flour added to acerola pomace flour

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ABSTRACT

Considering that acerola residues are not used as a nutritional source for human consumption and that there is still a lack of knowledge on the part of the scientific community about these residues, it was necessary to prepare the flour from acerola residues. The objective of this work was to develop pasta containing flour from acerola residues, as well as the physicochemical and technological characterization of the prepared pastas. Acerola pomace flour was specifically incorporated at concentrations of 0%, 3%, 5%, 7% and 10% in relation to wheat flour, and the quality of the developed pasta was evaluated through baking tests (cooking time, water absorption, mass increase after cooking), total acidity and pH. The pasta was prepared in the Bakery Laboratory and the chemical and technological analyses were carried out in the Chemistry Laboratory of IFMA São Luís - Maracanã Campus. The whole and dehydrated seeds of the acerola were crushed with the help of a domestic blender and sifted through a 40 mesh sieve to obtain the flour. The production process of the "dry pasta" type was developed according to the following steps: preparation, mixing, kneading, rolling, cutting, drying, packaging, and cooking. The data obtained in the chemical and technological analyses showed that the developed food masses are within the legislation, which indicates an adequate food mass. According

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to the results obtained, it is concluded that acerola pomace flour can be added to the formulation of pasta, as it is an alternative in the elaboration of new products and use of acerola fruit residue.

Keywords: Acerola pomace flour, Pasta, Chemical and technological analysis.

INTRODUCTION

Waste disposal is a global concern both in terms of the environment and the waste of parts of food with high nutritional content. It must be disposed of correctly and away from the processing unit, as they have several compounds with high organic value that can be used as a source of nutrients for microorganisms. Therefore, finding another destination for waste other than disposal has been the focus of study for many researchers, using as the main alternative the elaboration of fruit and vegetable flours and the application in food products from various areas, especially in the bakery industry, always aiming at the nutritional enrichment of commercial food formulations.

Acerola processing waste represents 40% of the production volume. These residues are generally discarded when they could be used as alternative sources of nutrients, with the aim of increasing the nutritional value of the diet of needy populations, as well as solving dietary deficiencies (ABUD & NARAIN, 2009). Considering that acerola residues are not used as a nutritional source for human consumption and that there is still a lack of knowledge on the part of the scientific community (nutritionists, food technologists and/or technicians and food engineers) about these residues, it was necessary to prepare the flour from acerola residues. The flour produced from acerola pomace partially inhibits several digestive enzymes, reducing the digestion of carbohydrates and fats, preventing their absorption by the intestine, helping to control postprandial hyperglycemia (AQUINO, 2009).

Pasta is a food that is indisputably part of the table of the Brazilian people, with a high rate of acceptability, regardless of the social class to which it belongs. Brazil is the third world market in consumption of this paste, behind only Italy and the United States, which highlights the socioeconomic importance of this food, because in addition to being a source of some important nutrients for the diet, it generates employment and income for the population. Because it is basically made up mostly of wheat flour, this food can be considered energetic, however, it is deficient in vitamins and minerals and its proteins are deficient in essential amino acids, like most proteins of vegetable origin (ABIMAPI, 2019). Due to its nutritional importance and because it is part of the basic food basket, pasta, along with bread, beans and rice, is one of the most used products in daily consumption, which makes it ideal to be a vehicle to incorporate important ingredients into the diet. Another important factor that justifies the choice of pasta is the shelf life, much longer than other wheat flour derivatives.

In view of the importance of the use of fruit residues in order to reduce the deposition of these residues and the increase of the nutritional value of food formulations, this work aimed to obtain acerola pomace flour and to develop dry pasta type pasta formulated with acerola pomace flour in partial replacement of wheat flour, evaluate their chemical and technological quality.

MATERIAL AND METHODS

OBTAINING AND PREPARING THE RAW MATERIAL

The residues used in the present study were obtained from acerola (*Malpighia glabra L.)* The fruits were purchased at a local fair in São José de Ribamar - MA, and three collections were obtained. These collections were used for the elaboration and chemical characterization for the purpose of producing acerola pomace flour for the preparation of "dry pasta" type pasta.

To prepare the residues, all fruits were washed in running water to remove the largest dirt present in the peels, then they were immersed in sodium hypochlorite solution at 200 ppm for 15 minutes and then washed in running water to remove excess chlorine, according to Resolution of the Health Surveillance Agency – RDC No. 216/2004 (BRAZIL, 2004)

After cleaning, the fruits were pulped and their residues were dried.

Figure 2- Dehydrated acerola residue

Source: The authors

FLOUR PRODUCTION

The whole and dehydrated seeds were crushed with the aid of a domestic blender and sifted in a 40 mesh sieve to obtain the flours. These were packed in plastic containers with lids and stored at room temperature until the time of the analyses. After processing, the flour was packed in plastic bags and stored until it was used.

Figure 3- Flour from acerola residue

Source: The authors

PREPARATION OF DRY PASTA FORMULATION

A standard formulation of noodles was adopted for all test conditions performed in this work. The noodles were prepared in the bakery laboratory of the Federal Institute of Education, Science and Technology of Maranhão - IFMA São Luís Maracanã.

Five formulations of pasta enriched with acerola pomace flour were elaborated, with the ingredients and their proportions described in (Table 1), it is worth mentioning that the amount of eggs and water in all formulations were constant.

Table 1 - Ingredients of the preparations (g) and quantity (net weight)

Ingredients: Acerola pomace flour, wheat, egg, water
M1 0g 100g 50g 10ml
M2 3g 97g 50g 10ml
M3 5g 95g 50g 10ml
M4 7g 93g 50g 10ml
M5 10g 90g 50g 10ml

Source: The authors (2019)

The production process of the noodle-type dry pasta followed the following steps: preparation, mixing, kneading, rolling, cutting, drying, packaging, and cooking.

Preparation

From the standard formulation, noodles were produced by applying different levels of unleavened wheat flour with acerola pomace flour. The percentages of acerola pomace flour were 0%, 3%, 5%, 7%, 10% in relation to wheat flour.

Mixing and kneading

An important step in the process, the dry ingredients were mixed in a bowl, then the liquid ingredients were added until a homogeneous dough with the desired consistency was formed, letting the dough rest for approximately 10 minutes. Soon after, they were modeled in a manual cylinder and cut.

Lamination/Cutting

For rolling, the dough passed through the cylinder numerous times until it obtained the appropriate thickness. After rolling, the dough was cut and the thickness of the shaped rolling depended on the desired final product. This procedure was repeated several times until it presented a smooth, uniform and brittle appearance. Then the dough was molded into the shape of noodles and cut by hand so that they acquired the desired length.

Figure 4- Cutting/Laminating

Source: The authors

Drying of the dough

The doughs have undergone a total drying process, in order to eliminate the water added in the production phase. After drying, the dough must have a maximum moisture content of 35% according to current legislation (BRASIL, 2005). At this stage, the fresh pasta was packed in a tray to provide ventilation and surface drying.

Figure 5 - Drying

Source: The authors

Packaging/Storage

The function of packaging is to keep the product free of contamination and protect it from damage caused during transport and storage (EL-DASH; GERMANI, 1994). The pasta was packaged in polyethylene plastic bags in quantities of 100 grams each, and closed in a manual sealer. They were then stored under refrigeration and sent for analysis, preparation (cooking in water) and physical-chemical tests.

Cooking

The pasta was cooked in boiling water. Cooking was carried out in stainless steel pans, where enough time was used for the white part to disappear from the center of each of the doughs.

CHEMICAL CHARACTERIZATIONS OF THE PREPARED PASTA:

The chemical and physicochemical characterizations of the prepared noodles were carried out at the Food Laboratory of the Federal Institute of Education, Science and Technology of Maranhão – IFMA São Luís Campus Maracanã.

Humidity

The moisture content was determined according to the analytical standards of the Adolfo Lutz Institute (2008), which is based on the removal of water by heating.

Figure 6 - Humidity

Source: The authors

Ashes

To determine the ash content, the empty crucible was placed in the oven at 105°C for 1 hour, then it was removed and placed in the desiccator for 30 minutes, after the time, it was weighed, soon after 2g of each sample was weighed in the previously desiccated crucibles, placed in the muffle furnace first at 50°C and gradually increased until it reached a temperature of 250°C, staying at this temperature for 2 hours, after the time, he withdrew and placed himself in the desiccator for 30 minutes, after that he was weighed again and the calculation made.

Figure 7- Cinzas

Source: The authors

Acidity (in ml NaOH solution/100g mass)

For this determination, a chemical analysis was performed, where 10 g of the sample was diluted in 40 ml of distilled water, filtered immediately afterwards, and titration with a 0.1mol NaOH solution was immediately carried out. L, using phenolphthalein as an indicator.

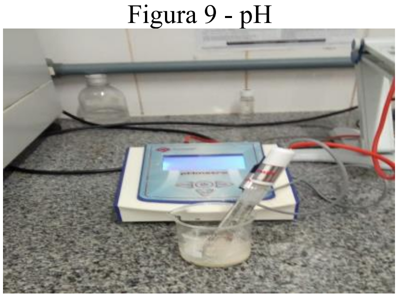
Figure 8 - Acidity

Source: own author

pH

To determine the pH, a physical-chemical analysis was performed, where 15 g of the sample were diluted in 15 mL of distilled water, previously boiled and homogenized. pH measurements were performed by reading in a digital pH-meter calibrated with buffer solution. The pH was determined by direct immersion of the electrode in the samples.

Figura 9 - pH



Source: own author

Cooking time

The quality parameter of the pasta is observed during cooking, as it is what matters to the consumer. To determine the cooking time , the physicochemical analysis was performed by cooking 10g of sample in 140 mL of boiling distilled water, until reaching the appropriate visual quality as a result of the starch gelatinization in the entire pasta section. This point was determined by compressing samples of the baked product every 1 minute, until the white core of the center of the dough disappeared.

Figure 10 – Cooked pasta samples

Source: The authors

Fat absorption (GA)

According to the method of Dench, Rivas & Caygill (1981) the absorption of fat from pasta was determined, 0.5 g of sample was weighed in a centrifuge tube and 3 mL of soybean oil was added. The contents were mixed for 30 seconds and left to rest for 30 min. Then, the sample was centrifuged at 3,000 rpm for 25 min. The excess oil was drained and the tube inverted for 30 min. Fat absorption was expressed as g of retained oil relative to 100g of sample

Increased mass of the cooked product

For mass increase, the sample was weighed before and after cooking, using the ideal cooking time for each sample. The mass increase value is the ratio of the cooked pasta mass to the raw pasta mass expressed as a percentage (%).

STATISTICAL ANALYSIS

The data were evaluated using the Excel version 2010 program (Microsoft Corporation). Analyses to compare the means between the sample points were used.

RESULTS AND DISCUSSION

DEVELOPMENT OF PASTA

In the development of the samples, the color difference between all samples was evident (Figures 11, 12, 13, 14 and 15).

Figure 11- Pasta dough 1

Figure 12- Pasta dough 2

Figure 13- Pasta dough 3

Figure 14- Pasta dough 4

Figure 15 - Pasta dough 5

Figure 11 showed the conventional pasta dough prepared with a mixture of 100% wheat, a 50g egg and 10 ml of water, while Figure 12 revealed the pasta dough made with 3% acerola pomace flour, 97% wheat flour, a 50g egg and 10 ml of water. This noodle had a darker color due to the color of the added flour. Figure 13 showed the pasta dough made with 5% acerola pomace flour, 95% wheat, an egg and 10 ml of water, in the same way, this pasta presented a darker color, as the portion of acerola pomace flour added was increased. Figure 14 showed the pasta dough made with 7% acerola bagasse, 93% wheat, one egg and 10 ml of water, with a darker colored dough, due to the percentage of flour used. Figure 15 showed the pasta dough made with 10% of acerola pomace flour, 90% wheat, an egg and 10 ml of water, the latter presented a darker color than the others, due to the portion of acerola pomace flour added being the largest. Color is the consumer's first contact with the product, it is usually with the visual presentation where color and appearance stand out, these characteristics are associated with personal reactions of acceptance, indifference or rejection. Such factors are generally associated with culture, religiosity, among others (NOGUEIRA et al., 2002).

PHYSICOCHEMICAL CHARACTERISTICS OF PASTA

The addition of eggs to the formulation of pasta is one of the ways to improve the quality of the product by giving color, improving elasticity, reducing the amount of residues in the water and increasing its nutritional value (ORMENESE et al. 2004). Table 2 presents the results of the analyses of the physicochemical characteristics of pasta.

Table 2. Results of the analysis of the physicochemical characteristics of pasta.

Analysis	Humidity (%)	ph	Titratable acidity	Ash(%)
Mass 1 (m1)	11,64	6	4,10	1,57
Mass 2 (m2)	11,52	6	3,84	1,63
Mass 3 (M3)	12,01	5,5	3,40	1,53
Mass 4 (M4)	12,03	5	2,51	1,50
Mass 5 (M5)	12,82	5	2,81	1,86

Source: Autor Himself (2019)

The determination of moisture is one of the most important and used measures in food analysis, as it is related to its stability, quality and composition and can affect aspects related to storage, product packaging and even processing. The moisture content is determined with the objective of verifying the efficiency of the drying process and verifying good storage conditions for the product (CASAGRANDI et al., 1999). However, all the pasta analyzed is similar with approximate values. Thus, it was observed that the values obtained in the pasta are within the parameters recommended by ANVISA's RDC No. 93/00, which are up to 35% for wet pasta and up to 13% for dry pasta.

In the determination of pH, all the pasta analyzed presented results equal to or less than 6. The values obtained showed that the pasta is within the standard, because according to RDC n° 90/2000 the maximum pH value should be equal to or close to 6.00 for pasta prepared with wheat flour. pH is a factor of great importance in limiting the ability of microorganisms to develop in food and contributes to defining technological procedures for conservation (SOUZA et al., 2008).

Acidity represents the state of conservation of flours, involving both chemical and microbiological aspects. The study of the acidity of wheat flour, as well as the products manufactured from it, is of great importance, not only in the economic aspect, through losses due to the reduction of shelf life, but also due to the reduction of the acceptability of these products by consumers through changes in color and flavor (ORTOLAN et al., 2008). Titratable acidity, according to the determination of ANVISA (2000), dry and wet pasta must have a content of 5 ml NaOH N/100g of acidity, and a variation beyond, if this limit is exceeded, it is important to observe the limit, as it can be considered as a warning sign. Thus, it was observed that none of the pasta presented values higher than those allowed by legislation.

Ashes are mineral salts present in flour, mainly iron, sodium, potassium, magnesium and phosphorus, which are obtained by burning the organic matter in the flour, by heating it to temperatures close to 550-5700C. The highest concentration of these minerals is found on the outside of the grain, that is, in the bran; From this it can be concluded that the greater the amount or contamination of bran in the flour, the higher the resulting ash content. According to Normative Instruction No. 8 of June 2, 2005, flour can be classified according to the ash content, with a maximum content of 2.5% for flours. The values obtained in the analysis of the samples showed that the referred fresh pasta is within the legislation, which indicates an adequate food mass. High levels of ash in flours may indicate high extraction, with the inclusion of bran, which is undesirable due to the fact that it provides a darker color, lower cooking and interferes with the continuity of the gluten network (COSTA et al., 2008).

TECHNOLOGICAL CHARACTERISTICS OF PASTA

The results obtained for the specific cooking analyses of the noodles are presented in Table 3.

Table 3 - Technological properties obtained in the specific analyses of pasta containing acerola residue flour

Samples	Cooking time (min.)	Fat absorption (%)	Weight Gain (%)
M 1	3,05	0,51	1,96
M 2	4,23	0,53	1,80
M 3	4,29	0,70	1,65
M 4	4,40	0,75	1,48
M 5	4,45	0,78	1,45

Source: Own Author (2019).

The baking test serves to indicate how a product behaves during its cooking and to determine the ideal cooking time of the dough, the increase in weight, and the loss of soluble solids in the water of this dough, as the final quality parameter of the cooking of this dough is of great importance to the consumer.

It was found that the averages obtained in the cooking time for the five samples of pasta analyzed ranged from 3 to 4 minutes. The small variations in the cooking time of the analyzed noodles may be due to the shape, size of the pasta and the time and temperature of these samples during drying. A different result in the cooking time of the control sample (100% wheat flour) of fresh spaghetti pasta was found by Spanholi and Oliveira (2009), who obtained a time of 7 minutes and also verified an increase in the cooking time with the replacement of 20% of wheat flour by the same amount of passion fruit albedo flour.

The fat absorption index in the analyzed pasta samples ranged from 0.51% (M1) to 0.78% (M5). The index increases as the amount of acerola pomace in the prepared pasta also increases. According to Cheftel et al. (1989), high values of fat absorption are desirable in products such as pasta, aiming to improve their mouthfeel (texture). Thus, acerola pomace flour is a recommended raw material to be used in the preparation of pasta, when considering the fat absorption parameter.

The weight increase of the cooked product of the pasta analyzed ranged from 1.96% (M1) to 1.45% (M5). It is noted that as there was an increase in the concentration of acerola pomace flour in the pasta analyzed, the weight gain of these pasta decreased. According to Costa (2001), weight gain is related to the capacity of water adsorption in pasta and also depends on the shape and size of the pasta analyzed.

CONCLUSION

The data found in the chemical and technological analyses showed that the food masses developed are within the legislation, which indicates an adequate food mass. According to the results obtained, it is concluded that acerola pomace flour (*Malpighia glabra L*) can be added to the formulation of pasta, as it is an alternative in the elaboration of a new product and use of acerola fruit residue.

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