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CHEMICAL CHARACTERIZATION OF FRUIT PULPES MARKETED IN SOUTHWEST OF PIAUÍ STATE

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ABSTRACT - The production of frozen fruit pulp is an agroindustrial activity that has become an important segment of the productive chain, favoring fruit consumption and guaranteeing the use of the surplus produced. However, despite the considerable increase of this production, it is still possible to find pulps with changes in their physico-chemical characteristics, due to problems associated with the lack of processing and/or storage. In view of this, the objective of this work was to perform the chemical characterization of the main frozen fruit pulps marketed in the southwestern region of Piauí, in view of their adequacy to the standards of identity and quality (PIQ) established by the legislation. The selection of pulps was carried out based on research in the retail trade in the city of Bom Jesus (Piauí, Brazil), to which the pulps of acerola, cashew, guava and mango were selected. The analyzed parameters were: soluble solids (SS), total acidity (AT), pH and total vitamin C. The values of SS/AT in the pulps of acerola, cashew, guava and mango were 5.2º/1.02%, 8.2º/0.45%, 4.8º/0.2% and 11º/0.51%, respectively. The pH in the pulps of acerola (3.0) and cashew (3.8) followed the legislation, while guava (2.72) and mango (3.1) were characterized below that proposed by legislation. When at vitamin C content, the acerola pulps 1015.42 mg 100 g^{-1}, cashew 152.42 mg.100 g^{-1}, guava 29.0 mg 100 g^{-1} and mango 82.02 mg 100 g^{-1} were as required in legislation. From the results obtained, it can be concluded that some parameters do not meet the minimum required by the legislation, being necessary to adapt them to reach a production of quality fruit pulps, through the adoption of Good Manufacturing Practices and standardization of raw materials.
Keywords: Chemical analysis, PIQ, tropical fruit.

CARACTERIZAÇÃO QUÍMICA DE POLPAS DE FRUTAS COMERCIALIZADAS NO SUDOESTE DO PIAUÍ

RESUMO - A produção de polpas de frutas congeladas é uma atividade agroindustrial que se tornou um importante segmento da cadeia produtiva, favorecendo o consumo de frutas e garantindo a utilização do excedente produzido. Contudo, apesar do considerável aumento dessa produção, ainda é possível encontrar polpas com alterações em suas características físico-químicas, devido a problemas associados à falta de processamento e/ou armazenamento. Diante disso, o objetivo deste trabalho foi realizar a caracterização química das principais polpas de frutas congeladas comercializadas na região sudoeste piauiense, frente à adequação das mesmas aos padrões de identidade e qualidade (PIQ) estabelecidos pela legislação. A seleção das polpas foi realizada a partir de pesquisa nos comércios varejistas na cidade de Bom Jesus (PI), ao qual foram selecionadas as polpas de acerola, caju, goiaba e manga. Os parâmetros analisados foram: sólidos solúveis (SS), acidez total (AT), pH e vitamina C total. Os valores de SS/AT nas polpas de acerola, caju, goiaba e manga foi 5,2º/1,02%; 8,2º/0,45%; 4,8º/0,2% e 11º/0,51%, respectivamente. O pH nas polpas de acerola (3,0) e caju (3,8) se apresentaram em conformidade com a legislação, enquanto a goiaba (2,72) e a manga (3,1) foram caracterizadas abaixo do proposto pela legislação. Quando ao teor de vitamina C, as polpas de acerola apresentaram 1015,42 mg 100 g^{-1}, aquela de caju 152,42 mg 100 g^{-1}, de goiaba 29,0 mg 100 g^{-1} e de manga 82,02 mg 100 g^{-1}, de acordo com o exigido na legislação. A partir dos resultados obtidos, pode-se concluir que alguns parâmetros não atendem ao mínimo exigido pela legislação, sendo necessário adaptá-los para atingir uma produção de polpas de frutas de qualidade, através da adoção de Boas Práticas de Fabricação e padronização de matérias-primas.
Palavras-chave: análise química, frutas tropicais, PIQ.

INTRODUCTION

Brazil is the third largest fruit producer (ANDRIGUETO et al., 2010). However, in recent years, Brazilian fruit production has produced less than it could, due to unfavorable climatic conditions, reducing about 1.7 million tons of fresh fruits (ABF, 2017).

The Brazilian Northeast has increasingly tried to advance the production of high-quality fruits, and with this, it has been necessary to apply and improve irrigation and management technologies, overcoming the limitations that the water deficit has caused (ABF, 2017). For example, the region of the São Francisco Valley has been

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prominent in fruit production, mainly due to the use of irrigation, a vast area destined to production and a climate favorable to the planting of fruit trees (SANTOS et al., 2016).

The emergence of storable products has made possible the preservation and integral consumption of these perishable foods, in which the consumer would often not be able to ingest in an in-nature way. The production of frozen fruit pulps is an agroindustry activity that has become an important segment of the productive chain, favoring fruit consumption and guaranteeing the use of the surplus produced (SANTOS et al., 2014; SANTOS et al., 2016).

Despite the considerable increase of this production, it is still possible to find pulps with changes in their physicochemical characteristics, due to problems associated with the lack of processing and/or storage (CALDAS et al., 2010).

In Brazil, the quality of marketed fruit pulp was regulated by resolution RDC n.12, January 2 (BRASIL, 2001) and by Normative Instruction n.1, dated January 7 (BRASIL, 2000), which determines the quality and identity standards (PIQ). This resolution defined the fruit pulp as the non-fermented, non-concentrated and undiluted product obtained from pulp fruits through a suitable technological process, with a minimum total solids content, from the edible part of the fruit (BRASIL, 2000). Currently, this instruction has been reformulated and today it is supported by ordinance n.58, of August 30 (BRASIL, 2016), which defines new minimum values for the PIQ and includes in the fruits used in the manufacture and elaboration of pulps. In the quality control of fruit pulp, parameters such as pH, total acidity, soluble solids, reducing and total sugars, and vitamin C are important for standardization of the product and analysis of possible changes during processing and/or storage (BENEVIDES et al., 2008; BRASIL et al., 2016).

With the increase in the production, commercialization and consumption of these frozen fruit pulps in the region, characterization studies of these products already inserted in the market become necessary. Thus, the objective of this work was to perform the chemical characterization of the main frozen fruit pulps marketed in the southwestern region of Piauí, in view of their adaptation to the identity and quality standards established by the legislation.

MATERIAL AND METHODS

The selection of pulps was carried out based on research in the retail trade of the city of Bom Jesus (Piauí, Brazil). The pulps of acerola, cashew, guava and mango were present in all trades visited during the research, being thus selected because they are the most commercialized. The pulps were removed from their packaging, identified by flavor (without characterization by brand of the product, since they were purchased from the same local company in order to standardize the values) and thawed until reaching room temperature. With the aid of a magnetic stirrer (Model AREC), the pulps were homogenized and divided into sealed plastic vials with capacity for 100 mL, duly identified.

Samples were stored with three replicates for each fruit pulp taste at the Laboratory of Biochemistry of the Federal University of Piauí, which were evaluated: soluble solids (SS) measured directly on a bench refractometer (RTD model), with the results expressed in ºBrix and total acidity (TA) determined by neutralization titration with 0.1 mol L^{-1} NaOH, with the results expressed in % (IAL, 2008). For the pH, a benchtop digital pHmeter (model HI 2221), calibrated with buffer solutions 4.0 and 7.0, following the method n. 981.12 of the Association of Official Analytical Chemists (LATIMER JÚNIOR, 2012) and total vitamin C, expressed as milligrams of ascorbic acid per 100 g of pulp, described by the method of Strohecker and Henning (1967).

The experiment was carried out in a completely randomized design, and all analyzes were performed in triplicate. The results of the analyzes were presented by averaging the three replicates of each sample, followed by the standard deviation. All the evaluated parameters were compared to the Standards of Identity and Quality (PIQ) of the Ministry of Agriculture, Livestock and Supply (MAPA) by means of Administrative Rule 58, of August 30 (BRASIL, 2016).

RESULTS AND DISCUSSION

The soluble solids are composed mainly of sugars, to which the highest levels of SS can be indicated by an indication of the increase in the content of these sugars (VIRMOND et al., 2014), and can therefore be used as a parameter and / or indirect measure of sugar content in the fruit, since the exact content of sugars are also constituted by other substances, such as phenolics, organic acids, pectin's and others (CHITARRA; CHITARRA, 2005).

Table 1 shows the results of SS, TA, pH and vitamin C of the most commercialized fruit pulps in the southwestern region of Piauí.

TABLE 1 - Values of SS, AT, pH and vitamin C in tropical fruit pulps marketed in southwest Piauí, Brazil.

Parameters	Pulps			
	acerola	cashew	guava	mango
SS (°Brix)	5.20 ± 0.09**	8.20 ± 0.42**	4.80 ± 0.2**	11.00 ± 0.19**
PIQ* (min)	5.50	10.0	7.0	12.00
AT (%)	1.02 ± 0.04	0.45 ± 0.04	0.64 ± 0.03	0.51 ± 0.06
PIQ* (min)	0.80	0.30	0.40	0.30
pH	3.00	3.80	2.72**	3.10**
PIQ* (min)	2.80	3.80	3.50	3.50
Vitamin C (mg 100 g^{-1})	1015.42 ± 0.29	152.10 ± 0.31	29.00 ±0.18	82.02 ± 0.02
PIQ* (min)	800	80	24	6.10

Min.: minimum. *Source: BRASIL (2016). **Values not in accordance with the legislation (BRASIL, 2016).

All fruits were below the minimum considered standard by the MAP/POLPA PIPA. The values obtained below the one recommended by the legislation were also observed by Batista et al. (2013) when studying the quality parameters of frozen fruit pulps in the Upper Vale do Jequitinhonha, suggesting dilution of the sample by addition of water during processing.

In another study, Brasil et al. (2016), evaluating the physico-chemical quality of the frozen fruit pulps marketed in the Cuiabá city (MS), among all the investigated ones, the cashew presented with its PIQ below the minimum of the legislation, to which they justify for problems of processing failures or distribution.

According to Leal et al. (2013), SS levels may vary due to the period of fruit harvesting, as well as the intensity of rainfall during the harvest, climatic factors, variety, soil, as well as eventual addition of water during the manufacturing process/preparation of the frozen pulps, and thus causing the decrease of the soluble solids.

Regarding AT values, all indicated that tropical fruit pulps conform to the standard established by the PIQ. The values of acidity are directly related to the degree of fruit maturation, considering that the citric acid content decreases as a result of maturation, and thus, being larger in immature fruits (BRASIL et al., 2016).

The high values of acidity are important for the agroindustry, since, according to Lira Júnior et al. (2005), when the citric acid contents are low, there is a need to add it, in order to allow the pulps to be unfit for the development of microorganisms. However, according to Santos et al. (2008), higher changes in this variable may also indicate potential risks to consumer health. Brasil et al. (2016) in their study, also observed high levels of AT in acerola pulps, justified by the physiology of the fruit, which because they are climacteric, present higher peaks in the respiration rate after harvest.

The acid or sour taste of the fruits is justified by the acidity present, being an important parameter in the analysis of the state of conservation of a food. Chitarra and Chitarra (2005) point out that volatile acids contribute to the aroma of the fruit, thus attracting consumers. Among these volatile acids, the most are malic, tartaric, citric and pyruvic.

According to Batista et al. (2013) some pulps are commonly marketed under the IPC, since fruit at an inappropriate stage of maturation or excessive dilution in the manufacture is often used, which is not the case in the pulps of this study. The SS/TA ratio allows a better evaluation of the fruit flavor, due to the balance of acids and sugars, and thus, representing better than the separate evaluation of these parameters (CHITARRA; CHITARRA, 2005).

The pH values found in this research for acerola and cashew agree with the Brazilian legislation (BRASIL, 2016), however the results of guava and mango pulps were below the minimum recommended by the same legislation. According to Santos et al. (2016), edaphoclimatic factors directly influence fruit pH, thus presenting variations. According to Santos et al. (2014), another factor that makes possible the pH variation of fruits is the presence of organic acids, since they are extremely important in the formation of numerous fruit properties.

The legislation establishes pH as a quality attribute because it contributes to the conservation of the pulp, reducing the risks of infestation and yeast growth, and consequently avoiding the loss of nutritional quality (BENEVIDES et al., 2008; BRASIL et al., 2016).

In relation to vitamin C levels, food of plant origin can supply most of the necessary vitamins to the body, but its importance comes mainly from the supply of vitamin C (CHITARRA; CHITARRA, 2005). All pulps were within the minimum established by the PIQ. As expected, the acerola was highlighted with greater amount of ascorbic acid, when compared with the other pulps. Brasil et al. (2016) in their study presented similar results to this research, however, it was recorded that some pulps presented changes at the end of the storage period, thus contravening the legislation.

This variation of vitamin C is most often attributed to storage conditions, due to the time and temperature at which they are submitted (SEBASTIANY et al., 2009). Another factor is fruit processing, in which it often contributes to the reduction of vitamin C through oxidation (ORDÓÑEZ-SANTOS e VAZQUEZ-RIASCOS, 2010). Vitamin C has low stability, being subject to degradation by the action of oxygen, light, pH, storage condition of the samples or even due to the

maturation stage of the fruits or even dilution of the pulps, in which case the need for product standardization. The value of vitamin C in the pulp decreases progressively according to the form the fruit is processed, the storage and the type of packaging used. In this study, it is possible to understand that all the pulps passed through processor that did not cause losses in relation to the quantity of vitamin C present.

Silva et al. (2010) found values of vitamin C, in cashew pulps, of 220.40 mg 100 g^{-1} and for mango pulp 55.99 mg 100 g^{-1}. In a study carried out by Nascimento et al. (2012), with acerola pulp, the result found in the research was 94.33 mg 100 g^{-1} of vitamin C, considered in disagreement with the current legislation. This difference may be related to some of the factors that interfere with vitamin C content: species, variety, biological evolution status, harvesting season, soil treatment, harvesting, transport, storage, conservation, geographical area, influence of light and sun rays and seasons of the year (PFAFFENBACH et al., 2003).

The result obtained in the mango pulp is superior to that reported in the literature, such as the work of Brunini et al. (2002), who reported average values of 34.65 mg 100 g^{-1}, showing that there was possibly degradation of vitamin C in the samples studied during processing and/or storage.

CONCLUSION

From the results obtained, it can be concluded that some parameters do not meet the minimum required by the legislation, being necessary to adapt them to reach a production of quality fruit pulps, through the adoption of Good Manufacturing Practices and standardization of raw materials.

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