EFFECT OF AÇAÍ PULP ON THE PHYSICAL PROPERTIES OF CEREAL-BASED EXTRUDATES

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RESUMO – O objetivo deste estudo foi incorporar polpa de açaí em pó na elaboração de extrusados e avaliar o efeito desse fruto nas propriedades físicas dos snacks. Concentrações de 0, 2, 4 e 6% de polpa de açaí em pó foram incorporadas nas farinhas de arroz e milho e os extrusados foram produzidos usando uma extrusora dupla rosca co-rotativa. A incorporação do açaí (2, 4 e 6%) não resultou em alterações no índice de expansão radial. No entanto, a incorporação de 6% resultou em maior densidade aparente, dureza e crocância. Apesar disso, todos os resultados foram comparáveis a extrusados a base de cereais sensorialmente aceitáveis reportados em estudos prévios.

ABSTRACT – The aim of this study was to incorporate açaí pulp powder in extrudates elaboration and evaluate the effect of this fruit on physical properties. Concentrations of 0, 2, 4 and 6 % of açaí pulp powder were incorporated into rice and corn flours and the extrudates were produced by using a co-rotating twin-screw extruder. Açaí incorporation (2, 4 and 6%) did not result in changes in the radial expansion index. However, the incorporation of 6% resulted in higher Bulk density, hardness, and crispness. Despite that, all the results were comparable to sensorially acceptable cereal-based extrudates reported in previous studies.

PALAVRAS-CHAVE: extrusados; extrusão; fruto açaí, índice de expansão, densidade aparente.

KEYWORDS: extrudates; extrusion; açaí fruit, expansion index, Bulk density.

1. INTRODUCTION

Açaí is a fruit with a high concentration of bioactive compounds (Yamaguchi et al., 2015). This fruit has been used as a functional ingredient in several foods. Sensorially acceptable nectar, chewy candy, and desserts have been developed using açaí (Fernandes et al., 2016; Silva et al., 2016; Vasconcelos et al., 2014).

Extruded snacks are convenience foods that have high acceptability among adults and children (Potter et al., 2013; Lucas et al., 2018a). In this context, studies have been carried out to enrich extruded formulations, resulting in ready-to-eat food with bioactive properties (Hirth et al., 2014). In addition, the physical properties of extruded products have also been evaluated as they directly influence sensory properties (Ding et al., 2005; Lucas et al., 2018a).

Fruits can be incorporate in extrudates formulations to improve nutritional and sensorial properties and to provide color (Potter et al., 2013; Oliveira et al., 2018). However, the addition of fruits to cereal-based materials can potentially alter their physical properties (Kosińska-Cagnazzo et al., 2017). Thus, such extrudates should be evaluated, since these properties are related to consumer acceptance (Oliveira et al., 2018). Therefore, the aim of this study was to incorporate açaí pulp powder in extrudates elaboration and evaluate the effect of this fruit on physical properties.

2. MATERIAL AND METHODS

2.1 Raw materials

The flours (Rice and corn) were obtained from Zwicky (Müllheim-Wigoltingen, Switzerland). Açaí pulp was obtained from Amazonbai (Macapá, Amapá, Brazil) and freeze-dried according to the procedures described by Lucas et al. (2018b). The snacks without açaí were elaborated using the ratio 2:1 of rice and corn flours, respectively (Lucas et al., 2018a). Furthermore, three formulations of snacks added with açaí were elaborated by the addition of 2%, 4%, and 6% of açaí powder replacing the same amount of flours. These concentrations of açaí were defined based on previous studies of food and beverages containing açaí, and cereal-based snacks added with fruit (Camire et al., 2007; Espírito Santo et al., 2010; Hirth et al., 2014; Sabbe et al., 2009; Tacer-Caba et al., 2014).

2.2 Extrusion cooking

The raw materials were mixed and then introduced in the extruder by a K-Tron powder feeder (Coperion K-Tron, Niederlenz, Switzerland). Extrusion trials were performed using a co-rotating twin-screw extruder (Model DNDL-44, Bühler, Uzwil, Switzerland) with L/D = 20.45. The screw speed was 250 rpm, feed rate of 12.6 kg/h, and 143ºC in the last zone of the extruder as defined previously by Lucas et al. (2018a). The moisture content was 16.2% and corrections were made using mass balance. A circular die was used in the end. After, the extrudates were dried until 6% of moisture and stored in metalized bags for further analyses.

Moisture loss (%) during the extrusion was calculated considering the difference between the initial moisture (16.2%) and the moisture of the extrudates at the end of the die. For these measurements, a moisture analyzer (HC103 Moisture analyzer, Mettler Toledo, Switzerland) was used.

2.3 Physical properties of the snacks

The expansion index (EI) was determined following the methods described by Gujska and Khan (1990). Bulk density (BD) was calculated using the method described by Alvarez-Martinez et al. (1988). The textural properties (hardness and crispness) of the extrudates were analyzed with a TA-XTplus Texture Analyser (Stable micro systems, Surrey, UK), using a cylinder probe with 25 mm diameter. The hardness was taken by the maximum force required for compression of the extrudates (by 50%). The crispness was obtained from the total number of peaks of the curve (Oliveira et al., 2017).

3. RESULTS AND DISCUSSION

Regarding the moisture lost during the extrusion process, the results were 50.5±2.3%, 51.5±0.9%, 47.6±0.5% and 51.4±2.1% for the samples containing 0, 2, 4, and 6% of açaí, respectively, without significant differences between the samples. According to Azzollini et al. (2018), the easier the moisture evaporates in the die of the extruder, the more expanded and porous the extrudates.

Table 1. Physical properties of extrudates

Trial (% açaí)	Expansion index (cm/cm)	Bulk density (g/cm^3)	Texture	
			Hardness (N)	Crispness[1]
0	4.81±0.03^{a}	0.056±0.002^{c}	20.39±1.37^{b}	100.00±5.29^{b}
2	4.81±0.08^{a}	0.059±0.001^{b,c}	21.42±1.00^{a,b}	101.33±5.03^{b}
4	4.80±0.03^{a}	0.064±0.004^{a,b}	23.61±1.45^{a,b}	116.67±7.09^{a}
6	4.77±0.04^{a}	0.066±0.002^{a}	23.85±1.26^{a}	117.33±2.52^{a}

[1]: Number of measured force peaks; Means ± standard deviation ($n = 3$). Different letters in the same column indicate significant differences between samples ($p < 0.05$).

The physical properties of the extrudates are shown in Table 1. The radial expansion, that is one of the most important properties of extrudates showed no significant difference between all the snacks developed. Lucas et al. (2018a) observed similar behavior for snacks with and without *Spirulina*. In contrast, some studies that used higher fractions of fruits (>6%) in extrudates observed significant differences in diameter and pore size of the expanded snacks (Basto et al., 2016; Höglund et al., 2018). Researchers found a reduction of the expansion index in extrudates enriched with 13, 23 and 28.5% of goji berry (Kosińska-Cagnazzo et al., 2017). In another study, Basto et al. (2016) added 25 % peach palm to corn extrudates and reported a smaller diameter and irregular air cells.

Bulk density represents the expansion in all directions (Jeyakumari et al., 2016). Samples added with 4 and 6% of açaí pulp powder showed significantly ($p<0.05$) higher Bulk density than the control (0% açaí). This behavior is probably due to increases in protein content (Sumargo et al., 2016; Lucas et al., 2018a).

The hardness in samples containing 2% and 4% of açaí did not differ significantly ($p>0.05$) from the sample containing no açaí. The addition of 4% and 6% of açaí to cereal-based extrudates resulted in crispier snacks formulations. According to Oliveira et al. (2018), crispness is directly related to the acceptance of extrudates. Our results are in line with those reported by Oliveira et al. (2018) for breakfast cereals elaborated with jabuticaba peel powder. Further analyses to evaluate the microstructure as well as sensory properties are suggested.

4. CONCLUSIONS

Açaí-enriched snacks presented no differences regarding the expansion index, comparing to the sample without açaí. Higher concentrations of açaí added to the formulations resulted in denser, harder and crispier snacks. However, despite the differences, all results are comparable with those obtained by other researchers for expanded snacks enriched with other sources.

Additional microstructure analysis is suggested to confirm the influence of açaí incorporation in the cell wall thickness of the extrudates. Furthermore, the next step could be to determine the sensory properties and acceptance of this product.

Therefore, we conclude that açaí can be added to develop innovative snacks and result in suitable physical properties. These expanded snacks can be used as healthier ready-to-eat food.

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