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TAMARIND PULP POWDER OBTAINED IN SPRAY DRYER

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ABSTRACT

Fruits have been the target of extensive studies due to their nutritional and functional properties. Tamarind is known for nutritional quality, being a good alternative as an ingredient food products, mainly in the form of powder. Therefore, the objective was to evaluate the effect of temperature (145.8 - 174.2 ºC) and concentration of the mixture in equal parts of adjuvants (5.8 - 30%) drying on the powder of tamarind pulp obtained in spray dryer. Three drying adjuvants were used: maltodextrin DE 20, inulin and WPI. Humidity, yield, solubility and hygroscopicity were analyzed. The quadratic effect was not present in the variable hygroscopicity. Temperature showed no influence ($p > 0.10$) on the parameters humidity ($R^2 = 0.9199$) and hygroscopicity ($R^2 = 0.4899$). Solubility was the only parameter influenced ($p < 0.10$) by temperature ($R^2 = 0.9277$). The yield was not shown to be significant. The test 11 (20% and 174.2 ºC) stood out, with 1.37% humidity, 38.86% yield, 97.09% solubility and 9.60% hygroscopicity.
Keywords: fruit, powder, drying, shelf life.

INTRODUCTION

The species *Tamarindus indicates* L., of the family Fabaceae, subfamily Caesalpinioideae, is a tree belonging to the genus Tamarindus, known to be an important fruit, native to the African continent. The fruits contain about 30% pulp, 40% seeds and 30% peel. It is known for the presence of low humidity, relatively high amount of sugars (30 - 40%), low pH (2.95 – 3.40), high content of carbohydrates, proteins and minerals, which makes it a good source of nutrients in human food, although not as consumed in natura form. The pulp is usually made available industrially in concentrated form, diluted in water and as an ingredient in powder form, being attractive for beverage production (1, 2, 3, 4).

Fruit powders have very different characteristics of pulp or juice, so it is important to know their properties (5). Spray drying *is* a technique widely used in food industries for commercial production of powdered foods because it has several advantages, including fast drying, high yield and continuous operation. During the spray drying process, the feeding solution is sprayed into drops in a hot air stream. Liquid droplets are dried in seconds and the finished product is in the form of powder, granules or agglomerates (6,7, 8, 9, 10, 11).

Adjuvant agents have been extensively used, in combination or not, as components of the drying process (12, 13, 14). The technological purpose of these substances is to alter the physical-chemical properties of the target drying matrix to facilitate or enable this process by increasing the glass transition temperature (11, 15). In the scientific literature there are records of several compounds used as drying adjuvants in fruit pulps such as maltodextrin in pine pulp (16), inulin in araticum pulp (17), arabic gum and whey protein in tamarind pulp (18).

In the form of powder, tamarind pulp has many advantages and economic potentials, which include convenient use in different food formulations and low logistics expenses due to weight and volume reduction (19, 20), demonstrating to be an interesting ingredient in the formulation of various food products.

OBJETIVO

The objective of this work was to obtain the tamarind pulp powder obtained in spray dryer, as well as to evaluate the drying air temperature and the concentration of the mixture of three different drying adjuvants (maltodextrin DE 20, inulin and whey protein isolated (WPI)) on the characteristics of the powders.

MATERIAL AND METHODS

The frozen tamarind pulps, from different lots, were acquired in the local trade of the city of Fortaleza, Ceará, Brazil. The pulps were thawed, diluted with distilled water in the proportion of 10%, added to adjuvants and sprayed in a spray dryer (model MSD 1.0 LABMAQ), where the following drying conditions were fixed: sample flow of 0.400 L h^{-1}; compressed air flow of 30 L min^{-1}, drying air flow 4.0 m^3 min^{-1} and spray nozzle with an opening diameter of 1.2 mm. The mixture in equal parts of maltodextrin with equivalent dextrose (DE) 20, inulin and WPI were used as drying adjuvants. For each assay, 400 g of sample were used.

A rotational central composite design (DCCR) was used using as independent variables the drying air temperature (145.8 - 174.2 ºC) and concentration of the mixture in equal parts of the adjuvants (5.8 – 30%) on the tamarind pulp. 11 trials were performed, four factorial assays (combinations between levels ± 1), three central (two independent variables at level 0) and four axial (one independent variable at level ± α and another at 0). The planning response variables were humidity, hygroscopicity and solubility of the powders, analyzed according to (21), (22) and (23), respectively. The drying yield was calculated by the relationship between the mass of solids present in the sample before drying and the mass of solids of the powder obtained.

Based on the results obtained in the experimental design, for the parameters that were significant at the 90% confidence level, quadratic regression models were adjusted evaluated through variance analysis (ANOVA) and figures were generated. The significance of the models were evaluated by the F test and the coefficient of determination (R^2).

RESULT AND DISCUSSION

The results of spray dryer drying experiments for each assay are presented in Table 1. The addition of the adjuvants maltodextrin, inulin and WPI in equal proportions in the tamarind pulp showed a significant estimated effect ($p < 0.10$) only on three parameters evaluated: humidity ($R^2 = 0.9199$), solubility ($R^2 = 0.9277$) and hygroscopicity ($R^2 = 0.4899$), Figure 1.

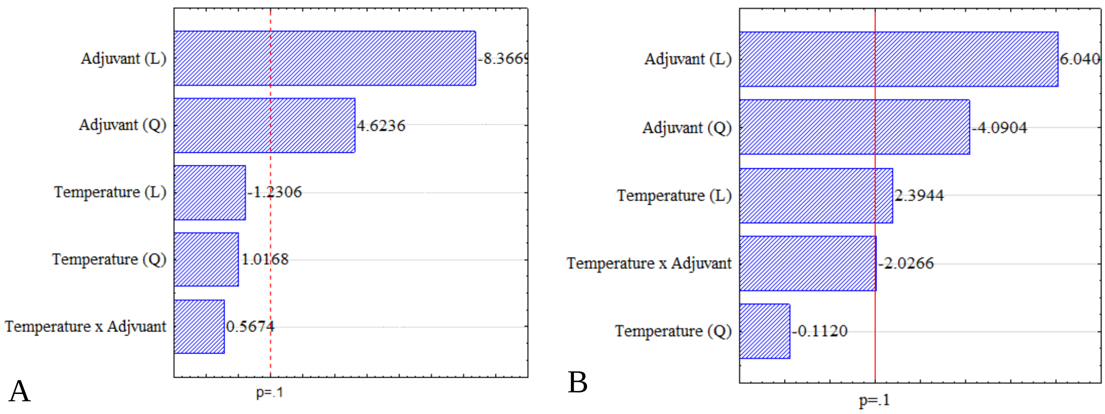
There was no significance for yield. The linear effect was present in all of them. The temperature showed no influence (p > 0.10) on the parameters humidity and hygroscopicity. Humidity ranged from 0.97% (assay 5) to 6.88% (assay 8). Hygroscopicity was lower for assay 9 and higher for Assay 8. Solubility was the only parameter influenced (p < 0.10) by temperature, ranging from 87.68% for Assay 8 and 97.96% for assay 6.

Table 1: Results of the DCCR experimental design for drying of tamarind pulp obtained in spray dryer.

	Independent variables		Dependent variables			
Essay	Inlet temperature (°C)	Adjuvant (%)[1]	Humidity (%)	Yield (%)	Solubility (%)	Higroscopicity (%)
1	170	30	1,28 ± 0,04	30,48 ± 0,15	96,46 ± 2,27	6,44 ± 1,04
2	170	10	3,65 ± 0,13	30,64 ± 0,16	93,96 ± 0,52	7,53 ± 0,75
3	150	30	1,19 ± 0,19	22,07 ± 0,12	96,96 ± 2,44	6,78 ± 0,53
4	150	10	4,26 ± 1,36	28,93 ± 0,20	89,55 ± 2,97	8,07 ± 0,88
5	160	20	0,97 ± 0,13	36,94 ± 0,14	95,63 ± 1,72	7,03 ± 0,25
6	160	20	1,45 ± 0,15	35,22 ± 0,61	97,96 ± 0,99	8,19 ± 1,00
7	160	20	1,45 ± 0,22	39,61 ± 0,34	94,47 ± 2,21	6,81 ± 0,74
8	160	5,8	6,88 ± 0,44	35,14 ± 0,61	87,68 ± 2,39	11,28 ± 0,22
9	160	34,2	0,64 ± 0,05	37,69 ± 0,08	95,32 ± 0,24	6,27 ± 0,57
10	145,8	20	2,48 ± 0,44	31,77 ± 0,27	94,05 ± 1,34	7,12 ± 0,64
11	174,2	20	1,37 ± 0,05	38,86 ± 0,43	97,09 ± 2,54	9,60 ± 0,60

Mean ± Standard Deviation (n = 3). [1]By mass (g^{g-1}).

Hygroscopicity is the ability of a material to absorb humidity from the environment of high relative humidity. Generally, powder with low hygroscopicity and humidity content and high solubility is considered a good powder (18). The increase in solubility with the increase in the temperature of the inlet air is due to its effect on the residual humidity content. The lower the humidity content of the powder sample, the more soluble it is (22). The test 11 presented the best set of results, with 1.37% humidity, 38.86% yield, 97.09% solubility and 9.60% hygroscopicity, whose independent variables were adjusted in 20% of adjuvants and 174.2 ºC of drying temperature.



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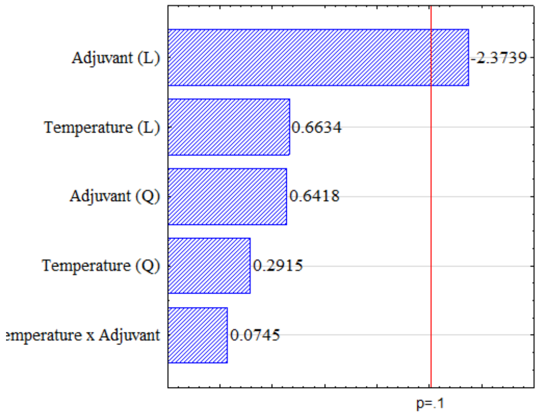

Figure 1: Effect of the addition of adjuvants and drying air temperature in (A): humidity, (B): solubility and (C): hygroscopicity of tamarind pulp obtained in spray dryer.

In Pareto, L is the linear term and Q is the quadratic term. Significant values at $p < 0.10$.

CONCLUSION

The tests performed in a spray dryer was effective in identifying the best concentration of adjuvants and drying temperature capable of presenting the best results for the parameters humidity, yield, solubility and hygroscopicity, demonstrating that the test 11 (20% adjuvant and 174.2 ºC) stood out before the other. Only solubility was influenced by temperature. However, it is still possible to optimize this study by preferably applying a design of mixtures, to observe the best proportion of adjuvants capable of producing the best tamarind powder, verifying more efficiently the joint and individual influence of adjuvants on the quality of this product.

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