OBTAINING THE POWDER OF TAMARIND PULP POWDER SPRAYED USING THE EXPERIMENTAL DESIGN OF MIXTURES

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ABSTRACT

The production of fruit pulp powder has been increasingly carried out. Due to its peculiar nutritional characteristics, tamarind has been the objective of several studies, whose objectives are to prolong its useful life and add commercial value. This study aimed to obtain the powder from the tamarind pulp by spray dryer using three different drying adjuvants (maltodextrin DE 20, inulin and WPI) in mixtures and evaluate its effect on the parameters humidity, yield, hygroscopicity, solubility, total phenolics and color. WPI had a strong influence on higher humidity, yields, lower hygroscopicities, solubility and luminosities. Inulin has contributed little to improve yield and when mixed maltodextrin promotes greater solubility as well as allows for a darker appearance. The total phenolic content was also influenced, especially the WPI, which presented the highest content among the individual adjuvants (1457.17 mg of EAG.100 g^{-1} BS) and in mixture (1176.62 mg of EAG.100 g^{-1} BS). Combined or in mixtures, WPI is the most prominent drying adjuvant, with better results for powder with 50% maltodextrin and 50% WPI.
Keywords: fruit, powder, drying, shelf life.

INTRODUCTION

The tamarindeiro (*Tamarindus indica* L.), native to the african continent, has fruits that 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 commonly consumed in natura form. The pulp is usually made available industrially in concentrated form, diluted in water and as an ingredient in powder form (1, 2, 3, 4). Turning tamarind into powder has numerous advantages, among them: (i) prolonging the service life at room temperature due to low water activity, (ii) reducing logistics transport expenses due to light weight and volume; and (iii)easy handling and use (5).

Spray dryer in spray drying is a process widely used in the food industry and, under ideal conditions, has proven effective for obtaining various products. Fruit powders have very different characteristics of pulp or juice, so it is important to know their properties. Adjuvant agents have been extensively used, in combination or not, as components of the drying process (6, 7). Among the main indicators of benefits of the use of drying adjuvants are: improvement of dryer performance (i); improvement of the properties of the target matrix (ii); modulation of particle size (iii); increased income (iv); increased stability of the final product (v); ease of handling, transport and storage (vi);

greater protection against environmental humidity adsorption (vii); and increased bioavailability (viii). For this, it is expected that the selected compounds are harmless, safe, chemically inert, with thermal and oxidative stability, low hygroscopicity and viscosity, high solubility and low cost.

In the scientific literature there are records of several compounds used as drying adjuvants in fruit pulps such as starch, inulin and maltodextrin in jussara and pine pulp (8, 9), arabic gum in araçá-boi pulp (10) and melon pulp (11), inulin in araticum pulp (12), arabic gum and whey protein in milk pulp of tamarind (13). The tamarind pulp powders obtained with whey protein concentrate showed better properties, compared to those obtained with maltodextrin and arabic gum (13).

With the technological advancement of scientific research, the planning of experiments gains increasing importance by generating savings and quality. Mixture experiments are those in which the studied properties (the answers) basically depend on the relative proportions between the constituents and not on the individual quantities (14).

OBJECTIVE

This study aimed to evaluate the influence of three drying adjuvants, maltodextrin DE 20, inulin and whey protein isolate (WPI), and their mixtures on the characteristics of tamarind pulp powder obtained in spray dryer.

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.

Through preliminary tests, the independent variables, drying temperature and total concentration of adjuvants were defined, under the conditions of 174.2 ºC and 20%, respectively. A design of mixtures of the Type Simplex Centroide Increased containing 10 assays was used, in which three assays contained tamarind pulp and each of the adjuvants individually, three assays contained the combination of two adjuvants in the proportion of 50% (m m^{-1}) each, three assays contained 66.67% (m m^{-1}) of one of the adjuvants and 16.67% (m m^{-1}) of the mixture of the others and one test contained the mixture of the three adjuvants in the proportion of 33.33% (m m^{-1}) each.

From the results obtained in the design of mixtures for the parameters that were significant at the 90% confidence level, regression models were generated, evaluated according to variance analysis (ANOVA), F test and determination coefficient (R^2). From the models, ternary diagrams were generated. The planning response variables were humidity, hygroscopicity and solubility, determined according to (15), (16) and (17), 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. Total phenolics were determined using 50% methanol (v v^{-1}) and acetone 70% (v v^{-1})) as extraction solvents. Then, 500 μL of the extracts were homogenized with 500 μL of the reagent Folin Ciocalteau, 1000 µL of sodium carbonate at 20% and 1000 µL of distilled water, subjected to agitation and rest for 30 minutes, protected from light. The results were calculated with the aid of a standard curve of lalic acid (0, 10, 20, 30, 40 and 50 mg of EAG 100 g^{-1}), where the results were expressed on a dry basis. The data were statistically treated with the help of statistica 7.0 software.

RESULT AND DISCUSSION

The ternary diagrams for the parameters humidity, yield, hygroscopicity, solubility and total phenolics of tamarind pulp powders obtained in spray dryer at 174.2 ºC and containing 20% maltodextrin, inulin and WPI in mixture are presented in Figure 1.

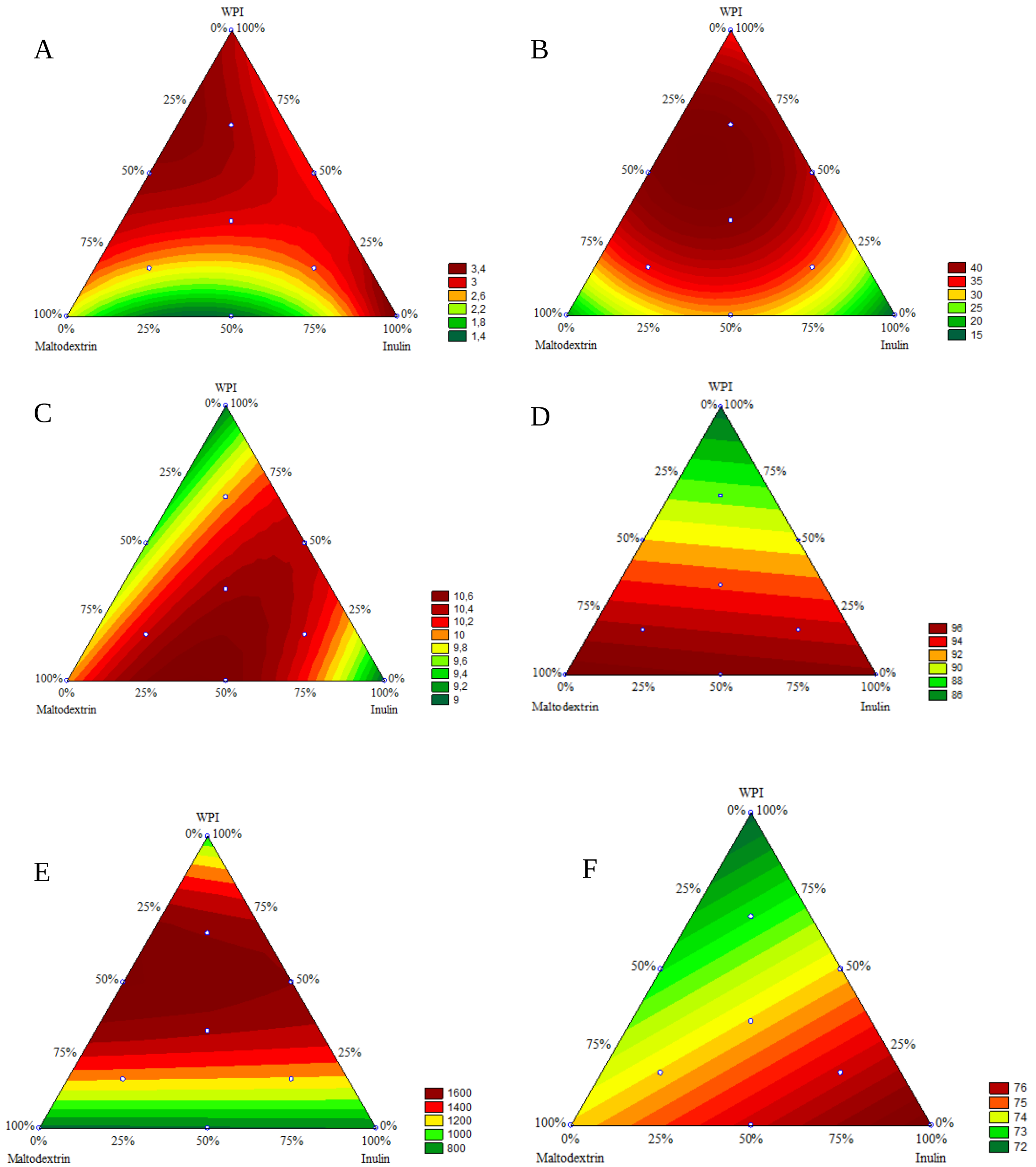

Figure 1: Ternary diagrams of the effect of the addition of maltodextrin, inulin and WPI adjuvants in mixture on the parameters: (A) humidity, (B) yield, (C) hygroscopicity, (D) solubility, (E) total phenolics and (F) color parameter L* of powder to tamarind pulp obtained in spray dryer.

The WPI had a strong influence on higher humidity (Figure 1A), yields (Figure 1B), lower hygroscopicities (Figure 1C), solubility (Figure 1D) and luminosities (Figure 1F). The yield presented average values close to 40%, standing out in relation to the adjuvants maltodextrin and inulin, ranging from 14.10% (with 100% inulin) to 44.75% (50% maltodextrin and 50% WPI). Clearly, inulin has contributed little to improve the drying yield of tamarind pulp, either individually or in mixtures, but it proves to be more efficient in promoting a greater solubility to the powders, along with maltodextrin, as well as in allowing a darker appearance, giving a greater performance to the pulp solids. The total phenolic content was also influenced, especially the WPI, which presented the highest content among individual adjuvants (1457.17 mg of EAG 100 g^{-1} BS). The highest total phenolic content (1176.62 mg EAG 100 g^{-1} BS) among the mixtures was for the assay with 66.67% WPI (Figure 1E).

The increase in powder yield is due to the reduction of viscosity and the formation of a film rich in protein, which is able to overcome the coalescence of droplets, as well as the sticky interactions of the particles in the dryer drying chamber, and may have a relatively higher glass transition temperature, due to the high molecular weight of WPI (13). The less luminous color of WPI powder can be correlated with the inherent color of WPI, which is naturally more yellowish and more luminous when compared to maltodextrin and ilunin (13). The phenolic content is justified by the greater polymerization capacity of WPI (13). Generally, powder with low hygroscopicity, humidity content and high solubility is considered a good powder (13).

Results similar to that of this study were foundwhen using the soy protein i-only in the production of tamarind pulp powder (18). The same was observed when using maltodextrin DE 20, arabic gum and whey concentrate as adjuvants in drying tamarind pulp (13), both by spraying.

CONCLUSION

The mixture design showed that the adjuvants maltodextrin, inulin and WPI are viable as drying adjuvants in obtaining tamarind pulp powder by spraying. Individually or in mixtures, WPI is more prominent, mainly in raising yield, total phenolic content, in mixture, and allowing a more luminous L* color parameter. Associated with maltodextrin, WPI has a higher yield when compared to the association with inulin, thus demonstrating that the powder with 50% maltodextrin and 50% WPI stands out among the others.

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