P-060	**IInfluence of spray driying on reconstitution properties of sweet corn powder**

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INTRODUCTION AND OBJECTIVES

Sweet corn is a product widely consumed in Brazil, but it is seasonal and perishable. It can be dried to increase its shelf life and can be used in different food formulations (cream, cakes, among others). Among different methods of drying, spray dryer is the most common method used in the industry for being flexible, economic and continuum. It allows drying solutions, emulsions, fruit pulp and vegetables eliminating water by evaporation. The instantizing of the product by evaporation is short, 1 to 10 seconds and the core temperature does not exceed 100 ° C, which reduces the occurrence of undesirable changes in thermosensitive compounds (Deymonaz, 2009). Using high drying temperatures can produce physical changes to the product that are usually noted after the powder reconstitution (Fuchs et al., 2006). Reconstitution process involves instantizing properties of: wettability, sinkability, dispersibility and solubility, resulting in the powder reconstitution (Schubert, 1993). The reconstitution properties of the product are difficult to study independent of the dissolution process properties and the criterion that can evaluate the powder behavior is the water (Thomas et al., 2004). This study aims to determine the influence of spray drying conditions on drying properties of instantizing of sweet corn pulp.

MATERIAL AND METHODS

The raw material used was sweet corn (*Zea mays L.*), acquired at the trade in Lavras-MG. Corn was selected, washed and immersed in a solution of sodium hypochlorite, chopped (a mixture of pulp and water), refined, packaged, and frozen until the time of drying.

Drying

The powder was produced by drying of the sweet corn pulp in a spray drying brand LABMAQ from Brazil, 1.0 MSD model. The equipment operates in a concurrent flow system and it has an atomizing nozzle with a hole of 2 mm in diameter. The temperature of the air in the entrance ranged from 143.2 to 176.8 ° C. The pulp was concentrated from 36.6 to 53.4 and transported by a peristaltic pump in a flow rate from 0.448 to 0.952 through the silicone tube that leads to the top of the dryer, where it joins the atomizing air from a compressor. When in contact with the drying air, water molecules evaporate from the particle that is separated by a cyclone installed at the outlet of the dryer and collected in a glass container. The air exits from the top of the cyclone and then is discarded into the environment.

Experimental design

The tests were performed according to a 2^3 experimental design, with 8 factorial points, 6 repetitions at the central point and 6 axial points totaling 20 trials (Iemma & Rodrigues, 2009). Independent variables were temperature T (°C), flow rate Q (L.h^{-1}), extract concentration EC (% w/w). Their levels are showed on Table 1. Dependent variables evaluated were: moisture, solubility, wettability.

Table 1. Experimental design of drying in spray dryer.

Variable	-1.68	-1	0	+1	+1.68
T	143.2	150	160	170	176.8
Q	0.448	0.55	0.70	0.85	0.952
EC	36.6	40	45	50	53.4

Analytical Methods

Moisture was determined by gravimetric method after drying at 105 ° C, according to AOAC (2000).

Solubility method followed the methodology proposed (Cano-Chaucer et al., 2005), using 1 g of powder in 100 mL of distilled water and homogenized. The solution was transferred into a tube and centrifuged at 2600 rpm for 5 min. An aliquot (25 mL) of supernatant was transferred to a petri dish previously weighed and put to drying at 105 ° C.

The wettability test was based on the methodology proposed by (Vissotto et al., 2006). It was determined by measuring the time required for complete dissolution of 1 g of the product in 100 mL of distilled water at 25 ° C. The mixture was measured on a stopwatch and observed until the moment all solid particles were dissolved.

RESULTS AND DISCUSSION

In Table 2 are the regression equations with the encoded variables, and coefficients of determination (R^2) and (F_{Cal}). Non-significant terms were eliminated and the models were evaluated by analysis of variance. The model adjustments for moisture, solubility and wettability were good, as can be observed by the high values of R^2. Analyzing data from the drying process the moisture was influenced by the flow rate and temperature, obtaining sweet corn powder with lower moisture content. This moisture content in the powder ranged from 1.49 to 2.90%. Based on this result, the starch, by law, can be traded up to 14% moisture, levels required for preservation of food products (Brazil, 1987). Temperature and

flow rate also exerted significant effects on the solubility of the powder, resulting in higher solubility of the powder at higher temperatures and flows in the drying. The solubility of the powder ranged from 92.57 to 95.45%. This range is presented consistent with the values found by Cano-Chauca et al (2005) between 91.27 and 96.41% in a study of microencapsulation of mango juice powder. Wettability values ranged from 101.61 to 155.28 seconds, presenting good wettability in water. Sweet corn powder was influenced by all the independent variables, negatively, that is, the higher is the temperature, flow rate and concentration of the pulp, lower is the value of wettability. Martinelli (2008) obtained values of wettability on lemon juice powder from 123.67 to 130.33 seconds, confirming the results obtained in this work.

Table 2. Coefficients of the adjusted model for temperature, flow rate and pulp concentration.

Response	Estimator model	F_{cal}	R^2
Moisture	$1.60 + 0.39\,T + 0.57\,Q$	20.35	0.86
Solubility	$95.27 + 0.47\,T + 0.56\,Q$	22.75	0.98
Wettability	$103.6 - 7.5\,P - 24.4\,T - 13.4\,Q$	14.00	0.97

T = inlet air temperature (ºC); V = flow rate (L.h^{-1}); P = Pulp concentration (% w/w). F_{tab} (4, 8, 5%) = 6,39

Figure 1 shows the response surfaces of the influence of temperature and flow rate on the solubility and wettability of sweet corn powder, submitted to the process of reconstitution.

(a)

(b)   (c)
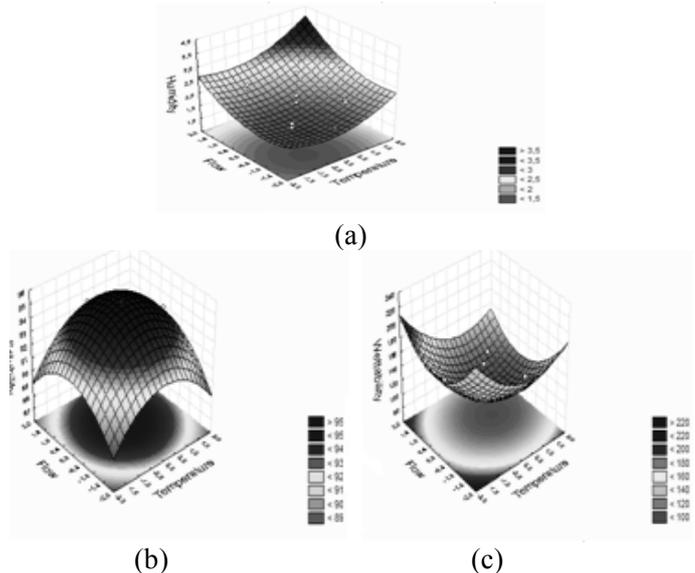
Figure 1-Response surfaces of the powders evaluated in obtaining (a) humidity, (b) solubility and (c) wettability.

CONCLUSION

Drying conditions evaluated allowed obtaining a powder product of low moisture, good solubility and high wettability, therefore stable in storage and with good features of reconstituition, using the temperature 150 ° C, flow rate 0.85 L.h^{-1} and concentration of 50% pulp.

REFERENCES

- A.O.A.C - Association of Official Analitical Chemistry (2000). Official methods of analysis of the association of chemstry. 17 ed. Washington.
- Brasil (1987), Portaria n.01, de 28 de janeiro de 1987. Regulamento técnico referente a alimentos e bebidas (produtos amiláceos e derivados incluídos). Diário oficial, Brasília, 25 fev. Disponível em: http://www.anvisa.com.br. Acesso em 2004.
- Cano-Chauca et al. (2005), *Effect of the carriers on the microstructure of mango powder spray drying and its functional characterization*. Innovative Food Science & Emerging Technologies, v. 6, nº 4, p. 420-428.
- Deymonaz et al. (2009). *Spray drying*. Disponível em: http://www.wsu.edu/~gmhyde/433_web_pages/drying-web-pages98/spray-dry/Spray-Drying-intro.htm>. Acesso em: 22 abr.
- Fuchs et al (2006), *Encapsulation of oil in powder using spray drying and fluidized bed agglomeration*. Journal of Food Engineering, v. 75, p. 27-35.
- Martinelli (2008), Construção e desenvolvimento de um secador de leito pulso fluidizado para secagem de pastas e polpas. Dissertação (Mestrado em Engenharia de Alimentos), Departamento de Engenharia e Tecnologia de Alimentos-Universidade Estadual Paulista Júlio de Mesquita Filho (UNESP), São José do Rio Preto, SP, 2008.
- Rodrigues & Iema (2009), Planejamento de Experimentos e Otimização de Processos: Uma estratégia seqüencial de planejamentos. Editora: casa do pão, Campinas, p. 135-215.
- Schubert (1993), *Instantization of Powered food Products*. International Chemical Engineering, v. 33, n. 1, p. 28-45.
- Thomas et al (2004), *Milk powders geing: effect on physical and functional properties*. Critical Reviews in Food Science and Nutrition, Boca Raton, v. 44, p. 297-322.
- Vissotto et al .(2006), *Avaliação da influência dos processos de lecitinação e de aglomeração nas propriedades físicas de achocolatado em pó*. Ciência e Tecnologia de Alimentos, v.2, n. 3.