Optimization of spray-drying of strawberry juice

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Introduction

Fruit juice powders present many benefits and economic potential over their liquid counterparts, such as reduced volume or weight, reduced packaging material, easier handling and transportation, and longer shelf life. The production of sugar-acid rich foods, such as fruit juices by spray-drying, may be complex because they are rich in sugars, such as fructose and glucose, which have very low glass transition temperatures (T*g*). High molecular weight compounds are commercially used as drying aids because of their high T*g* (Adhikari *et al.,* 2004). In alternative, prebiotics could be used, adding value to the final product.
This work aimed to test the use of prebiotics, such as maltodextrin and arabic gum, as drying agents of strawberry juice. The spray-drying parameters, inlet and outlet temperatures, air pressure and feed temperature, as well as the amount of prebiotics, were optimized in order to obtain the highest powder yield.

Methods

Samples were prepared with concentrated strawberry puree, with average content of total soluble solids equivalent to 6.0 ^{0}Brix. Before dehydration, the puree was diluted in distilled water until a total soluble solid content of 0.5 ^{0}Brix. Maltodextrin 10 DE (Sigma-Aldrich, USA) or arabic gum (Merck, Germany) were added with a final concentration between 0.25% and 4% (w/v) before spray-drying. Powder was obtained by means of mini spray dryer (BUCHI, B-191, Laboratory-Techniques LTD, Flawil Switzerland). The spray dryer operates in concurrent flow and has a spray nozzle with an orifice of 1 mm in diameter. The inlet air temperature was 120 ºC and 130 ºC and the outlet air temperature was 65 ºC and 70 ºC respectively, for all the solutions investigated. The liquid feed to the dryer was at about 10 mL min^{-1} and 40 ºC. The experiments were performed in triplicate. The water activity of the spray-dried strawberry powders was measured at 23.0 ± 1 ºC, using a water activity meter.

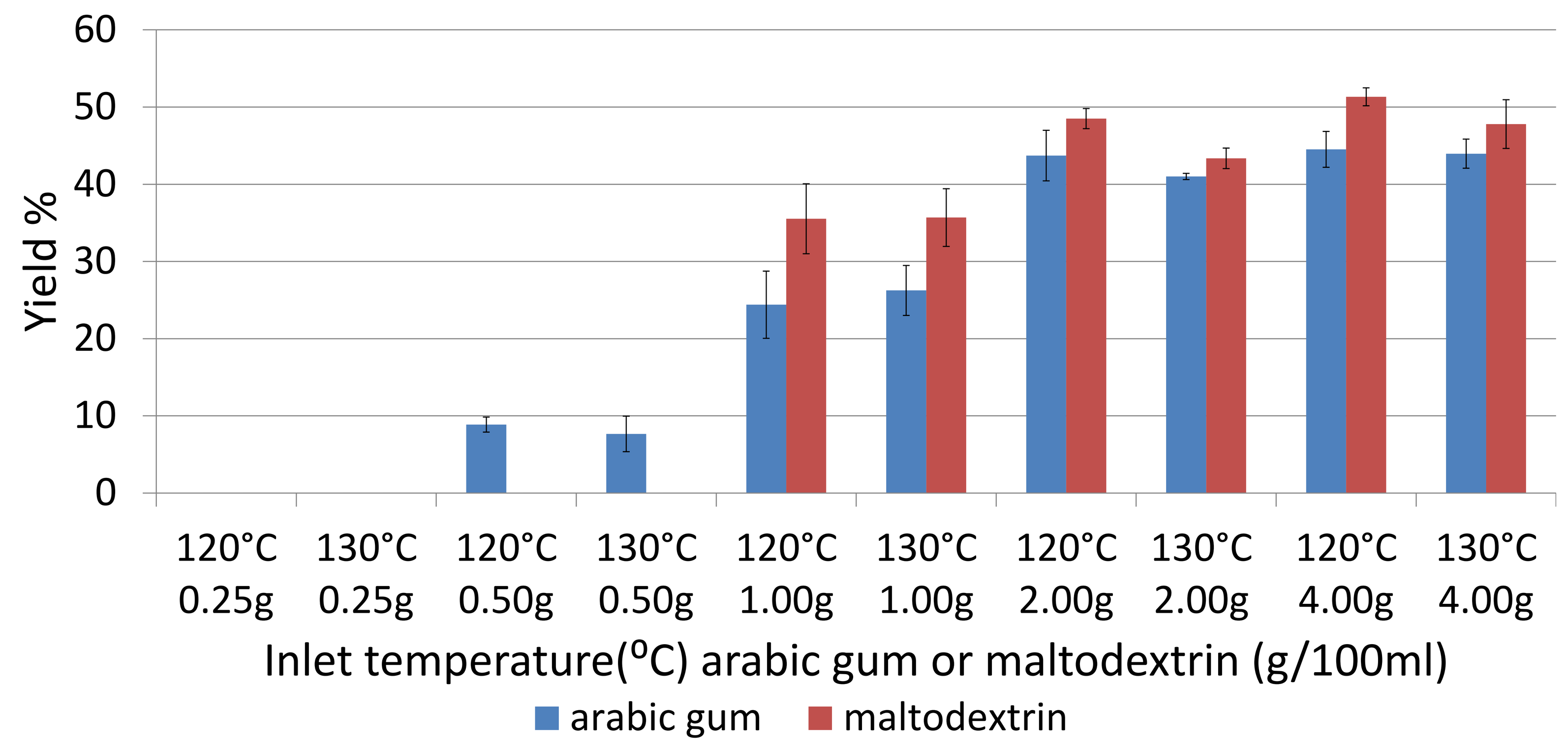

Figure 1. Yield of spray-drying of strawberry juice with maltodextrin or arabic gum

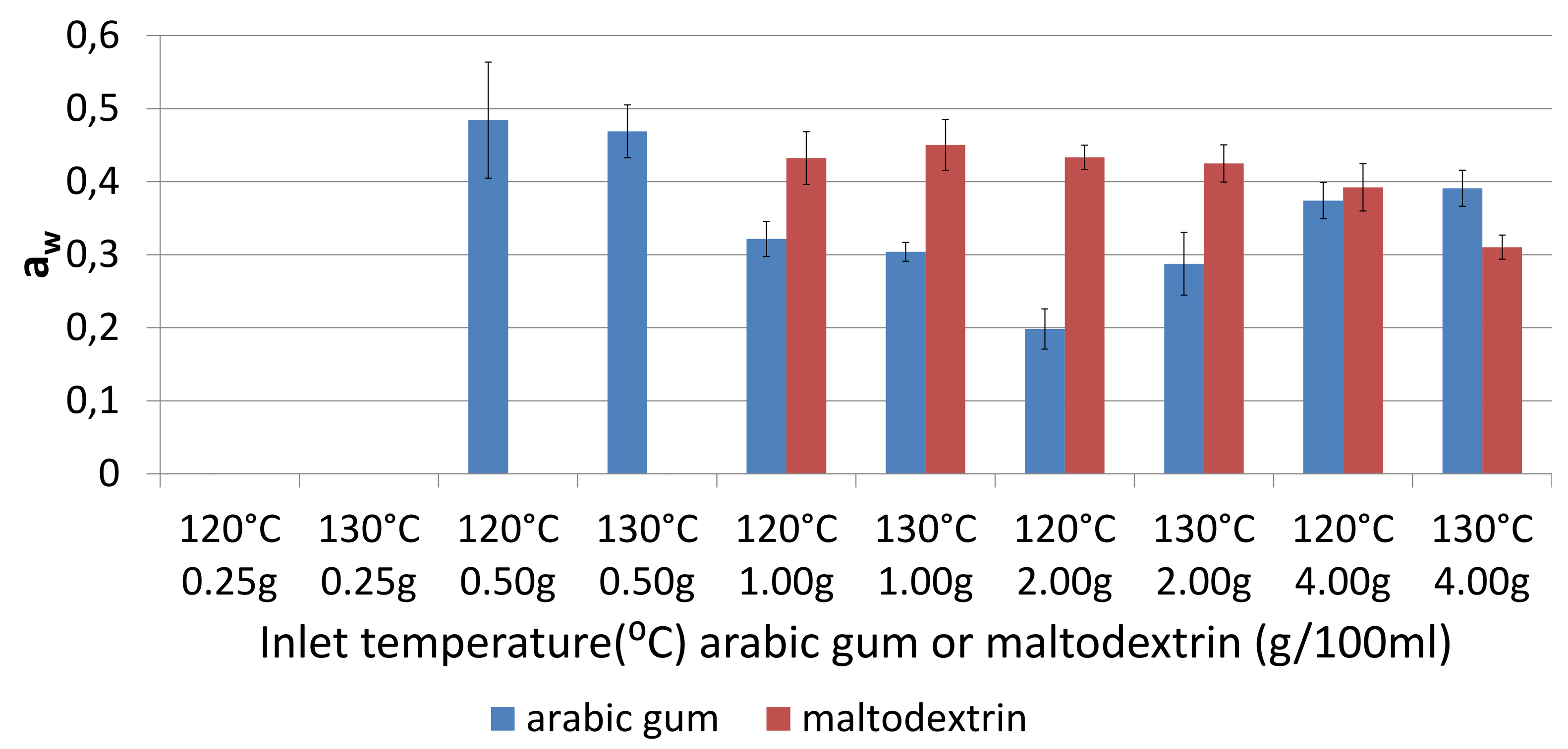

Figure 2. Water activity of strawberry juice powder

Results and Discussion

There was an increase of the yield with the concentration of maltodextrin or arabic gum (figure 1). This can be explained by an increase of T*g* of the product, making the drying easier and avoiding the stickiness of the product. The water activity of the strawberry powder did not change for the different concentrations of maltodextrin. On the other hand, with adition of arabic gum the water activity decreased with the yield until a concentration of 2% (w/v), reducing the water activity, the drying of the powder also being easier (figure 2).

This study allows to conclude that 2% (w/v) of maltodextrin or arabic gum is enough to reach a product yield of near 50% during spray-drying of strawberry juice, which is the value granted for a sucessfull spray drying at laboratory scale (Jayasundera *et al.*, 2011).

References

M. Jayasundera, B. Adhikari, R. Adhikari, P. Aldred, 2011 . The effect of protein types and low molecular weight surfactants on spray drying of sugar-rich foods, *Food Hydrocolloids*, 25, 3: 459-469
B. Adhikari, T. Howes, B.R. Bhandari, V. Troung, 2004. Effect of addition of maltodextrin on drying kinetics and stickiness of sugar and acid-rich foods during convective drying: experiments and modelling, *Journal of Food Engineering*, 62:1 53-68

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