Effects of spray drying conditions on the physicochemical and antioxidant properties of Gac powder

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Introduction

Gac fruit is considered as one of the "super" fruits, containing extraordinarily high levels of carotenoids, especially carotenes and lycopene in the Gac aril. Moreover, α-tocopherol (vitamin E) concentration in the Gac fruit pulp is also comparatively high. Vitamin E, as a natural antioxidant, helps protect Gac oil from oxidation. In addition, Gac fruit also contains a significant amount of polyunsaturated fatty acids.

Spray drying has been widely utilised for commercial production of dried fruits and vegetables. However, very little information has been published on spray drying of Gac fruit.

Figure 1. Gac fruit on vine and its components

Materials and methods

Fresh Gac fruits were purchased from a local market in Hochiminh City, Vietnam. The red aril was blended with distilled water, in the ratio of 1 to 5, in a laboratory blender. The resulting juice was filtered twice, using a 100 µm mesh screen. Next, different ratios of commercial maltodextrin (12 DE, Glucidex®, Roquette, France) were added into the juice, which was blended and finally filtered before spray drying. The three ratios of maltodextrin 12 DE to the juice were 10%, 20% and 30% (w/w).

The feed mixtures comprising added maltodextrin and the aril juice were spray-dried in a Lab Plant SD-05 spray dryer (Lab Plant Ltd., England). The inlet temperatures, the drying air flow rate, compressor air pressure and feed rate were constant, at 120, 140, 160, 180 and 200^{0}C, 56 ± 2 (m^3/h), 0.06 MPa gauge and 12-14 mL/min, respectively. The spray drying processes were all carried out in duplicate.

Moisture content, pH, water activity (Aw), bulk density, water solubility index (WSI), colour characteristics, total carotenoid content (TCC) and total antioxidant activity (TAA) using ABTS (2,2'-azino-bis [3-ethylbenzthiazonline-6-sulfonic acid]) assay of the powders were evaluated for recommended processing conditions.

Spray-dried powders (maltodextrin addition of 10% and spray-dried at 120^{0}C) were added into "xoi", a Vietnamese name of steamed glutinous rice, pasteurized milk and fruit juice. Total colour change (ΔE), TCC (mg/g) and TAA (Trolox equivalents (TE)/ g) were evaluated, before, after processing and storage periods of up to 30 days.

Milk mixed with the spray-dried powder and Gac fruit powder juice were pasteurized at temperature of 90^{0}C for 5 minutes.

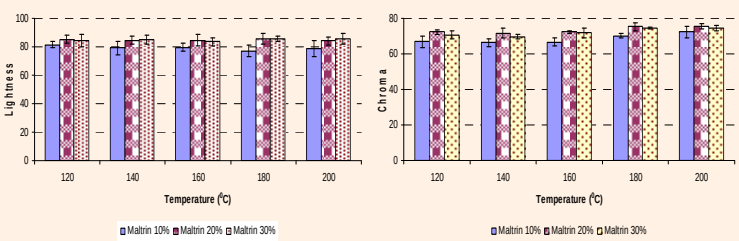
Results

Statistical analyses showed that the pH, Aw and WSI (%) of spray-dried powders were not significantly affected by different maltodextrin concentrations and different drying temperatures (P>0.05). The ranges of pH, Aw and WSI (%) powder samples were 3.94 - 4.64, 0.38 - 0.54 and 35.94 - 39.07, respectively.

The bulk density (g/mL) of powder products was statistically influenced by drying temperatures (P<0.01), but not by maltodextrin concentration (P>0.05).

All samples were satisfactorily dried with acceptable colour and appearances. The higher maltodextrin concentration resulted in lighter colour.

Significant loss of TCC and TAA was observed as inlet temperature increased from 120^{0}C to 200^{0}C and maltodextrin increased from 10 to 30%.



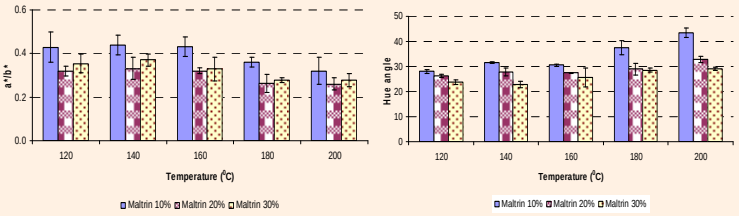


Figure 2. Colour characteristics of spray-dried powders

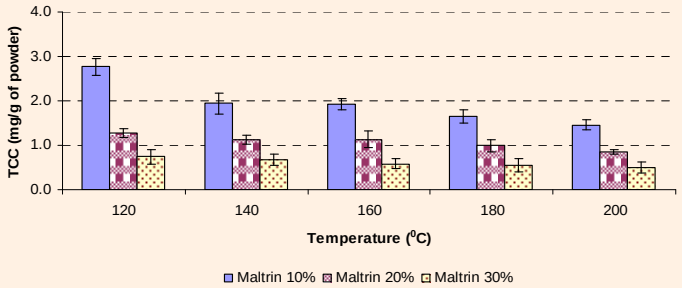


Figure 3. Total carotenoid content of spray-dried powders

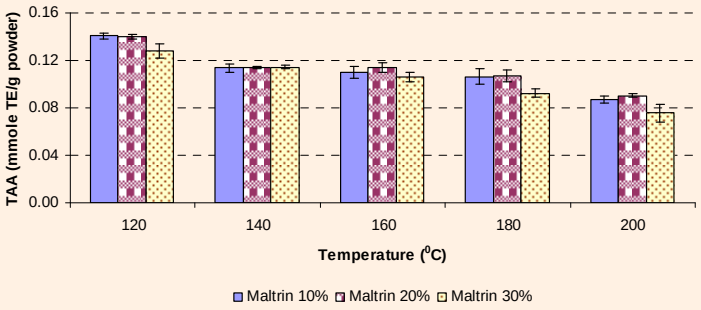


Figure 4. Total antioxidant activity of spray-dried powders

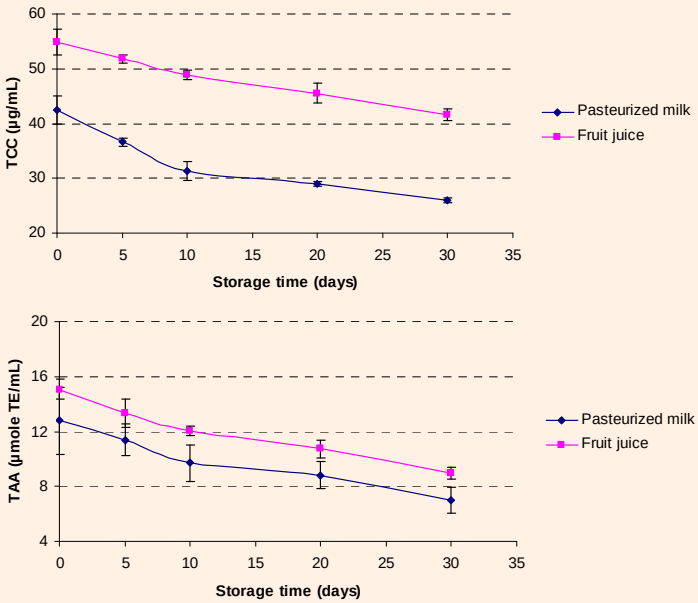


Figure 5. TCC and TAA of pasteurized milk and fruit juice

Conclusions

Spray-dried powder was easily incorporated into "Xoi Gac", pasteurized milk and fruit juice. These products were found to be satisfactory during storage of 30 days.

Further research into the incorporation of spray-dried Gac aril in other food products such as yoghurts and beverages are highly recommended.