Whey protein concentrated/maltodextrin blend as carrier agent to grape juice spray drying

Moser P.*, Janzantti N.S., Souza R.T. and Telis V.R.N.
UNESP - São José do Rio Preto, Brazil (polianamoser@yahoo.com.br)

INTRODUCTION AND OBJECTIVE

Phenolics, such as anthocyanins, are interesting additives for functional foods. Considering that grape contain large amounts of anthocyanins and consequently a high antioxidant activity, and considering the fact that anthocyanins are unstable pigments that are affected by physical and chemical factors as temperature, pH, light, solvent and the structure of the pigment itself, microencapsulation can represent a promising technique to increase the stability of these natural pigments.

Spray drying of fruit juices can be used to encapsulation and to improve the quality of final product, resulting in easy storage and transportation. Nevertheless, due to their high content of low molar mass compounds, fruit powders obtained by atomization usually present problems during drying, resulting in low process yield, as well as during handling and storage, presenting stickiness, caking and collapse (Phisut 2012). Part of these problems can be overcome by addition of high molar mass carrier agents, such as maltodextrin and proteins, thus improving the product stability.

The objective of this study was to investigate the potential of whey protein concentrated and maltodextrin blends as alternative materials for anthocyanin grape juice encapsulation by spray drying. The influence of the carrier agent concentration and the ratio protein:polysaccharide on yield, moisture, anthocyanin retention, encapsulation efficiency and color have been evaluated.

MATERIAL AND METHODS

Grape juice (14.0 ± 0.1 ºBrix) was extracted from grapes (Vitis labrusca) cv. BRS Violeta provided by EMBRAPA (Jales, Brazil). Maltodextrin DE-10 MOR-REX 1910 (Corn Products, Brazil) and whey protein concentrated (Alibra, Brazil) with a protein content of 80 % were used as carrier agents.

Drying was performed in a mini spray dryer (model B-290, Büchi, Switzerland) with inlet air temperature 140 ºC, feed flow rate 2 mL/min, air flow 500 L/h. Blends of whey protein concentrated (WPC) and maltodextrin (MD) containing 10, 20 and 30 g dry WPC/100 g dry carrier agent were added to juice in concentrations (CAC) of 0.25 0.5 and 0.75 g of carrier agent/g of soluble solids of the juice, under magnetic agitation, until complete dissolution.

Soluble solids content was determined in refractometer. Powder moisture contents were determined gravimetrically by drying in vacuum oven at 70 ºC for 48 hours. Process yield was calculated as the relationship between total solids content in the resulting powder and total solids content in the feed mixture.

Anthocyanins were extracted with 95 % ethanol/1.5 N HCl (85:15, v:v), according to the procedure described by Francis (1982). Absorbance was measured in a UV-vis spectrophotometer (SP-220, Biospectro) at 520 nm, and the total anthocyanin content was calculated by using molar absorbance of 28000 $L.mol^{-1}.cm^{-1}$, molecular weights 493.5 $g.mol^{-1}$ corresponding to malvidin-3-glucoside in ethanol/1.5 N HCl (Wrolstad 1976). Anthocyanin retention was calculated as the ratio between the total anthocyanin content (mg/100 g of dry matter) in the resulting powder and in the mixture before drying.

To determine the encapsulation efficiency, 10 mL of ethanol 99.5 % was added to 0.2 g of dried juice so that the alcohol could dissolve the anthocyanins that were outside the capsules, without their disruption. The mixture was stirred at room temperature for 1 minute, filtered and subjected to anthocyanin extraction with the ethanol/HCL solution. The encapsulation efficiency was calculated as the difference between total anthocyanins and anthocyanins that were out of capsules.

Color attributes (L*, a* and b*) were measured using a colorimeter Color Flex EZ, Hunter Lab, USA, with D65 illuminant and 10º observation angle. The results were statistically analyzed by analysis of variance (ANOVA) at 5 % significance level ($p \leq 0.05$).

RESULTS

Moisture content is the major factor that affects powder stability. The carrier agent concentration (CAC) and the WPC content did not influence moisture, which varied from 0.79 and 2.86 % (dry basis). The use of 0.15 g maltodextrin showed no acceptable yield, because a great amount of product adhered to dryer wall. With CAC higher than 0.5 % the process resulted in high yield (Table 1). According to Fang (2012) a small amount of whey protein (1 %)

was efficient to spray drying of bayberry juice (powder recovery > 50 %).

Table 1: Influence of carrier agent concentration (CAC) and WPC in yield, anthocyanin retention (Ret) and encapsulation efficiency (EE).

CAC (g/g)	WPC (g/100 g)	Yield (%)	Ret (%)	EE (%)
0.25	10.00	41.47	64.01	62.81
0.25	30.00	57.22	70.24	69.48
0.75	10.00	75.48	47.78	78.77
0.75	30.00	74.59	52.18	80.20
0.15	20.00	3.15	67.94	84.10
0.85	20.00	74.75	50.74	81.14
0.50	5.86	75.58	57.78	68.19
0.50	34.14	74.25	55.78	72.25
0.50	20.00	74.27	59.24	72.27
0.50	20.00	72.58	57.03	78.47

Lower concentrations of carrier agents resulted in higher anthocyanin retention ($p < 0.05$). This suggests that the use of lower concentrations could result in a less "diluted" product. The encapsulation efficiency was not influenced by CAC, however there was a trend of higher EE values at higher CAC, showing the ability of MD and WPC to bind anthocyanins.

Color analysis was performed and parameters a*, b* and L* are shown in Table 2. Lower carrier agent concentration and WPC content resulted in lower lightness, resulting in darker product. Ferrari (2012) reported that an increase in maltodextrin concentration increased the L* value of blackberry pulp, with a dilution effect caused by the addition of maltodextrin. Lower carrier agent concentration and WPC content resulted in greater a* value, indicating increase in red color, while larger CAC resulted in more negative values of b*.

CONCLUSIONS

The carrier agent concentration showed significant influence on yield, anthocyanin retention and color parameters. CAC higher than 0.5 g/g presented higher yield. On the other hand, lower carrier agent concentrations resulted in larger anthocyanin retention. Lower carrier agent concentration and lower WPC content resulted in more intense coloration. We conclude that the use of a CAC of 0.5 g/g with 10 % WPC lead to the best global results.

Table 2: Influence of carrier agent concentration (CAC) and WPC in color parameters.

CAC (g/g)	WPC (g/100 g)	L*	a*	b*
0.25	10.00	37.47	23.41	-12.39
0.25	30.00	42.14	20.47	-12.77
0.75	10.00	53.33	17.41	-13.50
0.75	30.00	55.66	13.28	-14.21
0.15	20.00	31.57	21.11	-9.50
0.85	20.00	57.77	13.37	-13.82
0.50	5.86	45.64	22.69	-14.13
0.50	34.14	53.68	16.03	-14.01
0.50	20.00	51.60	18.34	-13.43
0.50	20.00	51.01	18.06	-13.29

REFERENCES

- Fang Z. et al. (2012) *Comparing the efficiency of protein and maltodextrin on spray drying of bayberry juice.* Food Research International 48 478-483.
- Ferrari C.C. et al. (2012) *Effects of Spray-Drying Conditions on the Physicochemical Properties of Blackberry Powder.* Drying Technology 30 154-163.
- Francis F.J. (1982) *Analysis of anthocyanins.* In: *Anthocyanins as Food Colors,* Markakis, P. (NY) 182-205.
- Phisut N. (2012) *Spray drying technique of fruit juice powder: some factors influencing the properties of product.* International Food Research Journal 19(4) 1297-1306.
- Wrolstad R.E. (1976). *Color and pigment analyses in fruit products*. Oregon St. Univ. Agric. Exp. Stn. Bull. 624.

ACKNOWLEDGMENTS

To FAPESP (Procs. 2012/09074-4 and 2010/09614-3) and EMBRAPA - (Jales, SP, Brazil).