

RESEARCH PAPER

Preparation and Evaluation of Spray Dried Honey Powder

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ABSTRACT

The present study on production of honey powder using spray drying technology was carried out and the selected physico-chemical properties of spray dried honey powder was estimated at different inlet air temperatures of 180, 190 and 200 °C and tricalcium phosphate concentrations of 1.25, 1.50 and 1.75% were chosen as independent variables to produce the spray dried honey powder. The values with respect to the fructose, glucose, total solids, water activity and hygroscopicity were 18.20, 20.18, 96.72, 0.10 and 10.92 per cent, respectively.

Keywords: Honey, spray drying, honey powder, physico-chemical, temperature

Honey is a sweet natural food made by bees using water, pollen and nectar from flowers (Cantarelli *et al.* 2008). The variety produced by honey bees (the Genus *Apis*) is the one most commonly referred to, as it is the type of honey collected by most beekeepers and consumed by people (Famuyide *et al.* 2014). Folayan and Bifarin (2013) reported that honey is produced by honey bee workers mainly from nectar of flower or honey dew on leaves. Nectar is reduced to honey containing predominantly carbohydrates with a very little protein, vitamins, minerals, enzymes, amino acids and as well as other several compounds like phenolic compound thought to function as antioxidants (Surendra, 2008; Oyeleke *et al.* 2010, James *et al.* 2015).

These physical and chemical components are of great importance as they influence the keeping quality, granulation, texture, as well as the nutritional and medicinal efficacy of honey (Surendra, 2008). The major constituents of honey are nearly the same in all the honey samples, however, the biochemical composition and physical properties of natural honeys varies greatly according to the plant species on which the bees forage (James *et al.* 2015). Honey is an extremely complex mixture of carbohydrates that is found naturally with almost 80-85% of carbohydrates, (53.5% of fructose, 43.6% of glucose, 2.5% of maltose, 0.3% of sucrose), 15-17% of water, 0.3% of proteins, 0.2% of ash and minor quantities of amino-acids and vitamins as well as other components in low levels of concentration (Cui *et*

al. 2008). Honey as a natural product, is appreciated for its unique taste, flavour and health benefits. The sweetness, functional advantages and nutritional value of honey are encouraging food processors to use it in a wide array of food products. However, the use of honey in various food products is limited due to its high viscosity which makes trade and handling difficult (Cui *et al.* 2008).

A product in a powder form, characterised by free flowing, ease handling, weighing, cleaning and the reduction in storage space, could be a good replacement for liquid honey (Cui *et al.* 2008). Dried honey can be used for direct consumption and can be added to a range of food products such as yogurts, beverages, sauces, edible coatings, snacks, as well as dietary supplements or cosmetics. The use of dried honey as an ingredient for cakes and breads enhances their attractiveness, improves their flavour, colour, aroma, texture and helps to maintain high product quality.

Conversion of liquid honey into powder form by spray drying however, may have the problems of stickiness and high hygroscopicity, which is mainly due to the presence of a high proportion of low molecular weight sugars in honey (Adhikari *et al.* 2007). Honey contains high proportion of inherent low molecular weight sugars, namely fructose and glucose, with the glass transition temperature of 16 °C and 31 °C, respectively. The honey powder is usually produced by adding ingredients such as honey, emulsifier and filler materials of high molecular weight to increase glass transition temperature of mixture and to minimize the problem during drying (sticky and difficult to dry) (Bhandari and Howes, 1999).

Spray drying is a one-step, continuous process, allowing ease of scale-up. It is also useful for the processing of heat-sensitive materials due to very short exposure time of product to heat, which can range in the order of 5 to 10 s. The operating parameters of dryer that must be optimized are inlet air temperature, outlet air temperature, feed rate, spray air flow and aspirator flow. Spray drying is a method where the result strongly depends upon the material properties and factors of spray drying

in a combined system influencing the product parameters such as temperature load, final humidity, particle size and yield (Patel *et al.* 2009). Spray drying converts liquid into an engineered powder product in one step. Spray drying technique was used for production of honey powder by Nurhadi *et al.* (2012).

To overcome these problems, make the easy availability and to increase the shelf-life, the surplus honey has to be processed into shelf stable product as powder for consumption, keeping these objectives in mind the present work was carried out.

MATERIALS AND METHODS

Raw honey or liquid honey used for the experimentation was obtained from Sirsi (Uttara Kannada district, Karnataka). The chemicals and reagents of analytical grade required for conducting the experiment and for quality analyses of the honey powder were procured from M/S. SD fine laboratory, Bangalore. The physico-chemical characteristics of liquid honey *viz.*, moisture content, carbohydrate, crude protein, ash, pH, specific gravity, water activity, TSS, colour, glucose and fructose were estimated by following the standard procedures and the recommendations of FSSAI for pure honey characteristics were considered for assessing the properties of procured liquid honey (AOAC, 2005).

The experiments were conducted to produce honey powder with maltodextrin as coating material along with tri-calcium phosphate as anti-caking agent in spray dryer at three drying temperatures namely, 180, 190 and 200 °C.

Liquid honey, maltodextrin and distilled water were mixed (1:1:3), and anti-caking agent, tri-calcium phosphate (1.25, 1.50, 1.75%) was added. Then honey solution was homogenised at 2000 rpm for 10 min and subjected to spray drying with different inlet air temperatures of 180, 190 and 200 °C and outlet air temperature of 85 °C at feed flow rate of 5 ml.min⁻¹ (10 rpm), blower speed of 1000 rpm and nozzle pressure of 1.5-2 kg.cm⁻².

The physico-chemical characteristics namely, moisture content, carbohydrate, crude protein,

ash, water activity, colour, glucose and fructose of spray dried honey powder was determined by the following the standard procedures.

All the experiments in the study were conducted in triplicate and mean values were reported. Factorial completely randomised design (FCRD) was used to analyse the data.

RESULTS AND DISCUSSION

The physico-chemical characteristics of spray dried honey powder from different treatments are given in Table 1. The effect of inlet air temperature and tricalcium phosphate concentration on moisture content of spray dried honey powder is discussed. It is found that the moisture content of honey powder decreased with the increase in inlet air temperature and TCP concentration.

Higher inlet air temperature resulted in higher drying temperature and higher rate of heat transfer in the drying zone causing faster and higher amount of water removal. Increasing the total solids content in the feed solution prior to spray drying, might also reduced the total amount of water available for evaporation leading to lesser moisture content in the honey powder. The fructose content in commercial honey powder was found to be 18.20%, which was lesser compared to the values of experimental honey powder. Similar effect of temperature and coating material on fructose content in spray dried honey powder was reported by Nurhadi *et al.* (2012). The glucose content in commercial honey powder was found to be 20.18%, which was more to the values of experimental honey powder and these results obtained are in confirmation with the findings of Nurhadi *et al.* (2012) for glucose content in spray dried honey powder.

From the table 1 it is revealed that the total solid content of the sample increased due to decrease in the moisture content of the spray dried powder as the temperature and TCP concentration increased. The total solids content in commercial honey powder was found to be 96.72%, which was closer to the values of experimental honey powder. Similar observations

were made by Silva *et al.* (2013) for jabotica caba peel extract powder which showed high total solids (TS) at highest air temperature considered under the study. The water activity in honey powder was found to be 0.10, which was closer to the values of experimental honey powder. Similar results were reported by Chegini and Ghobadian (2005) and Kha *et al.* (2010) for orange juice and Gac juice powder, respectively. The hygroscopicity per cent in commercial honey powder was found to be 10.92%, which was lesser to the values of experimental honey powder. Similar results have been reported by Shi *et al.* (2013) for addition of maltodextrin as coating material in honey powder.

Table 1: Physico-chemical characteristics of spray dried honey powder from different treatments

(A) TCP conc. (%)	(B) Temp. (°C)	Fructose (%)	Glucose (%)	TS (%)	a_w	Hygroscopicity (%)	Powder recovery (%)
0	180	20.09	18.72	94.87	0.32	23.27	35.34
	190	21.24	19.06	94.98	0.30	22.86	36.82
	200	22.28	19.92	95.48	0.29	22.19	37.08
1.25	180	18.82	16.34	95.72	0.23	15.67	53.21
	190	19.20	17.81	96.24	0.20	14.38	54.68
	200	20.86	18.66	96.95	0.19	13.98	55.08
1.50	180	21.10	18.20	96.36	0.22	14.72	57.04
	190	22.29	19.19	97.18	0.18	13.63	57.89
	200	22.79	19.68	97.88	0.17	12.58	58.64
1.75	180	21.26	18.25	96.50	0.21	14.18	59.21
	190	22.24	19.28	97.58	0.16	13.02	60.43
	200	22.92	19.84	98.00	0.15	12.19	60.98
CP	—	18.20	20.18	96.72	0.10	10.92	—

TCP conc. = Tricalcium phosphate concentration; Temp. = Temperature; TS = Total solids; a_w = Water activity; CP = Commercial honey powder; No. of replications = 3.

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