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ORIGINAL ARTICLE

Preparation, chemical composition and storage studies of quamachil (*Pithecellobium dulce* L.) aril powder

Galla Narsing Rao · Allani Nagender · Akula Satyanarayana · Dubasi Govardhana Rao

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Abstract Quamachil aril powder samples were prepared and evaluated for chemical composition and sensory quality by packing in two packaging systems during storage for six months. The protein contents were 12.4 and 15.0% in white and pink aril powders respectively. The titrable acidity of white and pink aril powders were 2.4 and 4.8% respectively. Ca and Fe contents in white aril powder samples were 60 and 12 mg/100 g where as in pink aril powder 62 and 16 mg/100 g, respectively. The anthocyanin content in pink powder decreased from 50.5 to 11.2 and 14.1 mg/100 g in samples packed in polyethylene (PE) and metalised polyester polyethylene laminated pouches respectively. Total polyphenol amount increased in both the powders irrespective of packaging material. Sorption isotherms indicated that both white and pink aril powders were hygroscopic and equilibrated at low relative humidity of 28 and 32%, respectively.

Keywords Chemical composition · Packaging · Quamachil aril powder · Pithecellobium dulce · Sensory quality · Sorption isotherm

Introduction

The fruit powders, extracts, concentrates, colours, flavours and juices are extensively used in food and drug industry. They constitute a rich source of vitamins, minerals and are highly palatable. The fruit powders can be utilized to produce fruit juices by reconstitution, which almost have the same nutritive value as that of juices prepared from fresh fruits. The handling, transport and marketing of powders are very convenient as compared to that of fresh/processed fruit juices. Many studies were reported on preparation and storage of different types of fruit powders and flavours. The preparation and processing of vacuum-dried mango powder was studied and reported by Jaya and Das (2005). Similarly, hygroscopicity of freeze dried pineapple juice powder was reported by Phanindra Kumar et al. (2005). Process for production of guava powder was reported by Chetan and Diane (2001). Quality spray dried banana fruit powder was prepared by Evelin Mary et al. (2007) and reported that the powder is shelf-stable in aluminium foil laminated pouches for one year under ambient conditions. The Ca, Fe and polyphenol contents in four different traditional Turkish fruits juice concentrates (Pekmez) were reported by Ozlem and Yuksel (2009). The polyphenol content in certain fruits and vegetables were investigated by Cieslik et al. (2006). Anthocyanins have been found to exhibit potential therapeutic effect as anti-inflammatory, radio-protective, chemo protective and vaso-protective and also prevent the risks of cardiovascular diseases (Seeram and Nair 2002; Kong et al. 2003). The polyphenols are important antioxidants which prevent cancer, coronary heart diseases and Alzheimer disease (Smith et al. 1996; Daiz et al. 1997).

Quamachil (*Pithecellobium dulce* L.) is an important minor fruit of Indian origin and it belongs to the family of Mimosaceae, native of tropical America, and is cultivated throughout India. The fruit contains 50% pulp, with characteristic flavor and taste. The pulp around the seed is having white and pink colours. The aril is highly perishable and turns brown once peel is removed. The aril is used in

G. N. Rao · A. Nagender · A. Satyanarayana · D. G. Rao (✉)
Central Food Technological Research Institute, Resource Centre, (Council of Scientific and Industrial Research),
Habshiguda, Uppal Road,
Hyderabad 500 007, India
e-mail: rchyderabad@cftri.res.in

the preparation of a beverage similar to lemonade in Mexico and the seed and leaves are rich in protein content and having good medicinal value (CSIR 1962). The amino acid composition of quamachil seed flour was also reported by Felker and Bandurski (1977). The seeds contain triterpene saponines which act as anti inflammatory (Niranjan and Shashi 1994). Quamachil seed protein solubility was also studied and reported to be 96% at pH 12 (Narsing Rao et al. 2008). The lipid content was 30% and fatty acid composition of seed revealed about 26.5% of linoleic acid (18:2) (Prabhakara Rao et al. 2009).

Quamachil fruit is mostly used for traditional preparations and the information on fruit aril based products is scanty. The sugars in the aril are mostly glucose and sterol glucoside, which were isolated by Nigam et al (1962). No work has been carried out so far on the preservation and processing of quamachil arils. Quamachil available in plenty during peak fruiting season, which is of very short duration (February and March) having a shelf-life of 3-4 days at room temperature. The fruit has rich characteristic aroma and rich in protein, polyphenols, anthocyanine and minerals. Hence, the present work was taken up to process the quamachil aril into powder from white and pink arils, and also to assess their important chemical and sensory quality. Storage studies were also taken up at room temperature after packing the powders in polyethylene (PE) and metalised polyester polyethylene laminated (MPE) pouches.

Materials and methods

Collection and preparation of quamachil aril powders Quamachil fruit pods were procured from local market. Initially the pods were separated based on colour as white and pink arils by visual observation. The arils were isolated manually from brown peel and black seed. Arils were coarse ground in a laboratory mixer (Sumeeth, Nasik, Maharashtra, India) and dried in a cabinet tray dryer (Chemida India, Mumbai) at 45-50°C for 6-7 h. The dried arils were separately ground in a laboratory mixer to pass through BS 30 mesh sieve (500 μ).

Packaging and storage PE (25 μ) and MPE metallized polyester (12.5 μ)/polyethylene (7.5 μ) laminated pouches of size 14×12 cm were used for packing and storing separately white and pink quamachil aril powders for six months at room temperature (26±2°C). Powders in both the packing systems were analysed initially and at regular intervals of 2, 4 and 6 months for different chemical and sensory parameters.

Chemical analysis The powders were analyzed for moisture, total ash, crude fat, crude protein, reducing sugars, total sugars, crude fiber, anthocyanin contents and acidity by using standard methods (Ranganna 1986). The total carbohydrates content of the powders was determined by difference. All chemical characteristics were analyzed in triplicate. The mineral contents such as Ca were measured gravimetrically and Fe by UV-Visible spectrophotometer (Shimadzu, UV-160A model, Japan) at 480 nm as per the standard methods of AOAC (1995).

The total polyphenols contents were determined by the method of Sadasivam and Manickam (1997). Polyphenols were extracted by leaching the powder in 80% ethanol and reacting with Folin-Ciocalteau reagent, and the colour was measured at 675 nm by using UV-visible spectrophotometer. Results expressed as mg of polyphenols per 100 g aril powder.

The visual colour of both the aril powders was measured by using Lovibound Tintometer (Model F, Salisbury, UK). The results were expressed in terms of red, yellow and blue colour units.

Sensory quality The aril powders were evaluated for sensory quality by a panel of 10 trained judges during the storage period on a Hedonic scale with a maximum score of 9 for 'like extremely' and minimum of 1 for 'dislike extremely' (Amerine et al. 1965).

Moisture sorption isotherm Moisture sorption isotherms of powders were recorded at room temperature (28±2°C). The powder sample of 5 g each were taken in glass Petri plates and exposed to 10-100% relative humidity (RH) maintained by solutions of sulphuric acid (Landrock and Procter 1951). The samples were observed visually for change in colour, lump formation and mold growth during the study. The powder samples which were exposed to different RH were weighed at regular intervals on electronic monopan balance till they attained constant weight. A graph was plotted against equilibrium moisture content (EMC) and RH to obtain sorption isotherms of powders.

Results and discussion

The fruit pod contained 65-75% pulp, seed 9-13% and the rest was peel (17-19%). The pulp upon drying yielded 13.5 and 15.1% white and pink arils, respectively based on the whole quamachil pods. The flow chart for preparation of powders along with various unit operations is depicted in Fig. 1.

The aril powders contained 12 and 15% protein in white and pink aril powders (Table 1) and results were comparable to those reported earlier (Gopalan et al. 2004). Considerable amount of minerals were available in the aril

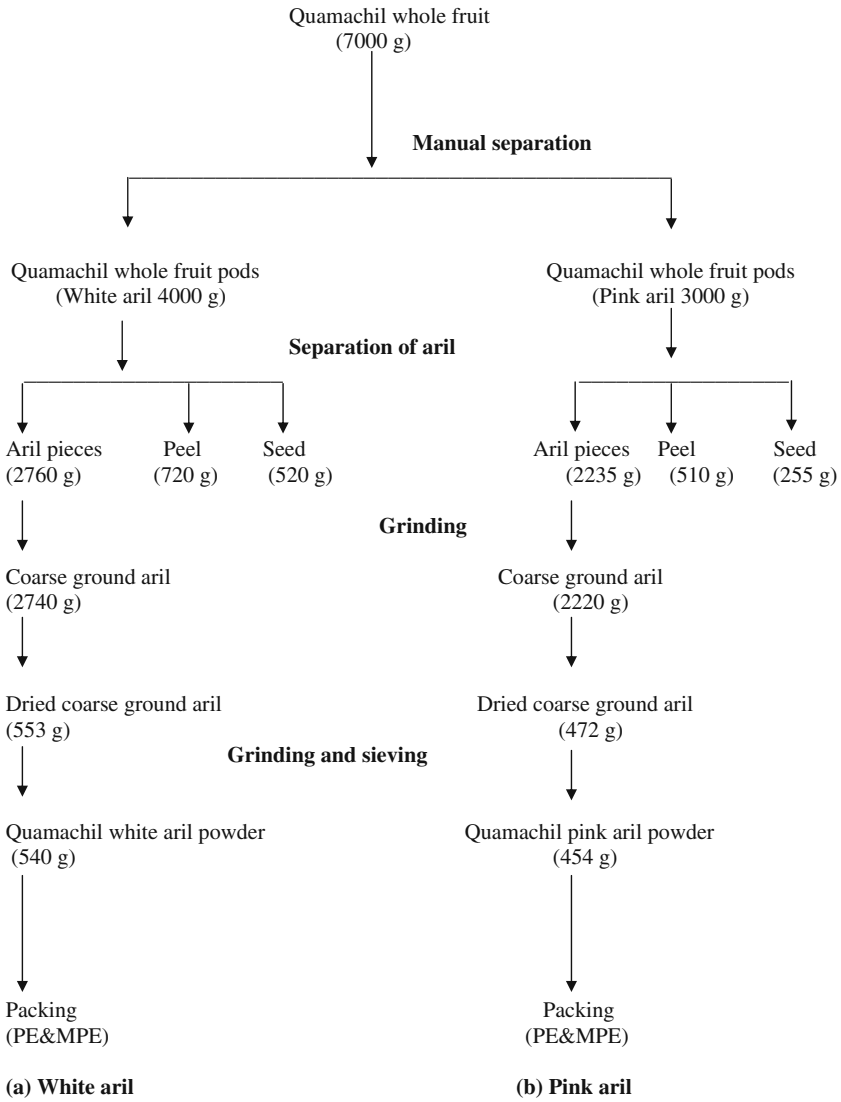

Fig. 1 Flow chart for the preparation of quamachil white (**a**) and pink (**b**) aril powders

Table 1 Chemical composition of white and pink quamachil aril powders

	White aril powder	Pink aril powder
Moisture, %	14.7±0.47	17.8±0.44
Total ash, %	2.4±0.15	3.0±0.09
Crude protein, %	12.4±0.34	15.0±0.28
Crude fat , %	0.44±0.07	0.31±0.01
Crude fibre, %	1.5±0.18	1.3±0.18
Acidity as citric acid, %	2.4±0.05	4.8±0.15
Reducing sugars, %	58.0±0.86	54.8±0.70
Total sugar, %	61.5±0.73	55.0±0.68
Carbohydrates (by diff) , %	68.5±0.14	62.5±0.29
Ca, mg /100 g , %	60.2±0.29	62.4±0.47
Fe, mg/100 g , %	12.4±0.33	16.6±0.31

n=3

powders. The Ca and Fe contents in white aril powder were 60 and 12 mg/100 g, respectively. Similarly the corresponding contents in pink aril powder were 62 and 16 mg /100 g.

Stability of polyphenol content Total polyphenol content increased in both the powders irrespective of packaging conditions during storage (Table 2). The total polyphenol content packed in PE and MPE pouches period of six months had increased during storage in both the powders. This could be due to increase in moisture content, which might have released the bound phenols from the cell wall during storage. A similar trend was also noticed during the storage of raw tamarind powder by Jyothirmayi et al. (2006) and oil fried brinjal and tomato by Gitanjali et al. (2004). An increase of total polyphenol content from 502 to 542 mg gallic acid equivalent/ L juice during storage was reported in apple juice (Guizhi Zhang et al. 2008).

Moisture content The moisture content of aril powders had gradually increased in both the packing conditions during storage. The results, presented in Table 2, indicated the hygroscopic nature of powders. It was observed that the samples packed in PE pouches gained more moisture than the samples packed in MPE pouches.

Colour units The Lovibond Tintometer red (R), yellow (Y) and blue (B) colour units indicated that deterioration in colour in the pink aril powder was more in PE than in MPE pouches during storage (Table 2) of six months. In white aril powder marginal change in colour was observed in both packaging pouches.

Stability of total anthocyanins The anthocyanin content decreased considerably in both packing pouches but the reduction was slightly lower in MPE than PE pouches during storage. The anthocyanin content decreased from 50 to 11 mg in PE and 14 mg/100 g in MPE pouches (Table 2). Similar observations were noticed by Zhang et al. (2001) in lichi pericarp during storage. Similarly, anthocyanin degradation was also noticed in squash of blue grapes preserved in polypropylene (PP) pouches during storage of 120 days (Thakur and Arya 1989).

Sensory quality Overall sensory scores on 0 day for white and pink aril powders were 8.5 and 8.7, respectively and

Table 2 Changes in chemical parameters of aril powders packed in PE and MPE during storage at room temperature

Storage period, months	White aril powder						Pink aril powder					
	PE			MPE			PE			MPE		
Total polyphenols, mg/100 g												
Initial	462.4±0.50			462.4±0.50			829.8±030			829.8±0.30		
2	538.6±0.47			506.7±0.69			845.0±0.16			836.5±0.56		
4	1259.2±0.57			989.2±0.43			968.5±0.53			894.3±0.56		
6	1370.5±0.6			1164.0±0.8			993.3±0.41			953.2±0.66		
Moisture, %												
Initia1	14.7±0.47			14.7±0.47			17.8±0.44			17.8±0.44		
2	17.0±0.24			15.8±0.97			19.4±0.82			18.4±0.69		
4	19.2±0.44			18.1±0.71			21.7±0.46			20.4±0.50		
6	21.4±0.50			19.6±0.43			22.9±0.10			21.7±0.42		
Tintometer readings												
	R	Y	B	R	Y	B	R	Y	B	R	Y	B
Initial	2.6	1.2	1.0	2.6	1.2	1.0	3.9	4.5	2.0	3.9	4.5	2.0
2	3.6	4.0	2.0	2.7	3.8	1.9	4.2	5.0	2.0	4.0	4.8	2.0
4	4.2	6.5	2.2	3.5	5.8	2.2	4.5	6.4	2.0	4.1	5.6	2.0
6	4.8	8.0	3.0	4.5	9.0	2.4	4.7	10.0	2.0	4.2	7.3	1.0
Anthocyanin, mg/100 g												
Initial							50.5±0.57			50.5±0.57		
2							27.2±0.96			39.5±0.50		
4							18.7±0.61			23.6±0.38		
6							11.2±0.91			14.1±0.18		

n=3,

PE Polyethylene, *MPE* Metallaised polyester polyethylene laminated pouches, *R* Red, *Y* Yellow, *B* Blue

Table 3 Sensory quality of quamachil aril powders packed in PE and MPE during storage for 6 months at room temperature

	White aril powder						Pink aril powder					
	PE				MPE			PE			MPE	
	0	2	4	6	0	2	4	6	0	2	4	6	0	2	4	6
Appearance	8.8±0.18	8.5±0.32	8.2±0.42	8.1±0.37	8.8±0.18	8.5±0.38	8.3±0.49	8.2±0.29	8.8±0.18	8.4±0.41	7.9±0.46	7.6±0.54	8.8±0.18	8.6±0.39	8.0±0.46	7.9±0.39
Colour	8.5±0.32	8.0±0.39	7.8±0.48	7.3±0.53	8.5±0.32	8.2±0.38	8.0±0.46	7.9±0.39	8.7±0.31	8.4±0.46	8.0±0.42	7.5±0.62	8.7±0.31	8.4±0.51	8.1±0.53	7.9±0.44
Flavour	8.8±0.21	8.6±0.46	8.4±0.56	8.3±0.48	8.8±0.21	8.8±0.25	8.6±0.47	8.5±0.30	8.7±0.29	8.2±0.40	8.0±0.12	7.6±0.90	8.7±0.29	8.4±0.32	8.1±0.38	7.7±0.30
Taste	8.6±0.41	8.2±0.49	8.2±0.46	7.9±0.53	8.6±0.41	8.3±0.50	8.2±0.27	7.9±0.36	8.6±0.48	8.4±0.51	8.2±0.40	8.0±0.47	8.6±0.48	8.4±0.38	8.2±0.40	8.1±0.45
Overall quality	8.5±0.35	8.0±0.69	7.7±0.77	7.5±0.53	8.5±0.35	8.0±0.38	7.8±0.44	7.6±0.41	8.7±0.38	8.2±0.65	7.9±0.63	7.5±0.51	8.7±0.38	8.2±0.54	8.0±0.70	7.8±0.64

PE, MPE: As in Table 2
n=10 panelists,

the scores decreased gradients during storage (Table 3). The powders were quite acceptable even after six months storage.

Equilibrium moisture content – relative humidity plots The white aril powder had an initial moisture content (IMC) of 14.71%, which equilibrated at 28% RH at room temperature, whereas the pink aril powder with an IMC of 17.8% equilibrated at 32% RH at room temperature (Fig. 2). The critical moisture contents for white and pink aril powders were 19.9 and 21.6%, which equilibrated at 48 and 50% RH respectively. The moisture content of both the aril powders increased sharply at higher humidity during the equilibrium RH studies. Both the powders gained moisture and discoloured at 50% RH at room temperature. Hence, packing material with good moisture barrier properties is required to pack the powders in order to enhance the keeping quality during storage.

Conclusion

A process for the preparation of quamachil aril powders is very easy, convenient and this process on value addition to the aril powder can be commercialized. The white and pink aril powders contained considerable amount of protein and they are also rich in Fe and Ca content and hence, could be a supplement in baby foods. Both the aril powders retained characteristic flavour and taste when packed in PE and MPE pouches during the 6 months storage. However, the aril powders packed in MPE pouches had better shelf-life

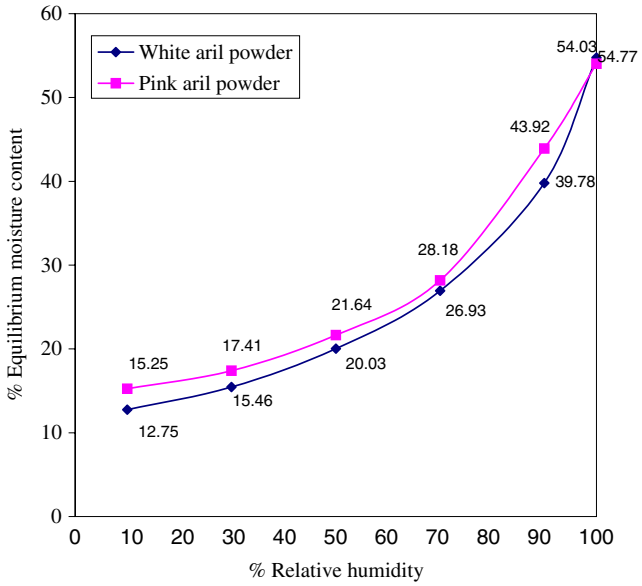

Fig. 2 Experimental sorption isotherm curves of quamachil aril powders

than those packed in PE during storage in terms of colour, flavour and taste. Since these powders could impart characteristic flavour and taste, processors may be interested to incorporate the aril powder into ice creams, ready-to-serve beverage, squashes, candies, mixed fruit jams, custards and bakery foods. The EMC-RH data showed the hygroscopic nature of powders warranting packing material to have good moisture barrier property.

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