Mineral Content in Dehydrated Mango Powder

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Abstract: The study was carried out to explore mineral content in dehydrated mango powder made from immature green stage fruits. For the purpose, two type of slices from peeled and unpeeled fruits of four commercial grown varieties viz. Desi, Sindhri, Langra and Chaunsa were prepared. These slices were categorized into three groups A, B and C. In group A, slices were kept in controlled conditions in electric cabinet chamber (dehydrator) at 65°C temperature, while in group B, slices were dried by open sun drying method using muslin cloth over the cots at (43 ± 5 °C) and in group C, slices were kept in wooden glass dehydrator at (48 ± 4 °C).

The statistical analysis reveals highly significant differences for all main factors including varieties, dehydration methods, type of mango powder and their interactions. Chaunsa had the highest mean calcium (389.54 mg kg^{-1}), potassium (912.07 mg kg^{-1}) and magnesium (90.92 mg kg^{-1}). However, only sodium was observed more in variety Langra (467.59 mg kg^{-1}). On the basis of dehydration methods, mean calcium (407.06 mg kg^{-1}) and magnesium (90.11 mg kg^{-1}) content were observed more in wooden glass drying method as compared to rest of the drying methods. The sodium (511.83 mg kg^{-1}) and potassium (811.35 mg kg^{-1}) content were recorded the highest in open sun drying method. The powder made from fruits without peel was observed more in all mineral content including sodium, calcium, potassium and magnesium.

Keywords: Minerals, Mango powder, Dehydration.

INTRODUCTION

Minerals play an important role in physiological function of the body especially in the buildings and regulation process. Mango is one of the favored fruits of the country and considered as a good source of vitamins, proteins, sugars, fat and dietary minerals including calcium, potassium, magnesium, iron and so many others [1, 2]. It has an excellent flavour, attractive fragrance, delicious taste and high nutritional value that have made it one of the best fruits [3]. The quality related attributes and mineral content of mango varies from variety to variety and ripening stage viz. from immature to mature and mature to ripened stage [4, 5]. Variation in mineral content was also reported in peeled and unpeeled fruits of mango. There are number of reports published on the nutritive value of the fresh and stored mango fruits of different varieties but little information is available regarding the mineral composition of dehydrated products of different varieties such as mango powder and mango slices [4-7].

Dehydration is one of the most widely used primary methods of food preservation in which moisture of the produce is removed to the level at which microbial spoilage and deterioration reactions are greatly minimized [8, 9]. It also provides longer shelf life, smaller space for storage and lighter weight for transportation [10] and slow the chemical changes that take place naturally in foods. An effective approach to dehydrate and preserve the perishable fruits at low temperatures so that the produce should remain preserved in its natural texture [8]. Textural changes, loss of vitamins and other essential nutrients through various reactions, colour changes associated with browning reactions, non uniformity in slice thickness and mould growth are some of the major problems associated with fruits and vegetables during and after drying [11]. The drying process causes the nutrients in the fresh fruit, like proteins, carbohydrates, and dietary fiber to concentrate. Moreover, they contain 60-70% natural sugars that can be easily digested and absorbed in the bloodstream. Dried fruits are also rich in vitamins like A, B_1, B_2, B_3, B_6 and pantothenic acid and also furnish the body with high levels of potassium, calcium, magnesium, iron and manganese.

Technologies used in dry processing and preservation of fruits are numerous and varied ranging from simple to sophisticated and complex technologies. Mango fruits are dried through different methods of drying systems. Some fruits are dried by vacuum air drying, direct solar drying, solar drying, microwave drying, freeze drying and osmotic drying.

Mango powder is generally required for certain food products like ice cream, mango fruit bar, yoghurt, flakes, mango cake [7].

MATERIAL AND METHODS

Two type of slices from peeled and unpeeled fruits of four commercial grown varieties viz. Desi, Sindhri, Langra and Chaunsa were prepared with the help of

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sterile stainless knife. The harvested immature mango fruits were brought to the laboratory of Food Sciences and technology followed by washing with double distilled water to remove dirt, dust and residues of pesticides (if any). The cleaned fruits were dried, peeled and cut into small pieces. These slices were categorized into three groups of A, B and C. In group A, slices were kept in controlled conditions in electric cabinet chamber (dehydrator) at 65^{o}C temperature, while in group B, slices were dried by open sun drying method using muslin cloth over the cots at (43 ± 5 ^{o}C) and in group C, slices were kept in wooden glass dehydrator at (48 ± 4 ^{o}C). Mango Slices were checked every day and turned on daily basis. The temperature of the open sun drying method was daily monitored thrice a day. After the 3rd day, the slices of cabinet dryer were dried at the required stage. After 7th day, the slices of wooden glass dehydrator were dried at desired level and at the 9th day the slices of open sun drying were dried at the required level.

Preparation of Mango Powder and Mineral Analysis

After drying, mango slices were ground using a stainless steel grinder. The cracked particles of mango slices were passed to air blowing to remove light brown particles. The ground particles were again passed through a series of reduction for further refine grinding. The purified ground powder was further sieved to obtain a refined powder. The sieved powder was then packed separately in the suitable polyethylene bags for further analysis. The bags were labeled and stored at room temperature. The average moisture was recorded about 3-4% in the mango powder. For mineral analysis, 0.2 g of dried powder was taken in conical flask in duplicate followed by addition of 2 ml of nitric acid (HNO_3). The mixture was heated on hot plate at 35-40^{0}C for one hour then covered the flask with watch glass. The mixture was cooled and later 2 ml of each nitric acid and hydrogen peroxide was added to the mixture following heating at the same temperature mentioned above. On cooling a colorless residue was obtained. After cooling, sample digests were filtered through whattman paper No.42. The final volume was made up to 25 ml in volumetric flask by adding double distilled water. The mineral composition of the mango powder was determined by the procedure of [12] by atomic absorption spectrophotometry. The digested samples were analyzed by using air-acetylene flame in combination with single element hollow cathode lamps into an atomic absorption spectrophotometer (Hitachi model A-1800). Calibration of the instrument was repeated periodically during operation. Mineral contents were calculated by comparison of their standards solutions. The blanks were used for zeroing the instrument before each analysis to avoid matrix interference. All standard used were of ultra high purity (certified > 99.9%) procured from E-Merck, Germany, or British Drug House (BDH) Chemicals Ltd., Poole, UK. Duplicate sub-samples of each sample were run separately in order to record average mineral concentrations.

RESULTS AND DISCUSSIONS

The statistical analysis of sodium content reveals highly significant differences for all main factors including varieties, dehydration methods, type of mango powder and their interactions with each other (Table **1**). Mean Na content was observed the highest (547.63 mg kg^{-1}) in mango powder obtained from the fruits which were without peel. These results were significantly followed by 476.03 mg kg^{-1} of Na in mango powder obtained from fruits with peel processed through same open sun drying method. On the basis of varieties, Langra had more mean content of sodium (467.59 mg kg^{-1}) as compared to rest of the varieties of mango.

The data in Table **2** reveals that Ca content in mango powder was significantly affected by various dehydration methods producing the highest mean Ca content of 407.06 mg kg^{-1} in wooden glass drying method followed by open sun drying (374.09 mg kg^{-1}) and cabinet drying method (224.81 mg kg^{-1}). However Ca content was also significantly affected by varieties. Variety Chaunsa had the highest Ca content of 389.54 mg kg^{-1} followed by Sindhri (364.86 mg kg^{-1}), Desi (299.77 mg kg^{-1}) and Langra (287.11 mg kg^{-1}). On the basis of mean values of peel and without peel mango powder, Ca content was significantly affected by various dehydration methods producing maximum Ca content of 468.82 mg kg^{-1} in mango powder made from fruits without peel using wooden glass drying method.

Potassium content in mango powder was significantly affected by dehydration methods and varieties depicting maximum mean K content (811.35 mg kg^{-1}) in open sun drying method (Table **3**). However maximum mean K content of 912.07 mg kg^{-1} was observed from variety Chaunsa followed by variety Desi (823.61mg kg^{-1}). On the basis of mean values of peel and without peel mango powder using various methods of drying, mango powder made without peel had the highest k content of 895.20 mg kg^{-1} followed by cabinet drying method (866.26 mg kg^{-1}).

Table 1: Sodium Content (mg kg^{-1}) of Mango Powder Dried by Various Methods of Drying

Dehydration methods	Mango powder	Varieties				
		Desi	Sindhri	Langra	Chaunsa	Mean
Cabinet drying	With peel	312.28	255.72	266.73	349.97	296.17 f
	Without peel	315.56	266.67	309.75	350.71	310.67 e
	Mean	**313.92 i**	**261.19 l**	**288.24 j**	**350.34 g**	**303.42 C**
Open sun drying	With peel	592.55	332.85	717.01	261.71	476.03 b
	Without peel	625.03	343.37	723.99	498.12	547.63 a
	Mean	608.79 b	338.11 h	720.50 a	379.92 e	511.83 A
Wooden glass drying	With peel	429.44	334.21	423.41	334.15	380.30 c
	Without peel	423.31	237.49	364.66	385.36	352.71 d
	Mean	**426.37 c**	**285.85 k**	**394.03 d**	**359.76 f**	366.50 B
Varieties mean		**449.69 B**	**295.05 D**	**467.59 A**	**363.34 C**	

Table 2: Calcium Content (mg kg^{-1}) of Mango Powder Dried by Various Methods of Drying

Dehydration methods	Mango powder	Varieties				
		Desi	Sindhri	Langra	Chaunsa	Mean
Cabinet drying	With peel	342.58	213.44	89.47	395.37	260.21 e
	Without peel	222.32	157.84	236.24	141.21	189.40 f
	Mean	**282.45 g**	**185.64 i**	**162.85 k**	**268.29 h**	**224.81 C**
Open sun drying	With peel	309.90	403.01	370.33	320.83	351.02 c
	Without peel	576.83	316.49	295.35	400.00	397.17 b
	Mean	443.37 c	359.75 e	332.84 f	360.42 e	374.09 B
Wooden glass drying	With peel	177.57	293.26	369.82	540.60	345.31 d
	Without peel	169.43	805.15	361.44	539.24	468.82 a
	Mean	**173.50 j**	**549.20 a**	**365.63 d**	**539.92 b**	**407.06 A**
Varieties mean		**299.77 C**	**364.86 B**	**287.11 D**	**389.54 A**	

Table **4** represents the data of magnesium content in mango powder that was significantly influenced with peel and without peel. Mean Mg content was also significantly influenced by dehydration methods producing maximum Mg content in wooden glass drying (90.11 mg kg^{-1})) followed by cabinet drying (75.19 mg kg^{-1})) and open sun drying (74.75 mg kg^{-1}). Mango powder made without peel had highest Mg content of 91.25 mg kg^{-1} processed through wooden glass drying method. On the basis of varietal comparison, variety Chaunsa had more Mg content (90.92 mg kg^{-1}) followed by variety Desi (85.55 mg kg^{-1}), Langra (72.19 mg kg^{-1}) and Sindhri (71.41 mg kg^{-1}).

DISCUSSION

Mango is a popular fruit with excellent flavor, attractive color, and delicious taste with high nutritional value. Due to higher moisture content (85%), it has very poor keeping quality and cannot with stand any adverse climatic conditions during storage [7]. This results in the loss of 30% of fruits every year [13]. To overcome, this post harvest loss and to increase the shelf-life, the surplus mango has to be processed into shelf table products like dried mango powder, flakes for consumption [14]. Mango dehydrated powdered products are widely applied in various food formulations

Table 3: Potassium Content (mg kg^{-1}) of Mango Powder Dried by Various Methods of Drying

Dehydration methods	Mango powder	Varieties				
		Desi	Sindhri	Langra	Chaunsa	Overall
Cabinet drying	With peel	707.96	610.63	612.45	707.35	659.60 f
	Without peel	761.93	932.41	719.03	1051.65	866.26 b
	Mean	**734.95 f**	**771.52 e**	**665.74 h**	**879.50 c**	**762.93 B**
Open sun drying	With peel	878.33	717.82	605.88	707.96	727.50 e
	Without peel	1008.97	800.70	715.00	1056.15	895.20 a
	Mean	943.65 b	759.26 e	660.44 h	882.05 c	811.35 A
Wooden glass drying	With peel	763.54	656.90	610.53	979.50	752.62 d
	Without peel	820.94	726.86	603.23	969.82	780.21 c
	Mean	**792.24 d**	**691.88 g**	**606.88 i**	**974.66 a**	**766.41 B**
Varieties mean		**823.61 B**	**740.89 C**	**644.35 D**	**912.07 A**	

Table 4: Magnessium Content (mg kg^{-1}) of Mango Powder Dried by Various Methods of Drying

Dehydration methods	Mango powder	Varieties				
		Desi	Sindhri	Langra	Chaunsa	Mean
Cabinet drying	With peel	91.56	67.88	79.95	69.06	77.11 c
	Without peel	85.43	54.62	74.06	78.98	73.27 e
	Mean	**88.49 d**	**61.25 k**	**77.00 f**	**74.02 g**	**75.19 B**
Open sun drying	With peel	76.24	78.57	51.78	92.53	74.78 d
	Without peel	68.90	59.34	82.90	87.73	74.72 d
	Mean	72.57 h	68.95 i	67.34 j	90.13 c	74.75 C
Wooden glass drying	With peel	94.95	81.16	70.97	108.80	88.97 b
	Without peel	96.25	86.89	73.44	108.44	91.25 a
	Mean	**95.60 b**	**84.02 e**	**72.21 h**	**108.62 a**	**90.11 A**
Varieties mean		**85.55 B**	**71.41 D**	**72.19 C**	**90.92 A**	

instant preparation and are easy to use in addition and mixing operation on an industrial scale. These products are characterized by having a high soluble solid content with an appreciable part of the amorphous which makes them highly hygroscopic and subjected undesirable physical changes [15].

The mineral content in dehydrated mango powder in the present study varied from variety to variety and method of dehydration. The obtained sodium content in the present study had significant differences for varieties. However contradictory results were observed by [16]. They used vacuum oven dry method for making mango powder and observed no statistical differences for sodium content between two varieties including Rosa and Tommy Atkins. They observed sodium concentration in both varieties ranged from 2333.3 to 2720 (mg kg^{-1})**.** Similar contradictory results we also observed for calcium, potassium and magnesium. They observed more calcium as compared to sodium content in both varieties ranged from 3931.5 to 5133.2 (mg kg^{-1}) for variety Rosa and Tommy Atkins respectively. [17] reported mean calcium content of the mango powder 2968.9 mg kg^{1} (296.89 mg per 100 g) while they reported calcium concentration in fresh mango is about 10 mg per 100 g fresh weight. Among all observed minerals, [16] they found potassium concentration in mango powder was on the top. In present study we also observed the highest potassium content among all the observed minerals but this is much less content of potassium as compared to [16] results. This difference in the results of all observed mineral content may be related to the variety and stage of maturation as they used fresh mature mango fruits as compared to immature green stage fruits used in the present study. Drying method may also have some role in variation of the results.

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