Preparation and Consumer Acceptance of Indian Mango Leather and Osmo-Dehyrated Indian Mango

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Abstract - *Indian mangoes are considered highly perishable products due to high moisture content which resulted in high postharvest losses in Pangasinan, Philippines. This study exploits the potential of underutilized indian mango to value-added products. The developed indian mango leather and osmo-dehyrated indian mango are dehydrated fruit products can be eaten as snacks or desserts. Indian mango leather was prepared by mixing fruit puree and other additives like sugar, citric acid, and sodium metabisulphite and then dehydrated them at 55 °C for 15 hours under convective oven. Osmo-dehydrated indian mango was prepared by immersing halves of deseeded and deskinned pulps in 50 % (w/w) sucrose solution for 20 hours followed by drying initially at 50 °C then after one hour at 60 °C for 15 hours. Thirty-three member untrained panels were involved in consumer acceptance evaluation. Panelists evaluated the color, sweetness, sourness, texture, and overall acceptability of the osmotically-treated indian mango and indian mango leather using seven-point hedonic scale. Over-all, the indian mango leather and osmo-dehydrated indian mango developed in this study seemed to be acceptable for all the sensory parameters as indicated by high scores of greater than five (>5).*

Keywords - osmotic-dehydration, leather, indian mango, sensory quality

INTRODUCTION

Mango (*Mangifera indica* L.) is considered as one of the most important fruit crops of the country and dubbed as the national fruit. It is also recognized as king of fruits in tropical countries due to its excellent flavor, attractive aroma, beautiful shades of color, delicious taste and high nutritive value [1].

Region 1 is the leading producer of mango in the country with 59.99 thousand metric tons contributing 55.60 % to the national total. Pangasinan contributes 72.21 % of the total production in the region. Carabao mango comprised 81.8 % and other varieties such as pico and indian comprised the 18.2 % [2].

According to the Department of Agriculture (DA), the demand for mango products has been increasing over time, brought about by increasing incomes and population preferences for healthy foods and freer flow of goods in the global market because of the reduction in trade barriers. France, The Netherlands, United Kingdom, United States of America, and Spain will be the primary export markets of mango fruit and products.

In the Philippines, Carabao mango or Manila super mango is considered as one of the finest and sweetest in the world. Other popular variety of mango in the Philippines are Pico, *Katchamita* (Indian) and *Pahutan* (FAOSTAT, 2006). Pulp which constitutes mainly of carbohydrates and acid is the most utilized part of the indian mango for human consumption. The market offers a range of processed products which includes juices, concentrates, jam, fruits bars, chutney, and dried fruit [3].

This study will explore osmotic dehydration technique to transform the underutilized indian mango to value added product such as indian Mango leather and osmo-dehyrated indian mango. Osmotic dehydration involves a process of water leaching and sugar penetration through the semi-permeable cell membranes of the fruit. During osmosis, water along with small amount of fruit acid leaches out followed by initial sugar penetration which progresses with the time. Therefore, the parameters can be varied by controlling temperature, sugar syrup concentration; concentration of osmosis solution and time of osmosis to make osmotic concentration process faster [4]. The process

reported to remove water to about 40 – 50 percent of the weight of the fruit slices, but the resulting product is not shelf stable. Therefore, additional step such as drying is necessary to remove water up to safe levels. Drying is defined as a process of moisture loss due to simultaneous heat and mass transfer [5]. Reduction of water to safe levels is important to greatly minimize microbial spoilage and deterioration reactions cause by enzymes [6].

Carabao mango was extensively used in making bars and leather. A study on the physicochemical properties of mango leathers was reported by [7]. They prepared the mango leather by passing the puree through as 1 mm mesh sieve. The puree was dried an oven at 60 – 80 °C until reaching the desired moisture content of 15–18 %. Mir[8] studied the sorption isotherms of mango bars prepared from the puree of soft ripe mangoes. They made the mango bars by heating the puree at 91–93 °C for 2 minutes. Additives such as cane sugar, 0.6 % citric acid, and 1734 ppm potassium metabisulphite were added. The total solids of the mango puree were adjusted to 30 %. The drying was carried out at 63±2 °C for 14–16 hours in a cross-flow cabinet dryer. Gujral [9] conducted an experiment to determine the effect of skim milk powder, soy protein concentrate, and sucrose on the dehydration behavior, texture, color, and acceptability of mango leather. They blended the mango puree with 10.60 % total solids with potassium metabisulphite (0.2% w/w), soy protein, skim milk powder, and sucrose. The mixture was spread in aluminum trays measuring 25.5 cm× 13 cm and 2 cm deep and dried at 60 °C in a cabinet dryer with an air velocity of 3.5 m/s. Results indicated that the addition of soy protein and skim milk powder significantly reduced the drying rate of mango leather and lowered the extensibility and energy.

At present, to the best of the researcher's knowledge, there is a limited literature on the utilization of *Katchamita* indian mango. To address this gap, this study was carried out with the following objectives: (1) to develop value-added indian mango products and (2) to determine if the products developed are acceptable to the consumers.

MATERIALS AND METHODS

Raw material

Fresh, naturally ripened and firm indian mangoes and without physical damage were obtained from the vicinity of Pangasinan State University (PSU)-Bayambang Campus. The indian mangoes were brought to the PSU-DOST 1 Food Innovation Center. Over-ripe, damaged and disease fruits were discarded. Indian mangoes were washed thoroughly with water and peeled manually with stainless steel knife.

Osmo-dehydrated indian mango production process

To facilitate the water removal and to minimize the direct drying effects on products osmotic dehydration was used as pre-treatment. Fifty percent (weight of the sliced mangoes) of white sugar was added. Let it stand for 10 to 20 minutes till it waters. The mixture was heated with small fire till translucent for 20 to 30 minutes with stirring occasionally. Then, the pot was removed from heat, 0.1 % sodium metabisulfite was added and stand for 18 to 20 hours at room temperature. Mango slices were removed from the syrup with a colander and rinse with water twice.

The pre-treated samples were arranged in drying trays with cheesecloth. Drying was carried out initially at 50 °C then after one hour at 60 °C for 15 hours. Dried mangoes were unloaded and reconditioned at room temperature for 24 hours.

Finish product was packed in laminated plastic bag, sealed and labelled.

Indian mango leather production process

Mango puree was weighed. Total solids were adjusted to 25°Bx by adding sugar to the puree. Citric acid was added to lower the pH, in order to inhibit the growth of microorganisms. The mixture was heated at 80°C for two minutes. Then, sodium metabisulfite was added to the mixture. The mixture was spread to the stainless-steel trays with plastic sheet. Trays were loaded in the drier and dried at 55°C for 15 hours. After that, trays were unloaded. Dried sheets were removed from the trays and transferred to a work surface previously dusted with confectioner's sugar. Each roll was cut into desired sizes. Each sheet was tightly rolled and coated with confectioner's sugar.

Finish product was packed in laminated plastic bag, sealed, and labelled.

Sensory Analysis

A 30-member consumer panel, consisted of faculty, students, and staff of Pangasinan State University-Bayambang Campus, rated the sensory quality of the Indian Mango Leather and Osmo-Dehyrated Indian Mango on the following attributes: color, texture, sourness, sweetness, and general acceptability. The samples were placed on small paper plate. They were presented in containers labeled with a random three-digits number and randomly displayed. Between samples, the panelists were asked to drink water.

A seven-point hedonic scale was used to evaluate the samples [10]. A score of 1 represents attributes most disliked and a score of 7 represents attributes most liked. Using the scale, the level of acceptability of the product was described using the following ranges: 1.00 to 1.49-dislike extremely; 1.50 to 2.49-dislike moderately; 2.50 to 3.49-dislike slightly; 3.50 to 4.49- neither like nor dislike; 4.50 to 5.49- like slightly; 5.50 to 6.49- like moderately; 6.50 to 7.00-like extremely. Scores higher or equal to 5 will be considered acceptable. The average and mean values of scores for each of attributes was computed and analyzed statistically.

RESULTS AND DISCUSSION

Table 1. Demographic and consumption characteristics of consumers.

Parameter		Frequency	
Sex		N	%
	Male	13	39.39
	Female	20	60.61
Age group			
	15-21	20	60.61
	22-28	5	15.15
	29-35	5	15.15
	35-60	3	9.09
Consumption frequency			
	1 -2 times/week	2	6.06
	3 or more/ week	1	3.03
	Seldom	30	90.91

The results of the demographic and consumption characteristics of consumers show that, out of 33 consumers participated in the study, 39.39 % were males and 60.61 % were females. Most of these consumers accounting for 60.61 % were between 15-21 years old while only 9.09 % were between 35-60 years old suggesting that majority of consumers participated in this study were youth. Furthermore, results suggest that majority of the consumers (90.91 %) seldom consumed the mango products (Table 1). The possible reason for this low consumption frequency trend is that the available dehydrated carabao mango products in the market are costly and mostly coming from Cebu City. To address this gap, the researchers developed dehydrated mango food products from underutilized indian mangoes.

Consumer acceptance of indian mango leather

The final product which is translucent and slightly tacky was subjected to consumer acceptability test for color, texture, sweetness, sourness, and overall acceptability (result is summarized in Table 2).

Table 2. Average scores for color, texture, sweetness, sourness, and overall acceptability of indian mango leather

Sensory Attribute	WM	INTERPRETATION
Color	6.46	Like moderately
Texture	6.54	Like extremely
Sweetness	6.58	Like extremely
Sourness	6.15	Like moderately
Overall Acceptability	6.65	Like extremely

Visual examination by the consumers is significant that constitutes the fitness of any food for consumption and the same is true for the indian mango fruit roll for which leather's color is one of the important quality parameters. Panellists moderately like the leather's color.

Organic acid and sugars interacts with specialized taste buds on the tongue which creates a sense of taste [11]. Thus, sweetness due to sugar and sourness from organic acids are dominant components in the taste of many fruits. The score for sweetness and sourness indicated that the panellist like it extremely and moderately, respectively. It is worthy to note that addition of sugar is a critical step because if too much sugar is added, the leather will remain tacky (sticky) after drying.

Addition of citric and sodium metabisulfite explains the high acceptance scores for color and sourness. Citric acid is often used as a pre-treatment for mangoes to prevent browning reaction when exposed to air. In this study, the purpose of adding citric acid is to lower the pH of the puree in order to

inhibit the growth of microorganisms during drying. Most microorganisms grow best at pH values around 7.0. The initial pH of indian mango puree was recorded at 4.5 and after addition of citric acid, the pH decreased to 3.7. It is worthy to note that food products with pH values below 4.5 are more susceptible to spoilage by yeasts and molds.

Meanwhile, sulfiting using sodium metabisulfite is a very effective way of improving shelf life of dehydrated fruit by retarding oxidation and browning of fruit. Aside from inhibiting the browning in fruit, sodium metabisulfite also destroys harmful bacteria during cabinet drying including *Escherichia coli* O157:H7, *Salmonella*, and *Listeria monocytogenes* [12].

Singh Gujral [13] prepared carabao mango leather with the addition of potassium metabisulphite. The resulting carabao mango leather were noted to have good sensory qualities and were satisfactorily liked by the consumers. Chan [14] developed papaya leathers with sucrose and sodiumbisulfite (SO_2). The results indicated that SO_2 reduced the change in color of the papaya leathers during drying and storage. Depending on the types of fruit leather, various additives can be used, such as glucose syrup, sodium metabisulphite, and sorbic acid [15].

Over-all, the indian mango fruit roll developed in this study seemed to be extremely acceptable for the consumers.

Consumer acceptance of osmo-dehydrated indian mango

Acceptability of dehydrated products by the consumer is highly dependent on its sensory attributes. In addition to color, sweetness, sourness, and textural attributes are critical in determining their degree of acceptance (Table 3). Results showed that the dehydrated indian mango had high score for color. The acceptable color of the dried product might be due to sodium metabisulfite treatment and fast drying of material under the cabinet drier. Foods such as baked goods, jams, wines, dried fruit, and many sauces are widely preserved using sodium metabisulfite. In addition, sodium metabisulfite is used suppress microbial growth and served as an antioxidant additive [12]. Also, it is is used to inactivate browning causing enzymes, mainly of polyphenol oxidase (PPO), and inhibit Maillard reaction by controlling reactive carbonyl compounds [16].

Table 3. Average scores for color, texture, sweetness, sourness, and overall acceptability of osmo-dehydrated indian mango.

Sensory Attribute	WM	VI
Color	6.03	Like moderately
Texture	5.73	Like moderately
Sweetness	6.03	Like moderately
Sourness	5.45	Like slightly
Overall Acceptability	6.12	Like moderately

Texture of osmo-dehydrated indian mango was moderately liked by the consumers. Rapid and controlled loss of moisture due to uniform heat transfer in cabinet drying may maintain the cell structure which could be a probable factor for contributing high texture acceptance scores. Sweetness and over all acceptability of dried product were also scored high while sourness was slightly like by the consumers suggesting addition of souring agents as indian mangoes are naturally not sour. No off flavors were detected by the consumers.

Finish product was packed in laminated plastic bag, sealed and labelled. Good quality, food grade, and airtight containers can be used to store osmotically dried foods to prevent absorption of moisture from atmosphere and to prevent spoilage due to contamination. Examples of ideal packaging material are aluminum foil and laminated polypropylene pouches [17]. Maintaining a relative humidity between 64.8 to 75.5 percent would be conducive for the retention of color, flavor, texture and taste [4], therefore prolonging the shelf-life of the osmotically dehydrated products from six months to one year.

CONCLUSION AND RECOMMENDATION

Indian mango leather was prepared by sorting, washing, peeling, and seed removing, and then cutting into slices of mature and fully ripe indian mango which can be pureed or pulped easily. Purees are heated to inactivate the enzymes. Additives such as sugar, citric acid, and sodium metabisulphite. These ingredients are mixed with the indian mango puree to make fruit leathers with a higher quality, longer storage, or better organoleptic quality than the original fruit. Indian mango leather was dried at 55°C for 15 hours.

Osmotic dehydration with subsequent cabinet-drying produced acceptable dried indian mango product. Osmotic pre-treatment caused a water outflow and solids infusion into the indian mango

slices. Drying at 60°C seemed appropriate for the osmosed indian mango as the final product was generally acceptable to the consumers for all the sensory traits.

Results of the consumer acceptance test showed that the indian mango leather and osmo-dehydrated indian mango developed in this study is acceptable for all the sensory parameters which include the color, sweetness, sourness, texture, and overall acceptability as indicated by high scores of greater than five (>5).

Technology transfer of developed indian mango leather and osmo-dehydrated indian mango developed and capacity building of the mango producers and manufacturers in Pangasinan is hereby recommended.

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REFERENCES

[1] Hui, Y. H., Barta, J., Cano, M. P., Gusek, T., Sidhu, J., & Sinha, N. (2006). *Handbook of Fruits and Fruit Processing*. 2121 State Avenue, Ames, Iowa 50014, USA: Blackwell Publishing Blackwell Publishing Professional.

[2] Bersales, L. G. S., Perez, O. B., & Recide, R. S. (2017). *Major Fruit Crops Quarterly Bulletin*. Quezon City, Philippines.

[3] Schieber, A., Ullrich, W., & Carle, R. (2000). Characterization of polyphenols in mango puree concentrate by HPLC with diode array and mass spectrometric detection. *Innovative Food Science and Emerging Technologies, 1*, 161–166.

[4] Chavan, U. D. (2012). Osmotic dehydration process for preservation of fruits and vegetables. *Journal Of Food Research And Technology, 1*(2).

[5] Ertekin, C., & Yaldiz, O. (2004). Drying of eggplant and selection of a suitable thin layer drying Model. *Journal of Food Engineering, 63*, 349-359.

[6] Akpinar, E. K., & Bicer, Y. (2004). Modelling of the drying of eggplants in thin-layers. *International Journal of Food Science and Technology, 39*, 1-9.

[7] Azeredo, H. M. C., Brito, E. S., Moreira, G. E. G., Farias, V. L., & Bruno, L. M. (2006). Effect of drying and storage time on the physicochemical properties of mango leathers. *International Journal of Food Science and Technology, 41*(6), 635–638.

[8] Mir, M. A., & Nath, N. (1995). Sorption isotherms of fortified mango bars. *Journal of Food Engineering, 25*(1), 141–150.

[9] Gujral, H. S., & Khanna, G. (2002). Effect of skim milk powder, soyprotein concentrate and sucrose on the dehydration behaviour, texture, color and acceptability of mango leather. *Journal of Food Engineering, 55*(4), 343–348.

[10] Carr, B. T., Meilgaard, M., & Civille, G. V. (1999). *Sensory evaluation techniques*. Washington, DC: CRC Preess.

[11] Akhtar, S., Mahmood, S., Naz, S., Nasir, M., & Saultan, M. T. (2009). Sensory evaluation of mangoes (*Mangifera indica* L.) grown in different regions of pakistan. *Pak. J. Bot, 41*(6), 2821-2829.

[12] Ismail, O., & Nagy, K. (2012). Characteristics of dried mango slices as affected by pre-treatments and drying type. *Australian Journal of Basic and Applied Sciences, 6*(5), 230-235.

[13] Singh Gujral, H., & Singh Brar, S. (2003). Effect of Hydrocolloids on the Dehydration Kinetics, Color, and Texture of Mango Leather. *International Journal of Food Properties, 6*(2), 269-279. doi:10.1081/JFP-120017846

[14] Chan, H. T., & Cavaletto, C. G. (1978). Dehydration and storage stability of papaya leather. *Journal of Food Science, 43*(6), 1723-1725. doi:10.1111/j.1365-2621.1978.tb07398.x

[15] Diamante, L. M., Bai, X., & Busch, J. (2014). Fruit Leathers: Method of Preparation and Effect of Different Conditions on Qualities. *International Journal of Food Science, 2014*, 139890. doi:10.1155/2014/139890

[16] Pott, I., Neidhart, S., Mühlbauer, W., & Carle, R. (2005). Quality improvement of non-sulphited mango slices by drying at high temperatures. *Innovative Food Science and Emerging Technologies, 6*, 412-419.

[17] Sagar, V. S., & Khurdiya, D. S. (1999). Studies on dehydration of dashehari mango slices. *Indian Food Pack, 53*(1), 5-9.