Journal of Postharvest Technology
2021, **09**(3): 29-39
www.jpht.in

RESEARCH ARTICLE

Development and physico-chemical analysis of value-added mango leather packed in different packaging materials

Baljor Singh[1], Vinay Kumar Pandey[2]*, R. N. Shukla[1], Kunal Singh[1], Sweta Singh[1]

[1] Department of Food Process Engineering, Sam Higginbottom Institute of Agriculture, Technology and Sciences- Deemed University, P.O-Naini, Allahabad, U.P-211007, India.

[2] Department of Bioengineering, Integral University, Lucknow, UP. -226026, India.

Received: 11.05.2021 Accepted: 14.07.2021

ABSTRACT

The study aimed to develop mango leather and to analyze the composition while observing the shelf life. The sensory, quality, and nutritional parameters were investigated. We selected one variety of mango (Lal patta) with one stage of ripeness (i.e., ripe mango). Also, the product was developed with the addition of the mango pulp, sugar, honey, milk powder, coconut powder, and potassium meta bisulfate. 4 samples (A, B, C, and D) were kept at 70°C for 10 hours in a tray dryer and these samples were compared to each other. We used these additives for enhancing the vitamin-A, vitamin-C, and carbohydrate content in mango leather. All statistical analyses showed that Physico-chemical properties were different in different variety and stages of ripeness. Sensory, texture and chemical analysis showed that the quality of mango leather was satisfactory with a high amount of nutrients. The statistical analysis of the consumer's preference showed that all the developed products were equally acceptable and sample B secured the highest score. The other products were also liked moderately as far as overall acceptability is concerned. The mango leather was stored in HDPE and LDPE bags but the best quality of mango leather was achieved in HDPE during the 60 days of storage.

Keywords: Mango, coconut powder, dehydrator, food packaging, performance evaluation

Citation: Singh, B., Pandey, V.K., Shukla, R.N., Singh, K., and Singh, S. 2021. Development and physico-chemical analysis of value-added mango leather packed in different packaging materials. *Journal of Postharvest Technology*, **9**(3): 29-39.

INTRODUCTION

Mango (*Mangifera indica)* is a highly perishable seasonal tropical fruit which is very famous among millions of people. Because of its taste, it also occupies a pleasant place among the best fruits of the world. Though it is constantly demanded but there are a pre-harvest and post-harvest scarcity and at times. To increase the availability of mango throughout the year, the surplus production must be processed into a variety of value-added products (Srinivasan et al. 2000; Singh et al. 2005). Dried mango products could successfully serve this purpose. Mango originated from Southern Asia; Eastern India, Burma, and the Andaman Islands to be precise but it is now widely cultivated throughout the tropical and subtropical regions of the world (Microsoft Encarta, 2008). The genus Magnifera belongs to the Sapindales order in the Anacardiaceae family (Medina and García, 2002).

* *For correspondence:* V. K. Pandey (Email: vinaypandey794@gmail.com)

ISSN2348-4330

There are over 1000 named varieties of mango throughout the world among which 69 species are mostly confined in the tropical region (Medina and García, 2002). At the global level, mango holds an account for approximately fifty percent of all tropical fruits produced. Mango is ranked just after the pineapple in quantity and value. Recent statistics show that India and Nigeria are among the top ten mango-producing countries in the world. India is leading in the list with overall manufacturing of 22,099, 225 MT contributing 69% of global production, while Pakistan is 8th in the list with an overall production of 860,000 MT (National Horticulture Board, 2015; APEDA, 2015). Mango has become more popular and demanded globally because of its delicious taste, attractive flavor, diuretic, and therapeutic significance (Maqbool et al., 2007).

The mango pulp is found to contain pigment carotenoids, polyphenols, and omega- 3 and 6 polyunsaturated fatty acids. These and other constituents of mango are important in peoples' diets (Abano et al., 2013). The Colour, shape, and size of mangoes depending upon variety. The color of ripe mango fruit may be greenish, greenish-yellow, yellow, red, orange, or purple, their shape varies between nearly round, oval and ovoid-oblong, and their weight vary from few grams to more than 2.3 kg (Medina and García, 2002). The Lal patta variety is mainly cultivated in India and Pakistan. In India, the name Lal patta is believed to be derived from that of a village between Hyderabad and Tamilnadu. The genesis of this variety was as a result of a superior chance-seedling in the southern garden. It is well distributed all over the Indo-Gangetic plain and Bengal in the North, and as far as Hyderabad (Deccan) in the South. Thus, Lal patta is one of the most popular mango varieties in Southern India (Gupta and Jain, 2014). The variety compares favorably with the Alphonso of Maharashtra State to which resembles in taste as well in respect of the color of the pulp. But it is smaller in size than Alphonso's variety. Lal patta mangoes can be stored safely for 2 to 3 weeks at 7 – 8 °C (Jha et al., 2010).

The fruit size ranges from small to medium having an average dimension of 13×8 cm and weighs between 130 and 260 g; its shape ranges from oblong to oblong-oblique and has a rounded to obliquely rounded base. It has a sweet taste, pleasant flavor, firm flesh, attractive cadmium yellow pulp, and has no fiber. It may have scanty or moderately abundant juice. It also has good keeping and peeling quality. In terms of physicochemical properties, the Lal patta mango matures in 116 days and produces about 34 fruits per panicle with each fruit-producing 141 mg (per 100 g) of vitamin C. Also, the mango variety has a length and width of 9.87 and 4.80 cm respectively. Fruit weight of 175.62 g, seed weight of 22.99 g, peel weight of 33.47, and pulp weight of 115.73 were also obtained. India dominates the world trade of mango which is processed, though hardly 1-2% of overall mango grown in India is processed. However, only 20% of the processed mango products are being exported, out of which mango pulp accounts for 80% of the exported products. The post-harvest losses of mango were estimated at around 25 – 40% (Vijayanand et al., 2015). Similarly, Pakistan is the leading producer in Africa and 8th on the global scale, the situation of mango is worse compared to India. The post-harvest losses reach up to 50%, mainly due to poor post-harvest practices along with environmental factors such as high temperature and relative humidity. Thus, these countries are not leading in terms of export and usage of fresh or processed mango. Mostly the processing of mango is performed locally at a very small scale and confined to mango juice only (Alaka et al., 2003; Saave, 2011).

MATERIAL AND METHODS

Raw materials

Mango: Fresh mango (*Magnifera Indica* cv. *Lal patta*) was purchased from local fruit sellers in Allahabad, India. Mangoes were then kept in refrigeration conditions till they were processed for research work.

Sugar: Associating sugar (sucrose) is very common for individuals due to its constructive taste properties. Sugar is being used in many foods because of its specific properties like sweetness, flavor, and few nutritional properties as well. Certain constructive properties of sugar can be categorized among four parameters which include sensory, physical, microbial, and chemical. These properties also make sugar an exceptional functional substance for non-food applications.

Milk powder: It is a dairy manufactured product prepared by evaporation of milk until it is converted into powdered form. Storage of milk is the main motive of these consecutive processes and hence milk powder has longer shelf life without any refrigerated condition due to less moisture content. Easy and economical transportation is another purpose for this state conversion. Powdered milk consists of certain materials like dry milk (whole and skimmed separately), dry whey products, and other blends. Many forms of milk powder are also traded on an international level.

Honey: The most constructive property of honey is its antibacterial activity which maintains a moist wound condition, and its barrier property is due to its high viscosity which prevents further infection.

Coconut powder: Coconut flour is gaining attention as people are rediscovering its health benefits and other nutritional factors. Besides, it is also used as a delicious gluten-free flavoring agent which is also a healthy alternative to other flours.

Extraction of mango pulp

Fresh fully ripe sound Lal patta mangoes will be utilized for the extraction to obtain pulp. Firstly, ripe mangoes were washed within clean water then fruits were peeled by knife. Pulp will be collected by squeezing the flesh of mangos. After that, the pulp was blended in an electrically operated blending machine. Obtained pulp had 15.1% total solids. It was then kept for storage in a deep freeze at a temperature of -18 °C for further use in the future (Fig 1).

Fresh ripe Lal patta

↓

Washing with portable water

↓

Peeling

↓

Cutting into bar form

↓

Blending

↓

Blanching (100˚C, 15 min)

↓

Cooling (15 min)

↓

Storage (-18˚C)

Fig. 1 Flow chart for preparation of mango pulp

Processing mango pulp

The mango was kept at a low temperature till the time of the experiment. The mango was taken out from the refrigerator to keep it at ambient temperature for two hours to reach equilibrium. The mango was peeled and then rectangular slabs of an average thickness of 5 mm each were sliced with a knife. Freshly cut mango pulp contains 15.1 % of the total solid. So, pulp TSS percentage should be increased for quality mango leather processing. First, all fresh mango pulp poured into a bowl. Then the bowl will be heated at 80-90 °C until the total soluble solid (TSS) percentage becomes 30.

Preparation of mango leather

At first, processed mango pulp will be taken and weighted by a balance. Then total mango pulps will be separated into three parts for processing of three kinds of the sample. After that mango pulps will be mixed with weighted sugar, milk powder, honey, and coconut powder according to the described formulation. Mixed pulp will be heated at 80-90°C for ten minutes and cooled. Then the mixture will be placed on a steel tray and covered with a very thin layer of polyethylene to preserve the sticking of mango leather after drying. The mixture will be dried by using a tray dryer with a constant temperature of 70°C for a maximum period of 10 hours. After drying, the sheet will be cut into (4"×1"×various thickness) bar form. The mango leathers were packed with HDPE (High-density polyethylene) bag and LDPE (Low-density polyethylene bag) and kept at room temperature (Fig 2).

Fresh mango pulp

↓

Addition of Sugar, Milk powder, Honey and coconut powder

↓

Mixing

↓

Heating

↓

Placing on a steel tray and smearing

↓

Drying

↓

Cut into bar form

↓

Packaging with high density and low-density polyethylene bag

↓

Storage (room temperature)

Fig. 2. Mango Leather preparation Flow chart

Development of mango leather

The product was developed by mango pulp, sugar, honey, milk powder, and coconut powder. The mango pulp, sugar, honey, milk powder, and coconut powder ratio were taken for the development of mango leather, which is as mentioned as following 100 gm, 13 gm, 15 gm, 7 gm, 10 gm for 3 mm thickness(A), 100 gm, 13 gm, 15 gm, 7 gm, 10 gm for 4 mm thickness(B), 100gm, 13gm, 15 gm, 7 gm, 10 gm for 5 mm thickness(C), 100 gm, 13 gm, 15 gm, 7 gm, 10 gm for 6 mm thickness(D) and the sensory evaluation was done for general taste color, texture, flavor, and overall acceptability.

Physical and chemical Analysis of mango leather during shelf-life study and effect of different treatments

The chemical, physical, and organoleptic evaluation of mango leather had been carried out. Studies on quality were based on physicochemical analysis (i.e., moisture, ash content, titrable acidity, vitamin-c, and texture analysis) and sensory characteristics, which were determined for fresh and stored samples.

Statistical Analysis

The analysis was performed using a completely randomized design the data recorded during the research work were statistically analyzed by the 'Analysis of variance- One-way classification or single factor 'ANOVA' (Fisher 2000). This is an appropriate method that has the capacity of analyzing the variation of the population variance. This remarkable effect of treatment was calculated with the help of 'F' (variance ratio). THE calculated F value was compared with the table value of F at a 5% level of significance. If the calculated value exceeded the table value the effect was considered to the significant. The relevance of the study was tested at a 5% level.

RESULTS AND DISCUSSION

The characteristics of mango leather were influenced by packaging material, storage of environmental condition, and chemical constituents of mango leather. Mango leather was packed in HDPE and LDPE bags and stored at room temperature. The storage studies were conducted at the interval of 15 days up to 60 days. The results of the study are being presented and discussed in the following section.

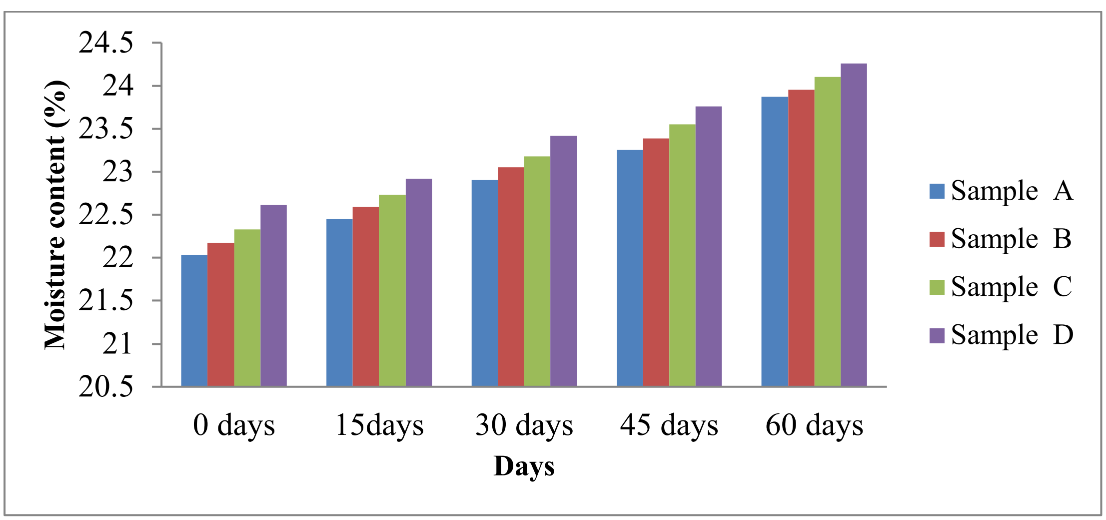

Fig. 1 Moisture content (%) of mango leather packed in (HDPE) during 60 days of ambient storage

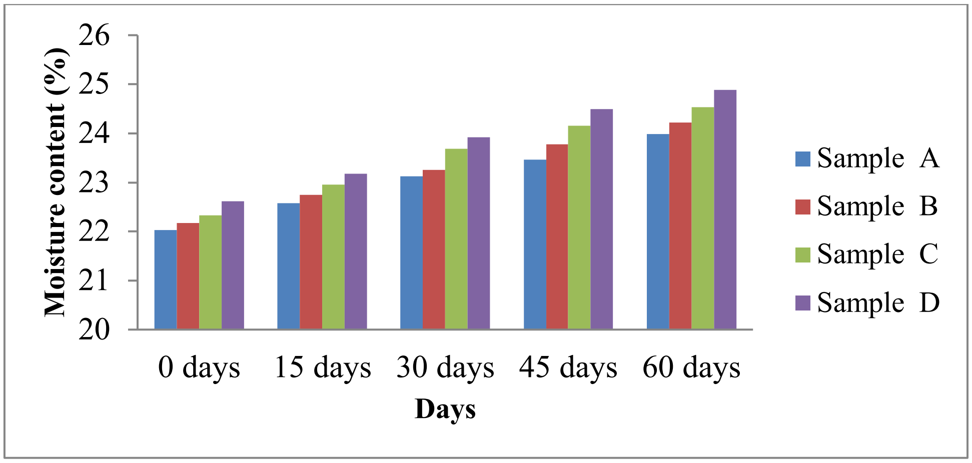

Fig. 2. Moisture content (%) of mango leather packed in (LDPE) during 60 days of ambient storage

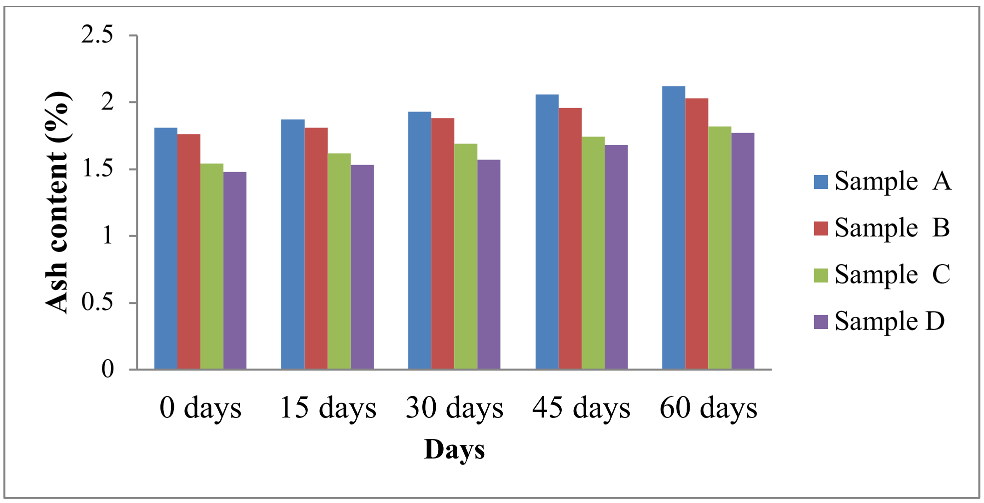

Fig. 3. Ash content (%) of mango leather packed in HDPE during 60 days ambient storage

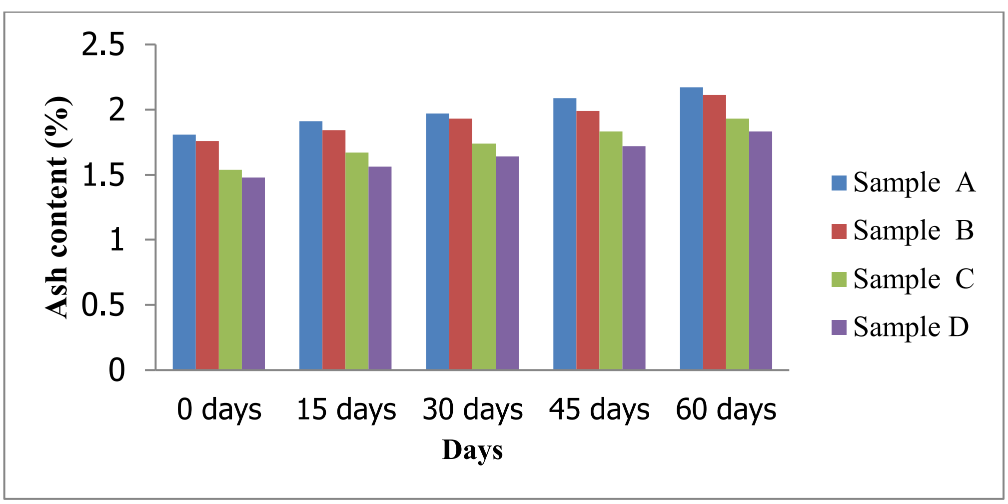

Fig. 4. Ash content (%) of mango leather packed in LDPE during 60 days ambient storage

Effect of different treatments on moisture content (%) of mango leather during storage packed in HDPE and LDPE

The moisture content of mango leather increased linearly with an increase in the concentration of mango pulp, this is attributed to the high water binding capacity of honey and milk powder which retain higher moisture content in ultimate products the moisture content is also increasing during storage due to the permeability of packaging material (Fig 1 and 2). The results for moisture content of mango leather were similar to the results obtained by the researchers who incorporate papaya in preparation of the papaya leather and increased moisture content of the papaya-based papaya leather also increased (Mishra and Kalpana, 2003).

Effect of different treatments on Ash content (%) of mango leather during storage

The data indicates that there was no significant difference in ash content of samples A, B, C, and D during storage (Fig 3 and 4). The ash content in foodstuff not necessarily accounts for the same composition as the mineral matter present in the original food, there may be some losses because of some interaction among the constituents. Anjumet et al. (2003) reported a non-significant effect of storage on ash content of mango leather samples. A similar non-significant effect has been observed in the present study during the storage of mango leather. But there is a slight decrease in ash content during the incorporation of mango pulp because mango pulp consists of mineral content which increases as the increase in the ratio of mango leather.

Effect of different treatments on vitamin-C content (mg) of mango leather during storage

The results in the present study showed that there was a significant decrease in the vitamin-c of mango leather during storage. The decrease in vitamin-c in mango leather may be attributed to the development of rancidity. The vitamin-c deterioration during storage may be due to the activity of acidity which split off the vitamin-c into free fatty acids and glycerol in the presence of catalysts like moisture, light, and heat and there is an increase in the vitamin-c content during the storage is due to vitamin retaining capacity of mango leather (Fig 5 and 6). An increase in the vitamin-c content of leather by (Tyagi, et al., 2006) was reported and explained to be largely due to the incorporation of milk powder and sugar.

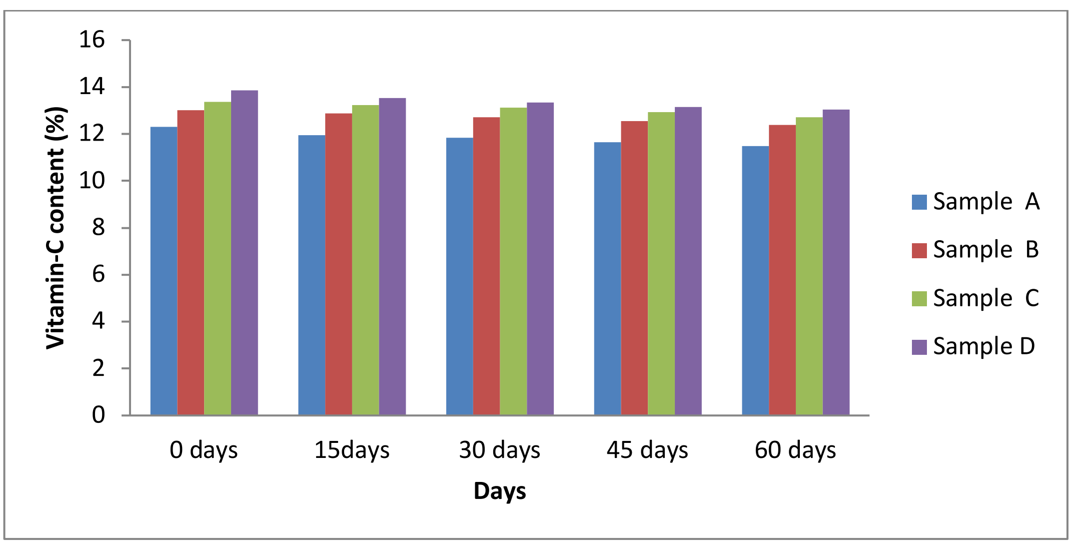

Fig. 5 Vitamin-C content (mg) of mango leather packed in HDPE during 60 days of ambient storage

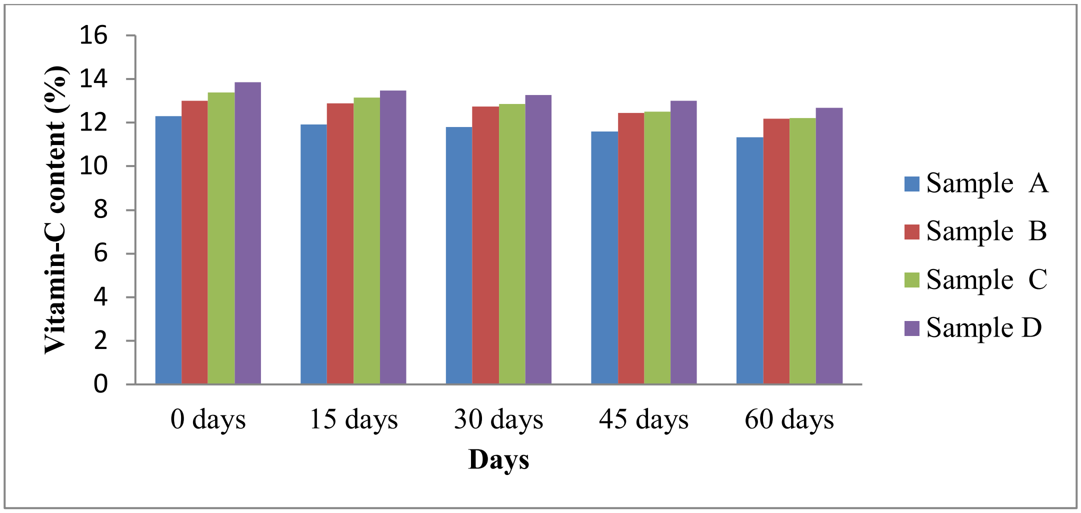

Fig. 6 Vitamin-C content (mg) of mango leather packed in LDPE during 60 days of ambient storage

Texture analysis

The effect of storage period and different contents of mango leather packed in HDPE and LDPE on critical evaluation of results it was found that the force response of the sample was shown on the digital display moving up or down depending on how far you pushed the balance into the sample – This was exactly how the texture analyzer works. Forces created during this movement were manipulated to recreate conditions that foods were exposed to when we eat them or process them. This means that we were able to directly measure and predict how food will perform or feel (Fig 7). Different test applications call for different levels of technology, load capacity, robustness, accuracy, and budget. The requirements of the test application directly affect the choice of instrument. For example, a high-powered software-driven system would be of no use for rudimentary field-testing.

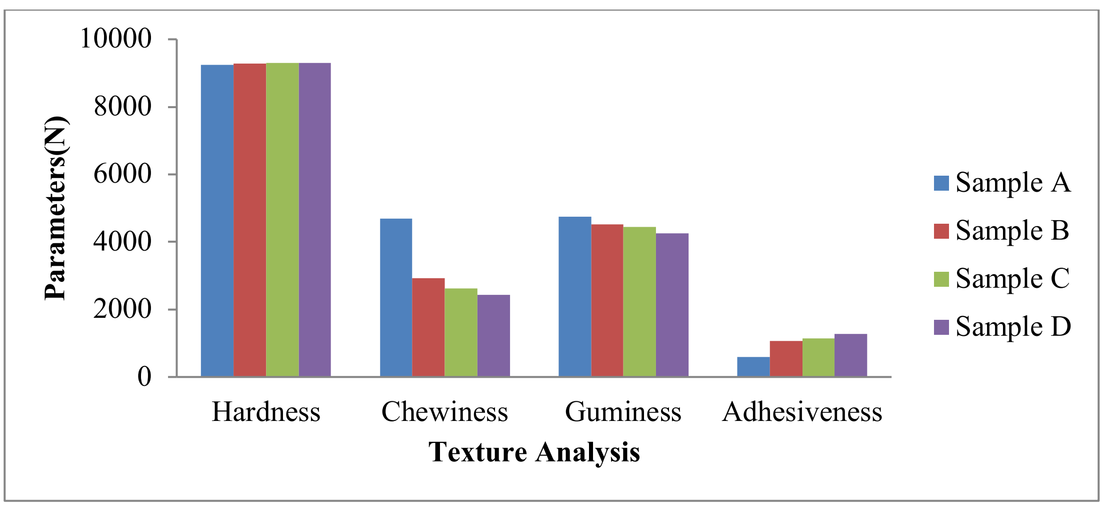

Fig. 7. Texture analysis

Sensory evaluation

Sensory analysis is performed by a panel on the parameters such as color, aroma, taste, and overall acceptability on a hedonic scale which helped in the evaluation of sensory characteristics (Fig 8). This test is used for acceptability by the consumer for the product. The color of sample B was more attractive than sample A, sample C, and sample D. The taste was almost the same. Flavor and overall acceptability were higher of sample B than others than sample A during the 0 days.

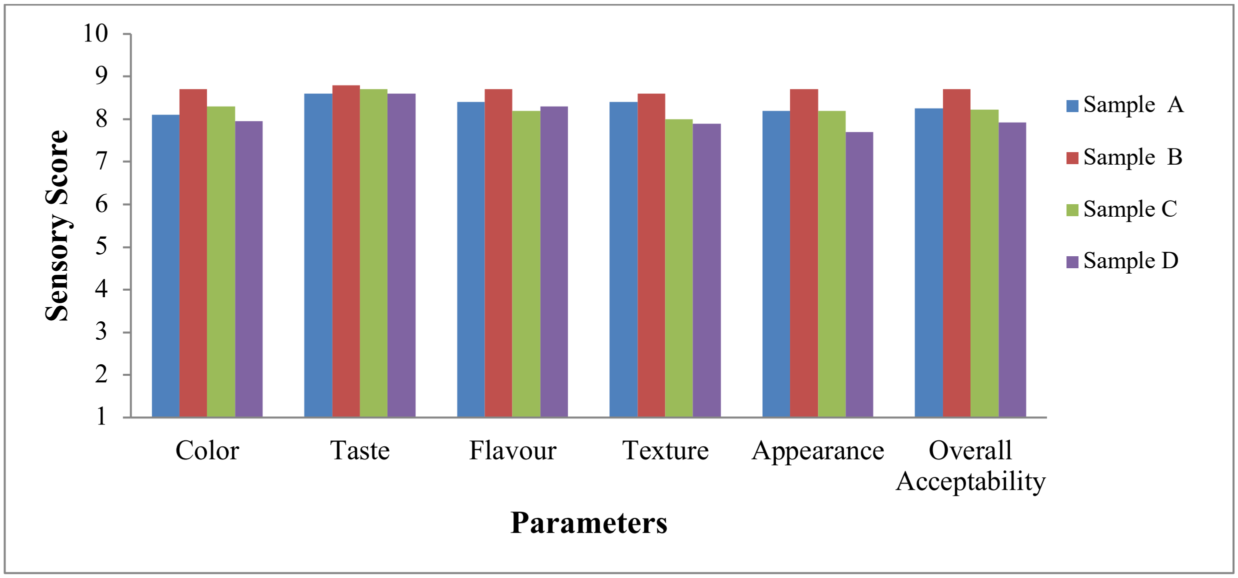

Fig 8. Sensory scores of mango leather on 0th day

CONCLUSION

The current experimental work was carried out for the Development of value-added mango leather packed in various packaging materials. Which is a good source of Vitamin C, four treatments were conducted i.e. (Controlled sample 3 mm, 4 mm, 5 mm, and 6 mm) of mango leather. The mango leather containing mango pulp 100 gm, sugar 13 gm, honey 15 gm, milk powder 7 gm and coconut powder 10 gm in sample B packed in HDPE found satisfactory after testing of Physico-chemical analysis like ash, moisture, vitamin-c, texture analysis and depending upon different sensory attributes like color, taste, flavor, texture, appearance and overall acceptability during shelf life study in comparison with 3 mm, 4 mm, 5 mm and 6 mm mango leather was found a significant difference in their physicochemical and organoleptic characteristics change to store for 60 days for shelf-life study. There were significant variations in these 3 mm, 4 mm, 5 mm, and 6 mm treatments but the 6 mm sample found more satisfactory as compared to sample 3 mm, 4 mm, and 5 mm in the case of Vitamin-C. From this result it can be concluded that mango leather can be a good food snack and can be used as a packaging material and on a theoretical basis we can conclude that all materials used in mango leather packaging and thus would not cause any harm to our environment. It can be regarded as a boon for our society in becoming pollution-free.

REFERENCES

Abano E. E., and Sam-Amoah L. K. 2011. Effects of Different Pretreatments on Drying Characteristics of Banana Slices. ARPN Journal of Engineering and Applied Sciences, 6(3): 121-129.

Ahmed J. 1997. Dehydration of turnip and radish slices. Journal of Food Science and Technology, 34(5): 410-412.

Akoy E. A. O., Hörsten D. V. and Luecke W. 2008. Drying Kinetics and Colour Change of Mango Slices as Affected by Drying Temperature and Time. 2008 Tropentag International Conference on “Competition for Resources in a Changing World: New Drive for Rural Development”, (pp. 1-6). Hohenheim.

Akoy E. O. 2014. Experimental characterization and modeling of thin-layer drying of mango. International Food Research Journal, 21(5): 1911-1917.

Al-Amin M., Hossain M. S. and Iqbal A. 2015. Effect of Pre-treatments and Drying Methods on Dehydration and Rehydration Characteristics of Carrot. Universal Journal of Food and Nutrition Science, 3(2): 23-28.

Asumeng L. 2009. Quality and drying characteristics of infrared dried mango sweet potatoes leather. A thesis was submitted to the department of food science andtechnology, Kwane, Nkrumah university of science and technology.

Augustin J., Swanson B. G. and Huang C. P. 1979. Changes in nutrient composition of dehydrated potato products during commercial processing. Journal of Food Science, 44(1): 216-219.

Azeredo M.C., Brito S., Moreira E.G. and Bruno M. 2005. Effect of drying and storage time on the physicochemical properties of mango leathers. International Journal of Food Science and Technology, 41(6): 635-638.

Bose T. K. and Mitra S. K. 1990. Fruits in tropical and subtropical, NayaProkash, Calcutta, pp. 250-275.

Bonazzi C. and Domoulin E. 2011. Quality Changes in Food Materials as Influenced by Drying Processes in Modern Drying Technology Volume 3: Product Quality and Formulation, First Edition. Tsotsas, E. and Mujumdar, A. S. (Eds). (pp. 1-20) Wiley-VCH Verlag GmbH and Co. KGaA.

Caparino O. A., Tang J., Nindo, Sablini S. S., Powers J. K. 2012. Effect of drying methods on the physical properties and microstructure of mango powder. Journal of Food Engineering, 111(1): 135-148.

Chen J. P., Tai C. Y., and Chen B. H. 2007 Effects of different drying treatments on the stability of carotenoids in Taiwanese mango (Mangifera indica L.). Food Chemistry, 100, 1005–1010. doi:10.1016/j.foodchem.2005.10.056

Corzo O., Bracho N. 2008. Water diffusion coefficient of mango slices at different maturity stages during air drying. Journal of engineering 87: 479-484.

Crapiste G. H. and Rotstein E. 1997. Design and Performance Evaluation of Dryers. In K. J. Valentas, E. Rotstein, and R. P. Singh (Eds.), Handbook of Food Engineering Practice (pp. 132-173). New York: CRC Press LLC.

Davoodi M. G., Vijayanand P., Kulkarni S. G. and Ramana K. V. 2007. Effect of Different Pre-treatments and Dehydration Methods on Quality Characteristics and Storage Stability of Tomato Powder. Swiss Society of Food Science and Technology, 40: 1832–1840.

Darvishi H., Azadbakht M., Rezaeiasl A. and Farhang A. 2013. Drying characteristics of sardine fish dried with microwave heating. Journal of the Saudi Society of Agricultural Sciences, 12: 121–127. doi:http://dx.doi.org/10.1016/j.jssas.2012.09.002

Developed at The University of Georgia, Athens, for the National Center for Home Food Preservation. Released by Elizabeth L. Andress, Ph.D., Department of Foods and Nutrition, College of Family and Consumer Sciences. January 2004.

Erbay Z., and Icier F. 2009. A Review of Thin Layer Drying of Foods: Theory, Modeling, and Experimental Results. Critical Reviews in Food Science and Nutrition, 50: 441–464.

Proceedings of the Canadian Society for Bioengineering Annual Conference,

Gupta S. V., and Patil B. N. 2014. Convective Drying of Osmo-Dehydrated Sapota Slices. International Journal of Agriculture and Food Science Technology, 5(3): 219-226.

Heilporn C., Wylock C., Spreutels L., and Haut B. 2012 Experimental Analysis and Modeling of Mangoes Drying Kinetics. 18th International Drying Symposium, (pp. 1-7).