Research Article

Development and Physico-Chemical Characterization of Apple-Peach Fruit Leather

Sadaf Javaria[1], Anum Marwat[1], Muhammad Nadeem[2], Mehwish Zerlasht[1], Aiman Kareem[3], Iqra Rubab[1] and Masooma Munir[4]*

[1]Institute of Food Science and Nutrition, Gomal University, Dera Ismail Khan, Pakistan; [2]Institute of Food Science and Nutrition, University of Sargodha, Sargodha, Pakistan; [3]Jiangnan University, Wuxi, Jiangsu, China; [4]Food Quality and Safety Research Institute, SARC, PARC, Pakistan.

Abstract | Fresh fruit leathers, a dehydrated snack have the potential to increase fresh fruit utilization especially in the children. The present investigation was designed to standardize the formulation of apple peach mixed fruit leather. Exact formulation has very important role in producing an acceptable and admired food product and the product grab more market. Therefore, the formulation of apple peach mix fruit leather was standardized by different treatments i.e. apple peach puree mixed in various combinations T_1 (100:0), T_2 (75:25), T_3 (50:50), T4 (25:75), T_5(0:75) to develop a nutritious functional snack. The effects of different fruit ratios on moisture content (MC), *pH, total titratable acid content, total soluble solids (TSS), vitamin C, protein, iron and* magnesium were investigated. Results of sensory evaluation showed that all the samples were in an acceptable range. However, Mix fruit leather with 50 % apple puree and 50% peach puree was liked the most by the panelists.

Received | April 10, 2020; **Accepted** | January 07, 2021; **Published** | April 09, 2021
***Correspondence** | Masooma Munir, Food Quality and Safety Research Institute, SARC, PARC, Pakistan; **Email:** masooma_ft@Yahoo.com
Citation | Javaria, S., A. Marwat, M. Nadeem, M. Zerlasht, A. Kareem, I. Rubab and M. Munir. 2021. Development and physico-chemical characterization of apple-peach fruit leather. *Pakistan Journal of Agricultural Research,* 34(2): 318-324.
DOI | https://dx.doi.org/10.17582/journal.pjar/2021/34.2.318.324
Keywords | Apple, Peach, Fruit leather, Nutritional value, Characterization, Snack

Introduction

Malnutrition is one of the basic problems of Pakistan, It is estimated that around 50% of children deaths are reported due to malnutrition. It is reported that malnutrition in Pakistan is due to consumption of food with low nutritional values (GoP and UNICEF, 2018). Especially iron, protein and zinc deficiency are prevalent. Micronutrient deficiency is common in developing countries especially in children and it leads to severe illness (Ho and McLean, 2011).

Apple and Peach are grown widely in Pakistan, these both fruits are nutrient dense and are loaded with minerals and vitamins. These two fruits are helpful to improve human nutrition, promote healthy cardiovascular system and are beneficial in preventing cancer and diabetes. Apple and peach are perishable fruits with moisture content of 85% and 87% respectively; hence require proper post-harvest handling, proper storage conditions and rapid transportation to reduce post harvest losses. In Pakistan there is lack of proper facilities (Durrani *et al.*, 2010; Kaushal and Sharma, 2010). Fruit leather is also known as fruit bar or a fruit slab, is a dehydrated fresh fruit-based snack which is often eaten as dessert. Fruit leather is chewy and palatable snack. It is high in fiber rich in micro and macro nutrients and low in fat. It is also light weighted and hence its storage and packaging is easy. It is economical value added product and is an excellent substitute of natural fruits

which gives good nutrition (Natalia *et al.*, 2010). Fruit leathers are not very well known fruit product especially in Pakistan.

Obesity and other health issues related to unhealthy food consumption are of great concern. The consumer trend is to seek out natural snack food items. Fruit bar or leather is an important confectionary product (Irwandi *et al.*, 1998; Phimpharian *et al.*, 2011). However, In Pakistan consumers are not aware of this wonderful food product.

Fruit leathers have chewy texture and sweet taste hence could be promoted as a substitute for sugary snacks with artificial ingredients, candies and toffies especially for children (Hodges *et al.*, 2011).

The objective of this research was to standardize the exact formulation of apple-peach fruit leather to produce natural, healthy and organoleptically acceptable snack especially for children as a substitute of candies and toffees.

Materials and Methods

The fully matured apple and peach fruits which were firm and free from blemishes were purchased from local market of Dera Ismail Khan. Fruits were washed and cleaned (in a 50 mg/L free active chlorine solution).

Preparation of apple-peach puree mix

The fruits were peeled, cored, sliced and blended into a puree. The blending was done at high speed for five minutes to get a fine smooth mixture. The puree was passed through a 1mm sized sieve. The apple-peach puree was mixed in five different ratios i.e. 100:0, 75:25, 50:50, 25:75 and 0:100 to prepare leather samples.

Preparation of apple-peach mix fruit leather

400 g of puree was prepared for each run. In fruit purees 20% of sugar (w/w), 0.2% of citric acid and 0.1% sodium benzoate were added. The mixture of each sample was poured into an aluminum tray lined with butter paper of 1mm thickness and dimensions of 25 cm X 15 cm X 1 cm. the hot air dryer was used to process the leathers. Trays of dryer were filled with puree were placed in the upper and middle section of dryer. The puree was dehydrated for 8 h at an average drying temperature of 60±1°C and 0.20 m/s air velocity (Rozina., 2012). Fruit leathers when could easily remove from the tray, indicated the appropriate moisture content. During the experiment the ambient temperature, relative humidity and drying temperature were constantly monitored by using data loggers. Flow diagram is shown in Figure 1.

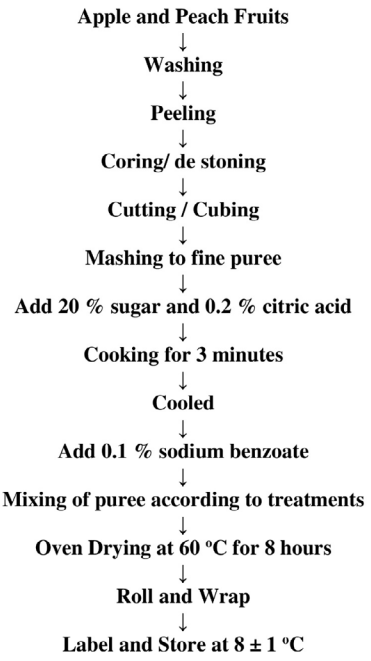

Figure 1: *Flow diagram for the preparation of apple peach fruit leather.*

Physiochemical analysis of fruit leathers

Preparation of sample for physico-chemical and nutritional analysis: For physico-chemical analysis 200 grams of leather sample was taken in a beaker and 500 ml distilled water was added to it. The mixture was heated with continuous stirring on the spirit lamp to avoid lumping till boiling. Then after boiling the mixture was cooled on room temperature, then it was filtered and the filtrate was used for further analysis (Manual of methods of analysis of foods fruits and vegetable products, 2005).

Assessment of physico-chemical components of fruit leathers

The moisture content of mixed fruit leather was determined by the method of Ranganna (2001), pH was measured using a pH meter (SES model 128, England), by the method given by AOAC (2005). Total Titratable acid (g/L) was determined by AOAC (2005) methods and expressed in terms of percentage mallic acid. Total Soluble Solids (Brix°) in the samples were directly recorded using refractometer (SHIBUYA, model # 91706, 0~32 Japan) and the results were expressed as per cent soluble solids (Brix°) as described

by standard methods of AOAC (2005). Ascorbic acid/ Vitamin C (mg/100ml) was determined according to the method of AOAC (2005) using 2, 6 dichlorophenol indophenol dye. Protein (g/100g) was determined by the method of Ranganna (2001). While, iron and magnesium (mg/100g) were determined in the samples by the method of AOAC (2005).

Sensory evaluation

Descriptive analysis was used to elucidate the sensory properties of the apple-peach mixed fruit leather. 30 both male and female graduate students between the ages of 19-25 were recruited for this study. Each panelist was asked to take 3x3 cm sq piece of each sample and evaluate it for taste, fruitiness, flavor, texture, color and overall acceptability. These attributes were analyzed by the method described by Ranganna (2001), on 9-point hedonic scale. Answers were coded from 1-9, with 9 being "liked extremely" and 1 being "disliked extremely". Samples were labeled by 3-digit numbers and presented to panelists in random order.

Shelf life studies

During 120 days of storage, Yeast and mold counts, Total and facecal coliforms andmesophylic anaerobes were determined according to guidelines of Downes and Ito (2001). Nutrient agar was used for periodical determination of total viable count.

Statistical analysis

The statistical analysis was carried out by the method of Steel *et al.* (1997).

Results and Discussion

Physicochemical analysis

Moisture content (%): Table 1 showed mean effect of treatments on moisture content (%) of mixed fruit leather. Data showed that moisture content of mixed fruit leather ranged from 2.85-4.15 %. The lowest moisture content was found in T1 (apple puree 100:0 peach puree) while highest moisture content was found in T4 (apple puree 0:100 peach puree). It is reported that if moisture content of dried food product falls in the range of 2.83-5% its water activity will be less than 0.8 and the product will be considered safe for longer time period and may have better quality (Jay *et al.*, 2005).

pH and total titratable acid (TAA)

pH and titratable acidity are very important characteristics which are interrelated with acidity. These two attributes effect the taste, flavor and shelf life of dried food product (Ahmed *et al.*, 2008; Nielsehn, 2001; Desrosier and Desrosier, 2006). Though, titratable acidity is a better interpreter of acid's impact on flavor in comparison with pH (Nielsehn, 2001). The data presented in table 1 showed that the titratable acidity of mixed fruit leather ranged from 0.30-0.45 g/L. While, pH of mixed fruit leathers ranged from 5.72-6.10. Lowest pH (5.72) was recorded in T5 (apple puree 0: 100 peach puree), while Highest pH (6.10) was recorded for T1 (apple puree 0: 100 peach puree). The results depicted that the leather samples were slightly acidic which added good taste to the product and it may also confer longer shelf life of the samples. The results are in accordance with the findings of Phimpharian *et al.* (2011); Jain *et al.* (2011) and Effah-Manu *et al.* (2013).

Total soluble solid (TSS) Brix

Maximum total soluble solids (18.30Brix°) were observed in T5, whereas, the lowest value of total soluble solid (11.90 Brix°) was observed in T1. Total soluble solids in a food product present total sugars (Ahmed *et al.*, 2008). Similar trend was also reported by Karki (2011) during her study on blue berries fruit leathers. It was reported that high TSS value resulted because of moisture loss during dehydration. However, high total soluble solids value is favorable for desirable recovery of processed food product (Phimpharian *et al.*,2011).

Vitamin C content (mg/100ml)

Vitamin C is essential for iron absorption as well as for the formation of collagen (Ogbonna *et al.*, 2013). Data regarding ascorbic acid or vitamin content (Table 2) revealed that the treated samples differed significantly from each other. Maximum Vitamin C value (74.5mg/100 ml) was reported in T5 whereas, the minimum value of ascorbic acid (4.50mg/100 ml) was found in T_1. Variation in Vitamin C levels of treatments might be due to the different blended ratios of apple and peach fruit pulp in making fruit leathers. Peach has higher amount of vitamin C in comparison with apple. Therefore, as the levels of peach increased in leather samples vitamin C increased.

Iron and magnesium (mg/100g)

The mineral analysis (Table 2) of apple-peach mix fruit leather depicted that minimum value iron

Table 1: *Physicochemical analysis of mix fruit leather.*

Parameters	Samples				
	T1	T2	T3	T4	T5
Moisture (%)	2.85[c] ± 0.01	3.10[c] ±0.01	3.70[b] ±0.01	4.13[a] ±0.12	4.15 ±0.01
pH	6.10[a] ±0.01	6.05[b] ±0.01	5.90[c] ±0.01	5.80[d] ±0.01	5.72[d] ±0.01
TTA (g/L)	0.30[d] ±0.01	0.34[c] ±0.00	0.39[b] ±0.01	0.43[a] ±0.01	0.45[a] ±0.01
TSS (Brix°)	18.30[a] ±0.06	17.03[b] ±0.06	15.70[c] ±0.06	12.03[d] ±0.01	11.90[d] ±0.01

Table 2: *Vitamin C, protein and mineral contents of mix fruit leather.*

Parameters	Samples				
	T1	T2	T3	T4	T5
Vitamin C (mg/100ml)	4.50[e] ±0.06	20.6[d] ±0.06	46.6[c] ±0.06	69.5[b] ±0.06	74.5[a] ±0.06
Protein (g/100g)	0.26[e] ±0.01	0.45[d] ±0.01	0.68[c] ±0.01	0.79[b] ±0.01	0.91[a] ±0.01
Iron mg/100g	0.12[d] ±0.01	0.15[c] ±0.01	0.19[b] ±0.01	0.21[b] ±0.01	0.25[a] ±0.01
Mg (mg/100g)	5.0[e] ±0.01	6.1[d] ±0.01	7.3[c] ±0.01	8.2[b] ±0.01	9.1[a] ±0.01

(0.12 mg/100g) and magnesium (5.0 mg/100g) were observed in T1 while maximum value of iron (0.25 mg/100g) and magnesium (9.1 mg/100g) were found in T5. The reason for this increase might be higher iron and magnesium content of peach in comparison with apple. The data is supported with the findings of Quintero *et al.* (2012).

Protein content (mg/100g)

The protein analysis (Table 2) of apple-peach mix fruit leather depicted that minimum value (0.26mg/100g) of protein content (g/100g) was found in T1, while maximum value of protein (0.91 mg/100g) was found in T5. The data revealed that as the ratio of peach increased in fruit leather the minerals and protein content increased. The data is supported by the findings of Quintero *et al.* (2012).

Sensory analysis

All the sensory characteristics of apple-peach mix fruit leather are shown in Figure 2. Color of fruit leather developed as a result of millared reaction between sugars and proteins (Demarchi *et al.*, 2013). The results depicted that apple peach mixed fruit leather having apple puree in larger quantity developed darker color in comparison with samples having peach puree. The panelists liked apple pear mixed fruit leather which developed color moderately. T3 was most liked treatment, while minimum color score was given to T1. However, Color scores for T3, T4 and T5 did not differ significantly. Similar trend was observed by Sadaf *et al.* (2013) and Effah-Manu *et al.* (2013). The data presented in Figure 1 reveled that there was no significant difference in taste in different samples. However, highest taste score rating was found for the leather samples in which 50% apple: peach 50% puree was incorporated. Similar trend for mixed fruit leather was found by Sharma *et al.* (2013). Flavor of the fruit leathers was affected significantly by treatments (Figure 1). It was observed that panelists liked the blend of apple and peach in equal proportions in the mixed fruit leather in comparison with apple or peach alone. It was observed that T3 got maximum score for flavor, while the lowest flavor perception was recorded in T1. Texture is also one of the major sensory characteristics. The results depicted that there was no significant difference in samples in terms of texture. Similar results of decrease in texture were observed by Azerdo *et al.* (2006). It is very important to note that human mouth is much more reliable and complex in terms of evaluating the texture in comparison with penetrometer, as penetrometer evaluates only one feature or aspect of texture (Huang and Hsieh, 2005). In organoleptic perceptions, taste is a very important attribute after color and flavor. The panelists liked all the apple-peach fruit samples moderately (Figure 2), there are many factors which may affect the taste like sugars in product and sugar acid ration. The consumers like the product if it is sweet, but if the sweetness increases beyond a limit, it is disliked (Jain and Nema, 2007). As the amount of sugar was same in all samples sweetness was affected by the type of fruit added. Similar trend was also reported by Effah-Manu *et al.* (2013) while studying mango-sweet potato mixed fruit leather. Overall acceptability of apple-peach mixed fruit leather

samples did not differ significantly. However, Highest overall acceptability value (8.08) was recorded in T_3, while lowest score (7.42) was recorded in T_1. Similar decline in overall acceptability was also reported by Rozina (2012) while studying fruit leathers. It could been observed from the results that panelists generally liked all the samples.

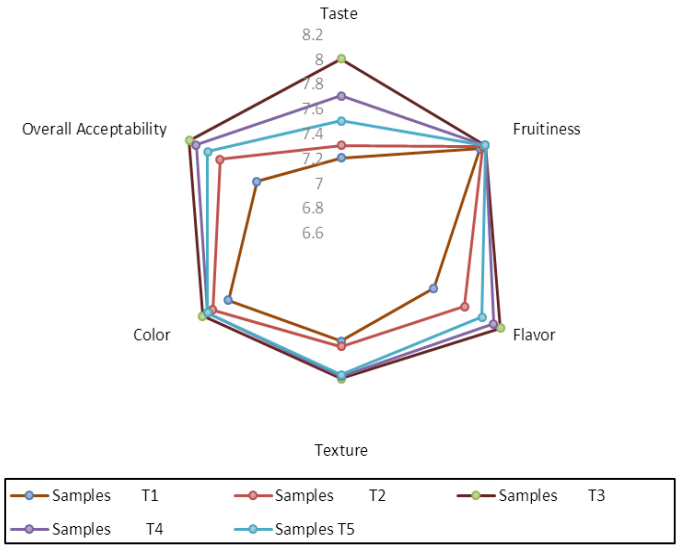

Figure 2: *Sensory characteristics of apple-pear mixed fruit leather.*

Shelf life studies

During 120 days of storage, the mesophylic aerobes count was lower than 10 CFU/g and of mold and yeast were <100 CFU/g. The Coliform MPN were <3/g. Thus the product was considered safe for at least 120 days at room temperature.

Conclusions and Recommendations

Dehydrating the fruits into healthy fruit leathers may help to reduce post-harvest losses and providing the consumers a nutrient dense product. Especially the children may be encouraged to consume fruit leather rather than candies or toffies. In the present study all the samples were in an acceptable range in terms of sensory evaluation but apple puree 50%: 50% peach puree was liked the most.

Novelty Statement

No work has been published before on the formulation, characteriza-tion and nutritional assessment of apple-peach fruit leather. This study will provide a preliminary basis for the advanced research about fruit leather.

Author's Contribution

Sadaf Javaria: Conceived the idea, oveall management of the article.
Anum Marwat: Physic-chemical analysis and methodology.
Muhammad Nadeem: Technical input at every step and methodology.
Mehwish Zerlasht: Statistical analysis.
Aiman Kareem: Statistical design application and analysis.
Iqra Rubab and Masooma Munir: Wrote the manuscript.

Conflict of interest

The authors have declared no conflict of interest.

References

Ahmed, M., A. Ahmad, Z.A. Chatha and S.M.R. Dilshad. 2008. Studies on preparation of ready to serve mandarin (citrus reticulata) diet drink. Pak. J. Agric. Sci., 45(4): 470-476.

AOAC, (Association of Official Analytical Chemists) 2005. Official methods of analysis association of official analytical chemists 18th edition. Washington, D.C. USA.

Azeredo, H.M.C., E.S. Brito, G.E.G. Moreira, V.L. Farias and L.M. Bruno. 2006. Effect of drying and storage time on the physico-chemical properties of mango leathers. Int. J. Food Sci. Technol., 41(6): 635–638. https://doi.org/10.1111/j.1365-2621.2005.01120.x

Demarchi, N. A. Quintero Ruiz, A. Concellon and S.A. Giner. 2013. Effect of temperature on hot-air drying rate and on retention of antioxidant capacity in apple leathers. Food Bioprod. Proc., 91: 310–318. https://doi.org/10.1016/j.fbp.2012.11.008

Desrosier, N. and J. Desrosier. 2006. The technology of food preservation. Connecticut, USA: AVI Publishing Co., Inc., Westport.

Downes, F.P. and K. Ito. 2001. Compendiun of methods for the microbiological examination of foods. Am. Public Health Assoc. 4th ed. Washington. https://doi.org/10.2105/9780875531755

Durrani, Y., M. Ayub, A. Muhammad and A. Ali. 2010. Physico-chemical response of apple pulp to chemical preservatives and antioxidant during storage. Int. J. Food Saf., 12: 20-28.

Effah-Manu, L., I. Oduro and A. Addo. 2013. Effect of dextrinized sweet potatoes on the physicochemical and sensory quality of infra-red dried mango leather. J. Food Proc. Technol., 4(5): 1-5. https://doi.org/10.4172/2157-7110.1000230

Government of Pakistan and UNICEF. 2018. National nutrition survey 2018 key findings report. pp. 641.

Ho, K. and J. McLean. 2011. The implementation of in-home fortification and nutrition education to combat anaemia and micronutrient deficiencies among children 6-23 Months in Rwanda. Kigali: Ministry of Health, Republic of Rwanda.

Hodges, R.J., J.C. Buzby and B. Bennett. 2011. Postharvest losses and waste in developed and less developed countries: opportunities to improve resource use. J. Agric. Sci., 149: 37-45. https://doi.org/10.1017/S0021859610000936

Huang, X. and F.H. Hsieh. 2005. Physical properties, sensory attributes, and consumer preference of pear fruit leather. J. Food Sci., 70: E177–E186. https://doi.org/10.1111/j.1365-2621.2005.tb07133.x

Irwandi, J. and B.Y. Man. 1996. Durian leather: Development, properties and storage stability. J. Food Qual., 19(6): 479-489. https://doi.org/10.1111/j.1745-4557.1996.tb00443.x

Irwandi, J., Y.B. Man, S. Yusof, S. Jinap and H. Sugisawa. 1998. Effects of type of packaging materials on physicochemical, microbiological and sensory characteristics of durian fruit leather during storage. J. Sci. Food Agric., 76(3): 427-434. https://doi.org/10.1002/(SICI)1097-0010(199803)76:3<427::AID-JSFA967>3.0.CO;2-3

Jahan, Z. and K. Zaheerullah. 2008. Peach marketing in NWFP. Sarhad J. Agric., 24(2): 162-168.

Jain, P.K. and P.K. Nema. 2007. Processing of pulp of various cultivars of guava (*Psidiumguajava* L.) for leather production. Agric. Eng. Int., 9: 1-9.

Jain, P.K., P. Jain and P.K. Nema. 2011. Quality of guava and papaya fruit pulp as influenced by blending ratio and storage period. Am. J. Food Technol., 6: 507-512. https://doi.org/10.3923/ajft.2011.507.512

Jay, M.J., 1992. Modern food microbiology. 4th ed. Van Nostrand, Reinhold, New York. pp. 644. https://doi.org/10.1007/978-94-011-6480-1

Jay, M.J., M.J. Loessner and D.A. Golden. 2005. Modern food microbiology. 7th ed. Springer Science, USA.

Karki, M., 2011. Evaluation of fruit leathers made from New Zealand grown blueberries. Lincoln University.

Kaushal, M. and K.D. Sharma. 2012. Suitability of tin cans and glass jars for processing of peach fruits in juice. Indian J. Nat. Prod. Resour., 3(4): 493-500.

Larmond, E., 1977. Laboratory methods for sensory evaluation of food. Publication 1284. Canadian department of agriculture, Ottawa, Canada.

Manual of methods of analysis of foods fruits and vegetable products. 2005. Manual of methods of analysis of foods fruits and vegetable products, directorate general of health services ministry of health and family welfare Government of India New Delhi.

Natalia, A., Q. Ruiz, S.M. Demarchia and S.A. Ginera. 2010. Dehydrated fruit leathers: A review. 11th Int. Cong. Eng. Food. pp. 1-6.

Nielsehn, S., 2001. Food analysis. USA: Springer Publication.

Ogbonna, A.C., C.I. Abuajah and G.E. Ekpe. 2013. A comparative study of the native factors and sensory acceptance of juices from selected Nigeraian fruits. Croat. J. Food Technol. Biotechnol. Nutr., 8(1-2): 41-57.

Phimpharian, C., J. Anuvat, J. Kamolwan, T. Nantawan, P. Witoon and N.H. Kyoon. 2011. Physicochemical characteristics and sensory optimisation of pineapple leather snack as affected by glucose syrup and pectin concentrate. Int. J. Food Sci. Technol., 46(5): 972– 981. https://doi.org/10.1111/j.1365-2621.2011.02579.x

Quintero, R.N.A., S.M. Demarchi, J.F. Massolo, L.M. Rodoni and S.A. Giner. 2012. Evaluation of quality during storage of apple leather. LWT – Sci. Technol., 47(2): 485–492. https://doi.org/10.1016/j.lwt.2012.02.012

Ranganna, S., 2001. Handbook of analysis and quality control for fruit and vegetable products. New Delhi: Tata MC Graw-Hill Llimited Company.

Rozina, N., 2012. Physical properties, sensory attributes and consumer preference of fruit leather. Pak. J. Fd. Sci., 22(4): 188-190.

Sadaf, J., A. Bibi, S. Raza, K. Waseem, M.S. Jilani and G. Ullah. 2013. Peanut butter incorporation as substitute for shortening in biscuits: Composition and acceptability studies. Int. Food Res. J., 20(5): 3243-3247.

Sharma, S.K., S.P. Chaudhary, V.K. Rao, V.K. Yadav and T.S. Bisht. 2013. Standardization of technology for preparation and storage of wild apricot fruit bar. J. Food Sci. Technol., 50: 784–790. https://doi.org/10.1007/s13197-011-0396-y

Steel, R.G.D., J.H. Torrie and D.A. Dickey. 1997. Principles and Procedures of Statistics, a biochemical approach (3 ed.) MC Graw Hill Book Co. Inc, New York, USA.