International Journal of Advanced Biochemistry Research 2024; 8(3): 551-557

International Journal of Advanced Biochemistry Research

ISSN Print: 2617-4693
ISSN Online: 2617-4707
IJABR 2024; 8(3): 551-557
www.biochemjournal.com
Received: 02-12-2023
Accepted: 05-01-2024

Supriya Gahane
Student Post Graduate Institute of Post-Harvest Technology and Management, Killa-Roha, Raigarh, Maharashtra, India

Pradeep Relekar
Head and Professor, Department of Fruit, Vegetable and Flower Crops, Post Graduate Institute of Post Harvest Technology and Management, Killa-Roha, Raigarh, Maharashtra, India

Jitendrakumar Kadam
Professor, Department of Medicinal, Aromatic Crops, Post Graduate Institute of Post Harvest Technology and Management, Killa-Roha, Raigarh, Maharashtra, India

Gargi Shirke
Head and Professor, Department of Medicinal, Aromatic Crops, Post Graduate Institute of Post Harvest Technology and Management, Killa-Roha, Raigarh, Maharashtra, India

Rahul Ranveer
Professor, Department of Meat, Poultry and Fish, Post Graduate Institute of Post Harvest Technology and Management, Killa-Roha, Raigarh, Maharashtra, India

Shital Rane
Student Post Graduate Institute of Post-Harvest Technology and Management, Killa-Roha, Raigarh, Maharashtra, India

Corresponding Author:
Supriya Gahane
Student Post Graduate Institute of Post-Harvest Technology and Management, Killa-Roha, Raigarh, Maharashtra, India

Development of sweet potato (*Ipomoea batatas* L.) and mango (*Mangifera indica* L.) blended bar

Supriya Gahane, Pradeep Relekar, Jitendrakumar Kadam, Gargi Shirke, Rahul Ranveer and Shital Rane

DOI: https://doi.org/10.33545/26174693.2024.v8.i3g.773

Abstract

The experiment was conducted for different parameters with five main treatments *viz*., 100, 90:10, 80:20, 70:30 and 60:40 percent sweet potato and mango pulp proportion with storage period as sub treatment and were analyzed for changes in physico-chemical parameters and sensory qualities. The quality of the fruit bar could be improved by blending the sweet potato pulp with Alphonso mango pulp. From the present investigation, it was observed that the chemical parameters such as titratable acidity, reducing sugars content exhibited an increasing trend while decreasing trend was observed in TSS, total sugars, starch and β-carotene content of the sweet potato-mango blended bar irrespective of treatments during storage. As regard the organoleptic evaluation, the bar blended with 60% Sweet potato and 40% mango obtained highest sensory score at 90th day of storage.

Keywords: Sweet potato, alphonso mango, blended bar, konkan Ashwini, alphonso, storage

Introduction

The sweet potato, *Ipomoea batatas* L., is a member of the South American-native Convolvulaceae family. A hardy crop that may be cultivated under conditions of drought is the sweet potato. It is frequently described as a food crop for the underprivileged. In the tropical and subtropical zone, it is a crucial crop. Its species is hexaploid, with chromosomal number 2n=96 (Palaswami and Raichand, 2008) [21]. Sweet potato is now being recognized as a health food due to several of its nutraceutical components and carotenoids. It contains magnesium, the key mineral for de- stressing and good mood. It also promotes artery, bone, muscle and nerve health. Mangoes are both nutritive and therapeutic. It contains a lot of minerals and vitamins A and C. They are a good source of dietary fibre, energy, and nutrients, and as a result, they may help guard against heart disease and cholesterol buildup, as well as improve immunological function and promote eye health.

Africa is the world's top producer of sweet potatoes, followed by Latin America, India, China, Japan, South East Asia and the southern United States of America. In India,

130.6 acres of land was planted with sweet potatoes in the years 2017-2018. Productivity is 11.5 MT/Ha, while production is 1500.5 MT. The Orissa has the highest acreage and production of sweet potatoes. The Kolhapur district in Maharashtra has the biggest acreage and production i.e., 3.14 hectares and 46.71 MT, respectively (Anon., 2018a) [5].

Rajendra Sakarkand-35 and Sree Bhadra (S-1010) are two cultivars that are grown in Maharashtra. Indira Naveen, Varsha (ideal for the kharif season) and Konkan Ashwini are the types that are most strongly suggested for the Konkan region out of all the available options. Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli released "Konkan Ashwini" in the year 2000, which is appropriate for the Rabi season. It is a short-duration high yielding variety with a yield of 19-20 t/ha. This variety's long, elliptical tubers are highly preferred by consumers because of the dark purple colour of flesh (Khandekar *et al*., 2000) [15]. In India, sweet potatoes are mostly grown for human consumption as boiled or baked tubers. A farmer in India needs 100g of tuber per day to replenish the energy he expends working hard (Gopalan *et al*., 1980) [13].

Next to potatoes, sweet potatoes (*Ipomoea batatas* L.) are the most significant tuber crops grown worldwide. Due to their short lifespan and innate ability to produce enormous amounts of dry matter, tuber crops are thought of as the poor man's diet since they are effective providers of calories. A good source of carbohydrates, sweet potatoes can also be used in place of rice and wheat (Boruch, 1985) [10]. The majority of sweet potatoes produced each year are sold as fresh, with only a minor part being sold in processed form. Little has been done to modernise the processing and use of sweet potatoes; they are still processed and consumed in the traditional ways. Sweet potato is now being recognized as a health food due to several of its nutraceutical components and carotenoids. It contains magnesium, the key mineral for de-stressing and good mood. It also promotes artery, bone, muscle and nerve health. Sweet potato varieties may be 'firm' or 'soft'. It is the soft varieties that are often labelled as yam in United States. Herbal medicines appear to be quite effective in treating various clinical disorders furthermore, these herbal drugs are essentially safe (Parle and Monika, 2015) [24]. Since sweet potato tubers have a low glycemic index and can help to stabilise blood sugar levels and reduce insulin resistance in animals, they play a significant role in monitoring blood glucose levels in diabetics. Since sweet potatoes may be cultivated all year round in climates that are suitable for it, they are sometimes known as an "insurance crop" (Preedy *et al*., 2011) [26]. Sweet potatoes are sometimes referred to as "space food" since the National Aeronautics and Space Administration (NASA) has chosen them as a particular crop to be grown and included in the diet for astronauts on space missions due to its health benefits (Bovell-Benjamin, 2007) [11].

One of the most important tropical fruit crops is the mango (*Mangifera indica*), which is grown in all tropical nations worldwide. The genus Mangifera has roughly 49 species, of which 8 have uncertain status and 41 are recognised species. The mango is the member of the anacardiaceae family. The mango is native of South East Asian region that is regarded as the king of fruits and the most popular fruit both in India and overseas (Yadav and Singh, 2017) [37].

India is the top mango producing country in the world, followed by China, Thailand, Mexico, Pakistan, Brazil, Nigeria, Indonesia and Egypt. In India, there were 2258.1 thousand ha under mango in the year 2017-18, which resulted in an output of 21822.3 thousand metric tonnes at a productivity of 9.7 Mt/ha. Andhra Pradesh is the top-producing state in India with a 363000-ha area, followed by Uttar Pradesh with 265620 ha, Odisha with 199080 ha, Karnataka with 183230 ha, Maharashtra with 166760 ha, Gujarat with 162770 ha, Tamil Nadu with 152570 ha, Bihar with 149280 ha and Telangana with 115990 ha. (Anon., 2018b) [6] As regards production, Uttar Pradesh is leading state having 455183 MT mango production, followed by Andhra Pradesh (4373610 MT), Karnataka (176000 MT), Bihar (244347 MT), Tamil Nadu (123400 MT), Gujarat 120778 MT, Telangana (108014 MT), West Bengal (918350 MT), Odisha (805770 MT) and Maharashtra (791360 MT) (Anon., 2018b) [6].

Mangoes are exported from India to more than 40 nations globally (APEDA, 2018) [7]. With income of Rs. 400.21 crores from fresh fruit exports of 49,658 tonnes and Rs. 584.31 crores from exports of mango pulp of 85,725 tonnes, mango is an important source of foreign exchange earnings in India. India exports 5.20 percent of the world's mangoes. In the years 2020-21, India exported 21,033.58 MT of fresh mangoes to the world for a total of 36.23 USD million (APEDA, 2020) [7].

In Maharashtra, Ratnagiri is the top district with 60050 ha under mango plantation with 19000 MT annual production, followed by Sindhudurg with 23500 ha and 70380 MT output. In Raigad, Pune, Beed and Osmanabad, the area and output of mangoes vitamins A and C. In each 100 g of mango, there are 75-82 g of water, 13.7 g of sugar, 1.6 g of dietary fibre, 0.82 g of protein, 36.4 mg of vitamin C and 250 KJ of energy. Almost 17% of its calories come from carbohydrates. Mangoes are a good source of dietary fibre, energy, and nutrients, and as a result, they may help guard against heart disease and cholesterol buildup, as well as improve immunological function and promote eye health (Anon., 2015) [4].

The post harvest processing of sweet potato has not been practiced to a great extent in India, unlike other countries like the United States, where canned sweet potato, sweet potato puree and sweet potato flakes are common and popular. There is very good scope not only for these products but also for the flour-based products and industrial products such as liquid glucose, high fructose syrup and alcohol. The only processed product of sweet potato in India is sweet potato flour (Nair *et al*., 1987) [20].

Fruit bars are essentially dried sheets of fruit pulp with a sweet flavour and a soft, rubbery texture. Fruit puree is dehydrated into a sheet to make these fruit bars. To enhance the physicochemical and sensory properties of fruit, the edible section is pulped, pureed or combined with other components. After that, they are heated, shaped and dried on flat trays to create cohesive fruit bars. Fruit bars can be used in a range of food preparations and as snacks (Raab and Oehler, 1999) [27].

Materials and Methods

Materials

The fresh and mature Sweet Potatoes were procured from Tuber crop Scheme, CES Wakavli and brought to laboratory for conducting the research. The Alphonso mangoes were brought from the APMC Market Vashi. Pectin, citric acid and sugar were used for the preparation of blended bar.

Methods

The colour of mango bar was measured using Colorimeter (Colour Reader CR-10) and expressed as L*, a*, b* values. Total soluble solids content was measured using Atago hand refractrometer. The moisture content of mango bar was determined using a Contech moisture analyser (model CA-123). Titratable acidity, reducing and total sugars, starch estimated by methods suggested by Ranganna (1997) [28]. The □-carotene was determined with the methods described by Srivastava and Kumar (2002) [34]. It was also evaluated during storage for sensory attributes like colour, flavour, taste and overall acceptability by panel of 5 judges on 9 point hedonic scale (Amerine *et al.*, 1965) [3]. The data were statistically analyzed by using Factorial Completely Randomized design (FCRD) described by Panse and Sukhatme (1985) [22].

Preparation of blended bar

Mature sweet potato tubers and ripe mango fruits were selected for preparation of blended bar. The fruits were washed with sodium hypochlorite to remove dust and dirt. The sweet potato tubers were then boiled to render them soft. After peeling, the boiled sweet potatoes were grated and the pulp was passed through 1mm sieve to remove fibres. The ripe Alphonso mango fruits were peeled and the pulp was extracted manually. Then, the pulp of sweet potato and mango was mixed as per the treatments. The pectin, citric acid and sugar was added at the rate of 0.25, 0.5 and 20 percent in the pulp and the mixture was heated at 75˚C for 5 minutes and stirred it continuously. After addition of 100 ppm KMS per treatment, hot blended pulp mixture was poured on aluminium tray and dried at 60˚C for 10-12 hours in cabinet dryer. The procedure was repeated for 2nd and 3rd layer. The bar thus prepared was cut into rectangular pieces, wrapped in butter paper and then packed into HDPE pouches and stored at ambient.

Results

The changes in physico-chemical composition of sweet potato-mango blended bar during storage are presented in Table 1 and 2. Among the treatments, T_1[sweet potato (100%)] exhibited maximum mean colour value L*, while it was minimum in the treatment T_5 [sweet potato (60%): mango (40%)]. The treatments T_5 [sweet potato (60%): mango (40%)] showed the highest a* value for colour, while treatment T_1 [sweet potato (100%)] showed the lowest. Maximum b* value for colour of sweet potato-mango blended bar was recorded in the treatment T_5 while the minimum in the treatment T_1. Treatment T_5 [sweet potato (60%): mango (40%)] had the highest moisture content, while treatment T_1 [sweet potato (100%)] showed the lowest. Within all treatments, the total soluble solid content was lowest in treatment T_1 [sweet potato (100%)] and highest in treatment T_5 [sweet potato (60%): mango (40%)]. The treatment T_1 [(sweet potato (100%)] had the lowest mean value for titratable acidity, while the highest in the treatment T_5 [(sweet potato (60%): mango (40%)]. The highest reducing sugars was obtained in the treatment T_5 [sweet potato (60%): mango (40%)] and lowest in the treatment T_1 [sweet potato (100%)]. Maximum total sugar content was observed in the treatment T_5 [sweet potato (60%): mango (40%)] whereas, minimum in the treatment T_1 [sweet potato (100%)]. The treatment T_1 [sweet potato (100%)] was recorded the highest starch content, while the lowest starch content in the treatment T_5 [sweet potato (60%): mango (40%)]. Minimum β-carotene content was observed in the treatment T_1 [sweet potato (100%)] and maximum in the treatment T_5 [sweet potato (60%): mango (40%)].

The sensory score for sweet potato- mango blended bar was graphically illustrated in fig 1 to 4. The treatment T_5 [sweet potato (60%): mango (40%)] was the highest sensory score for colour, while treatment T_1 [sweet potato (100%)] was the lowest for sweet potato-mango blended bar. The sensory score for flavour of sweet potato-mango blended bar was found to be increased with increase in the levels of mango pulp. A better retention of texture of bar was observed in treatment T_5 [sweet potato (60%): mango (40%)]. Within all treatments, the treatment T_5 [sweet potato (60%): mango (40%)] was recorded maximum score for overall acceptability, while it was minimum score in the treatment T_1 [sweet potato (100%)] for sweet potato- mango blended bar.

Table 1: Effect of different proportions of sweet potato and mango pulp on L*, a* and b* value for colour of blended bar during storage at ambient temperature

	L* value of colour					**a* value of colour Storage period (Days)**					**b* Value of colour**				
	0	**30**	**60**	**90**	**Mean**	**0**	**30**	**60**	**90**	**Mean**	**0**	**30**	**60**	**90**	**Mean**
T_1	52.37	51.67	51.28	50.95	51.57	5.25	5.49	5.90	6.02	5.66	29.37	29.14	28.77	28.49	28.94
T_2	50.87	50.67	49.75	49.31	50.15	12.42	12.67	13.00	13.32	12.85	39.87	39.59	39.25	38.95	39.42
T_3	48.87	47.26	46.70	46.02	47.21	17.37	17.52	17.77	17.99	17.66	46.67	46.36	46.09	45.87	46.25
T_4	44.37	43.87	43.03	42.68	43.49	21.67	21.83	21.99	22.24	21.93	50.05	49.83	49.63	49.39	49.72
T_5	41.45	41.03	40.64	40.15	40.82	25.56	25.80	26.02	26.36	25.94	55.33	55.09	54.90	54.67	55.00
Mean	47.59	46.90	46.28	45.82		16.45	16.66	16.94	17.19		44.26	44.00	43.73	43.47	44.26
		S.Em ±		CD at 5%			S.Em ±		CD at 5%			S.Em ±		CD at 5%	
Treatment (T)		0.04		0.11			0.006		0.016			0.006		0.017	
Storage (S)		0.03		0.09			0.005		0.014			0.005		0.015	
Interaction (TxS)		0.07		0.22			0.011		0.032			0.012		0.034	

Table 2: Effect of different proportions of sweet potato and mango pulp on moisture, TSS and titratable acidity of blended bar during storage at ambient temperature

Treatment	**Moisture (%)**					**Total soluble solids(°B)**					**Titratable acidity (%)**				
	Storage period (Days)					**Storage period (Days)**					**Storage period (Days)**				
	0	**30**	**60**	**90**	**Mean**	**0**	**30**	**60**	**90**	**Mean**	**0**	**30**	**60**	**90**	**Mean**
T_1	16.02	16.13	16.25	16.42	16.21	44.95	44.81	44.21	44.04	44.50	0.702	0.719	0.935	0.957	0.828
T_2	16.33	16.53	16.74	16.97	16.64	48.90	48.73	48.58	48.32	48.63	0.918	0.929	0.941	0.962	0.938
T_3	17.22	17.48	17.65	17.88	17.56	52.87	52.74	52.61	52.47	52.67	0.948	0.959	0.972	0.986	0.966
T_4	17.82	17.95	18.03	18.16	17.99	54.44	54.37	54.23	54.12	54.29	0.973	0.984	0.997	1.230	1.046
T_5	18.48	18.62	18.97	19.11	18.79	60.95	60.87	60.73	60.62	60.79	1.100	1.220	1.340	1.520	1.295
Mean	17.17	17.34	17.53	17.71		52.42	52.30	52.07	51.92		0.928	0.962	1.037	1.131	
		S.Em ±		CD at 5%			S.Em ±		CD a 5%			S.Em ±		CD at 5%	
Treatment (T)		0.0033		0.010			0.008		0.022			0.002		0.007	
Storage (S)		0.0030		0.009			0.007		0.020			0.002		0.006	
Interaction (TXS)		0.006		0.020			0.015		0.044			0.005		0.014	

Table 3: Effect of different proportions of sweet potato and mango pulp on reducing sugars, total sugars, starch and β - carotene content of blended bar during storage at ambient temperature

Treatment	Reducing Sugars (%)					Total sugar (%)					Starch (%)					β - carotene (µg/100g)				
	Storage period (Days)					Storage period (Days)					Storage period (Days)					Storage period (Days)				
	0	30	60	90	Mean	0	30	60	90	Mean	0	30	60	90	Mean	0	30	60	90	Mean
T_1	16.07	17.62	18.25	19.37	17.83	42.03	42.25	41.82	41.69	41.95	14.25	14.02	13.68	13.32	13.81	1.66	1.55	1.44	1.26	1.48
T_2	16.34	17.76	18.68	19.68	18.09	42.81	42.71	42.56	42.41	42.62	13.12	12.96	12.78	12.54	12.85	987.66	850.20	819.00	703.80	840.16
T_3	18.25	19.68	20.58	21.42	19.98	43.24	42.79	43.01	42.93	42.99	12.36	12.22	12.04	11.88	12.12	1,973.6	1,700.6	1,638.0	1,407.6	1,679.9
T_4	20.67	21.42	22.72	23.69	22.13	44.53	44.41	44.36	44.26	44.39	11.72	11.54	11.36	11.19	11.45	2,960.4	2,550.6	2,457.0	2,111.4	2,519.8
T_5	22.74	23.83	24.68	25.14	24.10	45.24	45.11	45.02	44.93	45.08	11.02	11.54	10.64	10.46	10.91	3,947.2	3,401.2	3,276.0	2,815.2	3,359.9
Mean	18.81	20.06	20.98	21.84		43.57	43.45	43.35	43.24		12.49	12.45	12.10	11.87		1,974.1	1,700.8	1,638.2	1,407.8	
		S.Em ±		CD at 5%			S.Em ±		CD at 5%			S.Em ±		CD at 5%			S.Em ±		CD at 5%	
Treatment (T)		0.0030		0.0087			0.05		0.15			0.04		0.11			0.19		0.58	
Storage (S)		0.0026		0.0078			0.04		0.13			0.03		0.10			0.17		0.50	
Interaction (MS)		0.0056		0.0165			0.106		NS			0.07		0.21			0.38		1.09	

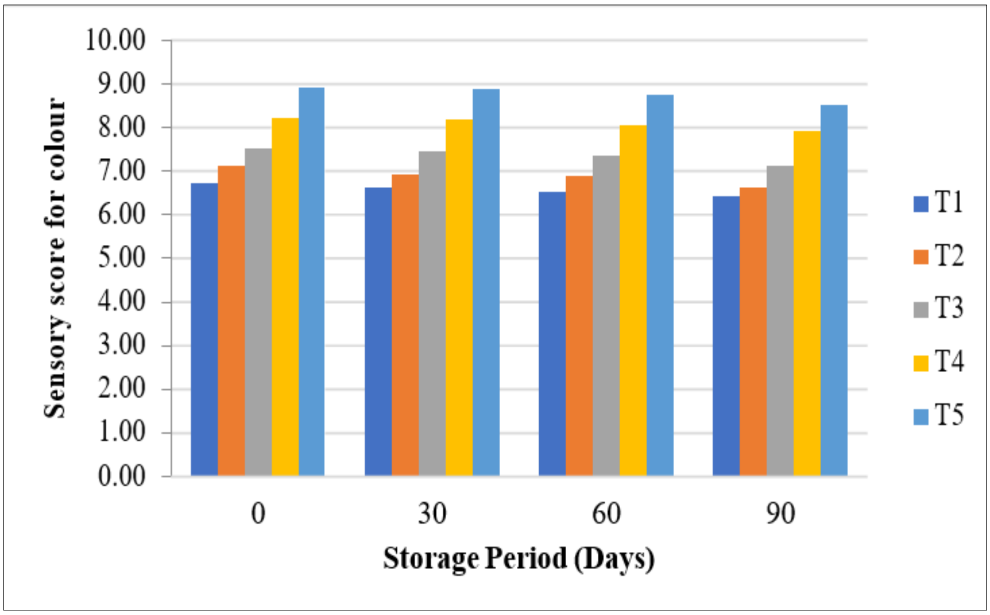

Fig 1: Changes in sensory score for colour of sweet potato-mango blended bar

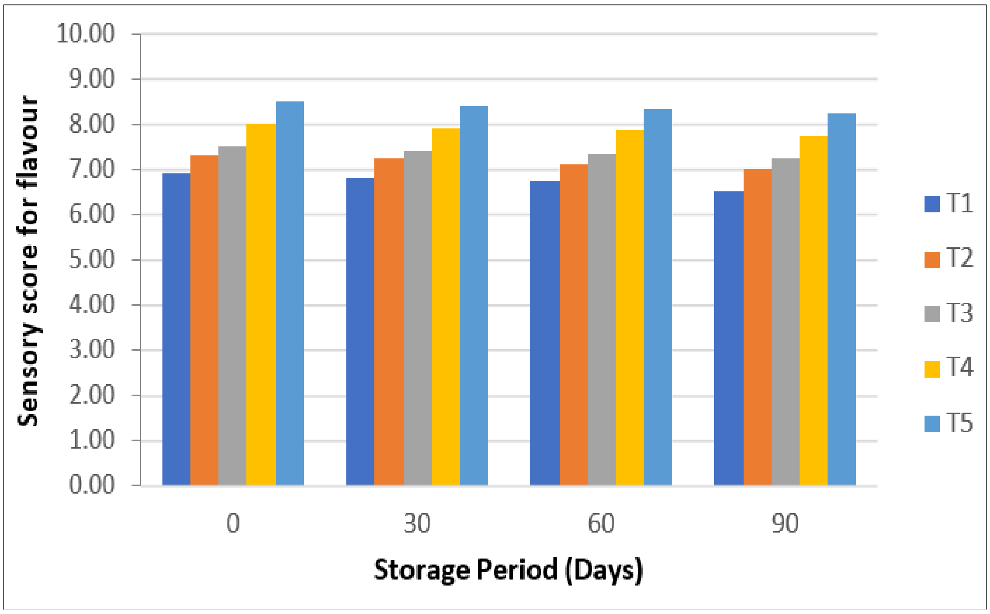

Fig 2: Changes in sensory score for flavour of sweet potato-mango blended bar

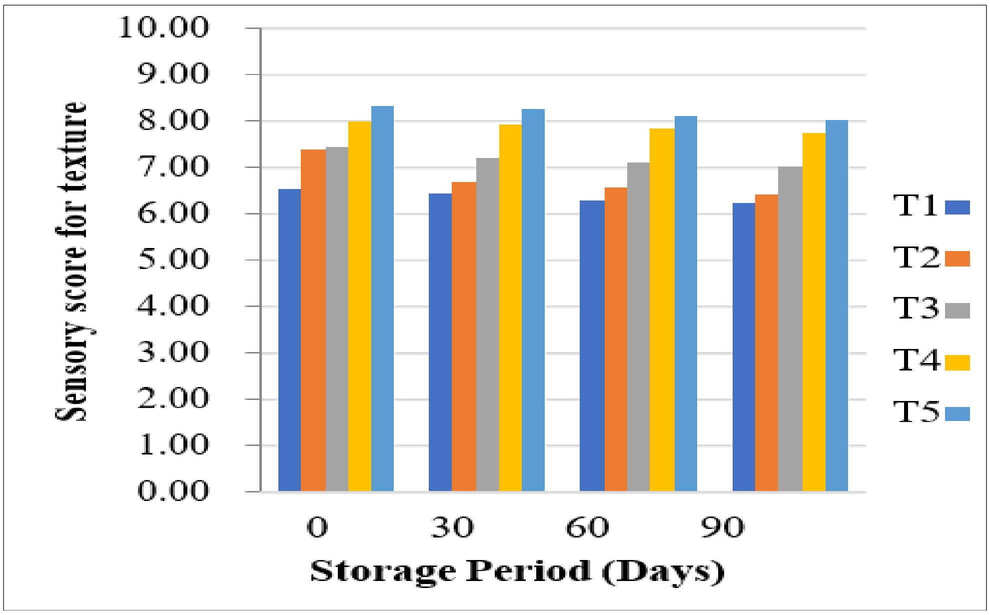

Fig 3: Changes in sensory score for texture of sweet potato-mango blended bar

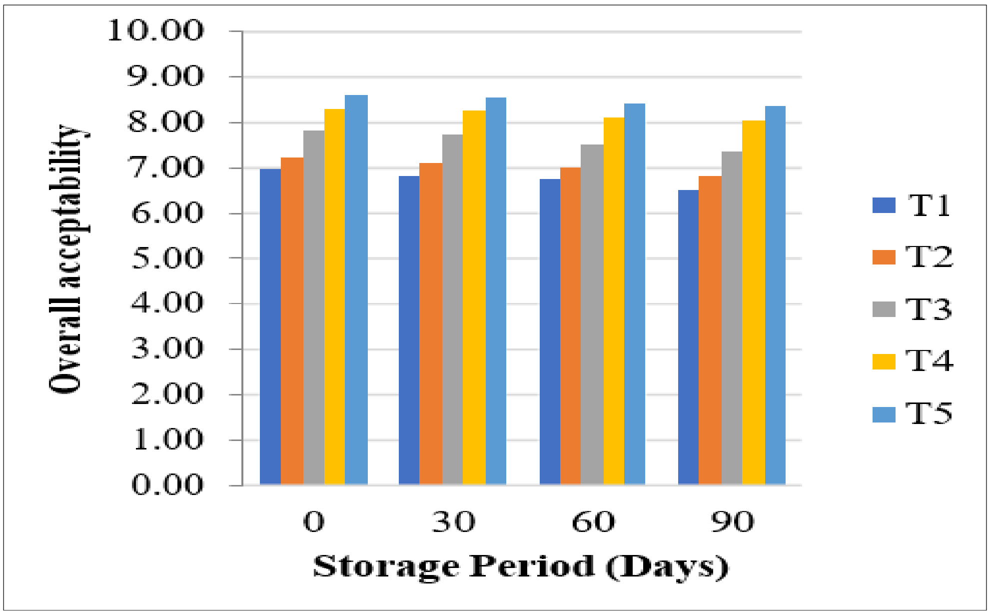

Fig 4: Changes in sensory score for overall acceptability of sweet potato-mango blended

Discussion

In the present study it was observed that darkness of the colour in bar increased with increase in storage period. It might be due to changes in colour of mango pulp due to browning reactions that proceeds oxidative and enzymatically controlled processes during storage. The results in accordance with these findings were reported by Parab *et al*. (2014) [23] in mango bar; Mahawar *et al*. (2019) [18] in mango apple fruit bar; Pawar (2019) [25] in guava-pineapple blended bar and Singh *et al*. (2019) [32] in banana-soy fruit bar. With respect to the storage, the maximum mean a* value for colour was observed at the end of 90 days of storage of the product while it was minimum mean initially. This indicates an increasing trend in a* value for the colour on 90 days of storage. The a* value for colour was increased due to browning reactions that proceeds oxidative and enzymatically controlled processes. Identical findings were content of sweet potato-mango blended bar. The gain in moisture might be due to absorption of moisture from the atmosphere by the package. Identical findings were noticed by Aanchal *et al*. (2019) [2] in guava- orange bar and Singh *et al*. (2020) [31] in guava- papaya leather. The highest total soluble solid was observed at initial stage of storage and lowest at the end of 90 days of storage. It would be due to pickup of the moisture from the atmosphere by the sweet potato-mango blended bar which lowered the concentration recorded by Mahawar *et al*. (2019) [18] in mango apple fruit bar and Singh *et al*. (2019) [32] in banana-soy fruit bar. According to Parab *et al*. (2014) [23], the a* value for colour was increased up to 90 days of storage of mango bar. Initially the b* value for colour was maximum mean and it decreased during storage with minimum mean b* value at 90 days of the storage. It might be due to browning reactions that proceeds oxidative and enzymatically controlled processes. The increasing trend was observed in the moisture accordance with this findings was recorded by Vennilla (2004) [36] in guava-papaya bar; Sivakumar *et al*. (2005) [33] and Parab *et al*. (2014) [23] in mango bar. There was a significant decrease in the titratable acidity during storage because the formation of organic acids by the degradation of the ascorbic acid as it decreased with the storage period of the fruit bar (Kumar and Deen. 2017) [16] and hydrolysis of pectin (Cruess 1958; Seth 1985) [12, 29], ascorbic acid degradation or conversion of sulphur dioxide into sulphurous acid and formation of acid from sugars resulting in increased acidity content. It is clear from the data that the sweet potato- mango blended bar exhibited an increase in the reducing sugar content with rise in the levels of mango pulp in the product. This could be due to the higher levels of acids in the product rich in the mango pulp. Hence, there was more conversion of non-reducing sugars into reducing sugars in the product with higher proportion of mango pulp. Sharma *et al*. (2013) [30] recorded an increase in reducing sugar content in apricot fruit bar. The total sugars showed significantly decreasing trend up to 90 days of storage period might be due to significant increase in the moisture. Presence of moisture in food stuffs has been reported to cause a decrease in the concentration of nutrients (Labuza, 1973) [17] and may be due to breakdown of carbohydrates and also because utilization of sugars in the non-enzymatic browning. Similar trend was observed by Vennilla (2004) [36] in guava-papaya fruit bar and Aruna *et al*. (2014) [8] in dried peach bar. As regards the storage, the highest starch content was noticed at initial stage and lowest at the end of storage. A decreasing trend in starch content of sweet potato- mango blended bar was observed during 90 days of storage. The decrease in starch content was probably due increase in the moisture percentage in the sweet potato-mango blended bar during storage. At the 0 day of storage, the maximum β-carotene content was found while minimum at 90 days of storage. It decreased with increase in storage period up to 90 days of storage. It might be due to oxidative and non-oxidative changes (thermal degradation) which altered the β- carotene content, the colour of the product and lowered the flavour and nutritive value of the product (Parab *et al*. (2014) [23] in mango bar and Avhad *et al*. (2019) [9] in papaya guava fruit bar).

Conclusion

In conclusion, the comprehensive analysis of physico-chemical changes and sensory attributes of sweet potato-mango blended bars during storage provides valuable insights into product stability and quality. The varying proportions of sweet potato and mango pulp significantly influenced color, moisture, total soluble solids, acidity, sugars, starch, and β-carotene content over the storage period. Notably, treatments with higher mango pulp content exhibited enhanced color intensity, moisture retention, and sensory appeal, while also displaying increased acidity and reducing sugars. However, prolonged storage led to alterations in these parameters, such as decreased starch content and β-carotene levels, likely due to oxidative processes. These findings contribute to our understanding of formulation effects on blended bar characteristics and underscore the importance of monitoring storage conditions to maintain product quality. Further research is warranted to explore optimization strategies for extending shelf life and enhancing nutritional value in sweet potato-mango blended bars.

References

1. AOAC. Official Method of Analysis. Association of Official Analytical Chemists, Washington D.C., USA; c2020.
2. Aanchal Srivastava, Deepika Kohli, Sanchit Vishnoi, Sanjay Kumar, Richa Badola. Quality evaluation of prepared guava-orange fruit bar. International Journal of Chemical Studies. 2019;7(4):1574-1581.
3. Amerine MA, Pangborn RM, Roessler EB. Principles of sensory evaluation of food. Food Science and Technology A Series of Monographs. Academic Press, New York, London; c1965. p. 27-242.
4. Anonymous. USDA National Nutrients Database for Standard Reference, Release 23; c2015.
5. Anonymous. Horticultural Statistics at a Glance-2018; c2018a.
6. Anonymous. Indian Horticulture Database 2018. National Horticulture Board, Ministry of Agriculture, Government of India, Gurgaon, India; 2018b:2-3.
7. APEDA. Agricultural and Processed Food Products Export Development Authority. [Accessed 2020]. Available from: http://www.apeda.com.
8. Aruna K, Vimala V, Dhanalaxmi K, Vinodini Reddi. Physico-chemical changes during storage of papaya fruit (*Carica papaya* L.) bar (Thandra). Journal of Food Science and Technology. 1999;36(5):425-433.
9. Avhad BA, Kotecha PM, Lande SB, Chavan UD. Studies on preparation of fruit bar from papaya and guava. Journal of Pharmacognosy and Phytochemistry. 2019;8(4):3219-3223.
10. Boruch M. Physio-chemical modification of sweet potato starch with different grain size. Acta Aliment Poly. 1985;11:43-51.
11. Bovell-Benjamin AC. Sweet potato: a review of its past, present, and future role in human nutrition. Advances in Food Nutrition Research. 2007;52:1-59.
12. Cruess W.V. Commercial Fruit and Vegetable Products. 4th ed. McGraw-Hill Book Company, Inc., New York, Toronto, London; c1958.
13. Gopalan C, Ramashastri BV, Balasubramanian SC. Nutritive value of Indian Foods. Health Bulletin No. 23. National Institute of Nutrition, ICMR, Hyderabad; c1980. p. 73-131.
14. Haldankar PM, Burondkar MM, Singh AK, Saitwal YS. Sustainable mango production technology for climatic aberration in coastal agroclimate of Maharashtra. World. 2020;37(26.34):9-3.
15. Khandekar RG, Karnik AR, Patil BP, Magadum MB. Konkan Ashwini: New Sweet Potato. Indian Council of Agricultural Research; c2000. p. 20-35.
16. Kumar A, Deen B. Studies on preparation and storage of jelly from wood apple (*Limonia acidissima* L.) fruits. Journal of Pharmacognosy and Phytochemistry. 2017;6(6):224-229.
17. Labuza TP. Effect of dehydration and storage. Food Technology. 1973;27:20-26.
18. Mahawar MK, Sharma A, Jalgaonkar K, Bibwe B, Ghodki B, Bharat B, Meena VS. Mixing of mango and apple pulp for making fruit bar. Beverage and Food World. 2019, 45(11).
19. Majumder PK, Sharma DK. Mango Fruits: Tropical and Subtropical; c1990.
20. Nair GM, Ravindran CS, Moorthy SN, Ghosh SP. Sweet potato: Indigenous Technologies and recent advances of production, processing and utilization in India. In: Proceedings of the International Sweet Potato Symposium. Visayas State College of Agriculture

(ViSCA), Baybay, Leyte, the Philippines; c1987. p. 301-312.
21. Palaswami MS, Raichand AS. Improved varieties in India. In: Tuber and Root crops, Ed. New India Publishing Agency, New Delhi; c2008. p. 131-146.
22. Panse VG, Sukhatme PV. Statistical methods of Agriculture workers. Indian Council of Agricultural Research, New Delhi; c1985. p. 70-72.
23. Parab AY, Relekar PP, Pujari KH. Studies on preparation of mango (*Mangifera indica* L.) bar from frozen Alphonso mango pulp. Asian Journal of Horticulture. 2014;9(1):243-247.
24. Parle Milind, Monika. Sweet potato as a super-food. International Journal Research Ayurveda Pharmaceutical. 2015;6(4):557-562.
25. Pawar Anita. Development of the process for preparation of guava (*Psidium guajava* L.) and pineapple (*Ananas comosus* L.) bar [M.Sc. (PHM) thesis]. Department of Post-Harvest Management of fruit, vegetable and flower crops, Post Graduate Institute of Post-Harvest Management, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri.
26. Preedy VR, Watson RR, Patel VB. Flour and breads and their fortification in health and disease prevention. London Academic Press; c2011.
27. Raab C, Oehler N. Making dried fruit leather fact sheet. Oregon State University Extension Service, USA. Fact Sheet. 1999;232:1-4.
28. Ranganna S. Handbook of analysis and quality control for fruits and vegetables. Tata Mc. Graw Hill Publishing Company Limited, New Delhi; c1986. p. 9-10.
29. Seth V. Simple and low-cost preservation of litchi juice. Indian Food Packer. 1985;40:42-44.
30. Sharma SK, Chaudhary SP, Rao VK, Yadav VK, Bisht TS. Standardization of technology for preparation and storage of wild apricot fruit bar. Journal of Food Science and Technology. 2013;50(4):784-790.
31. Singh LJ, Tiwari RB, Ranjitha K. Studies on effect of different packaging materials on shelf life of blended guava-papaya fruit leather. European Journal of Nutrition and Food Safety. 2020;12(8):22-32.
32. Singh R, Giri SK, Singh SP. Color changes in protein enriched banana-soy fruit bar during storage. Bioved. 2019;30(1):15-18.
33. Sivakumar KP, Malathi D, Nallakurumban B, Kalaiselvan A. Studies on storage stability of guava bar in different packaging material. Beverage and Food World; c2005. p. 80-81.
34. Srivastava RP, Kumar S. Fruit and Vegetable Preservation- Principles and Practices. International Book Distributing Company, Lucknow, India; c2002. p. 512.
35. Vasanthaiah HK, Ravishankar KV, Narayanaswamy P, Shivashankara KS. Influence of temperature on spongy tissue formation in 'Alphonso' mango. International Journal of Fruit Science. 2008;8(3):226-234.
36. Vennilla P. Studies on storage behavior of guava-papaya bar. Beverage and Food World; c2004. p. 63-64.
37. Yadav D, Singh SP. Mango: History origin and distribution. Journal of Pharmacognosy and Phytochemistry. 2017;6(6):1257-1262.