International Journal of Food Science and Nutrition
ISSN: 2455-4898; Impact Factor: RJIF 5.14
Received: 10-01-2021; Accepted: 02-02-2021; Published: 05-03-2021
www.foodsciencejournal.com
Volume 6; Issue 2; 2021; Page No. 10-15

Functional jam production from blends of carrot and sweet potato pulp

Ibrahim Mahmoud Ahmed Ibrahim
Special Food and Nutrition Department, Food Technol. Research Institute, Agriculture Research Center, Giza, Egypt

Abstract
The study conducted to compare the mixed vegetable jams of carrots and sweet potatoes pulp at ratios 75:25 (M1), 60:40 (M2), 50:50 (M3), 40:60 (M4), and 25:75 (M5). Samples of jam tested for sensory and physicochemical characteristics. Jam blends at a ratio of 75:25 yielded the highest performance in terms of sensory properties and the physicochemical composition comprising 64.6°Brix, 3.63 pH, 0.36 acidity%, 31.64 total phenols mg/100 g, 1.91 carotenoids mg/100 g, 35.3 L*, 22.2 a*, 69.73 hue and 23.67 chroma at the storage finishing. Increasing sweet potatoes up to 50% decreased the score of texture for increasing fiber as well as the color became paler. The previous data confirmed the possibility of developing a new type of jam with high nutritional and sensory qualities by combining carrots and sweet potatoes at 75: 25% and 60: 40%.

Keywords: carrots; sweet potatoes; jam; sensory attributes; physicochemical

Introduction

Consumers now demand functional foods that are healthy, safe, high nutritionally functional, rich in antioxidants, and without synthetic additives [28, 10]. [15] Identified functional foods as processed and natural foods, which have potentially positive impacts on health when routinely consumed as part of an assorted diet at efficient levels and may reduce the risks of diseases. Functional foods no need for a medical prescription when eaten regularly in a balanced diet [18]. The production of functional foods involves the development of new recipes, the use of advanced technology, and innovative processing used in the manufacture of food products to enhance their quality and preserve the maximum value of bioactive compounds [17]. In many publications, higher consumption of fruit and vegetables rich in antioxidants correlated with lowering the risk of overall death, especially cardiovascular mortality [26]. Dietary antioxidants inhibited oxidation and avoided oxidative stress [11]. Exogenous dietary antioxidants (tocopherols, carotenoids, phenolic compounds and ascorbic) act as a second mechanism of defense for cells/organs after antioxidant enzymes produced by different body organs [16, 27]. The use of bioactive compounds, or different types of fruit or vegetables rich in bioactive substances, particularly when many of them are combined for the creation of a new product, can be useful in the development of functional foods. Carrots and Sweet potatoes have an enormous number of nutrients like phenols, B-carotene, dietary fiber, vitamins (C, B, A, E, and K), and minerals [7, 24]. The concentrations of carotenoids were (26.55 mg/100gm) for dark orange carrot variety, (5.99 to 12.52 mg/100 gm) for orange carrot, (0.47 to 0.56 mg/100gm) for yellow carrot [23]. Carrots and sweet potatoes have good sources of dietary antioxidants, especially the β-carotene that greatly reducing cardiovascular morbidity/mortality by modulating particular biomarkers [9, 14]. β-Carotene increases total antioxidant capacity (TAC) in plasma, inhibited lipid hydroperoxides, and oxidized LDL (ox-LDL) which develop atherosclerotic disease and incidence of cardiovascular [5]. β-carotene enhancing pancreatic working and lowering insulin resistance by reducing oxygen/nitrogen reactive species [13]. β-Carotene have many benefits such as provitamin A, repair of tissues, supports the body to fight with infections, nourish epithelial tissues within the lungs and skin, prevents eye diseases, radioprotective, antimutagenic and lowering the risk of Many cancers [2]. Carrots and sweet potatoes are one of the richest sources of beta-carotene at all, mixed them give a product with a high-content antioxidant and biological value. The study aims to evaluate the new types of functional jam produced from carrot and sweet potato pulp with different recipes.

Material and Method

Materials and chemicals

Fresh orange carrots root and tubers of sweet potato bought from a local farm in Abo Hamaad, El Sharkia, Egypt. The sugars and pectin obtained from the same region. All the chemicals used in the analysis were the analytical grade.

Methods

Raw materials and jam manufacture

Carrots trimmed, tailed, and washed with water, and cut into small slices by a sharp knife. The slices stayed at the same weight of boiling water for 15 minutes. Then, one-fourth of the blanching water added to slices in the blender at max speed for six minutes.

After washing the sweet potatoes were put within the water by 1:1 w: w, then boiled for 15 minutes, the outer crust removed, the sweet potatoes pulped by a blender with one-fourth of blanching water.

The pulp of carrot and sweet potato combined at ratios 75 carrots: 25 sweet potatoes (M1), 60 carrots: 40 sweet potatoes (M2), 50 carrots: 50 sweet potatoes (M3), 40 carrots: 60 sweet potatoes (M4), 25 carrots: 75 sweet potatoes (M5). Table 1 displayed the amount of pulp used to prepare different formulations.

Jam produced by additional sugar with 35% percent to 65% pulp mixture, then pectin added by 0.5%. The blends cooked in a stainless steel pan, and the pH changes to 4 by a concentrated solution of citric acid before the endpoint jam formation got. Jams poured into sterilized glass jars (400 g), sealed with metal lids, pasteurized at 85 °C for 15 min, and cooling. Jars stored at room temperature for analysis.

Table 1: Different ratios of carrot and sweet potato pulp

Treatments	Carrot	Sweet potato
M1	75	25
M2	60	40
M3	50	50
M4	40	60
M5	25	75

Physicochemical analysis

Measurement of total soluble solids (TSS), pH, and titrable acidity (TA)

TSS was determined by refractometer (ATAGO, Japan), and the results expressed as °Brix degree. Jenway 3510 (UK) was used to measure the pH value. TA was determined as a citric acid % by titration with 0.1N of NaOH [3].

Measurement of vitamin C (VC), and total phenolic compounds (TPC)

VC was defined by titration with the 2, 6-dichlorophenol indophenol solution and expressed as mg/100 g of jam [3]. Folin-Ciocalteu was used to determine TPC as mg equivalents from gallic acid each 100 g sample [25].

Measurement of the color index, total carotenoids (TC), and color parameters

The color index is a test made to jam samples to calculate non-enzymatic browning as described by [20]. Samples were diluted with ethyl alcohol 95% (1:1, v/v) and filtered with Whatman filter paper (No. 4). The reading was performed at 420 nm by a spectrophotometer. The method of [8] used to determine β-carotene with some modifications. Briefly, 1.5 g of jam sample was strongly shaken with 100 mL of acetone-hexane (4:6) for one minute and filtered over Whatman paper (No. 4). The absorption was conducted at 453, 505, 645, and 663 nm. Β-carotene was calculated as mg/100g. CIE L* (transparence), a* (red to green), and b* (yellow to blue) values of jam samples measured by the color reader CR-10 (Konika Minolta, Inc., Osaka, Japan). The hue angle (H*) and chroma (C*) were calculated as follows $H^* = \tan^{-1}(b^*/a^*)$ and $C^* = (a^{*2} + b^{*2})^{1/2}$.

Sensory analysis

The sensory evaluation was carried out using the method of [4] with some modifications. Ten semi-trained panelists from the Food Technology Research Institute, Agriculture Research Center, Ismailia were asked to show their observations from 10 degrees for each parameter of color, taste, odor, appearance, texture, mouthfeel, and sweetness. The analysis was carried out on five samples. The average scores of tested attributes were expressed as overall acceptability.

Statistical analysis

SPSS software (version 17, SPSS Inc., Chicago, USA) was used to determine the significance between means of treatments at ($p < 0.05$) level.

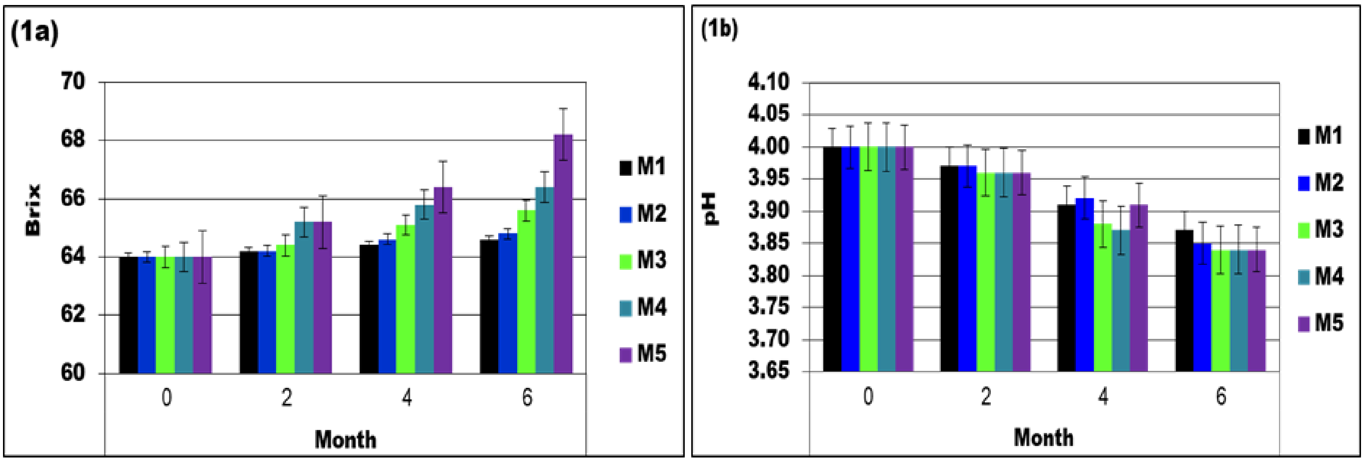
Results

TSS, pH, titrable acidity, and color index

Figure 1 indicates differences in TSS, pH, titrable acidity as well as color index values for various jam samples during six months of storage. The results indicate that the values of TSS between different treatments did not vary significantly at zero times. The TSS rose markedly during the storage ($p<0.05$). Treatment T1, T2 was the lowest rate of change in TSS and, in general, the increase in TSS increased in the direction of increasing the proportion of sweet potato in the samples.

The pH parameter is necessary for optimal gel structure in jams. It is clear from the findings that there were no changes in the pH value adjusted samples on it during the manufacturing phase (4). The pH reduction continued in the samples during storage. The pH ranged from 3.84 to 3.87 after storage finishing. The five treatments didn't appear any changes between them before and after the storage term.

The acidity levels in all samples of jam produced from blending carrots and sweet potatoes ranged from 0.19 to 0.27%. The first three treatments recorded the high acidity, with a value ranged between 0.24 −0. 27%, and there were no significant differences between them. The other two treatments (M5, M4) had the lowest acidity of 0.19%. With storage end, the titrable acidity rose in all samples and the acidity levels varied from 0.30 to 0.36%. The first



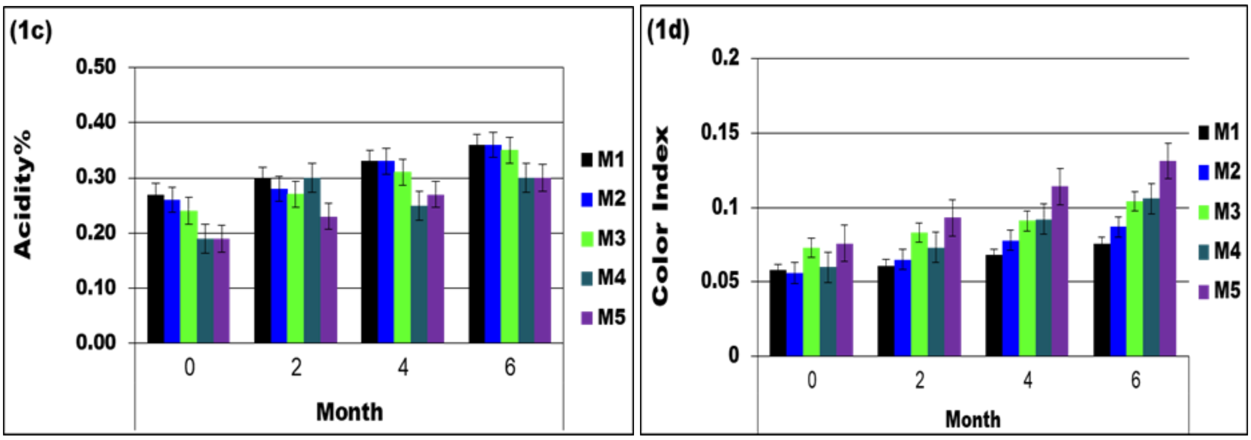


Fig 1: TSS, pH, titratable acidity and color index in different jams stored at room temperature for six months.

Third treatment recorded the maximum titrable acidity compared with F4, F5 that displayed a lower decrease in acid values after the storage end.

The alcoholic extracts of different jams have a good indicator of non-enzymatic browning. The highest browning at zero time recorded by M5 (0.076) followed by M3 (0.073), where there were no significant differences between them, M4 came after them with value (0.060) while the lower level registered by M2 and M1, no major differences occurred between them. By the storage end, non-enzymatic browning increased for all treatments and M5 had the maximum browning. Increasing sweet potato content in the samples increased browning at the storage end. Overall, M1 showed the lowest browning compared to the other treatments

Ascorbic acid and total phenolic compounds (TPC)

The changes in vitamin C and TPC of different jam samples showed in Figure 2. Increasing the percentage of sweet potatoes in the jam samples increased vitamin C after processing. In this study, the vitamin C levels of the resultant jams decreased with increased storage time. The residual amount of vitamin C after the store was about one-third of the initial amount at zero time. M5 sample recorded the highest vitamin C content by storage end, which contains the highest proportion of sweet potatoes relative to the rest of the other samples.

Total phenolic compounds (TPC) ranged from 41 to 62 mg/100g of gallic acid at zero time. Both findings at zero time and after storage confirmed on increasing the content of TPC in the samples by increasing the proportion of carrots in the samples and decreased by increasing the proportion of sweet potatoes in the resulting mixture. As storage continues, the amount of TPC decreased. TPC ranged from 15 to 31 mg/100g gallic acid after finishing the storage. M1 had the highest TPC value of 31 mg/100 gram, followed by M2 at 25 mg/100g, while the M5 had the lowest TPC value at the storage ending.

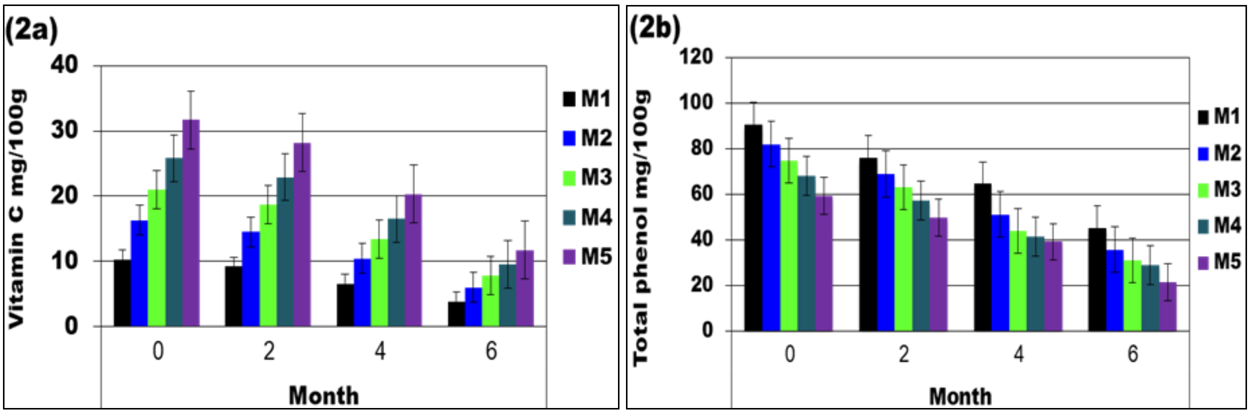


Fig 2: Vitamin C and phenols content in different jams stored at room temperature for six months.

β-Carotene and color

The difference in β-carotene, L* (transparence), a * (redness), b* (yellowness), hue, chroma of different jam samples seen in Figure 3. The increase in carrots in the sample increased the level of β-carotene in the sample. The concentration of carotenoid ranged from 1.40 to 2.60 mg/100 g at zero. The carotenoids are gradually decreased by storage. Changes between samples during storage continued with the same pattern as at zero time. The level of β-carotene was ranged from 1.10 to 1.80 mg/100 g by the storage end.

L* (transparence) value ranged from 36.4 to 38.2 at zero time. As seen from the figure (3b), the highest transparence observed at time zero with a value of 38.2 in M1, then M3 with a value of 37.8, followed by M5 with a value of 36.8, while M4 had a lower transparence of 36.4. During the storage time, the transparence of the jams has been decreasing dramatically for 180 days at room temperature. M1 had the highest transparence at 36.8, followed by M3 at 36, while the M5 had the lowest transparence.

Thea*value (redness) varied between 6.8 and 9.5 at zero time. The redness decreased at zero time as carrots decreased in the samples, which responsible for orange or red. The highest redness score registered by the M1 while the M5 scored the lowest redness. There was a drop in redness during storage, with values varying from 4.5 to 8.2. The preferred order of treatments was in direction samples from M1to M5. The results of redness closely linked to the observations of carotenoids.

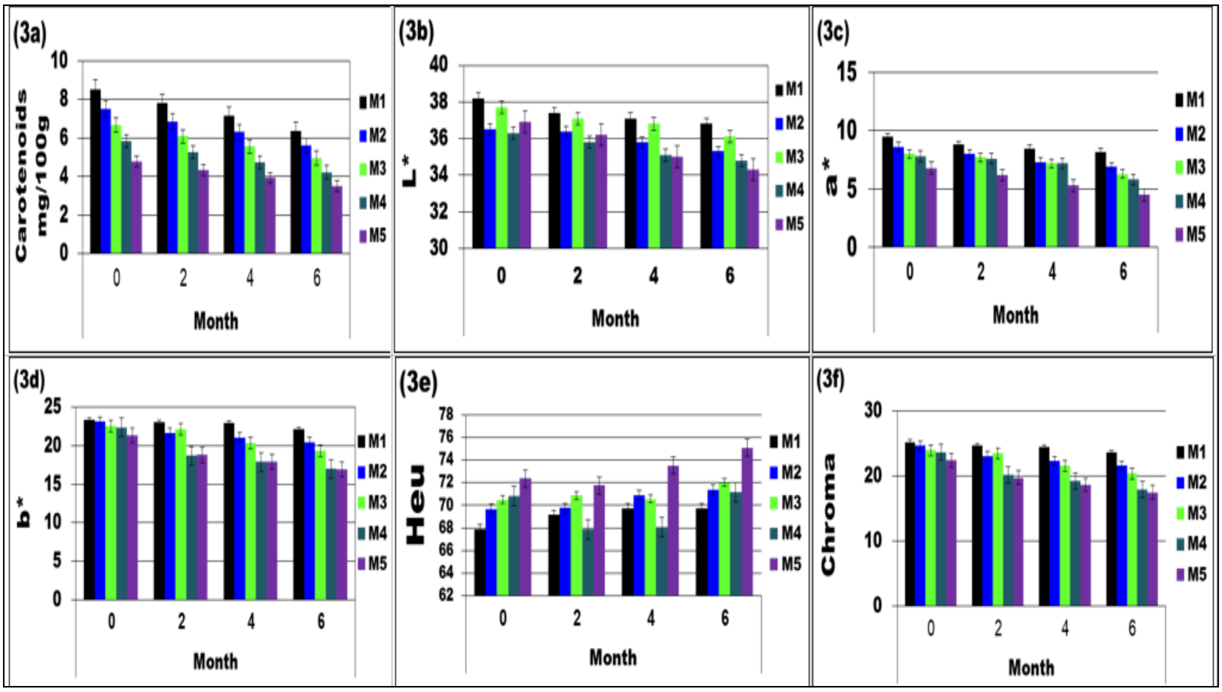


Fig 3: Carotenoids, L*(transparence), a*(redness), b*(yellowness), hue, chroma in different jams stored at room temperature for six months.

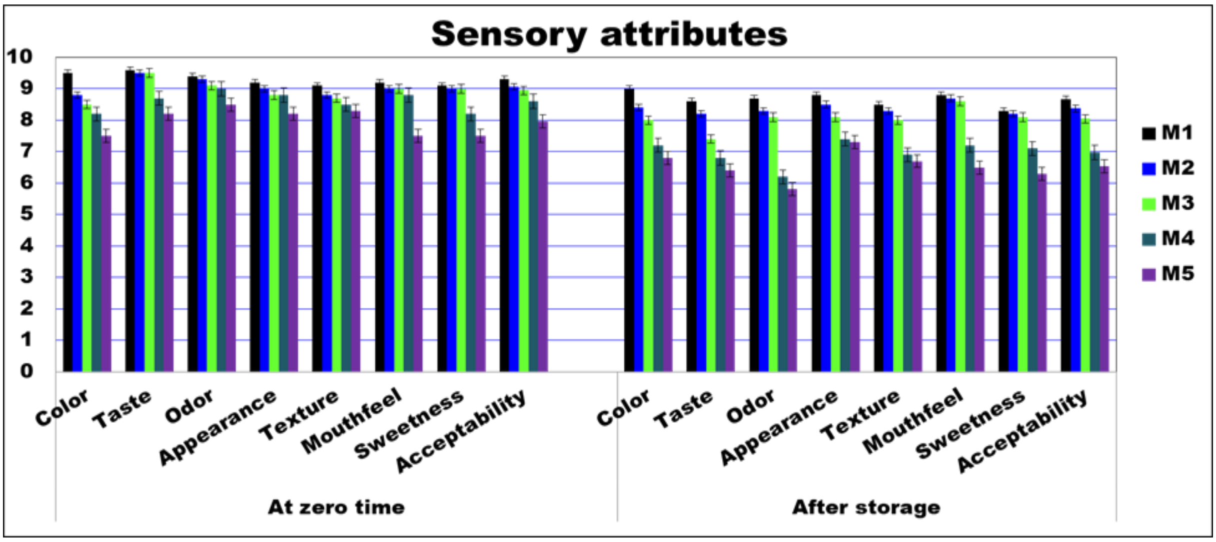


Fig 4: Sensory attributes in carrot and sweet potato blend jams stored at room temperature at zero time and after storage for 6 months.

The b* values (yellowness) were between21.4-23.4 at Zero time. There were no moral differences between the five samples at any time of storage periods. Based on the previous results, there was no effect of storage or processing on the yellow color during storage, and this happened to the values of hue and chroma.

Sensory properties

Figure 4 displays the changes in the sensory features of jam samples at the start and end of storage. The mean score of color, taste, odor, appearance, texture, mouthfeel, sweetness, and overall acceptability significantly decreased during storage for the different treatments. The paleness of the color increased from sample M3 to sample M5, while the appearance of fiber and the potent smell of sweet potato increased from sample M4 to sample M5. It is clear from the data that the acceptance of the samples increased in the direction from T5 to T1.

Discussion

The composition of the samples had a significant effect on TSS during storage, the rise content of sweet potato increased the TSS in the sample. [32] Also observed the same rise in the TSS for apricot jam after storage.

The variation due to sample compositions in pH and acidity did not found at time zero or storage finishing. The pH and acidity of the samples were significantly affected by storage, which is following previous studies on low-calorie quince (*Cydonia oblonga*) jam by [33] who reported that the acidity increasing and pH decreased during storage.

The high content of sweet potatoes in this study is associated with higher vitamin C content and increased browning. Vitamin C decomposition optimized browning with storage finalization. The decrease in vitamin C during storage is compatible with the results obtained on strawberry and raspberry jams [19]. After six months at (25±5°C), [22] observed the same rise in the browning of guava nectar.

The higher carrot content of the samples raises the TPC of the jam samples and the increase in transparency, redness, yellowness, hue, and chroma. The drop in TPC during storage decreased the values of all phenols-associated parameters, such as transparency, redness, yellowness, hue, and chroma. Upon prolonged storage, TPC, transparency, redness, yellowness, hue, and chroma values were decreasing as reported by [33, 19]. The samples ranking in terms of preference was in the direction from F1 to F5.

The association between carotenoids and the measurements of transparency, redness, yellowness, hue, and chroma have confirmed for carotenoids which a significant impact on the values of redness, yellowness, and hue by its yellow or orange color, besides their antioxidant effect, which maintains transparency and chroma. Carotenoids have influenced by sample compositions, increasing the percent of carrot raised carotenoid content in the sample. The storage significantly decreased carotenoid content. The decrease in carotenoids resulted from the degradation by auto-oxidation, oxidative analysis, isomerization [1, 30]. The degradation of carotenoids during storage similar to those reported by [12] in pumpkin beverages.

Despite the high quality of all the treatments, the sensory attributes declined as storage continued. Increasing browning, loss of volatile components, degradation of (polysaccharides, colloidal particles, and protein) as well as the formation of complexes with pectin and phenolics reduced the scores of sensory characteristics during storage [6, 31]. A similar drop in sensory attributes scores was recorded during storage by [29] for a mixture of strawberry and mandarin juice, [21] for apple drinks, and [22] for guava nectar. Our data confirmed that the M1 followed by M2 achieved the highest score of color, lower fiber, and minor odor of sweet potato by store ending.

Conclusion

From the previous results and discussions, it becomes clear that different recipes had a significant impact on the bioactive compounds of the jam producing from mixing the carrots and sweet potatoes pulp. The different antioxidants such as β-carotene and phenols were increased by increasing carrots percentage in jam recipe as in M1 and M2 while increasing sweet potatoes percentage in a recipe from M3 to M5 decreased the bioactive compounds and produced an unpleasant odor and texture for the high fiber besides the pale color. M1 recorded the highest nutritional value and organoleptic properties. Therefore, it is recommended to produce functional jam at ratios (75:25) from carrots and sweet potatoes on a large industrial scale.

References

1. Alkesh Production of carotenoids as food colourants from natural sources. Ph.D. Thesis, Horticulture and Forestry University, Nauni, Solan, India, 2005.
2. Anderson L, Gugerty K. Sweet potato Value Chain: Ethiopia. Evans School Policy Analysis and Research. University of Washington. EPAR Brife. 2013; 219:11.
3. AOAC Official methods of analysis. 18th ed. Association of Official Analytical Chemists, Washington DC, USA, 2010.
4. Awolu OO, Okedele GO, Ojewumi ME, Oseyemi1 FG. Functional Jam Production from Blends of Banana, Pineapple and Watermelon Pulp. International Journal of Food Science and Biotechnology. 2018; 3(1):7-14.
5. Bacchetti T, Turco I, Urbano A, Morresi C, Ferretti G. Relationship of fruit and vegetable intake to dietary antioxidant capacity and markers of oxidative stress: a sex-related study. Nutrition. 2019; 61:164-72.
6. Bal LM, Ahmad T, Senapati AK, Pandit PS. Evaluation of quality attributes during storage of guava nectar cv. Lalit from different pulp and TSS ratio. Journal of Food Processing and Technology, 2014, 5. 1000329.
7. Barański R, Allender C, Klimek-Chodacka M. Towards better tasting and more nutritious carrots: carotenoid and sugar content variation in carrot genetic resources. Food Res. Int. 2012; 47:182-187.
8. Barros L, Cabrita L, Boas MV, Carvalho AM, Ferreira ICFR. Chemical, biochemical and electrochemical assays to evaluate phytochemicals and antioxidant activity of wild plants. Food Chem. 2011; 127:1600-1608. https://doi.org/10.1016/j.foodchem.2011.02.024
9. Bitok E, Sabaté J. Nuts and cardiovascular disease. Prog, Cardiovasc Dis. 2018; 61:33-37.
10. Chen B, Xu M. Natural antioxidants in foods. See Varelis *et al*, 2019, 180-88.
11. Cömert ED, Gökmen V. Evolution of food antioxidants as a core topic of food science for a century. Food Res., Int. 2018; 105:76-93.
12. Dhiman AK, Negi V, Attri S, Ramachandran P. Optimization of instant halwa mix from dehydrated pumpkin and its stability during storage. International Journal of Agriculture Sciences. 2017; 9(11):4026-4030.
13. Facchini FS, Humphreys MH, Donascimento CA, Abbasi F, Reaven GM. Relation between insulin resistance and plasma concentrations of lipid hydroperoxides, carotenoids, and tocopherols. Am., J., Clin, Nutr. 2000; 72:776-79.
14. Fedacko J, Singhal S, Singh RB, Hristova K, Itharat A, Halabi G *et al*. Functional food security for prevention of cardiovascular diseases. See Singh *et al*. 2019, 167-83.
15. Granato D, Nunes DS, Barba FJ. An integrated strategy between food chemistry, biology, nutrition, pharmacology, and statistics in the development of functional foods: a proposal. Trends Food Sci., Technol. 2017; 62:13-22.
16. Granato D, Shahidi F, Wrolstad R, Kilmartin P, Melton LD. Antioxidant activity, total phenolics and flavonoids contents: Should we ban in vitro screening methods? Food Chem. 2018; 264:471-75.
17. Koubaa M, Barba FJ, Bursa´cKovaˇcevi´c D, Putnik P, Santos MD. Pulsed electric field processing of fruit juices. In Fruit Juices: Extraction, Composition, Quality, and Analysis, ed. G Rajauria, BK Tiwari, 2018, 437-49. London: Academic
18. Lenssen KGM, Bast A, De Boer A. Clarifying the health claim assessment procedure of EFSA will benefit functional food innovation. J. Funct., Foods. 2018; 47:386-96.
19. Martinsen BK, Aaby K, Skrede G. Effect of temperature on stability of anthocyanins, ascorbic acid

and color in strawberry and raspberry jams. Food Chemistry. 2020; 316:126297.

20. Meydav S, Saguy I, Kopelman IJ. Browning determination in citrus products. Journal of Agricultural and Food Chemistry. 1977; 25:602-604.
21. Moazzem MS, Sikder MBH, Zzaman W. Shelf-life extension of wood apple beverages maintaining consumption-safe parameters and sensory qualities. Beverages. 2019; 5:25.
22. Mokhtar SM, Ibrahim IMA. Physicochemical, Antioxidant and Sensorial Properties of Pasteurized Guava Nectar Incorporated with Pomegranate Peel and Guava Leaf Extracts. World Journal of Food Science and Technology. 2020; 4(1):8-16.
23. Nicolle C, Simon G, Rock E, Amouroux P, Rémésy C. Genetic variability influences carotenoid, vitamin, phenolic, and mineral content in white, yellow, purple, orange, and dark-orange carrot cultivars. Journal of the American Society for Horticultural Science. 2004; 129: 523-529.
24. Oloo BO, Shitandi A, Mahungu S, Malinga JB, Ogata BR. Effects of Lactic Acid Fermentation on the Retention of BetaCarotene Content in Orange Fleshed Sweet Potatoes. Int., J., Food Stud. 2014; 3:13-33.
25. Osorio-Esquivel O, A ´ lvarez VB, Dorantes-A´ lvarez L, Giusti MM. Phenolics, betacyanins and antioxidant activity in Opuntia joconostle fruits. Food Res., Int. 2011; 44:2160-2168. https://doi.org/10.1016/j.foodres.2011.02.011.
26. Parohan M, Anjom-Shoae J, Nasiri M, Khodadost M, Khatibi SR, Sadeghi O *et al*. Dietary total antioxidant capacity and mortality from all causes, cardiovascular disease and cancer: a systematic review and dose–
27. Sharma R, Choudhary R, Thakur NS Thakur A. Development and quality of apple-whey based herbal functional ready-to-serve beverage. Journal of Applied and Natural Science. 2019; 11:291-298.
28. Wani TA, Amin QA, Fauzia S, Dorjey N, Zargar BA, Tundup P *et al*. Standardization, Stability Study and Chemical Properties of Apricot Jam Prepared in Cold Arid Region of Ladakh. International Journal of Current Microbiology and Applied Sciences. 2019; 8(5):495-499.
29. Yousefi M, Hossein SA, Kadivar M. Physicochemical and Nutritional Stability of Optimized Low-calorie Quince (Cydonia oblonga) Jam Containing Stevioside During Storage. Current Nutrition and Food Science. 2018; 14:79-87.