Plant Archives Vol. 23, No. 2, 2023 pp.6-11 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2023.v23.no2.002

FORMULATION AND QUALITY EVALUATION OF TOMATO-BROCCOLI BLENDED INSTANT VEGETABLE SOUP MIX

Kamaldeep Kour, Monika Sood*, Julie D. Bandral, Neeraj Gupta and Ankita Choudhary
Division of Post Harvest Management, Faculty of Horticulture & Forestry,
Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Chatha, Jammu
*Corresponding author: monikasoodpht@gmail.com
(Date of Receiving : 02-03-2023; Date of Acceptance : 18-05-2023)

ABSTRACT

The study was conducted to utilize tomato and broccoli in the development of instant vegetable soup mix and to conduct its quality evaluation (water activity, moisture, crude fat, crude protein, ash, crude fibre, carbohydrate and energy) during storage period of 90 days. The instant vegetable soup mix was prepared by blending tomato and broccoli powder in varied ratios (100:00, 95:05, 90:10, 85:15, 80:20, 75:25, 70:30) and mixed with corn flour, onion powder, garlic powder, salt and black pepper powder as per standard recipe. Prepared soup mix was packed in laminate pouches of 15 g and were then stored for 90 days under ambient conditions. Among seven combinations the highest water activity (0.579), moisture (7.80%), crude fat (3.52%), crude protein (16.06%), crude fibre (9.55%), ash (7.58%) were recorded in T_7 (70:30:: Tomato powder: Broccoli powder) whereas maximum carbohydrate (61.22 %) and energy (323.47 Kcal) was observed in T_1. In general, there was an increase in water activity and moisture content, whereas, decrease in crude fat, crude protein, crude fibre, ash, carbohydrate and energy.
Keywords : Tomato, broccoli, soup mix, water activity, protein, fibre

Introduction

People are passing frantic life due to suburbanization. They do not have enough time to cook foods and are becoming adapted to consume junk food which contain high sugar, fat, salt content, and are low in nutrient value in terms of protein, fiber, vitamin, and mineral content (Kaushik *et al*., 2011). Consumption of these nutrient-deficient foods ultimately leads to malnutrition and related diseases. This problem could be overcome by supplying easy-to-cook nutrient-enriched foods. Vegetables are rich and comparatively cheaper source of carbohydrates, proteins, vitamins, minerals and can supplement the main cereals of the country. Many specific chemical substances from vegetables are required to human body for growth, reproduction and for maintenance of health. Vegetable containing food products provide not only nutrients but also change flavour and palatability which act as appetizer. Digestible fibre present in vegetables can be helpful in treating constipation. Vegetables are also important in stabilizing the hydrochloric acid in stomach which overall help in digestion and also provide valuable roughages for movement of food in intestine.

Tomato (*Solanum lycopersicum* L.) is one of the most popular vegetable worldwide, it is typically consumed in fresh form, although a large amount of products are obtained from tomato such as ketchup, sauces and soups (Santos-sanchez *et al.*, 2013). Tomatoes are the major dietary source of the antioxidant lycopene, which has been linked to many health benefits, including reduced risk of heart diseases and cancer. A raw tomato contains 93.5 per cent water, 0.9 g of protein, 0.3 g of fiber and 0.2 g of fat (Hanif *et al*., 2006). This horticultural crop is also a rich source of lycopene (60-90 mg/kg), polyphenols (10-50 mg/ kg) and small quantities of vitamin E (5-20 mg/kg). The average vitamin C content supplied by tomato is about 40 per cent of the adult USDA of 60 mg (Charanjeet *et al*., 2004). Tomatoes are an excellent source of health promoting compounds having a balanced mixture of minerals and antioxidant vitamins including vitamin E and C as well as rich in β carotene, thiamine, riboflavin, niacin, lutein and flavonoids such as quercetin (Kulshreshta and Pandey, 2017). However, tomatoes are highly perishable in the fresh state leading to losses and wastage during peak season. Huge quantities of tomatoes are lost due to lack of proper processing, storage and transportation facilities.

Broccoli (*Brassica oleracea*) belongs to the genus Brassica, and family Brassicaceae which is highly nutritious and has been considered as anti-cancerous food by the American Cancer society. It is also high in iron and calcium and is a non-fattening food which possesses many medicinal properties (Mishra and Mukherjee, 2012). Broccoli also contains a compound called 'indole-3-carbinol' that can combat breast cancer by converting a cancer promoting estrogen into a more protective variety (Phillip, 2011). Broccoli is consumed both as fresh and processed food and is regarded as a dual use vegetable. Typically, broccoli is processed as canned or frozen vegetable for retail sale however, it offers great advantage and can enhance its share of the market (Boriss and Brunke, 2005). One of the easy-to-cook foods that are available in our country is dried soup

powder which is playing an important role in fulfilling present and future social consumer requirements (Krejcova *et al*., 2007). Dried soup powders have an advantage of protection from enzymatic and oxidative spoilage and flavour stability at room temperature over long periods of time (6-12 months). Moreover, they exert light weight for shipping and availability at all time of the year (Rekha *et al*., 2010). However, most of the available soups are not up to the mark regarding nutritional quality. The nutritional quality could be improved by introducing protein, minerals, and vitamin sources from plant origin that are suitable for all types of people. Considering these, tomato and broccoli would be good choice of sources owing to their high nutritional quality. Therefore, the objective of this study was to formulate nutritionally balanced and easily digestible instant food which is light in weight having longer shelf life and can be suitable for all age groups.

Materials and Methods

Good quality tomato and broccoli were collected from the market. Ripened tomatoes with a uniform outer red coat were selected while the injured and defective fruits were sorted out. The broccoli florets with a uniform green colour and no visible outer damage were selected for processing.

Preparation of tomato powder

Tomatoes were cleaned, washed and subjected to hot water blanching for 3-5 minutes and were then allowed to cool afterwards. The blanched tomatoes were cut into small slices (around 1cm) and dipped in 2% sodium benzoate solution at room temperature for 5 minutes and were drained thoroughly after the dip treatment. (Aderibigbe *et al*., 2018). The tomato slices were then placed uniformly on stainless steel trays by spreading them as a single layer and dried at 50°C for 16 hours in a tray drier. After obtaining constant moisture content, cooling was done at room temperature, the dried tomato slices were ground by using grinder and sieved to obtain fine tomato powder.

Preparation of broccoli powder

Broccoli was cleaned, washed under running tap water and surface water was dried. The florets were then separated from the bottom and blanching was done at 80ºC for 3 minutes in 0.1% solution of sodium bicarbonate (Kaur *et al*., 2018). The broccoli florets were then crushed so as to reduce time for drying and increase drying rate. The crushed broccoli was spread evenly in a single layer on trays and drying was carried out at 50ºC for 8 hours with constant air flow rate. After obtaining constant moisture content dried broccoli was ground and sieved to obtain fine broccoli powder.

Onion and garlic powder

Peeled onion and garlic samples were washed, sliced and dried in a tray drier at 60ºC for 5-6 hours and ground. The ground onion and garlic samples were sieved to obtain fine powder (Niththiya *et al.,* 2014).

Formulation of Tomato-Broccoli Blended Instant Soup Mix

The dried tomato and broccoli powder were blended in different ratios (100:00, 95:05, 90:10, 85:15, 80:20, 75:25, 70:30) for preparation of instant vegetable soup mix. For formulation of instant vegetable soup mix the tomato and broccoli powders were seasoned with dried onion powder (8%), garlic powder (8%), salt (2%), black pepper (2%) and commercially available corn flour (20%) to formulate seven different soup mixtures (three replications for each formula).

Quality Analysis

Water activity was measured using an Aqua Lab water activity meter (Model series 3TE) and readings were corrected at 20°C (AOAC, 2012). Moisture content was determined by standard AOAC (2012) method by following the oven drying method as the loss in weight due to evaporation from sample at a temperature of 105±1°C till constant weight was achieved. Crude fat was determined by the Soxhlet extraction technique (AOAC, 2012). Fat content of the sample was easily extracted into organic solvent (petroleum ether) at 60 to 80°C and followed to reflux for 6 h. The crude protein content was determined by micro Kjeldahl method, using the factor 6.25 for converting nitrogen content into crude protein (Sadasivam and Manickam, 2008). Fibre and ash of the sample was determined by method as described in AOAC (2012). The carbohydrate content was estimated by the difference method. It was calculated by subtracting the sum of percentage of moisture, crude fat, crude protein, crude fibre and ash contents from 100 according to AOAC (2012). Energy was calculated by multiplying protein, fat and carbohydrate values obtained from analysis by 4, 9 and 4, respectively and expressed in Kcal per 100 g. The data obtained was analysed statistically using Factorial completely randomized design (CRD) for interpretation of the results through analysis of variance.

Results and Discussion

The mean water activity among control and final treatment with 30 per cent broccoli showed an increase of 21.89 per cent (Table 1). The water activity increased with the addition of broccoli which might be due to higher water activity in broccoli powder (Ishrat *et al*., 2019). The water activity of tomato broccoli vegetable soup mix recorded 7.26 per cent inclination with progression in storage period. The gain in moisture by instant vegetable soup mix during storage might be responsible for increase in water activity content. The findings were in close conformity with the findings of Sagar and Kumar (2012) in bael powder.

The moisture content (Table 2) showed an increase of 6.26 per cent among control and broccoli blends. The moisture content increased due to higher moisture content in broccoli powder as compared to tomato powder (Upadhyay *et al*., 2017). The mean value of moisture content during 90 days of storage showed an increase of 24.62 per cent. Increase in storage might be due to hygroscopic nature of dried product and storage environment (temperature, relative humidity). Among blends, 21.79 per cent increase was observed in crude fat content (Table 2) of tomato-broccoli powder soup mix. With the supplementation of broccoli powder increased the crude fat content of soup mix which might be attributed to the fact that crude fat content of broccoli powder added in the product is more in comparison to tomato powder (Upadhyay *et al*., 2017). During storage, crude fat content showed a decline of 10.24 per cent. The decrease might be due to the increase in relative humidity which stimulates the activity of lipase enzyme which causes breakdown of fat into fatty acid and glycerol (Zahra *et al*., 2020).

The crude protein content of blend T_7 (70:30:: Tomato powder: Broccoli powder) was 22.22 per cent higher than T_1 (100:00:: Tomato powder: Broccoli powder) (Table 3). The supplementation of broccoli powder increased the value of crude protein content which might be due to high amount of protein in broccoli powder (Madhu and Kochhar, 2014). With the advancement in storage, crude protein content decreased by 4.6 per cent by the end of 90 days. The decrease might be due to hydrolysis of peptide bonds by the help of protease enzyme that causes splitting of protein molecules, denaturation and degradation of protein into amino acid during storage (Bhat *et al.,* 2014). Similar results were reported by (Rawal and Masih, 2014) in apple pomace powder during storage period of 45 days. Among control and blends increase of 5.80 per cent was recorded in ash content (Table 3). Similar results were recorded by (Upadhyay *et al*., 2017) who observed an increase in ash content when high amount of herbs were added in the vegetable soup mix. During 90 days of storage, the ash content of soup mix decreased by 1.70 per cent. The decrease in ash content might be due to the mineral losses from binding of minerals by maillard reaction products during storage (Nadarajah and Mahendran, 2015).

The mean crude fibre content (Fig 1) of tomato-broccoli vegetable soup mix showed an increase of 16.03 per cent among blends. Blend T_7 (70:30:: Tomato powder: Broccoli powder) showed maximum crude fibre content. Abdel-Haleem and Omran (2014) also observed similar results in dried vegetarian soup mixtures supplemented with legumes. With the advancement in storage period, the mean crude fibre content declined by 3.31 per cent. The decrease in crude fibre content might be due to degradation of structural polysaccharides and hemicelluloses during storage. Also heat and moisture solubilizers can degrade pectic substances leading to the decrease in the fibre content (Sharon and Usha, 2006).

Carbohydrate content of T_1 (100:00:: Tomato powder: Broccoli powder) was 9.3 per cent higher than that of T_7 (70:30:: Tomato powder: Broccoli powder) (Table 4). Carbohydrate content decreased with the increasing proportion of broccoli powder which might be attributed to lower carbohydrate content in broccoli powder. Carbohydrate content decreased by 0.27 per cent by the end of 90 days storage period. This decrease in carbohydrate is determined by calculation difference of other components (moisture, fat, protein, ash and fibre) which automatically decreases the carbohydrate (Rokhsana *et al*., 2007). Energy content of instant soup mix showed a decline among blends by 0.29 per cent. The decrease in level of energy with blending might be due to lower energy content in broccoli powder. During storage period of 90 days, 2.11 per cent decrease was observed in energy content (Table 4). This might be attributed due to decrease in protein and fat content with increase in storage period (Regmi *et al*., 2009).

Conclusion

Thus, from the experiment it could be concluded that despite of having high therapeutic and nutritional properties, broccoli is still being used only by unorganized sector and not given much importance for its commercialization. The present investigation has shown a way for efficient use and value addition of tomato and broccoli. The blended instant vegetable soup mix can be stored for more than 90 days with minimum changes in nutritional quality.

Table 1 : Effect of blending and storage on water activity of instant vegetable soup mix

Blends (Tomato: Broccoli)	**Water activity**				**Mean (Blends)**
	Storage periods (days)				
	0	30	60	90	
T_1(100:00)	0.458	0.469	0.481	0.494	0.475
T_2(95:05)	0.475	0.486	0.498	0.513	0.493
T_3(90:10)	0.492	0.505	0.516	0.530	0.510
T_4(85:15)	0.509	0.523	0.535	0.546	0.528
T_5(80:20)	0.527	0.540	0.551	0.564	0.545
T_6(75:25)	0.543	0.556	0.568	0.582	0.562
T_7(70:30)	0.561	0.574	0.585	0.596	0.579
Mean (Storage)	0.509	0.521	0.533	0.546	
Effects	C.D ($p \leq 0.05$)				
Blends	0.004				
Storage	0.003				
Blends × Storage	0.008				

Table 2: Moisture and crude fat (%) content of instant vegetable soup mix.

Blends (tomato: broccoli)	**Moisture (%)**				**Mean**	**Crude Fat (%)**				**Mean**
	Storage period (days)					Storage period (days)				
	0	30	60	90		0	30	60	90	
T_1(100:00)	6.51	7.06	7.61	8.18	7.76	3.09	2.95	2.82	2.71	2.89
T_2 (95:05)	6.60	7.13	7.68	8.26	7.90	3.18	3.07	2.94	2.83	3.00
T_3 (90:10)	6.67	7.21	7.77	8.33	8.02	3.30	3.19	3.08	2.94	3.12
T_4 (85:15)	6.74	7.29	7.85	8.41	8.21	3.41	3.27	3.15	3.02	3.21
T_5 (80:20)	6.82	7.38	7.93	8.48	7.66	3.50	3.38	3.25	3.10	3.30
T_6 (75:25)	6.89	7.45	8.01	8.56	7.55	3.62	3.49	3.34	3.22	3.41
T_7 (70:30)	6.96	7.55	8.08	8.63	7.43	3.71	3.60	3.46	3.33	3.52
Mean	6.74	7.29	7.84	8.40		3.40	3.28	3.15	3.02	

Effects	**CD $_{(p\leq0.05)}$**	**CD$_{(p\leq0.05)}$**
Blends (B)	0.03	0.03
Storage (S)	0.03	0.02
B×S	0.07	0.05

Table 3 : Effect of blending and storage on crude protein and ash (%) of instant vegetable soup mix

Blends (tomato: broccoli)	**Crude protein (%)**				**Mean**	**Ash (%)**				**Mean**
	Storage period (days)					Storage period (days)				
	0	30	60	90		0	30	60	90	
T_1(100:00)	13.44	13.25	13.05	12.84	13.14	7.22	7.19	7.15	7.10	7.16
T_2 (95:05)	13.92	13.71	13.47	13.29	13.59	7.29	7.25	7.21	7.17	7.23
T_3 (90:10)	14.46	14.20	13.98	13.72	14.09	7.37	7.34	7.29	7.24	7.31
T_4 (85:15)	14.95	14.68	14.49	14.24	14.58	7.44	7.40	7.36	7.32	7.38
T_5 (80:20)	15.42	15.19	14.92	14.71	15.06	7.50	7.46	7.42	7.38	7.44
T_6 (75:25)	15.90	15.68	15.43	15.18	15.54	7.58	7.53	7.49	7.42	7.50
T_7 (70:30)	16.42	16.16	15.96	15.72	16.06	7.65	7.60	7.56	7.51	7.58
Mean	14.93	14.69	14.47	14.42		7.43	7.39	7.35	7.30	

Effects	**CD$_{(p\leq0.05)}$**	**CD$_{(p\leq0.05)}$**
Blends (B)	0.04	0.05
Storage (S)	0.03	0.09
B×S	0.07	N.S

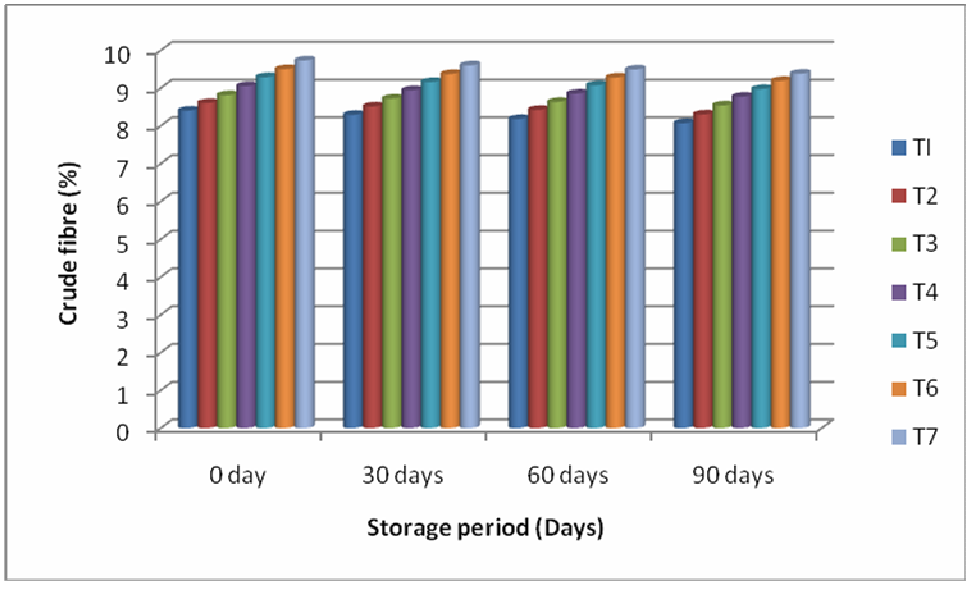

Fig. 1 : Effect of blending and storage on crude fibre (%) of instant vegetable soup mix

Table 4: Carbohydrate (%) and Energy (Kcal/100g)) content of instant vegetable soup mix

Blends (tomato: broccoli)	Carbohydrate (%)				Mean	Energy (%)				Mean
	Storage period (days)					Storage period (days)				
	0	30	60	90		0	30	60	90	
T_1(100:00)	61.34	61.26	61.19	61.10	61.22	326.93	324.49	322.34	320.15	323.47
T_2 (95:05)	60.41	60.33	60.28	60.15	60.29	325.94	323.79	321.14	319.23	322.52
T_3 (90:10)	59.39	59.34	59.27	59.24	59.31	325.10	322.87	320.81	318.30	321.77
T_4 (85:15)	58.41	58.39	58.35	58.24	58.34	324.13	321.73	319.67	317.10	320.66
T_5 (80:20)	57.47	57.42	57.40	57.36	57.41	323.06	320.52	318.57	316.33	319.52
T_6 (75:25)	56.51	56.48	56.45	56.43	56.46	322.22	320.05	317.58	315.42	318.81
T_7 (70:30)	55.53	55.49	55.45	55.43	55.47	321.19	319.00	316.78	314.41	317.85
Mean	58.43	58.39	58.34	58.27		324.08	321.79	319.56	317.24	

Effects	$CD_{(p\leq0.05)}$	$CD_{(p\leq0.05)}$
Blend(B)	0.05	0.06
Storage (S)	0.04	0.04
B×S	0.09	0.11

References

Abdel-Haleem, A.M.H. and Omran, A.A. (2014). Preparation of dried vegetarian soup supplemented with some legumes. *Food and Nutrition Sciences*, 5(22): 2274-2285.

Aderibigbe, O.R., Owolade, O.S., Egbekunle, K.O., Popoola, F.O. and Jiboku, O.O. (2018). Quality attributes of tomato powder as affected by different pre-drying treatments. *International Food Research Journal*, **25**(3): 1126-1132.

AOAC (2012). *Official Methods of Analysis*. 19th edition. Association of Official Analytical Chemists, Washington, D. C.

Bhat, A., Kumari, K.R., Anand, V. and Anjum, M.A. (2014). Preparation, quality evaluation and storage stability of peach-soy fruit leather. *SAARC Journal of Agriculture*, 12(1): 73-88.

Boriss, H. and Brunke, H. (2005). *Commodity profile, Broccoli*. Agricultural Marketing Research Center, University of California, Davis, 1-6.

Charanjeet, K., George, B., Deepa, N., Singh, B. and Kapoor, H. C. (2004). Antioxidant status of fresh and processed tomato. *Journal of Food Science and Technology*, 41(5): 479-486.

Hanif, R., Iqbal, Z., Iqbal, M., Hanif, S. and Rasheed, M. (2006). Use of vegetables as nutritional food, Role in human health. *Journal of Agricultural and Biological Science*, 1(1): 18-22.

Ishrat, S.A., Naik, H.R., Zargar, I.A., Wani, S.M. and Altaf, U. (2019). Investigation of the physical properties of tomato powder prepared by spray drying technology. *International Journal of Chemical Studies*, 8(1): 1071-1074.

Kaur, N., Aggarwal, P. and Rajput, H. (2018). Effect of different blanching treatments on physicochemical, phytochemical constituents of cabinet dried broccoli. *Chemical Science Review and Letters,*7(25): 262-271.

Kaushik, J.S., Narang, M. and Parakh, J. (2011). Fast food consumption in children. *Indian Pediatrics.*, 48(2): 97-101.

Krejcova, A., Cernohorsky, T. and Meixner, D. (2007). Elemental analysis of instant soups and seasoning mixtures by ICP-OES. *Food Chemistry*, 105: 242–247.

Kulshreshta, K. and Pandey, A. (2017). Value addition of fruits and vegetables for nutritional security. *International Journal of Food Science and Technology,* 7(2): 27-34.

Mishra, P. and Mukherjee, V. (2012). Broccoli, a rich source of nutrition and medicinal value. *Science Research Reporter*, 2(3): 291-294.

Nadarajah, S. and Mahendran, T. (2015). Influence of storage conditions on the quality characteristics of wheat-defatted coconut flour biscuits packed in metalized polypropylene. *International Journal of Engineering Research and Technology*, 40(7): 948-951.

Niththiya, N., Vasantharuba, S., Subajini, M. and Srivijeindran S. (2014). Formulation of instant soup mix powder using uncooked palmyrah (*Borassus flabellifer*) tuber flour and locally available vegetables. *Proceedings of Jaffna University International Research Conference*. University of Jaffna, Jaffna, Sri Lanka. pp 198-202.

Phillip, J. (2011). Sulforaphane from broccoli destroy cancer cells. *Nutrition and Food Research,* 45: 57-68.

Rawal, R. and Masih, D. (2014). Study of the effect on the quality of apple pomace powder prepared by two different dryers. *Journal of Agriculture and Veterinary Science*, 7(8): 54-61.

Regmi, P.R., Ferguson, N.S. and Zijlstra, R.T. (2009). In vitro digestibility techniques to predict apparent total tract energy digestibility of wheat in grower pigs. *Journal of Animal Science*, 87(11): 3620-3629.

Rekha, M.N., Yadav, A.R., Dharmesh, S., Chauhan, A.S. and Ramteke, R.S. (2010). Evaluation of antioxidant properties of dry soup mix extracts containing dill (*Anethum sowa* L.) leaf. *Food Bioprocess Technology*, 3(3), 441-449.

Rokhsana, F., Yeasmin, R. and Nahar, A. (2007). Studies on the development and storage stability of legume and

vegetable based soup powder. *Bangladesh Journal of Agricultural Research*, 32(3): 451-459.

Sadasivam, S. and Manickam, A. (2008). Anti-nutritional factor, In *Biochemical Methods for Agricultural Sciences*, New International Publication (IP) Limited, New Delhi, India, 215-216.

Sagar, V.R. and Kumar, R. (2012). Effect of drying treatments and storage stability on quality characteristics of bael powder. *Journal of Food Science and Technology*, 51(9): 2162-2168.

Santos-sanchez, N., Valadez-Blanco, R. and Salas-Coronado, R.S. (2013). Factors affecting the antioxidant content of fresh tomatoes and their processed products. *Journal of Food Chemistry*, 9(10): 191-212.

Sharon, C. and Usha, V. (2006). Effect of storage on nutritional and sensory qualities of breadfruit flour. *Journal of Food Science and Technology*, 43(3): 256-258.

Upadhyay, S., Tiwari, R., Kumar, S. and Kohli, D. (2017). Production and evaluation of instant herbal mix soup. *International Journal of Agricultural Science and Research*, 7(3): 37-42.

Zahra, S.M., Hussain, S., Mahmood, S., Kausar, T., Din, G.M.U., Tufail, T., Altaf, N., Quddoos, M.Y., Rafique, A. and Shahid, M.Z. (2020). Shelf stable iron fortified fruit bar's development, proximate estimation and organoleptic characterization. *International Journal of Bioscience*, 16(4): 111-135.