Research Article

Development and Storage Study of Orange Date Blended Squash

Muhammad Adnan Khan[1*], Majid Suhail Hashmi[1], Ali Muhammad[1], Muhammad Muneeb[1], Haris Bilal[1] and Gul Wali[2]

[1]Department of Food Science and Technology, Faculty of Nutrition Sciences, The University of Agriculture Peshawar, Khyber Pakhtunkhwa, Pakistan; [2]Department of Food Science and Technology, Faculty of Agriculture, Gomal University, Dera Ismail Khan, Pakistan.

Abstract | This research was conducted to determine the possibility of orange date blended squash at different ratios, i.e. OD_1 (orange 90% + date 10%), OD_2 (orange 80% + date 20%), OD_3 (orange 70% + date 30%), OD_4 (orange 60% + date 40%), OD_5 (orange 50% + date 50%) and OD_6 (orange 40% + date 60%). Orange date blended squash was prepared by the combination of pulp: sugar: water, with 3: 4: 1 ratio respectively. All samples were tested for total soluble solids (TSS), pH, titratable acidity, reducing sugar, non-reducing sugar, ascorbic acid and sensory properties as flavor, color and overall acceptability. Samples were stored for three months and readings were recorded at every 15 days interval. During storage intervals, TSS increased from 48.0 to 51.31˚Brix, pH increased 3.82 to 4.25, titratable acidity decreased from 1.02 to 0.86%, reducing sugar increased from 16.50 to 17.76%, non-reducing sugar decreased from 28.25 to 26.98%, ascorbic acid decreased from 19.11 to 15.65mg/100g, mean score of judges for flavor decreased from 7.9 to 6.2, color means decreased from 7.6 to 5.8 and overall acceptability decreased from 7.6 to 5.7. The results demonstrated that the treatments and 90 days storage interval have great effect ($p<0.05$) on all the experiments of orange date blended squash. The treatment OD_2 (orange 80% + date 20%), was found exceptional followed by OD_1 (orange 90% + date 10%), while OD_6 (orange 40% + date 60%) results found not satisfactory. Moreover, further study is needed to test suitability of orange-date (80:20) blended squash for commercial feasibility to this product.

Received | April 04, 2018; **Accepted** | May 29, 2018; **Published** | July 02, 2018
***Correspondence** | Muhammad Adnan Khan, Department of Food Science and Technology Faculty of Nutrition Sciences, the University of Agriculture Peshawar, Khyber Pakhtunkhwa, Pakistan; **Email:** adnanmwt.007@gmail.com
Citation | Khan, M.A., M.S. Hashmi, A. Muhammad, M. Muneeb, H. Bilal and G. Wali. 2018. Development and storage study of orange date blended squash. *Sarhad Journal of Agriculture,* 34(3): 509-515.
DOI | http://dx.doi.org/10.17582/journal.sja/2018/34.3.509.515
Keywords | *Citrus cinensis, Phoenix dactylifera*, Blended squash, Physico-chemical and organoleptic analysis

Introduction

Orange (*Citrus cinensis*) is a winter fruit. It is originated in north eastern India and southern China and somewhere in south eastern Asia. Cultivation of oranges was first reported in China 2500 BC. The production and consumption of oranges increase every year. Recently about 50 million tons was produced around the world. Brazil is the leading country in orange production approximately 35.6 million tons having 30% of the world output. Pakistan is at 20th number in worldwide orange production which produce approximately 1.5 million metric tons on 160,000 hectares area. Generally, oranges are squeezed for juice and also consumed fresh. Mostly orange juice is utilized as a fruit juice around the globe usually collected from the Orange fruit endocarps (Galaverna et al., 2014). It is full of vitamin C containing up to 65% and also a rich source of potassium, folic acid and excellent source of bioactive anti-oxidant. French population representative investigated that orange contributes 16% of the daily vitamin C consumption for adults and 31% vitamin C intake for children (Rolle et al., 2016). Health benefits

of oranges play key roles in human life. Currently the most common cause of premature death in the world is heart disease. Oranges contain flavonoids (Hesperidin), have the ability to protect body against heart disease. It is also a good source of antioxidant and fiber which helps to reduce the risk of heart disease. Orange juice may prevent kidney stone formation due to citric acid and citrate (Asgary and Keshvari, 2013).

Date palm (*Phoenix dactylifera*) belonging to the family *Arecaceae*, is a fruit enriched in fiber, minerals, carbohydrates, and vitamins. Date fruit are the product of date palm tree which is one of the oldest cultivated plant in the Middle East and Islamic countries. Its health benefits and nutritional qualities are well known across the world due to high valuable nutrients and health promoting abilities. Its production throughout the world increased over the last forty years. Recently Egypt is the leading country in production of dates approximately 1,084,529 million tons of dates produced every year. Pakistan is the 5th largest country in production of dates approximately 556,608 million tons of dates are produced every year. Dates are consisting of various nutrients and medicinal substances. Due to its long shelf life and high nutritional value the date palm has been known as tree of life. It is used for different purposes as food proportions like confectionary, snacks, sweets, baking products and healthy foods. It is the source of natural sugar i.e. sucrose, glucose and fructose that gives instant energy to the body. It also gives human diet with high quality of some essential amino acids (Shaba et al., 2015). Dates are delicious and most important fruit containing phytonutrients, minerals and vitamins necessary for good health, normal growth and development. Fresh dates contain fructose and dextrose which fulfill energy and regenerate the body instantly. It is also a rich source of dietary fiber which lower LDL cholesterol level that prevents from heart disease and cancer. It contains flavonoids polyphenolic antioxidants known as Tannins, hold anti-inflammatory, anti-infective and anti-hemorrhagic properties. Dates are major source of vitamin A which is important for vision and also maintain health of skin and mucosa. It is an excellent source of iron and potassium. Iron is the component of hemoglobin in red blood cells that carries oxygen to body cells. Potassium is essential for heart rate regulation and blood pressure.

Squash is non-alcoholic concentrated fruit flavored syrup made from fruit juice, sugar and water with constant proportions. In some cases, food flavor and food colors may also have added for best results. It is used as a drink by mixing it with water or carbonated water. Squash is prepared from major ingredients such as fruit juice, sugar and water at the ratio of 3:4:1 respectively (Gupta et al., 2017). Squash blends are the vital way of improvement in squash quality and produce valuable product by combination of nutritional and health promoting ability depending upon the quality and type of fruits (Carrvalho et al., 2007). The aim of this research work is to develop a suitable combination of Orange and Date for the preparation of blended squash. This would enable the value addition of date, which is produced in large amount in Southern Khyber Pakhtunkhwa. In addition, the date orange squash would give consumer a new product with high nutritive value.

Materials and Methods

This research was conducted in Food Science and Technology Laboratory, The University of Agriculture Peshawar, Pakhtunkhwa, Pakistan.

Preparation of orange juice, date pulp and squash

Fresh, ripe, fully mature and abrasion free orange (blood red) and date fruits were purchased from market. The selected oranges were washed under running water. The surface microbes and other contaminants were removed by washing with 5% hypochlorite solution and then rinsed immediately several times with distilled water. Oranges were cut into equal halves with stainless steel knife and placed in a juice extractor for the extraction of juice. Juice was filtered through a muslin cloth. Airtight screw cap and pre-sterilized glass bottles were used to withstand during storage. Juice was stored at refrigerated temperature (5°C) before analysis.

Dates were cleaned from impurities and seeds removed. Cleaned dates were weighed and washed by dipping in water and placed in a juicer. During blending small amount of water was added to get smooth and clear pulp. Date pulp was taken in a glass bottles and stored at 5 °C before analysis.

Date pulp was blended with orange juice in varying proportions i.e. 10:90, 20:80, 30:70, 40:60, 50:50 and 60:40. Juice, sugar and water were mixed in the ratio of 3:4:1 respectively. Preservative (potassium meta-bisulphite) was added to all the treatments at constant

concentration (0.1%). The blend was homogenized, and placed into 250 ml plastic bottles and stored at room temperature (25-30 ◦C) in a dark place.

Physico-chemical, Sensory and statistical analysis

All the samples of orange date blended squash were subjected to evaluate physico-chemical analysis (pH, titratable acidity, total soluble solids, reducing sugar, non-reducing sugar and ascorbic acid) by the recommended methods of (AOAC, 2012) and sensory evaluation (color, flavor and overall acceptability) by 9 points Hedonic scale (Larmond, 1977). All the samples were studied for 3 months with every 15 day interval. The data was analyzed statistically by using CRD (two factorial), and means were separated by using LSD test at 0.05% significant level (Steel and Torrie, 1997).

Results and Discussion

Physico-chemical analysis

The mean value of pH was significantly ($p<0.05$) increased from 3.82 to 4.25 during storage. The minimum value was observed in O_0 (3.71) followed by OD_1 (3.70), while maximum value was observed in D_0 (5.01) followed by OD_6 (4.25), (Table 1 and Figure 1A). Nath et al. (2005) observed the similar results for kinnow ginger blended squash. Tasnim et al. (2010) says that fruit juices have low pH because they contain higher amount of organic acids. Maia (2002) observed that pH increased in apple juice during storage due to the reduction of titratable acidity because both pH and titratable acidity are inversely proportion to each other.

The mean value of titratable acidity was significantly ($p<0.05$) decreased from 1.02 to 0.86% during storage period. The maximum mean value was observed in O_0 (1.26%) followed by OD_1 (1.23%), while minimum value was observed in D_0 (0.55%) followed by OD_6 (0.68%), (Table 1 and Figure 1B). Break down of pectic substances and storage conditions are responsible for increase in acidity (Hashmi et al., 2007). Due to co-polymerization of organic acids with amino acids and sugar the percent acidity was decreased (Malav et al., 2014). Similar results were observed in Lime Amla blended squash by Chikkasubbanna (2008). From these results it is confirmed that titratable acidity decreases during storage.

Table 1: *Physico-chemical analysis of orange date blended squash during storage.*

Treatments	Physico-chemical analysis					
	pH	%Acidity	TSS	Ascorbic acid	Reducing sugar	Non-reducing sugar
O_0	3.70g	1.26a	48.12g	29.68a	13.89h	31.15a
D_0	5.01a	0.55h	49.59d	5.19h	21.51a	23.69h
OD_1	3.70fg	1.23b	48.96f	27.04b	14.54g	29.68b
OD_2	3.72f	1.19c	49.34e	21.16c	15.19f	29.16c
OD_3	3.79e	1.09d	50.22c	17.66d	16.15e	28.49d
OD_4	3.94d	0.87e	50.51b	15.05e	17.45d	27.66e
OD_5	4.09c	0.69f	50.89a	12.79f	18.39c	26.38f
OD_6	4.25b	0.68g	51.02a	11.44d	19.72b	24.99g
P value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LSD value	0.0209	0.0729	0.2052	0.1825	0.146	0.1109

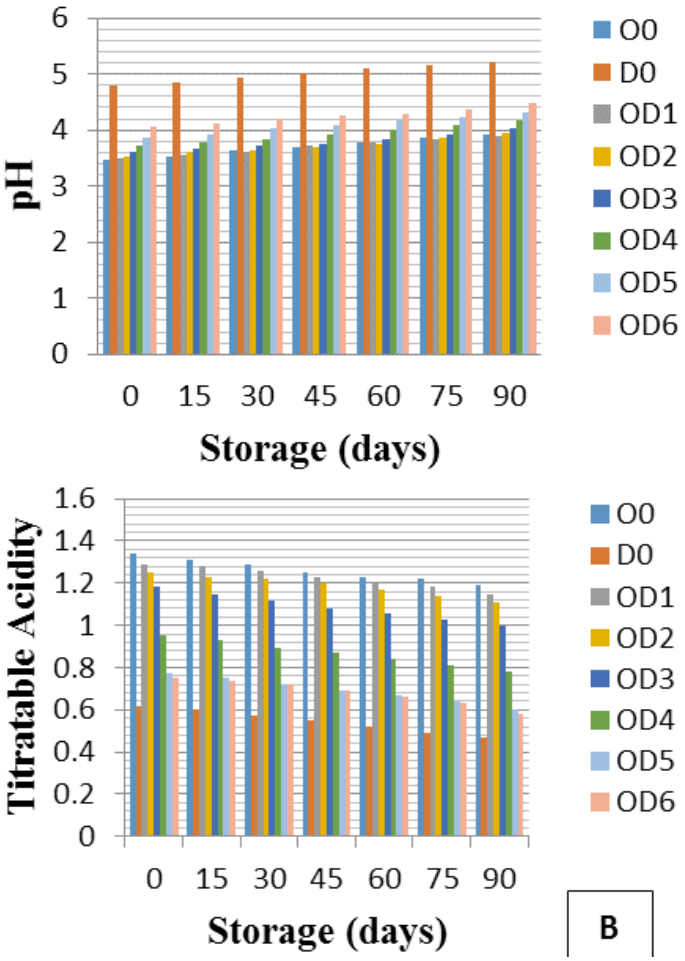

Figure 1: *pH (A) and Titratable acidity (B) of Orange Date blended squash during storage.*

The mean value of TSS was significantly ($p<0.05$) increased from 48.58 to 51.31˚Brixduring storage. The maximum mean value was observed in D_6

(51.02°Brix) followed by OD_5 (50.89°Brix), while minimum mean value was observed in O_0 (48.12°Brix) followed by OD_1 (48.96°Brix) (Table 1 and Figure 2A). According to (Nath et al., 2005) the hydrolysis of polysaccharides (starch and pectin) into simpler substances was responsible for increase in TSS of mandarin ginger blended squash during storage. Kinh et al. (2001) investigated that TSS might be increased by using chemical preservative in apple juice. Similar results were observed in mixed fruit squash by Kayshar et al. (2014). It is confirmed that TSS of orange date blended squash increased with treatments and storage.

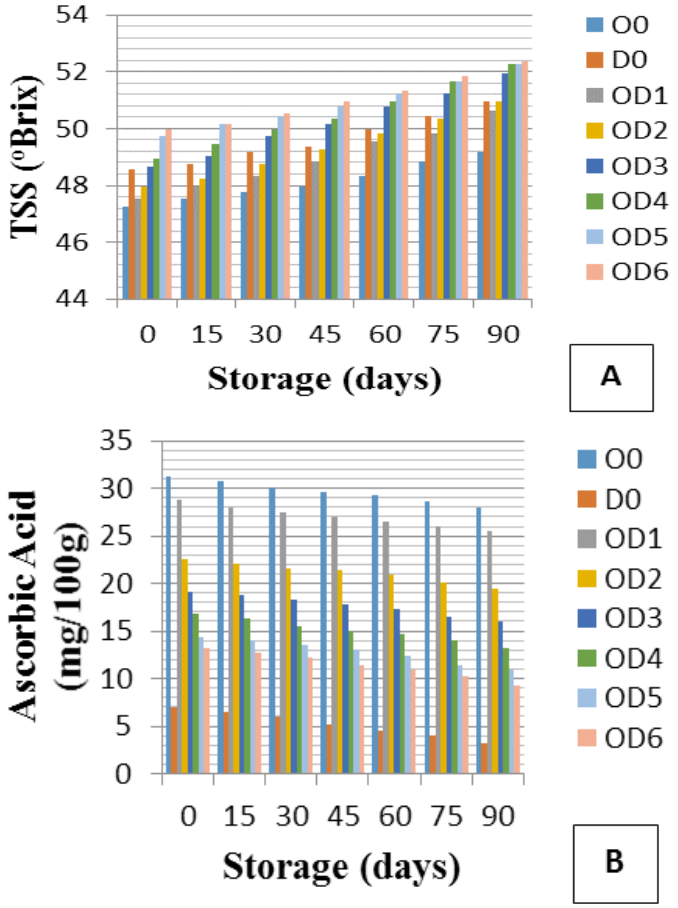

Figure 2: *Total Soluble Solids (A) and Ascorbic acid (B) of Orange Date blended squash during storage.*

The mean value of ascorbic acid was significantly ($p<0.05$) decreased from 19.11 to 15.65mg/100g during storage. The maximum mean value was observed in O_0 (29.68mg/100g) followed by OD_1 (27.04mg/100g), while minimum mean value was observed in D_0 (5.19mg/100g) followed by OD_6 (11.44mg/100g), (Table 1 and Figure 2B). Bender, (1958) reported that ascorbic acid losses up to 20% in 6 months, 48% in 18 months and 60% in 2 years. According to Jain et al. (2003) ascorbic acid decrease might be due to the fact that it is easily oxidized by both enzymatic and non-enzymatic catalyst and in the presence of oxygen, as it is being sensitive to light, heat and oxygen. Thus, it is concluded that ascorbic acid decreases during storage.

The mean value of reducing sugar was significantly ($p<0.05$) increased from 16.50 to 17.76% during storage. The maximum value was observed in D_0 (21.51%) followed by OD_6 (19.72%), while the minimum value was observed in O_0 (13.89%) followed by OD_1 (14.54%), (Table 1 and Figure 3A). According to Kotecha and Kadam (2003) and Sahu et al. (2006) the total and reducing sugar was increased in tamarind syrup and mango lemongrass beverages respectively during storage which might be due to the breakdown of polysaccharides into monosaccharide's. According to Singh et al. (1999) temperature and acidity were responsible for the conversion of sucrose to fructose and glucose. Due to sucrose reduction, the reducing sugar increases correspondingly. From the results it is confirmed that reducing sugar increased with treatments and storage interval.

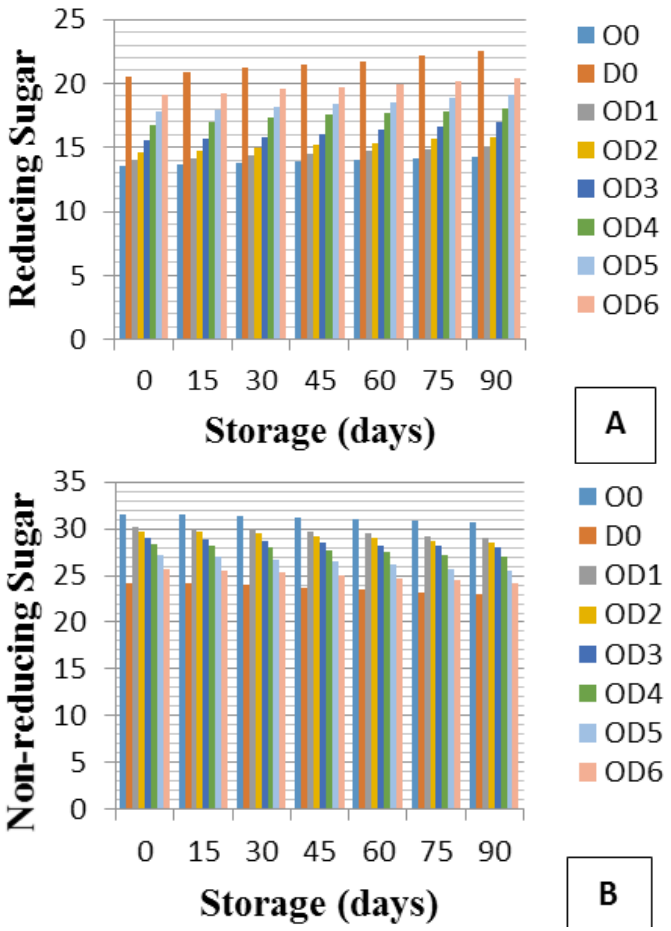

Figure 3: *Reducing sugar (A) and Non-reducing sugar (B) of Orange Date blended squash during storage.*

The mean value of non-reducing sugar was significantly ($p<0.05$) decreased from 28.25 to 26.98% during storage. The maximum mean value was observed in O_0 (31.15%) followed by OD_1 (29.68%), while minimum mean value was observed in D_0 (23.69%) followed by OD_6 (24.99%), (Table 1 and Figure 3B). Non-reducing sugar converted to reducing sugar might be due to glycogenesis during storage. Similar results observed by Palinswamy et al. (1984) in mango squash and in mixed fruit squash by Kayshar et al. (2014). Thus, it is confirmed that non-reducing sugar decreases during storage.

The statistical analysis demonstrated that the treatments and storage had a significant ($p<0.05$) influenced on physico-chemical properties of orange date blended squash at ambient temperature.

Organoleptic evaluation

The mean score of judges for color was decreased from 7.6 to 5.8. The maximum mean score was recorded in OD_1 (7.5), OD_2 (7.5) and OD_3 (7.5) followed by OD_4 (7.4), while the minimum mean score was recorded in D_0 (4.5) followed by OD_6 (5.0) (Table 2 and Figure 4A). Bezman et al. (2001) studied that, beverages color decreases during storage of orange juices might be due to the presence of 2 methyl 3 furanthiol and methanol. Similar score for color also observed in orange and pineapple blended squash (Akusu et al., 2016).

Table 2: *Sensory evaluation of orange date blended squash during storage.*

Treatments	Sensory Evaluations		
	Color	Flavor	Overall Acceptability
O_0	7.21b	7.71b	1.26a
D_0	4.51e	5.44f	0.55h
OD_1	7.59a	7.96a	1.23b
OD_2	7.56a	7.84ab	1.19c
OD_3	7.56a	7.71b	1.09d
OD_4	7.44ab	7.26c	0.87e
OD_5	6.78c	6.79d	0.69f
OD_6	5.04d	6.09e	0.68g
P value	0.00	0.00	0.00
LSD value	0.34	0.19	0.25

The mean score of judge for flavor was progressively decreased from 7.9 to 6.2. The maximum mean score was recorded in OD_1 (7.9) followed by OD_2 (7.8), while the minimum mean score was recorded in D_0 (5.4) followed by OD_6 (6.0) (Table 2 and Figure 4B). Jain et al. (2003) reported that there were significant changes in flavor of mix fruit squash might be due to enzymatic and non-enzymatic reactions and presence of oxygen. Paracha, (2004) studied that during 3 months of storage interval flavor of guava squash was decreased.

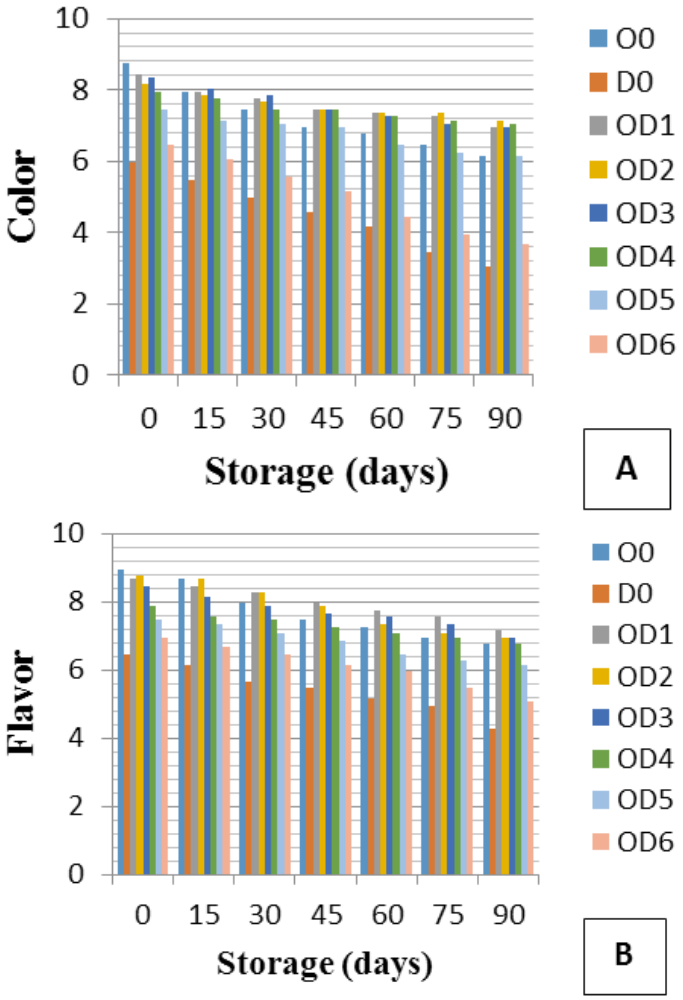

Figure 4: *Color (A) and Flavor (B) of Orange Date blended squash during storage.*

The mean score of judges for overall acceptability was decreased from 7.6 to 5.7. The maximum mean score was recorded in OD_2 (7.8) followed by OD_1 (7.6), while the minimum mean score was recorded in D_0 (4.4) followed by OD_6 (5.5) (Table 2 and Figure 5). According to (Rosario, 1996) the overall acceptability of squashes decreases with increasing days of storage period. Overall qualities were affected by temperature and storage (Hye et al., 2000).

The statistical analysis demonstrated that the treatments and storage had a significant ($p<0.05$) influenced on sensory properties of orange date blended squash at ambient temperature.

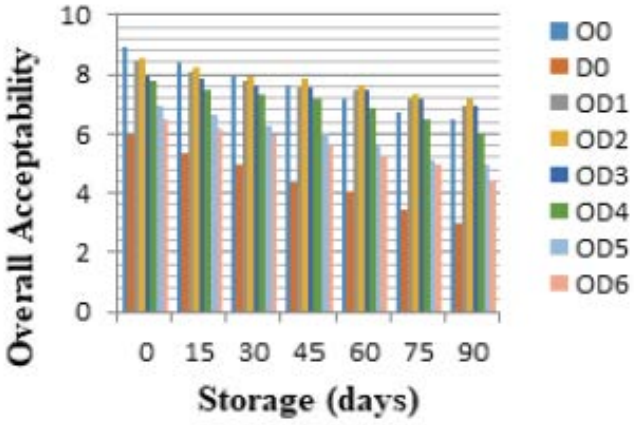

Figure 5: *Overall acceptability (A) of Orange Date blended squash during storage.*

Conclusions

This research was conducted for the preparation of orange date blended squash. This study demonstrated that the treatment $OD_2$with orange 80% and date 20%, have best results both in physico-chemically and organoleptically as compared to other treatments. In addition, it is suggested that further study should be carried out to test the commercial viability of this product.

Author's Contribution

Muhammad Adnan Khan: Designed and conducted the study and wrote the manuscript.
Majid Suhail Hashmi: Supervised the research, helped in designing the study and writing the manuscript.
Ali Muhammad: Co-supervised the research, helped in designing the experiments.
Muhammad Muneeb: Helped in writing the manuscript.
Haris Bilal: Assisted inlab work and data analysis.
Gul Wali: Did statistical analysis and helped in planning the experiments.

References

Akusu, O.M. and D.B. Kiin-Kabari. 2016. Quality characteristics of orange/pineapple fruit juice blends. Am. J. Food Sci. Tech. 4(2): 43-47.

Asgary, S. and M. Keshvari. 2013. Effects of *Citrus cinensis* juice on blood pressure. ARYA Atheroscler. 9: 98-101.

AOAC. 2012. Arlington Virginia. USA.

Bezman, Y., R.L. Russell and M. Naim. 2001. 2-Methyl-3-furanthiol and methional are possible off-flavors in stored orange juice. J. Agric. Food Chem. 49: 5425-5432. https://doi.org/10.1021/jf010724+

Bender, A.E., T. Wood and J.A. Palgrave. 1958. Analysis of tissue constituents. Extract of fresh ox-muscle. J. Sci. Food Agric. 9: 812-817. https://doi.org/10.1002/jsfa.2740091207

Carvalho, J.M., G.A. Maia and R.W. De-Figueredo. 2007. Development of a blended non-alcoholic beverage composed of coconut water and cashew apple juice containing caffeine. J. Food Qual. 30: 664-681. https://doi.org/10.1111/j.1745-4557.2007.00149.x

Chikkasubbanna, V. and A.H. Reddy. 2008. Standardization of recipe and storage behavior of lime blended amla squash. Asian J. Hortic. 3(2): 203-207.

Galaverna, G. and C. Dall'Asta. 2014. Production Processes of Orange Juice and Effects on Antioxidant Components. Elsevier, Amsterdam. 203-214. https://doi.org/10.1016/B978-0-12-404738-9.00021-0

Gupta, K., M. Tiwari and G. Sanadya. 2017. Quality assessment of fresh squashes through organoleptic analysis by hedonic test. Int. J. Curr. Microbiol. App. Sci. 6: 483-487. https://doi.org/10.20546/ijcmas.2017.609.058

Hashmi, M.S., S. Alam, A. Riaz and A.S. Shah. 2007. Studies on microbial and sensory quality of mango pulp storage with chemical preservatives. Pak. J. Nutr. 6: 85-88. https://doi.org/10.3923/pjn.2007.85.88

Hye, W.Y., C.B. Streaker, Q.H. Zhang and D.B. Min. 2000. Effect of pasteurized electric field on the quality of orange juice and comparison with heat pasteurization. J. Agric. Food Chem. 48: 4597-4605. https://doi.org/10.1021/jf000306p

Jain, S., A.P.K. Sankhla, A. Dashora and A.K. Sankhla. 2003. Physiochemical and sensory properties of orange drink. J. Food Sci. Tech. India. 40: 656-659.

Kareem, S.O. and A.A. Adebowale. 2007. Clarification of orange juice by crude fungal pectinase from citrus peel. Niger. Food J. 25(1): 130-137.

Kayshar, M., A.S. Rahman, M. Sultana, K. Fatima and M. Kabir. 2014. Formulation, preparation and storage potentiality study of mixed squashes from papaya, banana and carrot in Bangladesh.

Kinh, A.E., C.P. Shearer, S. Dunne and D.G. Hoo-

ver. 2001. Preparation and preservation of apple pulp with chemical preservatives and mild heat. J. Food Process. 28: 111-114.

Kotecha, P.M. and S.S. Kadam. 2003. Preparation of ready to serve beverage, syrup and concentrate from tamarind. J. Food Sci. Tech. 40: 76-79.

Kulkarni, S.G., P. Vijayan and L. Shubha. 2010. Effect of processing of dates into date juice concentrate and appraisal of its quality characteristics. J. Food Sci. Tech. 47:157. https://doi.org/10.1007/s13197-010-0028-y

Larmond, E. 1985. Lab methods of sensory evaluation of food. Can. Dept. Agric. Pub. 1282: 36-37.

Maia, G.A. and E. Cecilia. 2002. Storage stability of cashew apple juice preserved by hot fill and aseptic process. J. Food Sci. Tech. 42: 66-69.

Malav, M., R. Gupta and T. Nagar. 2014. Studies on biochemical composition of orange based blended RTS beverages. Biosci. Biotechnol. Res. Commun. 7(1): 78-83.

Muhammad, R., M. Ahmed, M.A. Chaudhry, B. Hussain and I. Khan. 1987. Ascorbic acid quality retention in orange squashes as related to exposure to light and container type. J. Pak. Sci. Ind. Res. 30: 480-483.

Nath, A., D.S. Yadav, P. Sarmaand, B. Dey. 2005. Standardization of ginger-kinnow squash and its storage. J. Food Sci. Tech. 42: 520-522.

Palaniswamy, K.P. and C.R. Muthukrishnan.1984. Studies on the physicochemical characters of mango squash during storage. India. Food Packer. 28(4): 37-41.

Paracha, G.M.U., A.B. Khattak, C.M. Ashraf, Z. Alam and A.W. Khalil. 2004. Development and storage stability of low caloric guava squash. Adv. Food Sci. 31(3): 127-131.

Ravishankar, L., S.P. Kumar and H.G. Sharma. 2015. Effect of Potassium Meta-bisulphite and Sodium Benzoate on Physico-Chemical Properties of Lime and Ginger Juice during Ambient Storage. 2(3): 49-297.

Rolle, A.C., V. Braesco, J. Chupin and L. Bouillot. 2016. Nutritional Composition of Orange Juice: A Comparative Study between French Commercial and Home-Made Juices. Food Nutr. Sci. 7: 252-261. https://doi.org/10.4236/fns.2016.74027

Rosario, M.J.G. 1996. Formulation of ready to drink blends from fruits and vegetables juices. J. Philippines 9: 201-209.

Sahu, C., P.L. Choudhary, L. Patel and R. Sahu. 2006. Physico-chemical and sensory characteristics of whey-based mango herbal (lemon grass) beverage. Ind. Food Pack. 60: 127-132.

Shaba, E., M.N. Damitso, J. Mathew, M. Etsunyakpa, A. Tsado and S. Muhammad. 2015. Nutritional and anti-nutritional composition of date palm (Phoenix dactylifera L.) fruits sold in major markets of Minna Niger State, Nigeria. Afr. J. Pure Appl. Chem. 9: 167-174. https://doi.org/10.5897/AJPAC2015.0643

Singh, S., U.S. Shivhare, J. Ahmed and G.S.V. Raghavan. 1999. Osmotic concentration kinetics and quality of carrot preserve. J. Food Res. Int. 32: 509-514. https://doi.org/10.1016/S0963-9969(99)00126-X

Steel, R.G.D. and J.H. Torrie. 1997. Principles and procedures of statistics with special reference to the biological sciences. J. Bio. Met. 4: 207 - 208.

Tasnim, F., H.M. Anwar, S. Nusrath, H.M.L.D. Kamal and H.K.M. Formuzul. 2010. Quality assessment of industrially processed fruit juices available in Dhaka city, Bangladesh. Malays. J. Nutr. 16: 431–438.

Tripathi, V.K., K. Lyndgoh and S. Singh. 1992. Studies on blending of pineapple juice with different ratio of guava juice for preparation of RTS beverage. Pro. Hort. 24: 60-65.