PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

Pakistan Journal of Nutrition 8 (6): 856-860, 2009
ISSN 1680-5194

The Studies on the Physico-Chemical and Organoleptic Characteristics of Apricot (*Prunus armeniaca* L.) Produced in Rawalakot, Azad Jammu and Kashmir During Storage

Saira Ishaq[1], Habib Ahmed Rathore[1], Saima Majeed[1], Siddique Awan[1] and Syed Zulfiqar Ali Shah[2]
[1]Department of Food Technology, [2]Department of Horticulture,
Faculty of Agriculture Rawalakot, University of Azad Jammu and Kashmir, Azad Jammu and Kashmir

Abstract: A highly significant effect ($p<0.05$) of storage period on physico-chemical characteristics and sensory parameters of Apricot fruit produced in Rawalakot areas of Azad Jammu and Kashmir was investigated at ambient temperature (Relative humidity 60-63% and temperature 28-30°C). The physico-chemical characteristics such as weight loss, total soluble solids, titratable acidity, ascorbic acid and sensory parameters like color, texture, taste, flavour and overall acceptability were studied at an interval of 2 days (0, 2nd, 4th, 6th, 8th and 10th day) for a total period of 10 days during storage. It was observed that there was an increasing trend of weight loss (0.00% at 1st day to 12.68% at 8th day of storage), gradual increase in TSS (11.8% at 1st day to 12.63% at 8th day of storage and then decreased to 5.22% at 10th day), decreasing trend of titratable acidity (0.94% at 1st day to 0.10% at 10th day) and ascorbic acid (14 mg/100 g at 1st day to 3.760 mg/100 g at 10th day). The organoleptic characteristics showed a gradual increase of colour scores (4.00 at 1st day to 5.25 at 8th day and at later stage this score was decreased to 1.97 at 10th day of storage), decrease of texture scores (7 at 1st day to 1.97 at 10th day) whereas, taste was increased to maximum scores (6.53 at 4th day and then decreased to 2.27 at 8th day of storage period), the flavour score was increased (5.00 at 1st day to 6.77 at 6th day and then decreased to 2.41 at 10th day of storage). The overall acceptability score was decreased with the passage of storage period and the highest overall acceptability score was 7.5 at 1st day in the fresh fruit that was reduced to a score 2.1 at the end of 10th day of storage.

Key words: Apricot, storage life, sensory evaluation, overall acceptability, titratable acidity, ascorbic acid

INTRODUCTION

Apricot (*Prunus armeniaca L.*) is the species of Prunus, classified with the Prunoidae subfamily of Rosaceae, family of the Rosales (Haydar *et al*., 2007). The apricot is native to central and western China. This fruit was brought to Italy about 100 B.C., to England in the 13th century and to North America by 1720 (Carlos and Adel, 1999). Turkey, Greece, Spain and France are major producers of this fruit (Ghorpade *et al*., 1995). In India, major apricot producing states are Jammu and Kashmir, Himachal Pradesh and Uttaranchal. Pakistan produces more than 10 million tons of fruits and vegetables annually. The area under cultivation of apricot is 29.3 thousand hectares and production is 177.2 thousand tons annually (Anonymous, 2007). Apricot fruits contain nutrient which can help in protection of heart and eyes, as well as disease fighting effects of fiber. The beta-carotene and lycopene activity of apricots may prevent the heart diseases. Apricots are a good source of fiber, which has a wealth of benefits such as prevent digestive condition called diverculosis. These fruits are antipyretic, antiseptic, emetic and ophthalmic (Pramer and Kaushal, 1982). Fruit of apricot is not only consumed fresh but also used to produce dried apricot, frozen apricot, jam, jelly, marmalade, pulp, juice nectar and extrusion products etc. Moreover, apricot kernel is used in production of oil, benzaldehyde, cosmetics, active carbon and aroma perfume (Yildiz, 1994). Apricot varieties grown in mid-hills and valley areas are not suitable for drying, due to low sugars and moderate to high acid contents (Sharma *et al*., 2004). Total production of apricot in Azad Jammu and Kashmir is 190 thousand tons annually (Anonymous, 2007) and apricot fruit produced in Rawalakot is highly nutritious and tasty when harvested but after harvesting due to the metabolic reactions, changes in quality of fruit occur. At present not only in Rawalakot but also, even in AJ and K unfortunately, no research work on changes in quality characteristics of apricot is available during storage. Therefore this study has been carried out to determine the physico-chemical and organoleptic characteristics of Apricot produced in Rawalakot, Azad Jammu and Kashmir during storage at ambient temperature.

MATERIALS AND METHODS

Collection of sample: Yellowish-green and firm ripe apricot fruit was directly harvested from farmer's field of Rawalakot, Azad Jammu and Kashmir. After collection, the fruit was immediately transferred to laboratory. The fruits were washed in running tap water, cleaned and dried with a piece of muslin cloth. After drying, sorted fruit was divided into equal lots, these lots were then

packaged in polyethylene and carton was stored at ambient conditions (Relative humidity 60-63% and temperature 28-30°C) during storage. The quality characteristics such as weight loss, total soluble solids, titratable acidity, ascorbic acid and sensory parameters like color, texture, taste, flavour and overall acceptability of apricot were determined by using standard procedures as described below.

Physical and chemical analysis

Weight loss: Fruits in each treatment were weighed by using electronic balance according to AOAC (1990).

Total soluble solids: Total soluble solids were determined by taking representative juice of each sample on hand refractometer, closing the lid and taking reading directly at room temperature according to AOAC (1990).

Titratable acidity %: Titratable acidity was determined according to AOAC (1990).

Ascorbic Acid (mg/100ml of fruit juice): Ascorbic acid was determined according to AOAC (1990).

Sensory evaluation: Samples were evaluated for colour, texture, taste, flavour and overall acceptability by a panel of five judges selected from the Department and nine point hedonic scales was used for sensory evaluation as described by Larmond (1977).

Statistical analysis: The data obtained was statistically analyzed using two-factor factorial in complete randomized design as described by Steel and Torrie (1980).

RESULTS AND DISCUSSION

Weight loss: Water is the most abundant nutrient in fruits. However, maximum amount of water content varies between individual fruit of same kind because of structural differences. It may also be affected by cultural conditions, which influence structural differentiation (Salunkhe *et al*., 1991). Weight is of great importance because it can cause fruit shriveling and advance senescence. It is mostly dependent on the relative humidity surrounding the fruit, but can also be associated with a slight reduction in flesh firmness (Antunes and Sfakiotakis, 1997 and Harris and Reid, 1981). A significant difference of weight loss in apricot fruit was observed during storage (Table 1). Data shows that there was an increasing trend of weight loss with the passage of storage period. The weight loss was ranged 4.78-12.68% during storage. The maximum weight loss 12.68% was observed at 8th day of storage as compared to 1st day having 0.000% weight loss. This increasing trend of weight loss might be due to respiration, transpiration of water and other biological changes taking place in the fruit during storage. These findings are corresponding with Agar and Polate (1995) who have observed an increasing trend in weight loss in all the three apricot varieties during storage. It was also observed that weight loss was decreased up to 3.63% at the end of storage due to spoilage of some samples at the 10th day of their storage.

Total Soluble Solids (TSS): Total Soluble Solids (TSS) of apricot fruits during its storage period are given in the Table 1. Generally there was gradual increase in TSS with the passage of time during storage. Data shows that TSS contents of the fresh apricot was 11.8% that was increased up to 12.63% at 8th day of storage and then decreased to 5.22% at the end of storage due to the spoilage of some samples of fruit. The increase in TSS content of apricot is might be due to the conversion of carbohydrates into sugars, organic acids and other soluble materials by metabolic process during storage. This result is in line with those of Agar and Polate (1995) who had observed that the TSS contents in different varieties of apricot were increased from 10.6-14% during storage, whereas, the decrease in TSS contents during storage might be due to the increase in respiration rate and conversion of sugars to carbon dioxide and H_2O at later stage of storage. First TSS increase and then decrease and again increase due to the hydrolytic change in starch and conversion of starch to sugar being an important index of ripening process in fruits (Arthey and Philip, 2005). In apricot main sugar is sucrose (Wills *et al*., 1983). Fruit contain starch, pectic material, disaccharides and monosaccharides such as the sugars like sucrose, fructose and glucose. The amount of each of these sugars drastically increased during ripening of fruit, because all of starch is fully hydrolyzed.

Titratable acidity: Titratable acidity is directly related to the concentration of organic acids present in the fruits. Organic acids exist as free acids, anions (malate) or combined as salt (potassium bitartarte) and esters such as isopentyle acetate (Kays, 1991). The results related to titratable acidity of apricot fruit during its storage are shown in (Table 1). The titratable acidity was higher (0.94%) in fresh fruit which was reduced to 0.101%, showing a decreasing trend with the passage of storage time. The decreasing trend of acidity during storage was might be due to the metabolic changes in fruits or was due to the use of organic acid in respiratory process that is in line with those of Echeverria and Valich (1989). These findings are also agreed with those of Agar and Polate (1995) who had observed that the titratable acidity was decreased from 1.4-0.8% in different varieties of apricot during storage.

Table 1: The effect of storage on the physico-chemical and organoleptic characteristics of Apricot produced in Rawalakot areas

	Storage (Days)					
Parameters	S_1	S_2	S_3	S_4	S_5	S_6
Weight Loss	0.0000 V	6.790 C	9.914 B	12.68 A	12.68 A	3.625 E
Total Soluble Solids	11.80 D	12.06 C	12.38 B	12.48 B	12.63 A	5.220 E
Titratable acidity	0.9400 A	0.8840 B	0.8260 C	0.7510 D	0.5417 E	0.1010 F
Ascorbic acid	14.00 A	12.78 B	11.73 C	10.77 D	9.530 E	3.760 F
Colour	4.000 D	4.313 C	4.777 B	5.240 A	5.253 A	1.979 E
Texture	7.000 A	6.302 B	5.866 C	5.555 D	5.062 E	1.971 F
Taste	5.000 E	5.835 C	6.532 A	6.431 B	2.275 F	5.265 D
Flavour	5.000 D	5.746 C	6.113 B	6.775 A	5.819 C	2.410 E
Overall acceptability	7.500 A	6.820 B	6.190 C	5.540 D	4.860 E	2.100 F

•S_1 = 2nd day, S_2 = 4th day, S_3 = 6th day, S_4 = 8th day, S_5 = 10th day.
•Means followed by the same alphabets are not significantly different from one another based on alpha

Ascorbic acid: The data on ascorbic acid of apricots is summarized in Table 1. It was observed that freshly harvested fruits contain ascorbic acid 14 mg/100 g which is an agreement with (Zudeckis, 1962; Wenkam, 1979; Arthey and Philip, 2005) who have described that range of ascorbic acid in fresh apricot is 6-14.3 mg/100 g. In our studies, the ascorbic acid in apricot fruit was reduced from 14 mg/100 g-3.760 mg/100 g during storage. That was showing a decreasing trend of ascorbic acid with the advancement of storage period that might be due to the conversion of dehydroascobic acid to diketogulonic acid by oxidation (Rai and Saxena, 1988). These findings are also in line with those of Lee and Kader (2000) who had reported that when the storage temperature or duration was increased, a gradual decrease in ascorbic acid content in those fruit was observed.

Colour: Appearance is a major determinant of quality. So, colour is the function of light striking the product, the differential reflection of certain wavelengths and their visual perception. The colour of plants is contributed by plant pigments, which are classified into four main categories based on their chemistry chlorophylls, carotenoids, flavonoids and betalains. Data pertaining to colour scores in (Table 1) revealed that the apricot fruits generally showed a gradual increase of colour score and at later stage this score was decreased with the advancement of storage time. The general range of colour score was noted from 4.00-5.94 during 10 days of storage period. It was observed that colour score was increased up to 5.25 at 8th day of storage and then decreased to 1.97 at 10th day of storage. The increase in colour score during storage might be due to the conversion of chlorophyll, the green colour of fruits, into carotenoid pigments by biochemical reactions. These results are in agreement with those of Wills *et al*. (1989) who described that the principle agents responsible for this degradation are pH changes, oxidation systems and chlorophyllases. Due to the degradation of chlorophyll, the carotenoid pigments become visible. Therefore, colour changes in ripening fruit have been correlated by the consumer with the conversion of starch to sugar that is, sweetening and the development of other desirable attributes so that the correct skin colour is often all required for a decision to purchase the commodity (Wills *et al*., 1989).

Texture: Fruit firmness is one of the important factors in determining the post harvest quality of fruits (Shear, 1975) and therefore, firmness could also be used as index for fixing optimum stage of maturity for harvest (Kudachikar *et al*., 2001). Pectic substances are structural polysaccharides responsible for the firmness of fruits and softening of fruit occurs when these pectin polymers become less tightly bound in the cell walls during ripening. Table 1 is related to the texture scores of apricot during its storage period and data shows gradual decrease of texture scores in all treatments with the passage of time. The highest texture score (7) was observed in the fresh fruit at 1st day of storage that was reduced to a score (1.97) at the end of storage. In our studies the reduction of texture score during storage is might be due to the degradation of pectic substances and the maximum changes may be attributed to minimum texture score at the end of storage. That is in agreement with other scientists who have described that degradation of pectic substances is related to the rate of softening of fruit (Wills *et al*., 1989) and softening of fruits is caused either by breakdown of insoluble protopectin, soluble pectin or by cellular disintegration leading to increased membrane permeability (Mattoo *et al*., 1975; Arthey and Philip, 2005). These changes occur due to non-sterilization caused by the enzyme pectin ametilestarase followed by a depolymerization induced by activity of polgalacturonase that caused a decrease in total pectin content (Pressey and Avants, 1982).

Taste: Taste is one of the important sensory property which is attributed to the presence of certain soluble constituents of the food that reach to the sensitive taste buds through film of saliva covering of tongue and other soft internal surface of mouth. It is relatively simple sense producing only four type of sensation: - those of

sweetness, saltiness, sourness and bitterness. The main chemical agents responsible for these sensation respectively sugar, salt, titratable acid and heterogenous collection of bitter principle including alkaloids (Duckworth, 1966). The amounts of sugars and organic acids and their ratios have been correlated with some of the sensory properties of fruits (Colaric *et al*., 2005). Results presented in Table 1 show mean values of taste scores of apricot during storage. It is cleared that taste score was increased to maximum score 6.53 at 6th day of storage and then decreased 2.27 at 8th day of storage period. The increase in the taste of apricot is might be due to the increase of the sugars like sucrose, glucose and fructose by metabolic changes occur during storage. Dolaric-Sturm *et al*. (1999) showed that in sensory and chemical evaluations of apricot fruits, the individual sugars and organic acids as well as their ratio could be crucial in determining taste of fruit. The other scientists also confirm our findings who have described that organic acids play an important role in fruit taste through sugar/acid ratio. Sugar provides sweetness and the organic acids sourness. The main organic acids present in fruit are citric and malic acids. Increasing and slightly decrease in taste score of may be conversion of starch/organic acid into sugars as occur in ripening stage (Arthey and Philip, 2005) whereas, the degradation of structural polysaccharides and carbohydrates into other simple compounds had reduced the taste of fruit at later stage during storage. These findings are in line with those of Kays (1991) who mentioned that decreased in taste score may be due to the formation of phenolic compounds.

Flavour: Flavour is a combination of taste, smell, touch and those of sensations which are attributable to stimuli affecting the nerves of common sensibility viz., temperature. Taste and smell are considered to be chemical senses as these are arisen by chemical stimuli (Bhutani, 2003). Data related to the flavour of apricot fruits during storage is presented in (Table 1). Data clearly revealed that there was an increasing trend of flavour score in apricot fruit with the passage of storage time and after that slightly decrease in flavour score was observed at the end of storage. The maximum flavour score (7.31) was recorded at the 6th day of storage and then decreased to 5.87 at the end of storage at 10th day. The increase in flavour scores of apricot during storage might be due to the formation of organic acids, alcohols, soluble sugars and other volatile essential compounds etc. attributes to increase in flavour of fruit during storage. Whereas, degradation of all these compounds into CO_2, water, ethylene and other phenolic compounds may cause a decrease in flavour at later stage of storage. These results are in agreement with those of Arthey and Philip (2005) who have described that there are four main groups contributing to the flavour characteristics in fruits. These are organic acids, sugar and bitter and volatile flavour constituents. The organic acids are usually citric, malic and these provide tartness in flavour. The sugar contributes sweetness and bitter related to phenolic compounds.

Overall acceptability: Results pertaining to overall acceptability of apricot fruits at room temperature during its storage periods are shown in (Table 1). The overall acceptability score was decreased with the passage of storage periods. The highest overall acceptability score (7.5) was observed in the fresh fruit at 1st day of storage that was reduced to a score (2.1) at the end of 10th day of storage. The reduction in overall acceptability of apricot fruit might be due to the metabolic changes occur in structural polysaccharide and reduction of sugars, organic acids etc. might have reduced the taste of the fruit during storage. The evaporation of water from fruit during storage may be the other reason of the reduction of overall acceptability of fruit.

REFERENCES

Agar, T. and A. Polate, 1995. Effect of different packing materials on the storage quality of some apricot varieties. Acta Hort., 384: 625-631.

Anonymous, 2007. Agriculture Statistics of Pakistan. Ministry of Food, Agriculture and Livestock Division. Islamabad, pp: 9.

Anonymous, 2007. Azad Government of the state of Jammu and Kashmir, Azad Kashmir at A Glance. Planning and Development Deparment http://www.pndajk.gov.pk.

Antunes, M.D.C. and E.M. Sfakiotakis, 1997. The effect of controlled atmosphere and ultra low oxygen on storage ability and quality of 'Hayward' kiwifruit. Acta Hort., 444: 613-618.

AOAC, 1990. Official Method of Analysis, Association of Analytical Chemists. Ed 16th, Arlington Virginia, USA.

Arthey, D. and R.A. Philip, 2005. Fruit Processing Nutrition, Product and Quality Management, Ed 2nd Brijbasi Art Press Ltd. India, pp: 45.

Bhutani, R.C., 2003. Fruit and Vegetable Preservation. Ed 2nd Biotech Books, Dehli.

Carlos, H. and K.A. Adel, 1999. Apricot Post Harvest Quality Maintenance Guidelines, California Deptt. of Pom., pp: 1-5.

Colaric, M., R. Veberic, F. Stampar and M. Hudina, 2005. Evaluation of peach and nectarine fruit quality and correlation between sensory and chemical attributes. J. Sci. Food and Agri., 85: 2611-2616.

Dolaric-Sturm, K., F. Stampar and V. Usenik, 1999. Evaluating of some quality parameters of apricot cultivars using HPLC method. Acta Alimentaria, 28: 297-309.

Duckworth, R.B., 1966. Fruits and Vegetables. Pergamon Press Limited. ISBN 0080119735.

Echeverria, E. and J. Valich, 1989. Enzymes of sugar and acid metabolism in stored Valencia organs. J. Am. Soc. Hort. Sci., 114: 445-449.

Ghorpade, V.M., M.A. Hanna and S.S. Kadam, 1995. Apricot In: Handbook of Fruit Science and Technology. Salunkhe D. K., S.S. Kadam (Eds). Marcel Dekker Inc., New York.

Harris, S. and M.S. Reid, 1981. Techniques for improving the storage life of kiwifruit (*Actinidia chinensis*). Publication G120, Auckland Indus. Develop. Division, DSIR, Auckland, New Zealand.

Haydar, H., G. Ibrahim, O.M. Mehmet and M. Bayram, 2007. Post harvest chemical and physical-mechanical properties of some apricot varieties cultivated in Turkey. J. Food Eng., 79: 364-373.

Kays, S.J., 1991. Post Harvest Physiology of Perishable Plant Products. Vas Nostrand Rein Hold Book, AVI Publishing Co., pp: 149-316.

Kudachikar, V.B., S.G. Kulkarni, M.S. Vasantha, B.A. Prasad and K.V.R. Ramana, 2001. Physico-chemical changes during maturity of mango (*Mangifera indica* L.) variety "Neelum". J. Food Sci. Technol., 38: 540-542.

Larmond, E., 1977. Laboratory Methods for Sensory Evaluation of Foods Research Branch Canada. Deptt. Agri. Publication, pp: 1637.

Lee, S.K. and A.A. Kader, 2000. Pre harvest and post harvest factors influencing vitamin C content of horticultural crops. Post harvest Biol. Technol., 20: 207-220.

Mattoo, A.K., T. Murata, E.B. Pantastico, K. Chachin, K. Ogata and C.T. Phan, 1975. Chemical Changes during Ripening and Senescence. In: Post Harvest Physiology, Handling and Utilization of Tropical and Subtropical Fruits and Vegetable. Pantastico E.B. (Ed.) AVI Publication, Westport, Connecticut, pp: 103-127.

Pramer, C. and M.K. Kaushal, 1982. Wild fruits of Sub-Himayalyan Region Kalyani Publishers, New Delhi, India.

Pressey R. and J.K. Avants, 1982. Solubilization of cell walls by tomato polygalacturonases: effects of pectinesterases. J. Food Bioch., 6: 57-74.

Rai, R.D. and S. Saxena, 1988. Effect of storage temperature on vitamin C content of mushrooms (*Agaricus bisporus*). Current Sci., 57: 434-435.

Salunkhe, D.K., H.R. Bolin and N.R. Reddy, 1991. Storage, Processing and Nutritional Quality of a fruits and Vegetables. Volume 1, Ed 2nd, CRC Press, Boca Raton Floride.

Sharma, K.D., R. Kumar and B.B. Kaushal, 2004. Mass transfer characteristics, yield and quality of five varieties of osmotically dehydrated apricot. J. Food Sci. Technol., 41: 264-275.

Shear, C.B., 1975. Calcium related disorders of fruits and vegetables. Hort. Sci., 10: 361.

Steel, R.G.D. and J.H. Torrie, 1980. Principles and Procedures of Statistics. McGram Hill Book Co. New York,USA pp: 134-145.

Wenkam, N.S., 1979. Nutritional Aspect of Tropical plant Foods. In: Inglett, G.E., Charalambous, G. (Eds.), Tropical Food: Chemistry and Nutrition, Academic Press, New York, USA, pp: 341-350.

Wills, R.B.H., W.B. Mcglasson., D. Graham., T.H. Lee. and E.G. Hall, 1989. An Introduction to the Physiology and Handling of Fruit and Vegetables. Oxford, London, Edinburgh, Boston, Melbourne. BSP Professional Books.

Wills, R.H.H., F.M. Scriven and H. Green, 1983. Nutrient composition of stone fruit (*Prunus* spp.) cultivars: apricot, cherry, nectarine, peach and plum. J. Sci. Food Agri., 34: 1383-1389.

Yildiz, F., 1994. New Technology in Apricot Processing. J. Standard Apricot Special Issue Ankara pp: 67-69.

Zudeckis, E., 1962. Ascorbic Acid Content of Fruit grown at Vineland, Ontario. In: 1962 Report of the Horticultural Experiment Station and Products Laboratory, Vine Land, Canada, pp: 90-96.