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Effect of various drying techniques on certain characteristics of apricot fruit

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Abstract

Man is innovating new tools and techniques to fulfill nutritional and food safety concerns for the growing population. Six drying methods were applied on apricot fruit to analyze their effect on certain characteristics of dried samples**.** The findings for open shade drying, open sun, sulfuring, solar house, portable solar house and cabinet drying for moisture content were 13.3±0.06, 11.3±0.12, 18.90±0.10, 7.7±0.06, 13.0±0.06, 11.0±0.10g/100g, pHfoundas4.00±0.00, 3.00±0.00, 3.00±0.00, 3.00±0.00, 4.00±0.00, 3.00±0.00), ascorbic acid determined as 42.00±0.00, 35.00±3.46,47.00±0.00, 38.67±2.89,37.00±0.00, 38.67±2.89 mg/100g,titratable acidity was 3.07±0.40, 3.53±0.40, 3.77±0.40, 3.53±0.40, 3.07±0.40, 4.20±0.35%, Ash content estimated as 11.05±0.15, 10.81±0.09, 10.77±0.08, 10.64±0.09, 10.71±0.03, 9.27±0.11%, reducing sugars results were 18.99±0.45, 20.91±1.04, 24.73±1.10, 21.40±2.97, 22.72±0.94, 22.39±1.05% while on reducing sugars assessed were 45.37±1.12, 39.04±0.99, 33.20±1.83, 41.40±2.05, 40.27±22.72, 35.75±2.09% and total sugars were 64.36±1.57, 59.95±1.13, 57.93±2.21, 62.80±2.97, 62.99±1.64 and 58.14±1.21%.

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Introduction

The day by day increase in population and elevation in food demand is a challenging issue for the growers, producers and food processors. The drying technique is one of the cheapest and oldest techniques of food preservation practiced by man. This technique involves removal of large amount of water present in a food by the use of heat under controlled environment, with the purpose to reduce the chemical, enzymatic and microbiological agents which are responsible to reduce the shelf life the foods commodities (Yousefi *et al.*, 2013).

Apricot *(Prunus armeniaca* L*)* is a major stone fruit, highly nutritious agricultural product widely grown in Pakistan especially in the extreme northpartie Gilgit-Baltistan (GB) and in few other regions of the country (Ishaq *et al.*, 2009). Our country ranks 5^{th} position regarding fresh apricot production. The annual production of apricot in Gilgit-Baltistan is about107737 metric tons and almost sixty varieties exist in this zone (FAO, 2005; DOA, 2009).

The widely grown fruit is full of nutrients which are compulsory for healthy life. It possess significant amount of crucial minerals which acts as structural components in macromolecules and play vital roles in regulating many metabolic processes. Researchers have confirmed the presence of phosphorus, potassium, calcium, sodium, magnesium, iron, manganese, zinc, copper and selenium in the fruit (Leccese *et al.*, 2010; Lichou *et al.,* 2003). Experiments for the presence of vitamins revealed that it is a rich source of pro-vitamin A, C, K, E, and vitamin B-complex (Chauhan *et al.*, 2001).

The highly nutritious fruit is also a good source of organic acids carrying tartaric, succinic, oxalic, galacturonic, quinic, malonic, acetic and fumaric acid (Hasib *et al.,* 2002),while malic acid and citric acid as the predominant acids. Fats and proteins are in small amount in fruit flesh, in spite of its low protein content it supplies essential amino acids to the body (Gurrieri *et al.*, 2001). Numerous factors are responsible for post-harvest losses of apricot i.e storage, handling, climatic conditions, harvesting and microorganisms.

Due to the climacteric property of apricot it ripens fast consequently, flesh softens, internal browning and breakdown of tissues occur which makes the fruit prone to post harvest decay and spoilage (Egea *et al.*, 2006). The fruits internal browning and breakdown of tissues are main physiological problems in apricot which reduces its shelf life. Breakdown of tissues result in release of phenolic compounds, enzymes and carotenoids that are present inside the fruits cells. With increase in metabolic activity these contents further breakdown leading in to loss of quality and quantity (Manolopoulou and Mallidis, 1999).

Each and every part is an essential ingredient for health, food and feed products but due to lack of awareness and appropriate drying techniques many produce of this fruits are going wasted in the Gilgit-Baltistan region of Pakistan. It is of great importance for the region according to economic point of view and large number of people relies on this fruit to fulfill their basic needs. Usually they are dried in the open air to keep them for winter use. The open air drying technique is not as suitable as the products to prevent from waste and keep the appearance to enhance the market value.

Material and methods

The present research was conducted in the lab of Agriculture and food technology Karakoram international University Pakistan. The fully ripened apricot fruits were purchased from the local market and dried by using six different drying methods and evaluated for Moisture content, pH, Ascorbic acid, Titratable acidity, Ash content, Total sugars, Reducing sugars and Non reducing sugars

Moisture Content

Moisture content of apricot fruit was determined in duplicate by modification of the vacuum oven method of AOAC (2005). Samples were heated for 24 hrs at 60 °C. After cooling the weight of the sample was taken again. This was obtained until a constant weight was achieved.

Moisture content was calculated by following formula.

Moisture%

$$= \frac{\text{Weight of sample} - \text{weight of sample after drying}}{\text{Weight of sample}} \times 100$$

pH

pH of dried apricot was determined by a pH meter (Model: Inolab) according to AOAC, (2005) method No. 981.12. Before taking readings, pH meter electrode were rinsed with distill water and then calibrated with buffer of pH 4 and 7. Then electrode was dried with soft tissue paper before taking reading

Ash Content

Ash content of the dried apricot was determined by AOAC, (2005), method No. 940.26. Fruit sample of 5g was weighed and taken in a porcelain dish. The dish with the contents was put in a muffle furnace at 100C^{o} for removal of moisture and the temperature was gradually increased at 50 C^{o} after every one hour and maintained at 500-550 c^{o} for 4 to 5 hours till the complete burning of contents to white ash. After complete ashing, the dish was cooled and weighed to determine ash content on percent basis.

Titratable acidity (%)

Titratable acidity was measured by standard method given by AOAC, (2006). To determine titratable acidity about 10ml juice from samples were taken separately in 100ml volumetric flasks and volumes were made up to 100ml with distilled water. (10ml) of diluted sample was taken in a conical flask separately and 2-3 drops of phenolphthalein was added as an indicator and diluted samples were titrated against 0.1N NaOH solution until the achievement of light pink color which remained for 15-20 seconds. The ml of 0.1N NaOH used was noted for the entire samples and acidity was calculated by following formula:

$$\text{Acidity\%} = \frac{F \times T \times 0.1N\ NaOH}{L \times M} \times 100$$

F =Factor of acid (citric acid) T = ml of 0.1 N NaOH solution used. M = ml of diluted sample taken for titration. L = sample taken for dilution.

Ascorbic acid

Ascorbic acid was determined with the help of standard method described in AOAC (2006). Standard dye solution was prepared by weighing 50mg of 2, 6 dichlorophenol indophenol dyes and 42 mg of sodium bicarbonate and was dissolved in hot distilled water and volume was also made up to 250 ml with distilled water. 50mg of standard ascorbic acid was also weighed in a 50ml volumetric flask and its volume was made with 0.4% oxalic acid to make a standard ascorbic acid solution. Fruit samples were prepared by extracting juice from 100g of sample with a small amount of oxalic acid. The juice was kept in a conical flask for 30 minutes for sedimentation and non-sediment layer of juice was transferred to 100ml volumetric flask and volume of each sample was made with 0.4% oxalic acid for dilution. 10ml of each sample and standard ascorbic acid solution was titrated against dye solution until or unless pink color appeared. Ascorbic acid was calculated by using the following formula:

$$\text{Ascorbic acid (mg/100g)} = \frac{F \times T \times 100 \times 100}{S \times D}$$

Where, F = Factor from standardization = ml of Ascorbic acid / ml of Dye; T = ml of Dye used in sample. S = ml of diluted sample taken for titration. D = ml of sample diluted by oxalic acid.

Total sugar

Total sugar content was determined by the method as described by AOAC (2005), method No. 925.36. Ten gram fruit sample was transferred to a beaker and diluted to 100 mL with hot water. The mixture was mixed thoroughly and to dissolve the contents and filtered with a cotton cloth in 250 mL volumetric flask. 100 mL of this solution along with 10 mL diluted hydrochloric acid was taken in a conical flask. The contents were boiled for 5 mints, cooled and neutralized with 10 mL NaOH. The volume of the solution was made up to 250 mL in a volumetric flask. Titration was made with Fehling's solution and was determined on percent basis by the following formulas.

Non Reducing Sugar (%) = Total Sugars – Reducing Sugar

Statistical analysis

Statistic software 8.1 (Analytical Software, USA) was used for all statistical calculations.

Results and discussion

pH

pH represents the hydrogen ion concentration of a product and it decreases with the ripening process of the fruit. Shade and open drying methods showed highly significant results (4.00±0.00) for pH analysis. While testing other techniques i.e. cabinet drying, solar house drying, sulfuring and Portable drying showed similar outcomes of pH (3.00±0.00) which revealed that these techniques non significantly affected the pH results. Shade and open sun drying techniques confirmed maximum change in the pH as compare to the other drying methods (Table 1). The current research work results are in agreement with the findings of Owais, (2007), Sarojini *et al.* (2009) and Chauhan *et al.* (2001).

Table 1. Effect of drying techniques on the physicochemical properties of dried apricot fruits.

Variable	pH	Ascorbic acid mg/100g	Titratable acidity%	Moisture content/100g
Shade drying	4.00±0.00a	42.00±0.00b	3.07±0.40b	1.33±0.06b
Cabinet drying	3.00±0.00b	38.67±2.89bc	4.20±0.35a	1.10±0.10c
Solar house drying	3.00±0.00b	37.00±0.00cd	3.53±0.40ab	0.77±0.06d
Sulfuring	3.00±0.00b	47.00±0.00a	3.77±0.40a	2.00±0.10a
Open Sun drying	4.00±0.00a	35.00±3.46d	3.53±0.40ab	1.13±0.12c
Portable Solar house drying	3.00±0.00b	38.67±2.89bc	3.07±0.40b	0.13±0.06e
LSD (P = 0.05)	0.00	3.43	0.68	0.12

Values are means± standard deviations. Values in column with different letter superscripts are significantly different at $p<0.05$.

The results pertaining to ascorbic acid of dried apricot fruit showed a different content due to the effect of different drying techniques. The sulfuring method established highly significant (47.00±0.00) effect on ascorbic acid content of apricot fruit. The shade drying, cabinet drying and portable drying practices showed significant (42.00±0.00, 38.67±2.89, 38.67±2.89) effect on the ascorbic acid content. The solar house drying techniques confirmed moderately significant (37.00±0.00) outcomes while open sun drying techniques affected slightly significant (35.00±3.46) on ascorbic acid content (Table 1). Akin *et al.* (2008) reported rich content of ascorbic acid in apricot fruits (20.6-96.80 mg/100g DW). The current research work findings are closely resembles with the study of Haciseferogullari *et al.* (2007).

Titratable acidity indicates the organic acid concentration. Apricot possesses malic acid as the major organic acid followed by citric acid (Gurrieri *et al.*, 2001).

The cabinet, sulfuring solar and open sun drying methods effected high significantly (4.20±0.3, 3.77±0.40 (3.53±0.40, 3.53±0.40) on the titratable acidity content of the fruit. The shade and portable drying methods affected significantly on the results (3.07±0.40, 3.07±0.40) (Table 1). Titratable acidity is normally high at mature stage when fruit is plucked out from the tree, where the maximum concentrations of organic acids are reported. Usually fruit composition is also related to species and agro-climatic conditions and harvesting stage, in dried apricot their concentration is minimized (Botondi *et al.*, 2004; Palou and Crisosto, 2003). During ambient storage of dried apricot fruit macromolecules break into smaller constituent to release energy. Main organic acids in apricot have been identified as malic, citric and oxalic acids respectively (Yousefi *et al.*, 2013; Hasib *et al.*, 2002).

Moisture content below 15% for most fruits is recommended as safer against deteriorative processes like sugar crystallization, non-enzymatic browning, oxidation of lipids and many more unwanted reactions (Suna *et al.,* 2014).

The results showed that the Sulfuring method effected moisture content of the fruit high significantly (18.90±0) while shade drying technique established significant (13.30±0.06) effect on the moisture results of the fruit (Table 1). The Cabinet and Open Sun drying procedures showed moderately significant (11.00±0.10) effect on the moisture content of the apricot fruit while the Solar House drying technique showed slightly significant (7.70±0.06d) effect while the Portable Solar House drying technique confirmed the non-significant effect on the tested parameter (13.0±0.06) Suna *et al.* (2014) and Cafindi and Otles, (2005) reported moisture content between 13.12-14.39g/100g and 13.0-18.3% in dried apricot while, Torley *et al.* (2006) found 7.4-18% moisture in commercially available fruit leathers.

The results for ash content using shade drying technique showed highly significant (11.05±0.15) effect, while the Open Sun drying technique showed significant (10.81±0.09) effect on ash content of the dried fruit (Table 2). The solar house drying technique showed moderately significant (10.64±0.09) outcome, while the cabinet dryer effect was slightly significant (9.27±0.11) on the tested parameter. The current research works findings are in agreement with the results of Sartaj *et al.* (2014). Their assessment for the ash content of six indigenous apricot varieties from Gilgit-Baltistan ranged from 8.20-12.10%.

Table 2. Effect of drying techniques on the physicochemical properties of dried apricot fruits.

Variable	Ash content%	Reducing sugars%	Non reducing sugars%	Total sugars%
Shade drying	11.05±0.15a	18.99±0.45c	45.37±1.12a	64.36±1.57a
Cabinet drying	9.27±0.11d	22.39±1.05b	35.75±2.09dc	58.14±1.21c
Solar house drying	10.64±0.09c	21.40±2.97b	41.40±2.05ab	62.80±2.97ab
Sulfuring	10.77±0.08bc	24.73±1.10a	33.20±1.83d	57.93±2.21c
Open Sun drying	10.81±0.09b	20.91±1.04bc	39.04±0.99bc	59.95±1.13bc
Portable Solar house drying	10.71±0.03bc	22.72±0.94b	40.27±22.72bc	62.99±1.64ab
LSD (P = 0.05)	0.16	1.93	4.79	3.61

Values are means± standard deviations. Values in column with different letter superscripts are significantly different at $p<0.05$.

According to the results for reducing sugars sulfuring drying method showed highly significant (24.73±1.10) effect on the tested parameter of the samples, while the cabinet, solar house and portable solar house drying methods showed significant (22.39±1.05, 21.40±2.97, 22.72±0.94) effect on the reducing sugars of apricot fruit (Table 2). The Shade dryer technique showed moderate significant (18.99±0.45) effect on the results regarding reducing sugar content of the tested samples. A slight decline in reducing sugars in fresh apricots caused by continuous respiration consequently sugars are utilized as substrates (Gupta and Jawandha, 2010). The results were also comparable with earlier studies by Leccese *et al.* (2010) and Sarojini *et al.* (2009).

The results for non-reducing sugars using Shade drying technique was highly significant (45.37±1.12), while the Solar house dryer showed the highly significant and moderately significant (41.40±2.05) effect on the non-reducing sugar of dried apricot (Table 2).

The other drying techniques as Open Sun and Portable Sun dryers were the significant and moderately significant effect (39.04±0.99, 40.27±22.72) on the tested parameter of the samples while the Sulfuring technique showed slightly significant (33.20±1.83) effect on the non-reducing sugar of the dried apricot. Our finding is in agreement with the previous studies of Haciseferogullari *et al.* (2007), Chauhan *et al.* (2001) and Gurrieri *et al.* (2001).

The outcomes for total sugars shows that among different drying techniques highly significant estimation were observed in shade drying method (64.36±1.57). while the solar house and Portable solar house drying methods effects ranged between highly significant and significant (62.80±2.97), and the open Sun drying techniques effect varied between significant and moderately significant (59.95±1.13) on the total sugar content of the samples, while the cabinet dryer and the sulfuring techniques showed moderately significant (57.93±2.21) effect on the tested parameter of the samples (Table 2). The current investigations outcomes are in agreement with the previous studies carried out by Haciseferogullari *et al.* (2007), Chauhan *et al.* (2001), Gurrieri *et al.* (2001) and Leccese *et al.* (2010).

Conclusion

Abruptly increasing population needs both quantity and quality of nutritional food. The study concluded that among the six various applied techniques, portable solar house, solar house and open shade drying methods showed better results in terms of minimum loss of tested parameters and are recommended for the production of dried apricot of good quality for small and commercial scale.

References

Akin EB, Karabulut I, Topcu A. 2008. Some compositional properties of main Maltaya apricot (*Prunus armeniaca*) varieties. Food Chemistry **10,** 1016-1026.

AOAC. 2005. Official Methods of Analysis of Association of Official Analytical Chemists 15th Edi. Washington, DC.

AOAC. 2006. Official methods of analysis the Association of Official Analytical Chemists. 18th ed. The Association of Official Analytical Chemist, Arlington, USA.

Botondi R, DeSantis D, Bellicontro A, Vizovitis K, Mencarelli F. 2003. Influence of ethylene inhibition by 1-methylcyclopropene on apricot quality, volatile production, and glycosidase activity of low-and high aroma varieties of apricots. Journal of Agricultural and Food Chemistry **51,** 1189-1200.

Cafindi O, otles S. 2005. Comparison of some properties on the different types of pestil: a traditional product in Turkey. International Journal of food Science and Technology 897-901.

Chauhan SK, Tyagi SM, Singh D. 2001. Pectinolytic liquefaction of apricot, plum, and mango pulps for juice extraction. International Journal of Food properties **4,** 103-109.

DOA. 2009. Department of Agriculture Gilgit-Baltistan. Gilgit-Baltistan, Agriculture Statistics. Survey Report Pp-7.

Egea MI, Martinez-Madrid MC, Sanchez-Bel P, Romojaro F. 2006. Influence of different storage treatments on antioxidant systems of apricot var. 'Bulide'. Acta Horticulturea **717,** 337-341.

FAO. 2005. Food and Agriculture Organization and United States Department of Agriculture (USDA). Foreign Agricultural Service, Attache Reports.

Gupta N, Jawandha SK. 2010. Influence of Maturity Stage on Fruit Quality during Storage of 'Earli Grande' Peaches Not Science Biology **2,** 96-99.

Gurrieri F, Audergon JM, Albagnac G, Reich M. 2001. Soluble sugars and carboxylic acids in ripe apricot fruit as parameters for distinguishing different cultivars. Euphytica **117,** 183-189.

Haciseferogullari H, Gezer I, Ozcan MM, Murat AB. 2007. Postharvest chemical and physical-mechanical properties of some apricot varieties cultivated in Turkey. Journal of Food Engineering **79,** 364-373.

Hasib A, Jaouad A, Mahrouz M, Khouili M. 2002. HPLC determination of organic acids in morocanapricots. Cien Technology Aliment **3,** 207-211.

Ishaq S, Rathore HA, Majeed S, Awan S, Shah ASZ. 2009. The Studies on the Physico-chemical and Organoleptic Characteristics of Apricot (*Prunus armeniaca* L.) Produced in Rawalakot, Azad Jammu and Kashmir During Storage. Pakistan Journal of Nutrition **8,** 856-860.

Jaswer I, Che-Man YB, Yusof S, Selamat J, Sugissawa H. 1998. Effect of glucose syrup solid, sucrose, hydrogenated palm oil and soylecithin on sensory acceptability of durian leather. Journal of food process pres **22,** 13-25.

Leccese A, Bureau S, Reich M, Renard MGCC, Audergon JM, Mennone C, Bartolini S, Viti R. 2010. Pomological and Nutraceutical Properties in Apricot Fruit: Cultivation Systems and Cold Storage Fruit Management. Plant Foods Humun Nutrition Doi: 10.1007/s11130-010-0158-4.40.

Lichou J, Jay M, Vaysse P, Lespinasse N. 2003. Reconnaitre les varietesd' abricots. Editions Ctifl, France.

Manolopoulou H, Mallidis C. 1999. Storage and processing of apricots. Acta Horticulturea **488,** 567-576.

Owais SJ. 2007. Physical and chemical characteristics of apricot fruits grown in Southern Jordan. Jordan Journal of Agricultural Sciences **3(3)**.

Palou L, Crisosto CH. 2003. Postharvest treatments to reduce the harmful effects of ethylene on apricots. Acta Horticulturea **599,** 31-38.

Sarojini G, Veena V, Rao MR. 2009. Studies on fortification of solar dried fruit bars. Society for energy and environment and development. International solar food processing conference pp. 2-9.

Sartaj A, Tariq M, Kashif S. Abbasi, Talat M, Amjad A. 2014. Some physico-chemical and functional attributes of six indigenous apricot genotypes from Gilgit-Baltistan, Pakistan. International Journal of Biosciences **4,** 221-231.

Suna S, Ece T, Bige I, Gulsah OS, Omer UC. 2014. Impact of drying methods in physicochemical and sensory properties of apricot pestil. Indian Journal of traditional knowledge **13,** 47-55.

Torley PJ, De-Boer J, Bhandari BR, Halley PJ. 2006. Composition-rheology-property relationships of commercial fruit leathers, proceedings of the 4th international symposium in food rheology and structure, Switzerland Feb 20-23.

Yousefi A, Niakousari M, Moradi M. 2013. Microwave assisted hot air drying of papaya (*Carica papaya* L.) pretreated in osmotic solution **8,** 01.