

SUN-DRYING OF APPLES IN THE NORTHERN AREAS OF PAKISTAN

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A simple technique has been developed for producing, at village level sun-dried apples adequately sulphured comparable to the dehydrated apples. Development of pink discoloration in apples during sun-drying has been controlled.

Key words: Rural apple drying.

INTRODUCTION

Growers receive six to ten times more return from apples than from food-grains. Apple growing orchards have rapidly expanded in Pakistan in areas where adequate facilities to economically handle the crops exist.

Apples grow well in cold climatic zones ranging from 4500 to 7500 ft. above sea level. Northern areas including Chitral provide suitable climatic conditions for the production of quality apples. Fruit production has been the only source of income for the people of these areas. Due to lack of technical know-how, difficult transportation system, non-availability of ready market, storage and preservation facilities, considerable quantity of the useful and profitable fruit goes waste. It is rather interesting to note that in certain parts of the region, the animals pick up apples of their choice from the trees and not from the ground lying on their feet [1,2] as there is no gainful utilization of the fruit. Some quantity of apples is sun dried only for domestic consumption. The practice followed is crude with little regard to sanitation, varietal suitability, stage of maturity or pretreatment of the fruit. The dried apples are consumed as such or made into flour for use in various local dishes [3].

Sulphuring or sulphiting applied to many fruits before drying preserves the desired colour, flavour and general quality of the dried fruit and has become a widely accepted treatment for most of the fruits and vegetables [6]. Sulphuring is primarily used to inhibit the non-enzymic browning occurring in the fruit while it is drying and during its subsequent storage. Browning affects both palatability and nutritive values [4]. Sulphuring is believed to produce changes in the permeability of the fruit cells by plasmolysing the cells in the tissues, making permeable the semi-permeable cell membranes and thus facilitates the diffusion of water from the interior to the surface [7].

However, there is an increasing demand for carefully dried and adequately packed apples of good quality both within the country and abroad. This paper describes the efforts made to devise a simple procedure for the production of sun-dried apples under local conditions and facilities. The results obtained provide some useful information to the apple grower.

MATERIALS AND METHODS

Selection of variety. Dried apples are graded on the basis of texture and appearance rather than flavour. Varieties that are sound and produce a dried product of white colour are therefore preferred. For instance, the Jonathan variety is in demand for drying while the Delicious variety does not yield a satisfactory produce since the slices, break badly and losses due to peeling and coring are considerable [5]. However, the "Naskushu" variety was selected for the present investigation to develop and demonstrate the preservation of apples by sun-drying under local conditions and facilities. This process can easily be adopted by the rural people in fruit growing areas.

Pretreatments

(i) *Washing.* It is done in running potable water to remove the dirt.

(ii) *Peeling and coring.*

(i) *Peeling and coring.* Manually carried out using stainless steel knives and borers. To prevent browning, the peeled fruit and slices were kept covered with 2.50 % sodium chloride solution.

(iii) *Slicing.* Apples were sliced into rings of about ¼" thick.

(iv) *Traying.* Apple rings were placed closely in trays

(2x3) ft. at the rate of about 1 kg. of the fruit per sq. ft. of the tray surface area.

(v) *Sulphuring*. The fruit loaded trays were stacked onto the sulphuring tent and exposed for 2 hr to the fumes of SO₂ coming from the burning sulphur in the pit. The trays were removed after the fruit was sufficiently sulphured (@ 40 g/Kg. fruit) [4].

(vi) *Drying*. Trays containing sulphured apple rings were placed on the ground in the direct sun-shine, while the second batch was covered with black cloth about 6" above the surface of the fruit. The north side of each tray was resting on the south side of the neighbouring trays. The fruit was allowed to remain in the sun until it reached the desired stage of drying. Then it was transferred to a dry and clean room, where batchwise it was heaped and turned over once a day for about a week.

(vii) *Packing*. The dried product was screened to remove seeds, peel fines and defective pieces. They were packed in polyethylene bags which were kept in wooden boxes lined with waxed paper.

Rehydration. The dried samples were rehydrated by taking about 5 g. apples in 200 ml distilled water and boiling them for 10 min. and after draining the rehydration ratios were determined accordingly.

RESULTS AND DISCUSSION

There are several varieties of apples grown in the northern areas and mostly known by the local names. Table 1 lists some of the most commercially important varieties.

Table 1. Apple varieties.

Variety	Characteristics of fresh fruit	Picking period
Shakar Kush	Red colour, large size, satisfactory long storage.	Sept – Oct.
Noor Shah Balt	Bright red, large size beautiful appearance, sweet to taste, skin very thin; considered the best in variety.	Sept – Nov.
Khushubui	Red fine flavour with a thick skin and small in size	3rd Week of Sept
Gohar Aman Balt	Large in size, less juicy, sweet in taste, good flavour, storage short.	August
Shinni Balt	Red colour with white background, medium size, fine flavour, sweet taste, short storage	August

(Continued.....)

Kachura Kushu	White with red lines from top to bottom, elongated shape, large good flavour and aroma, juice yield medium, storage 3-4 months under normal conditions	September
Saspula Kushu	Deep red, smaller than the kachura variety, round, taste similar to that of the Kachura variety	November
Skakar Kushu	Deep red small size, sweet juice storage short (2 months), flavour low	August
Samar Qandi	Similar in size and taste to the Ambari variety but deep red, more juicy than ambari	September
Nas Kushu	White with light red patches, medium size, low juice, early variety, storage about 2 months	August
Sakar Kushu	Light yellow when fully mature, medium size, very sour, storage short	August
Wardab	Large, white, taste fine, storage 2 months	September
Markushu	Attractive deep red colour, round, elongated, sharp taste, interior white texture, hard, long, storage 9 months	September
Red Delicious	Red colour, large size, round shape, interior white, juice low, sweet in taste.	September
Golden Delicious	Slight red colour with golden background, medium size, more than red, delicious, very sweet in taste when fully mature. Taste and colour improve much after storage; storage, good.	September

Table 2. shows that the average loss of the product due to peeling and coring amounts to 32.08 % which is usual for apple preparation. These losses depend upon the variety, stage of maturity, locality, and techniques of peeling. Losses reported in this paper agree with the reported information [5].

Table 2. Component parts of apple.

Determination	Open	Sun-drying under black cloth	Dehydration
Total weight of apple (Kg.)	10.00	10.050	10.030
Total weight of peels (Kg.)	2200	2250	2100
Total weight of cores (g.)	10.30	10.00	10.50
Peels and cores (%)	32.50	32.34	31.41
No. of apples	123	123	123
Weight per apple (g.)	81.300	81.707	81.544
Soluble solids (%) (fresh apple)	13	13	13

The temperature and relative humidity of the surroundings during drying operation affect the rate of drying and subsequent quality of the dried product. Weather conditions (Table 3) of the region are favourable for the sun-drying of fruits since the annual rainfall is approximately 4.5" and the sun-shine is plentifully available for about 8.9 hours [9].

Table 3. Drying conditions of apple.

Conditions	Open(A)	Sun-drying under black cloth(B)	Dehydrator
Temperature range (C ^o)	40-43	45-48	65-70
Weather conditions	Fine	Fine	—
Total drying time (hr)	18	17.0	8
Sulphuring	2	2	2
Weight of prepared fruit per tray (Kg)	2	2	2

The field varies in accordance with the variety of the apple, locality, handling and procedures of preparation. However, the yields were determined on the basis of the prepared apples and are shown in Table 4.

Table 4. Drying rates and yields.

Particulars	Open	Sun-drying under black cloth	Dehydrator
Weight of prepared fruit (g.)	76.50	6800	6880
Moisture content of the fresh fruit (g/100 g).	84.5	84.5	84.5
Weight of dried apples (g.)	1100	1220	1100
Moisture content of dried apples (g/100 g).	18.18	18.10	17.0
Yields (%)	16.30	16.17	15.99

It appears from Table 4 that the yield from the open sun-dried apples a bit higher (16.30 %) than that dried under black cloth (16.12 %). This minor difference may be due to small variations in the drying temperature (5 to 8^o) of both experimental environments. Furthermore, there exist minor variations in the moisture contents of the open sun-dried (18.18 %) and under black cloth dried apples (18.10 %), which support the possibility of quicker drying process in the latter case.

Apples dried in the open sun yielded rings with partly pinkish patches on the surfaces exposed to the sun. No discolouration was noticed in rings dried under black cloth. The entire product was white. The texture of the product produced under black cloth was soft and pliable.

The sun-dried apples were compared with the dried apples of the same variety, maturity and locality obtained from a dehydrator (at 65-70^o). The colour of the dehydrated rings was found to be clean white with light characteristic flavour and soft texture.

The rehydration ratio for the sun dried apples was higher (1:75) than the dehydrated (at 70^o) apples (1:65). The low water absorbing capacity of the dehydrated apples may be due to the higher drying temperature of the dehydrator (70^o) which might have damaged the cell walls of apples causing low absorption of water as compared to low drying temperature of sun drying [4].

The samples of the dried apples were packed in polyethylene bags which were placed in wooden boxes lined with sheets of waxed paper for further investigation. Packaging plays an important role in achieving acceptable shelf-life of the dried fruits and vegetables. It provides

Table 5. Quality of sun-dried apples.

Attributes	Open	Sun-drying under black cloth	Dehydration
Colour	(1) The surface of dried rings towards sun partly pinkish (2) Surface of rings away from direct sun rays light cream.	Even white colouration of dried rings	Clean white
Texture	Soft and pliable	Soft and pliable	Soft
Flavour	Characteristic	Characteristic	Light characteristic
Rehydration	1:75	1:73	1:65

protection against absorption of moisture from the surrounding air by the dried food products and entry of oxygen. Thus, the quality of dried food reaching the consumer depends to a large extent on the protection offered by the packaging to it [10].

It has been pointed out [11] that polyethylene is the best transparent film for the packaging of dried products as it has good strength, satisfactory moisture barrier properties and is flexible.

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