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ORIGINAL ARTICLE

Studies on drying and storage of chilgoza (*Pinus gerardiana*) nuts

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Abstract Present studies were undertaken with the aim of screening a suitable mode of drying and packaging material for storage of chilgoza nuts. A temperature of 55 °C was found most suitable for the drying of nuts in cabinet drier. Cabinet drier was found the best drying mode among four for drying of chilgoza nuts on the basis of quality characteristics such as moisture, water activity and sensory attributes. Further, out of five packaging materials selected in the study, glass jar followed by aluminium laminate pouch was found to be suitable for the packing and storage of dried nuts in ambient conditions for 6 months on the basis of retention of better physico-chemical and sensory attributes.

Keywords Chilgoza · Cabinet drier · Solar polyethylene tunnel drier · Aluminium laminate pouch

Introduction

India is a country of vast diversity and is blessed with all types of vegetations. About 20.64 % area is under forest in this country where various species of trees are found depending upon climatic conditions. There are about 29 species of pine which produce edible nuts those are utilized by indigenous tribal cultures in the world. However, in India, out of six species of pine, *Pinus gerardiana* is the only species which produces edible and highly nutritious nuts (Gupta 1945). This species is distributed not only in India but also in Afghanistan, Tibet, Baluchistan (Pakistan) (Dogra 1964; Critchfield and Little 1966) between 2000 and 3350 m elevation (Farjon 1984; Farjon 1998). In India, it is distributed only in Himachal Pradesh (Kinnaur and Chamba Districts) and Jammu and Kashmir.

Chilgoza is a small to medium sized evergreen pine tree with short and horizontal branches forming a tree of compact habit. As a timber tree, it is of little importance but its seeds or nuts are edible which has got an economic importance. The edible nuts are highly nutritious having carminative, stimulant and expectorant properties. Its kernels are rich source of fats, proteins and carbohydrates with no cholesterol like other edible pine nuts (Thakur et al. 2009).

This is the only pine which is of immense social forestry importance because most of the tribals of Kinnaur district of Himachal Pradesh (HP) depend on the income from nuts of this pine tree. Tribals have the rights to harvest the seeds/nut from this pine tree for their livelihood. This also forms an important part of their diet as well as for various social obligations. Tribals handle this crop traditionally by adopting the age old practice. After harvesting the cone and extraction of nuts from the cones they sell their produce to the local traders without drying. Some proportion of the nuts is stored without drying for social obligations. These have a short shelf life due to attack by storage fungi as well as nut borer. Hence, drying is the foremost step to extend the shelf life of chilgoza nuts. It is well known that drying prevents postharvest losses of nuts by inhibiting fungal activity, prevents insect damage and improves chemical and physical stability of food (Bansal and Garg 1987). Although efforts

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have been made to standardize the pre-drying treatment of chilgoza nut by Thakur et al. (2009), no efforts have been made so far to evaluate drying modes and packaging material for packing and storage of dried chilgoza nuts. No literature on the packaging and storage of chilgoza nuts is available. The present studies evaluate for the first time the best drying mode and suitable packaging material for packaging and storage of dried nuts.

Materials and methods

Mature green chilgoza cones were procured from the different villages of the Kinnaur district of Himachal Pradesh (HP) for conducting the present studies. Packaging material and other material were procured from the local market of Solan town of HP.

Extraction of nuts Nuts were extracted from the cones as explained by Thakur et al. (2009). Mature green cones were dried at 60±2 °C in a cabinet drier of Wiswo make manufactured by M/S Widson Scientific Works, Sadar Thana Road, New Delhi, India having 90x60x90 cm dimensions, untill the complete opening of the cones. Then nuts were extracted by hitting the cone on the hard surface and these nuts were used for further studies.

Standardization of drying modes for the drying of nuts Freshly extracted chilgoza nuts (1 kg each) were subjected to drying in various drying modes. In cabinet drier, nuts were dried in varying temperatures ranging from 35 to 70 °C and the best time-temperature combination for the drying of nuts was selected on the basis of minimum time taken for drying, nuts having minimum moisture and water activity, and maximum scores of sensory quality of the nuts. In other drying modes such as solar polyethylene tunnel drier, glass solar drier and sun, nuts were dried under natural temperature conditions. Finally, the best mode of drying was selected on the basis of the characteristics mentioned for best time-temperature combination in cabinet drier.

Evaluation of packaging material for packing and storage of dried nuts The cabinet dried chigoza nuts were packed in five different packaging materials like i) HDPE jar (P_1), ii) glass jar, (P_2), iii) polyethylene bag, 93.9 gsm (P_3), iv) aluminium laminate pouch, 99.8 gsm (P_4), v) thermofoam tray (P_5) each of 250 g capacity and stored at ambient temperature (25 °C) for a period of six months. The changes in various physico-chemical and sensory characteristics during storage were studied at an interval of three months.

Physico-chemical characteristics of nuts The nuts were analysed for various physico- chemical characteristics as per standard methods of analysis. The colour of nuts and kernel was compared with the colour charts of Royal Horticultural Society, London. The water activity (a_w) of the nuts was estimated with water activity meter (HygroLab 3 model) from M/S Rotronic ag Switzerland. The chemical characteristics such as proteins were analysed as per the Lowry's method (Thimmaiah 1999). The reducing and total sugars of nuts were estimated as per Nelson-Somogyi's method (Sadasivam and Manickam 1996). The phenol sulphuric acid method was used to estimate the total carbohydrates (Sadasivam and Manickam 1996). The moisture, oils, fibres and ash content were also estimated as per standard method described by Ranganna (1986). Nuts were evaluated for sensory quality by 10 semi-trained panelists on the basis of colour, texture, taste and overall acceptability on a 9 point Hedonic scale (9- like extremly, 8-like very much, 7-like moderately, 6- like slightly, 5-neither like nor dislike, 4-dislike slightly,3-dislike moderately, 2-dislike very much, 1-dislike extremely) according to the method described by Ranganna (1986).

Statistical analysis All the experiments were replicated thrice except in case of experiment No. 2 and 3 where experiments were replicated four times. The number of replications (n) of each experiments have also been mentioned in the respective tables. In case of fresh chilgoza nuts, samples of 50 nuts in each replication were taken for analysis of physical characteristics, whereas, for chemical characteristics three random samples were analysed for each characteristics of nuts. In case of drying of nuts in cabinet drier at varying temperatures, four random samples in each temperature (250 g in each tray) were dried at a time in cabinet drier. Whereas, in different drying modes, four random samples of 250 g in each tray were dried at a time in respective drying modes. For packaging and storage studies nuts were dried in bulk in the cabinet drier and and five random lots were made and packed in five different packaging materials. For replicatiing each packing material three times, nuts were packed in three packs of each packaging material for storage studies. In case of sensory evaluation of fresh as well as dried nuts the value of each replication represents the average points of 10 panelists. Statistical analysis of data of various attributes including physico-chemical characteristics was carried out by CRD and CRD (factorial) (Mahony 1985), whereas, sensory analysis of data was carried out by RBD (Cochran and Cox 1967).

Results and discussion

Physico-chemical characterstics of fresh chilgoza nuts Table 1 shows the physico-chemical and sensory characterstics of fresh and cabinet dried chilgoza nuts. The visual colour was

Table 1 Physico-chemical and sensory characteristics of fresh and cabinet dried chilgoza nuts

Characteristics	Fresh	Cabinet dried
Physico-chemical		
Colour	Brown 200D	Brown 200D
Moisture,%	28.9±1.4	3.0 ±0.14
Water activity	1.0	0.098±0.005
Fats,%	7.2±0.48	52.3±2.1
Protiens,%	2.1±0.12	12.4±0.87
Total Carbohydrates,%	4.1±0.03	26.0±1.4
Total sugars,%	2.8±0.11	19.9±0.98
Reducing sugars,%	1.0±0.03	6.7±0.49
Fibers,%	0. 31+0.02	1.8±0.09
Ash,%	0. 43±0.13	2.9±0.04
*Sensory Characteristics, scores		
Colour	7.6±0.17	7.8±0.12
Texture	5.5±0.09	7.6±0.13
Taste	5.2±0.11	7.8±0.11
OA	6.1±0.18	7.8±0.10

* Based on 9 point Hedonic scale (Nr of panelists 10), OA = Overall acceptability

(n=3), Drying temperature in cabinet drier=55 °C

observed as brown 200D in fresh as well as in dried nuts. The average moisture and a_w of fresh nuts were 28.9±1.4 % and 1.0, respectively. In the fresh nuts, oils were recorded as 7.2±0.48 % and proteins as 2.1±0.12 %. Total carbohydrates, total sugars, and reducing sugars in the fresh nuts were found to be 4.1±0.03, 2.8±0.11, 1.0±0.03 %, respectively. The fibres content in the same nuts were 0.31± 0.02 %, whereas, ash content was 0.43±0.13 %.

Screening of drying modes for drying of nuts The time taken to dry the nuts in the cabinet drier decreased with an increase in temperature of drying, which ranged from 2 to 15 days (Table 2). Drying of nuts at 55 °C was found to be the optimum in terms of time required for drying (5d) and also best sensory scores of colour, texture, taste and overall acceptability. Further, at this temparature moisture content of 3.0 %, water activity of 0.098 and no defects in the nuts were recorded. However, kernells became brittle and bitterness developed in nuts on drying above 55 °C as a result of oozing out of the oil and hence they were discarded.

Among the various modes (Table 3) the time taken to dry the nuts (till their constant weight) ranged from 5 to 24 days. In cabinet drier, minimum time of 5 days was required for the drying the nuts, whereas, a maximum time of 24 days was recorded for the samples that were sun dried. The moisture content of nuts ranged between 3.0 % and 8.2 % with lowest in cabinet drier. Similar trend was observed in the water activity of the nuts dried in various modes. The data in Table 3 show significant differences among the various modes of drying of nuts for sensory quality scores of colour, texture, taste and overall acceptability. The higher colour (8.8), texture (8.3), taste (8.6) and overall acceptability (8.6) scores of nuts dried in the cabinet drier showed it to be superior over other drying modes. The minimum drying time (5d), water activity (0.098), moisture content (3 %) and maximum sensory scores indicate that drying of nuts at 55 °C for 5 days in cabinet drier was an advantage over the other modes. Further, all the other modes were rejected as they took more drying time and had lower sensory scores.

Physico-chemical characterstics of cabinet dried chilgoza nuts Data in Table 1 indicate that moisture and a_w of the dried nuts were observed as 3.0±0.14 % and 0.098±0.005, respectively and quite a high amount (52.3±2.1 %) of oil content was also observed in these nuts. Proteins, total carbohydrates, total sugars and reducing sugars were observed to be 12.4±0.87 %, 26.0±1.4 %, 19.9±0.98 % and 6.7±0.49 %, respectively in dried nuts. The fibres content in

Table 2 Effect of different drying temperatures on drying of chilgoza nuts in cabinet drier

Drying Temp, °C	Drying Time, Days	Water activity	Moisture, %	*Sensory quality			
				Colour	Texture	Taste	OA
35	15	0.972	15.0	6.8	6.2	5.8	6.0
40	12	0.672	13.8	7.2	6.6	7.4	7.2
45	10	0.181	13.0	7.2	6.9	7.2	7.0
50	8	0.124	10.0	7.4	7.0	7.6	7.0
55	5	0.098	3.0	8.4	8.2	8.4	8.9
60	5	0.091	2.5	7.4	5.8	7.8	7.8
65	4	0.067	2.3	–		–	–
70	2	0.061	2.1	–		–	–
SE		0.010	0.75	0.20	0.40	0.50	0.36
$CD_{0.05}$	–	0.030	2.3	0.6	1.2	1.5	1.1

*Based on 9 point Hedonic scale (Nr of panelists 10), OA = Overall acceptability, (n=4), SE = Standard error of mean

Table 3 Effect of different drying modes on chilgoza nut drying

Drying Modes	Time taken for drying, Days	Temperature of various modes, °C	Water activity	Moisture, %	* Sensory quality			
					Colour	Texture	Taste	OA
Solar Glass drier	16	49	0. 201	7.2	7.2	6.5	5.0	6.0
Solar Polyethylene Tunnel drier	20	45	0.169	6.8	7.6	7.5	7.2	7.8
Sun	24	20	0.217	8.2	7.0	6.6	7.0	7.0
Cabinet drier	5	55	0.098	3.0	8.8	8.3	8.6	8.4
SE	–	–	0.049	0.26	0.23	0.43	0.33	0.23
$CD_{0.05}$	–	–	0.150	0.8	0.7	1.3	1.0	0.7

OA = Overall acceptability, *Based on 9 point Hedonic scale (Nr of panelist 10), (n=4),

SE = Standard error of mean

these nuts was 1.8±0.09 %, whereas, ash content was 2.9± 0.04 %. The present results corroborates with the results reported by Kumar and Sharma (2009). The values of some of the characteristics of dried nuts in the present studies are in the range of the values reported by Anonymous (2009).

Evaluation of packaging material for packing and storage of dried nuts

Chemical characteristics

Moisture a_w and oils During storage of 6 months a significant increase in moisure content of nuts (Table 4) from the intial values of 3.0 to 3.9 % was observed irrespective of package. The minimum moisture content (3.1 %) of nuts was observed in the glass jar and aluminium laminate pouch and maximum in thermofoam tray (3.7 %).

The general increase in the moisture content of dried nuts during storage is in agreement with the findings of Butt et al. (2004). Increase in the moisture content could be due to the decomposition of oils in the nuts. However, changes in moisture content vary with the packaging materials during storage. This might be due to the differences in the level of moisture permeability possessed by the packaging materials (Brown 1992) with glass and aluminium laminate pouch offering a better protective barrier against moisture than thermo foam tray and polyethylene bag. This is in agreement with the report of Fellow and Axtell (1993). Kosoko et al. (2009) have also have reported increase in moisture content of cashew nut packed in different packaging materials. They have further observed that glass and plastic bottle offers a better barrier against moisture than polyethylene bag during packaging and storage of dried cashew nuts in ambient storage conditions. The difference between packaging materials may be due to their thermal conductance properties which affect the decomposition reactions in the product during storage.

Data in Table 5 also reveal a significant increase in a_w of the nuts during storage in the ambient conditions. It increased from an intial values of 0.098 to 0.217. It was however, observed to be the lowest (0.132) in the nuts packed and stored in glass jar closely followed by aluminium laminate pouch and HDPE jar and maximum in the thermofoam tray (0.189).

Table 4 Effect of different packaging materials on the moisture, a_w and oils content of dried chilgoza nuts during storage

	Package	Storage period, months		Mean	$CD_{0.05}$
		3	6		
Moisture, %	P_1	3.1	4.1	3.4	
	P_2	3.0	3.2	3.1	P=0.2
	P_3	3.3	4.3	3.5	S=0.2
	P_4	3.1	3.3	3.1	PxS=0.4
	P_5	3.4	4.5	3.7	
	Mean	3.2	3.9		
a_w	P_1	0.145	0.205	0.149	
	P_2	0.119	0.179	0.132	P=0.040
	P_3	0.180	0.240	0.173	S=0.036
	P_4	0.129	0.191	0.139	PxS=0.081
	P_5	0.201	0.269	0.189	
	Mean	0.155	0.217		
Oils, %	P_1	52.1	50.8	51.7	
	P_2	52.2	51.2	51.9	P=0.3
	P_3	52.1	49.9	51.4	S=0.2
	P_4	52.2	51.0	52.0	PxS=0.5
	P_5	52.0	50.1	51.5	
	Mean	52.1	50.6		

$P_{1=}$ HDPE jar, $P_{2=}$ glass jar, $P_{3=}$ polyethylene bag, $P_{4=}$ aluminium laminate pouch

$P_{5=}$ thermofoam tray, (n=3), a_w = water activity, Initial values at the time of commencement of storage: Moisture=3.0 %, a_w=0.098, oils=52.3 %

Table 5 Effect of different packaging materials on the total carbohydrates, reducing and total sugars, proteins and fibres of dried chilgoza nuts during storage

	Package	Storage period, months		Mean	$CD_{0.05}$
		3	6		
Total Carbohydrates, %	P_1	26.2	26.9	26.4	
	P_2	26.2	27.7	26.7	P=NS
	P_3	26.2	26.9	26.4	S=NS
	P_4	26.1	27.5	26.6	PxS=0.3
	P_5	26.1	26.5	26.2	
	Mean	26.2	26.2		
Reducing sugars, %	P_1	6.8	7.2	6.9	
	P_2	6.8	7.5	7.0	P=NS
	P_3	6.8	7.1	6.9	S=NS
	P_4	6.8	7.3	6.9	PxS=0.4
	P_5	6.8	7.2	6.9	
	Mean	6.8	7.2		
Total sugars, %	P_1	19.9	20.1	20.0	
	P_2	19.9	21.9	21.0	P=NS
	P_3	19.9	20.3	20.0	S=NS
	P_4	19.9	20.2	19.9	PxS=0.3
	P_5	19.9	20.4	20.1	
	Mean	19.9	20.6		
Proteins, %	P_1	11.5	11.3	11.7	
	P_2	12.2	11.9	12.2	P=0.2
	P_3	11.5	11.3	11.7	S=0.2
	P_4	12.0	11.9	12.1	PxS=0.4
	P_5	11.2	10.7	11.4	
	Mean	11.7	11.4		
Fibres, %	P_1	1.6	1.5	1.7	
	P_2	1.8	1.7	1.8	P=0.1
	P_3	1.5	1.3	1.6	S=0.1
	P_4	1.7	1.6	1.7	PxS=0.2
	P_5	1.6	1.4	1.6	
	Mean	1.6	1.5		

$P_{1=}$ HDPE jar, $P_{2=}$ glass jar, $P_{3=}$ polyethylene bag, $P_{4=}$ aluminium laminate pouch

$P_{5=}$ thermofoam tray, (n=3), Initial values at the commencement of storage:

Total carbohydrates=26.0 %, reducing sugars=6.7 %, total sugars=19.9 %, proteins=12.4 %, fibres=1.8 %

A significant increase in the a_w found in the nuts during storage might be due to the absorption of moisture by the nuts in the different packages. Although there was increase in a_w in the nuts in different packages during storage, it was within the limit as observed by Vnkatachalam and Sathe (2006) who reported a safe storage of edible nuts at a_w below 0.53 at 25 °C for 6 months. Dried foods are usually packaged and stored to keep a_w value near to 0.3, where microbial, chemical, biochemical and physical changes are minimal (Anonymous 1993). However, a_w values between 0.3 and 0.4 in dried food containing high oil becomes susceptible to lipid oxidation. The minimum increase in a_w of nuts packed in glass jar in the present studies might be due to its better moisture barrier as compared to other packages during storage.

With the passage of time in the storage measurable oil content of dried nuts (Table 4) decreased significantly from the intial values of 52.3 to 50.6 %. However, the maximum content of measurable oils (52.0 %) of the nuts retained in aluminium laminate pouch which was at par with glass jar and HDPE jar, and minimum in polyethylene bag (51.4 %).

Decrease in the measurable oils content during storage might be due to the oxidation of lipids. Minimum loss of measurable oils in aluminium laminate pouch, glass jar and HDPE jar might be due to the lesser amount of oxidation during storage because of higher barrier properties of these packaging materilals against oxygen. Similar results on decrease in oil content on oxidation of lipids in almond have been reported to be strongly influenced by packaging (Severini et al. 2003). The film with highest barrier against oxygen was able to preserve almond better.

Carbohydrates, reducing sugars, total sugars, proteins and fibres Table 5 reveals that there were non significant changes with respect to total carbohydrates, reducing and total sugars content of the nuts during storage of 6 months. Also no significant differences were observed among the different packages during storage of 6 months in the ambient conditions. Kazantzis et al. (2003) have also reported no significant changes in sugar contents in almond kernels stored at 5 °C and 20 °C during 6 months of storage

During storage of 6 months a significant decrease in measurable protein content from intial values of 12.4 to 11.4 % was observed. However, the maximum measurable proteins content of nuts was retained in the glass jar closely followed by aluminium laminate pouch and minimum in thermofoam tray (Table 5).

Decrease in the measurable protein content in the nuts during storage might be due to the participation of nitrogenous compounds in some chemical reactions during storage. However, minimum losses of measurable protein in the nuts packed in the glass jars and aluminium laminate pouch might be due to the participation of lower amount of nitrogenous compounds in chemical reactions because of the better packaging conditions. Our results are in line with the results of Malik and Shamet (2009) in which they have also reported decrease in the protein content of the chilgoza seeds in the various storage temperature conditions.

Data in the Table 5 show that the fibre content in the nuts decreased during storage significantly. It decreased from the intial values of 1.8 to 1.5 %. The maximum (1.8 %) content of fibres in the nuts were retained in glass jar followed by aluminium laminate pouch and minimum in thermofoam tray (1.6 %).

Losses in fibre content during storage might be due to the conversion of fibres into sugars. However the negligible loss of fibres in glass jar and aluminium laminate pouch might have restricted the conversion of fibres into sugars in the chemical reactions because of better packaging conditions.

Changes in the ash content of the nuts during storage were found to be non significant. No visual microbial growth was observed during storage in the nuts.

Sensory characteristics

Table 6 clearly reveal that no significant changes with respect to colour score were found in the nuts in all the packages during storage of 6 months that means judges did not find any change in the colour of the nuts during storage. However, significant decrease in the scores of texture, flavour and overall acceptability of the stored nuts were observerd during storage. Texture scores significantly decreased from the intial values of 7.6 to 7.2. Flavour scores decreased significantly from the intial values of 7.8 to 7.2 and overall acceptability scores also decreased significantly from the initial values of 7.8 to 7.2. The highest scores of texture, flavour and overall acceptability of the nuts packed in the glass jar closely followed by aluminium laminate pouch were observed during storage. The highest scores retained in the nuts packed in the glass jar followed by aluminium laminate pouch might be due to the better texture retained during the storage in these packaging materials and not much loss in taste and aroma might be due to the lesser loss of fatty acids due to the oxidation in these containers. Better overall acceptability scores of nuts reflects the better quality retention by these packages in the nuts during storage. Savage et al. (1999), Kita and Figiel (2007) have also reported decrease in texture (crispness), taste, aroma scores in the walnut during storage which might be due to the moisture absorption by nuts and oxidation of fats which affected their texture, taste and aroma. Tao et al. (2007) have reported LDPE film with aluminium foil as best package compared to others for packing of walnut during storage. Severini et al. (2003) have also reported sensory quality

Table 6 Effect of different packaging materials on the *sensory scores of dried chilgoza nuts during storage

	Package	Storage period, months		Mean	$CD_{0.05}$
		3	6		
Colour	P_1	7.7	7.7	7.7	
	P_2	7.8	7.7	7.8	P=NS
	P_3	7.7	7.5	7.7	S=NS
	P_4	7.8	7.7	7.8	PxS=0.1
	P_5	7.7	7.6	7.7	
	Mean	7.7	7.6		
Texture	P_1	7.4	7.2	7.4	
	P_2	7.6	7.4	7.5	P=0.1
	P_3	7.4	7.2	7.4	S=0.1
	P_4	7.6	7.4	7.5	PxS=0.2
	P_5	7.4	7.0	7.3	
	Mean	7.5	7.2		
Flavour	P_1	7.6	7.2	7.5	
	P_2	7.7	7.5	7.7	P=0.1
	P_3	7.5	7.2	7.5	S=0.1
	P_4	7.6	7.4	7.6	PxS=0.2
	P_5	7.4	6.7	7.3	
	Mean	7.6	7.2		
O A	P_1	7.5	7.2	7.5	
	P_2	7.7	7.5	7.7	P=0.1
	P_3	7.4	7.0	7.4	S=0.1
	P_4	7.6	7.4	7.6	PxS=0.2
	P_5	7.3	6.7	7.3	
	Mean	7.5	7.2		

$P_{1=}$ HDPE jar, $P_{2=}$ glass jar, $P_{3=}$ polyethylene bag, $P_{4=}$ aluminium laminate pouch,

$P_{5=}$ thermofoam tray, *Based on 9 point Hedonic scale (Nr of panelists 10), OA: Overall acceptability, (n=3), Initial values at the commencement of storage: Colour=7.8, texture=7.6, flavour=7.8, OA=7.8

of packed almond to be preserved better for 8 months under ambient temperature conditions in films having better oxygen barrier properties. If the entry of light and oxygen to the package is prevented, it reduces the preservation requirements and increase the shelf life of the dried hazel nuts (Kinderlerer and Johnson 1992; Bonvehi and Coll 1993; Pershern et al. 1995).

Conclusion

Cabinet drier was the best mode of drying of nuts followed by solar polyethylene tunnel drier on the basis of some physico-chemical and sensory characteristics of dried chilgoza nuts, whereas, glass jar was the best package for the storage of nuts on the basis of better retention of physico-chemical and sensory attributes. This was followed by the aluminium laminate pouch. Aluminium laminate pouch is light weight and easy to handle. Hence, it can be recommended for the packaging of dried chilgoza nuts on commercial scale.

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