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Tehmeena Ahad
Division of food science and technology, Skuast-K Shalimar, Jammu and Kashmir, India

Lubna Masoodi
Division of food science and technology, Skuast-K Shalimar, Jammu and Kashmir, India

Jasia Nissar
Division of food science and technology, Skuast-K Shalimar, Jammu and Kashmir, India

AH Rather
Division of food science and technology, Skuast-K Shalimar, Jammu and Kashmir, India

Syed Zameer Hussain
Division of food science and technology, Skuast-K Shalimar, Jammu and Kashmir, India

Khushnuma Maqbool
Division of food science and technology, Skuast-K Shalimar, Jammu and Kashmir, India

Correspondence
Tehmeena Ahad
Division of food science and technology, Skuast-K Shalimar, Jammu and Kashmir, India

Effect of packagings and ambient temperature on organoleptic observations of inshelled walnuts under different various storage periods

Tehmeena Ahad, Lubna Masoodi, Jasia Nissar, AH Rather, Syed Zameer Hussain and Khushnuma Maqbool

Abstract
Statistically significant effect of packaging materials and storage periods was observed on kernel on all the organoleptic parameters of whole4 walnuts. The highest and lowest mean kernel colour score of 3.43 and 3.26 was observed in HDPE [P3] and Gunny bag [P1] packed samples respectively. The mean shell colour score of 3.41 and 3.34 awarded to HDPE [P3] and cardboard [P2] packed samples proved superior to score of 3.29 awarded to Gunny bag [P1] packed samples. The mean taste score of 3.26 received by gunny bag samples was significantly lower than statistically at par scores of 3.36 and 3.43observed in samples packed in cardboard)and HDPE respectively. Storage periods showed significant effect on the taste of the packaged samples as the mean taste score of 3.60 (0 day), 3.42 (90 days), 3.12(180 days) and 2.86 (270 days) varied significantly from one another. The mean mouthfeel score of 3.24 received by HDPE packed samples was significantly higher than statistically at par scores of 3.18 and 3.11 observed in cardboard and Gunny bag packed samples respectively. Storage periods showed significant effect on the taste of the packaged samples as the mean taste score of 3.40 (0 day), 3.26 (90 days), 3.15(180 days) and 2.92 (270 days) varied significantly from one another.

Keywords: organoleptic, inshelled walnuts

1. Introduction
Walnut (*Juglans regia* L) a member of Juglandaceae family is one of the finest nuts of temperate regions. It is the oldest cultivated fruit in the world and grown spontaneously almost all over Kashmir, India. Although walnuts are rich in fat, a diet supplemented with walnuts had a beneficial effect on blood lipids, lowering blood cholesterol and lowering the ratio of serum concentrations of low lipoprotein: high density lipoprotein by 12% (Sabate *et al* 1993; Savage *et al* 2001) [12, 13]. Most nuts are rich in monounsaturated fat (oleic acid) while walnuts are also high in two polyunsaturated fatty acids linoleic acid and α-linolenic acids. The major fatty acids found in walnut oil are oleic, linoleic and linolenic acids (Ozan *et al*, 2005; Greve *et al*, 1992) [9, 7]. The fatty acid profile of walnut oil varies between cultivars. It is important to a identify these differences in locally grown cultivars and to identify which fatty acids give the best nutritional qualities (Zwarts 1999) [17].
Walnut has been used globally in human nutrition since ancient times. The high protein and oil contents of the kernels of *Juglans regia* L. (Juglandacea) make this fruit indispensable for human nutrition. Therefore, the walnut is classified as a strategic species for human nutrition and is included in the FAO list of priority plants (Gandev, 2007) [6]. Walnuts have high amount of omega-6 and omega-3 PUFA, which are essential dietary fatty acids. Clinical studies suggest that omega-3 PUFA have significant role in prevention of coronary heart disease (Davis *et al*., 2007) [5].
Oil rich in oleic acid displays greater oxidative stability therefore; it could be widely used as frying oil. According to an investigation conducted by several researchers, It was found that the average value for protein was 18.1% (Amaral *et al*., 2003) [2]. They are mainly composed of glutelins (about 70% of the total seed proteins) together with lesser amounts of globulins (18%), albumins (7%) and prolamins (5%) (Martinez *et al*., 2010) [8]. The amino acid (AA) composition of walnut flour is dominated by the acidic AA residues of aspartate and glutamate together with relatively high levels of arginine
Walnut cultivars analyzed have recorded rich mineral composition, especially potassium, magnesium, and calcium. The minimum and maximum macro and micro nutrient contents of walnut are presented in Table 1 (Ravai, 1992; Souci *et al*., 1994; Cosmulescu *et al*., 2009) [11, 14, 4].

Walnuts contain high levels of potassium, phosphorus and magnesium and lower sodium. These elements play an important role for many enzymes activity especially as cofactor.

Material and methods

The study was conducted in feb 2014 at the division of Food Science and Technology Skuast-K Shalimar, Srinagar. Medium shelled walnut were procured from the market and packed in three different packaging viz. Gunny bags, Cardboard and HDPE packagings for a period of 9 months under ambient and were analysed for various organoleptic observations.

Organoleptic Observations

Coded samples of inshelled walnuts from each packaging were provided to selected judges to record their sensory appreciation for shell colour of inshelled walnuts and colour, mouthfeel and taste of kernels.

Shell colour of inshelled walnuts:- Samples were drawn and evaluated by a color difference meter and panel of semi-trained judges (drawn from the technical staff of Division of Food Science and Technology) on a 4 point scale given by IPGRI (1994) for shell colour attributes as follows :

Description	Numerical value
Very light	4
Light	3
Medium	2
Dark	1

Kernel colour

Samples were drawn at 0, 90, 180 and 270 days of storage and evaluated by a panel of semi-trained judges (drawn from the technical staff of the Division of Food Science and Technology) on a 4 point scale given by IPGRI (1994).

Description	Numerical value
Extra light	4
Light	3
Light amber	2
Amber	1

Kernel taste and mouthfeel.

Samples were drawn at 0, 90, 180 and 270 days of storage and evaluated by a panel of semi-trained judges (drawn from the technical staff of the Division of Food Science and Technology) on a 4 point scale given by IPGRI (1994).

Description	Numerical value
Excellent	4
Good	3
Fair	2
Poor	1

Results and discussion

The data pertaining to the effect of packaging materials and storage periods on the shell and kernel colour of whole walnuts are presented in the table-1 and 2. Mean shell colour scores of 3.29 and and 3.34 recorded in Gunny bag [P1] and cardboard [P2] packed walnut samples were statistically at par, but significantly lower to score of 3.41 awarded to HDPE [P3] packed samples. The mean colour score of 3.7 and 3.52 recorded at 0 and 90 days respectively did not show any significant difference. However, there was colour deterioration in all the samples at 180 and 270 days of storage. The samples received significantly lower mean shell score of 3.24 and 2.94 at 180 and 270 days of storage.

The data reveal that samples from HDPE [P3] packaging recorded highest mean kernel colour score of 3.43, followed by score of 3.36 and 3.26 recorded in samples from cardboard [P2] and Gunny bag [P1] respectively. The mean kernel colour score of 3.60 and 3.48 recorded at 0 and 90 days respectively did not show any significant difference. However, there was colour deterioration in all the samples at 180 and 270 days of storage. The samples received significantly lower mean kernel colour score of 3.29 and 3.03 at 180 and 270 days of storage.

HDPE packaging are impervious to oxygen and moisture. Therefore, colour deterioration was much less in walnuts in contrast to cardboard and gunny bag packed samples which allow movement of air thus allowing some respiration to take place leading to build up of simple sugar in the product. This in turn may result in colour deterioration in both shell and kernels, which is reflected in significantly lower colour scores in gunny bag packaged samples. Several workers Tajeddin (2004) [15] and Tao *et al.* (2008) [16] have studied relation between types of packaging and lipid oxidation in walnuts and have reported improved maintenance of quality attributes over extended storage in materials that allow some degree of gaseous movement in and out of the package.

Again deterioration in colour may most probably be due to the very nature of gunny bags [P1] material that allows some breathing to take place, allowing ingress of oxygen and moisture. Migration of moisture into packaging increases water activity in stored product which may lead to hydrolysis of polysaccharides thus releasing reducing sugars. Change in kernel colour is attributed to hydrolysis of phenolic substance present in the outer covering of walnut kernels as a result of exposure to light and oxygen (Bhatia *et al.*, 1984) [3]. Besides, other constituents like polysaccharides and reducing and non-reducing sugars also contribute to colour deterioration.

Table 1: Shell color of inshelled walnuts.

Packaging materials	Storage periods (days)				Mean
	0	90	180	270	
Gunny bags (P1)	3.70	3.47	3.16	2.83	3.29
Cardboard (P2)	3.70	3.50	3.21	2.97	3.34
HDPE (P3)	3.70	3.60	3.35	3.01	3.41
Mean	3.70	3.52	3.24	2.94	

$C.D_{(p=0.05)}$
Packagings (A) =0.08
Storage (B) =0.10
A × B =NS
Mechanical Drying (40˚C)

Table 2: Kernel colour of inshelled walnuts.

Packaging materials	Storage periods (days)				Mean
	0	90	180	270	
Gunny bags (P1)	3.60	3.40	3.19	2.84	3.26
Cardboard (P2)	3.60	3.50	3.27	3.05	3.36
HDPE(P3)	3.60	3.53	3.41	3.30	3.43
Mean	3.60	3.48	3.29	3.03	

$C.D_{(p=0.05)}$
Packagings (A) =0.06
Storage (B) =0.10
A × B =NS
Mechanical Drying (40˚C)

The data pertaining to the effect of packaging materials and storage periods on the kernel taste and mouthfeel of inshelled walnuts are presented in the table-3 and 4. Analysis of data

indicate that packaging materials had significant effect on taste of walnut kernels. Mean taste score of 3.32 and 3.26 awarded to HDPE [P3] and Cardboard [P2] packed samples were found statistically at par but were significantly higher to score of 3.17 recorded in samples packed in Gunny bag [P1].

Significant difference in taste scores were exhibited by the samples at different storage durations. The mean taste score of 3.60 recorded at o days dropped to a score of 3.42, 3.12 and 2.86 at 90, 180 and 270 days of storage respectively.

Analysis of data reveal that packaging materials and storage periods significantly effected mouthfeel of whole walnuts kernels. Among all the three different packaging materials, significantly highest mean mouthfeel score of 3.24 was awarded to HDPE [P3] packed samples followed by score of 3.18 and 3.11 to samples from cardboard [P2] and gunny bag [P1] respectively. However, mean mouthfeel score of 3.24 recorded in HDPE [P3] packed samples was at par with score of 3.18 in Cardboard [P2] packed samples. Also mean Mouthfeel score of 3.18 was at par with score of 3.11 awarded to Gunny bag [P1] packed sample. With the advancement of storage period there was significant decrease in mouthfeel score of whole walnuts as indicated by highest mean score of 3.40 and lowest of 2.92 recorded at 0 and 270 days of storage.

Taste deterioration in packed food materials depends up to the permeability of packaging material to oxygen and moisture. HDPE are impermeable to oxygen and moisture which discourage oxidative rancidity. Further there is some build-up of carbon dioxide in HDPE packaging. Carbon dioxide is a known oxygen antagonistic agent which prevents oxidative rancidity in fatty foods. Carbon dioxide also lowers pH of stored foods, thus discouraging any microbial growth (Prabhakar, 1977) [10]. In comparison cardboard and gunny bags allows some degree of oxygen and moisture exchange, thus encouraging oxidative rancidity leading to development of off flavours.

Decrease in mouthfeel score during storage may be attributed to loss of texture, taste and certain biochemical changes. Adebayo *et al*., 2013 reported an decrease in mouthfeel score of walnut with extended storage.

Table 3: Kernel taste of inshelled walnuts.

Packaging materials	Storage periods (days)				Mean
	0	90	180	270	
Gunny bags (P1)	3.60	3.38	3.00	2.71	3.17
Cardboard (P2)	3.60	3.41	3.15	2.87	3.26
HDPE(P3)	3.60	3.47	3.21	3.01	3.32
Mean	3.6	3.42	3.12	2.86	

$C.D_{(p=0.05)}$
Packagings (A) =0.08
Storage (B) =0.10
A × B =NS
Mechanical Drying (40˚C)

Table 4: Kernel mouthfeel of inshelled walnuts.

Packaging materials	Storage periods (days)				Mean
	0	90	180	270	
Gunny bags (P1)	3.40	3.20	3.09	2.76	3.11
Cardboard (P2)	3.40	3.27	3.16	2.91	3.18
HDPE(P3)	3.40	3.30	3.20	3.08	3.24
Mean	3.40	3.26	3.15	2.92	

$C.D_{(p=0.05)}$
Packagings (A) =0.08
Storage (B) =0.10
A × B =NS
Mechanical Drying (40˚C)

Conclusion

Statistically significant effect of packaging materials and storage periods was observed on kernel colour, shell color, kernel taste and kernel mouthfeel score of whole walnuts. No deterioration was observed in the samples up to 90 days of storage. HDPE packaging proved to be superior with respect to maintaining the organoleptic observations during 270 days ambient storage of whole walnuts compared to cardboard and gunny bags.

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