International Research Journal of Pure & Applied Chemistry

21(11): 79-91, 2020; Article no.IRJPAC.59361
ISSN: 2231-3443, NLM ID: 101647669

Studies on Storage Quality Evaluation of Dried Wild Pomegranate Arils (*Anardana*) Prepared in Mechanical Cabinet Drier

Abhimanyu Thakur[1*], N. S. Thakur[1], Hamid[1], Pradeep Kumar[1] and Sunakshi Gautam[1]

[1]Department of Food Science and Technology, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan, 173230, Himachal Pradesh, India.

Authors' contributions

This work was carried out by author AT during Ph.D. in Food Technology under the guidance of author NST. All authors have helped in preparation of manuscript and approved the final manuscript.

Article Information

DOI: 10.9734/IRJPAC/2020/v21i1130226
Editor(s):
(1) Dr. Hao-Yang Wang, Shanghai Institute of Organic Chemistry, China.
Reviewers:
(1) Rahayu Kusuma Pratiwi, Udayana University, Indonesia.
(2) Dil Raj Yadav, Nepal Agricultural Research Council, Nepal.
Complete Peer review History: http://www.sdiarticle4.com/review-history/59361

Original Research Article

Received 20 May 2020
Accepted 27 July 2020
Published 07 August 2020

ABSTRACT

Wild pomegranate (*Punica granatum* L.), fruit is widely found in hilly slopes of Himachal Pradesh, Uttarakhand and Jammu and Kashmir. It contains higher amount of acid content along with other quality characteristics. To exploit the appreciable amount of acid content in this fruit, a popular dried product known as *anardana* was prepared in mechanical cabinet drier from the fruits procured from Karsog area of Mandi district of Himachal Pradesh, India (1265 m above mean sea level). The *anardana* was packed in aluminium laminated pouch with vacuum (ALPV), aluminium laminated pouch (ALP) and gunny bags which were stored under ambient and refrigerated storage conditions so as to study the effect of packaging and storage on its quality. During storage, moisture, water activity, reducing sugars, NEB (Non enzymatic browning), HMF (Hydroxymethyl furfural) and furfural content increased whereas, TSS (Total soluble solids), titratable acidity, total sugars, ascorbic acid, anthocyanins, starch, total fibre and residual SO_2 decreased during storage. After 12 months of storage period, higher retention of various quality characteristics was observed in *anardana* packed in ALPV followed by ALP and gunny bags. However, changes were slower in refrigerated storage conditions as compared to that under ambient conditions.

**Corresponding author: E-mail: abhimanyuthakurprashar@gmail.com;*

Keywords: Anardana; dried arils; quality; storage; vacuum packaging; wild pomegranate.

1. INTRODUCTION

Wild pomegranate (*Punica granatum* L.) belonging to family Punicaceae resembles the cultivated pomegranate for various morphological characters and widely distributed in sub tropical tracts of Western Himalayan states like Jammu and Kashmir, Himachal Pradesh and Uttarakhand at an altitude of 900 to 1800 m above mean sea level [1-3]. In Himachal Pradesh, it is found growing wild in some parts of Solan, Sirmour, Mandi, Shimla, Kullu and Chamba districts. The arils of wild pomegranate are rich source of organic acids apart from having appreciable amount of anti-oxidants including anthocyanins, phenols, flavonoids and ascorbic acid etc. The unique anti-oxidant activity of this fruit contributes towards its medicinal value and various human health benefits like prevention of neurodegenerative disorders [4-7]. The different plant parts of wild pomegranate have been reported to posses high antimicrobial activity against food borne pathogens like *Staphylococcus aureus*, *Enterobacter aerogenes*, *Salmonella typhi*, *Klebsiella pneumonia*, *Escherichia coli*, etc [8].

The fruit being highly acidic in nature is being processed into its dried product known as *anardana.* Dried wild pomegranate arils with distinct sour or tart flavour are commercially available in many West and East Asian countries [9]. *Anardana* is a good source of organic acids, sugars, vitamin C, phenols, flavonoids and have been used in formulations of various ayurvedic medicines which are helpful in curing a number of ailments [10,11]. Although pre-treatments for the scientific drying of arils of this fruit has already been standardized [12], but attempts on advanced packaging material like vacuum packaging and its comparison with traditional packaging (gunny bags) has not attempted yet. So the present studies were carried out to compare the effect of storage and packaging materials on quality characteristics of dried wild pomegranate arils (*anardana*) prepared in mechanical cabinet drier.

2. MATERIALS AND METHODS

2.1 Procurement of Raw Material and Preparation of Dried Arils (*Anardana*)

The wild pomegranate fruits were procured from Karsog area of Mandi district of Himachal Pradesh, India (1265 m above mean sea level). The fruits were further used for the preparation of *anardana* as per the method suggested by Thakur et al. [12]. The pre-treated arils were spread on the perforated steel trays and dried at constant temperature at 60 ± 2^{o}C inside a mechanical cabinet drier.

2.2 Packaging and Storage

The *anardana* was packed in different packaging materials like gunny bags, aluminium pouches (ALP) and aluminium laminated pouches with vacuum (ALPV). All the packages were stored under ambient temperature (9.8-24°C) and refrigerated temperature (4-7°C) for a period of 12 months and overall effect of storage period, storage conditions and packaging was analyzed for changes in various quality attributes.

2.3 Physico-chemical and Sensory Analysis

The colour of *anardana* was observed visually by comparing with the colour cards of Royal Horticulture Society, London. Moisture, TSS, sugars, titratable acidity, ascorbic acid, anthocyanins, starch, NEB (non enzymatic browning), HMF (hydroxyl methyl furfural), furfural and residual SO_2 were determined according to Ranganna [13]. Water activity of the dried product was estimated by computer based digital water activity meter (HW3 model, Rotronic International, Switzerland).Total fibres content was estimated by the method given by Gould [14]. The sensory evaluation of the samples was carried out by 9 point hedonic rating test. Sensory evaluation of *anardana* was conducted to assess the consumer acceptance and panel of ten judges (Faculty members and students of the Department of Food Science and Technology) was selected to evaluate the product for sensory qualities on the basis of colour, texture, flavour and overall acceptability.

2.4 Statistical Analysis

The data on physico-chemical characteristics of dried arils were analyzed by Completely Randomised Design (CRD factorial) whereas, data pertaining to the sensory evaluation of dried wild pomegranate arils were analyzed by Randomized Block Design (RBD). The data on physico-chemical and sensory characteristics of dried arils were replicated three times.

3. RESULTS AND DISCUSSION

The data regarding physico-chemical and sensory quality changes of *anardana* dried under mechanical cabinet drier during twelve months of storage have been explained under the following heads.

3.1 Physico-chemical Characteristics

3.1.1 Visual colour

It is evident from the data given in Table 1 that the colour of *anardana* as per Royal Horticultural Society Cards was retained as such [Red group 46 (B)] during twelve months of storage in ALP with vacuum and ALP under refrigerated conditions. The intensity of red colour of *anardana* stored under ambient conditions decreased throughout the storage period. The colour of *anardana* was affected the most in gunny bags and turned brown at the end of twelve months of storage.

The intensity of red colour of *anardana* decreased during storage which might be due to the loss of colour pigments like anthocyanins. Non-enzymatic browning reactions could be the other major reason for the loss in intensity of red colour. Retention of better colour in refrigerated storage might be due to the better retention of colour of the product as a result of the suitable storage conditions where the rate of degradation of anthocyanins and rate of other chemical reactions was slower as compared to ambient. However, maximum intensity of red colour of *anardana* in ALP with vacuum might be due to the better retention of colour as a result of favourable conditions inside the pouch which created barrier to light, air and moisture, therefore prevented degradation of anthocyanins. A similar trend of decrease in intensity of red colour of *anardana* during storage has also been observed by Bhat et al. [15] and Sharma and Thakur [16].

3.1.2 Moisture and water activity

An appraisal of data (Fig. 1a) reveals that moisture content in *anardana* increased from 8.51 to 10.31 % during storage, lower (9.17%) was found in refrigerated storage conditions and higher (10.02%) in ambient storage conditions. The lower (8.60%) moisture content was recorded in *anardana* packed in ALP with vacuum as compared to gunny bags (11.18%) while comparing the overall effect of packaging materials on moisture content of *anardana*. Scrutiny of data presented in (Fig. 1b) indicates that water activity in *anardana* increased from 0.211 to 0.321 during storage, lower (0.249) was found in refrigerated storage conditions and higher (0.297) in ambient storage conditions The lower (0.224) water activity was recorded in *anardana* packed in ALP with vacuum as compared to gunny bags (0.340) while comparing the overall effect of packaging materials on water activity of *anardana*.

Moisture content and water activity of *anardana* increased significantly during storage which might be due to the absorption of moisture from its surroundings as a result of hygroscopic nature of the dried product. Other reason of increase in the moisture content during storage might be because of the release/formation of moisture during non-enzymatic browning reactions in the product [17]. Similar trend of increase in moisture content and water activity of *anardana* has been observed earliar [15,16,18,19].

3.1.3 Total soluble solids and titratable acidity

An appraisal of data (Fig. 1c) reveal that during entire storage period of 12 months the TSS content of *anardana* prepared in mechanical cabinet drier decreased from 41.40 to 39.62 ^{o}B. Further, while comparing the overall effect of storage conditions it was found that higher (40.90 ^{o}B) TSS were retained under refrigerated storage conditions as compared to ambient storage conditions (40.08 ^{o}B). The overall effect of packaging materials indicates that higher (41.15 ^{o}B) TSS were retained in ALP with vacuum as compared to gunny bag (39.41 ^{o}B) during storage. An appraisal of data (Fig. 1d) reveal that there was a general decreasing trend in acid content of *anardana* from 11.55 to 10.02 % during storage. Further, while comparing the overall effect of storage conditions it was found that maximum (10.97 %) acid was retained under refrigerated storage conditions as compared to ambient storage conditions (10.63 %). The overall effect of packaging materials indicates that maximum (11.44 %) acid was retained in ALP with vacuum as compared to gunny bag (9.95 %) during storage. A significant decrease in TSS content of *anardana* was recorded with the advancement of storage which might be attributed due to increase in the moisture content and degradation of chemical components like sugars and other soluble constituents. *Anardana* packed in ALP with vacuum showed less decrease in TSS due to the negligible amount of residual moisture and air inside the pouch along with its minute permeable

nature towards moisture and air as compared to other packaging material. Thus the conditions inside the ALP with vacuum restricted the various degradation reactions of various nutritional components. During storage, significant loss in the titratable acidity of *anardana* might be due to their participation in the chemical reactions with sugars and amino acids for the formation of NEB products and HMF as well as utilization in the inversion of non-reducing sugars to reducing sugars. The *anardana* packed in ALP with vacuum have retained maximum acid content which might be due to the vacuum conditions inside the pouch which restricted the involvement of acids in various chemical reactions. Similar trend of results have also been reported by Sharma et al. [18] and Dak et al. [19] in *anardana* prepared from wild pomegranate and Maridula cultivar, respectively.

3.1.4 Reducing and total sugars

Scrutiny of data presented in (Fig. 1e) indicates that the reducing sugars of *anardana* increased from 24.80 to 25.64 %, higher (25.41 %) were found in ambient storage conditions and lower (25.03 %) in refrigerated storage conditions. The higher (25.65 %) reducing sugars were recorded in *anardana* packed in gunny bags as compared to ALP with vacuum (24.92 %) while comparing the overall effect of packaging materials on reducing sugars of *anardana*. Data appended in Fig. 1f reveal that the total sugars content of *anardana* decreased from 26.90 to 25.81 % during storage. Further, while comparing the overall effect of storage conditions it was observed that more (26.67 %) total sugars were retained under refrigerated storage conditions as compared to ambient storage conditions (26.17 %). The overall effect of packaging materials indicates that higher (26.80 %) total sugars were retained in ALP with vacuum as compared to gunny bag (25.87 %) during storage.

A significant increase in reducing sugars was recorded in *anardana* during storage which might be attributed to the inversion of non-reducing sugars and breakdown of polysaccharides into reducing sugars. Minimum increase in reducing sugars was observed in the product stored under refrigerated storage conditions as compared to ambient which might be due to the delayed inversion of non-reducing sugars as well as breakdown of polysaccharides by slowing down the chemical reactions as a result of low temperature. The *anardana* packed in ALP with vacuum had recorded minimum increase in reducing sugars which might be due to the vacuum conditions inside the pouch which restricted the conversion of polysaccharides to reducing sugars and did not allow the inversion reactions faster as compared to the others. Total sugars of the *anardana* deceased significantly during storage period of 12 months which might be attributed to the utilization of sugars in non-enzymatic browning reactions and formation of HMF. The total sugars were retained maximum in *anardana* stored under refrigerated storage conditions as compared to ambient which might be due to the slower non-enzymatic browning reactions as a result of low temperature. Further, better packaging conditions in ALP with vacuum might have restricted the formation of NEB products and HMF because of the higher concentration of SO_2 inside it. Sharma and Thakur [16], Sharma et al. [18], Singh and Kingsley [20] and Grande et al. [21] have also observed a similar trend of results for reducing and total sugars of *anardana.*

Table 1. Effect of storage on *visual colour of *anardana* prepared under mechanical cabinet drier

Treatments	Storage conditions									
	Ambient storage (months)					Refrigerated storage (months)				
	0	3	6	9	12	0	3	6	9	12
T_1	Red 46 B	Red 46 B	Red 46 C	Red 47 C	Brown	Red 46 B	Red 46 B	Red 46 B	Red 46 B	Red 46 C
T_2	Red 46 B	Red 46 B	Red 46 B	Red 46 C	Red 46 C	Red 46 B	Red 46 B	Red 46 B	Red 46 B	Red 46 B
T_3	Red 46 B	Red 46 B	Red 46 B	Red 46 B	Red 46 C	Red 46 B	Red 46 B	Red 46 B	Red 46 B	Red 46 B

T_1: Gunny bags, T_2: Aluminium laminated pouch and T_3: Aluminium laminated pouch with vacuum
** Colour card number (with alphabet) of Royal Horticulture Society, London*

3.1.5 Ascorbic acid and anthocyanins

Data appended in Fig. 1g reveal that the ascorbic acid content of *anardana* prepared in mechanical cabinet drier decreased during the entire storage period. The ascorbic acid content of *anardana* decreased from 15.20 to 11.08 mg/100 g during storage. Further, while comparing the overall effect of storage conditions it was found that higher (13.77 mg/100 g) ascorbic acid content was retained under refrigerated storage conditions as compared to ambient storage conditions (12.65 mg/100 g). The overall effect of packaging materials indicates that higher (14.35 mg/100 g) ascorbic acid content was retained in ALP with vacuum as compared to gunny bag (11.81 mg/100 g) during storage. An appraisal of data Fig. 1h reveal that anthocyanins content of *anardana* decreased from 40.40 to 33.31 mg/100 g during storage. Further, while comparing the overall effect of storage conditions it was found that maximum (38.18 mg/100 g) anthocyanins content was retained under refrigerated storage conditions as compared to ambient storage conditions (35.47 mg/100 g). The overall effect of packaging materials indicates that maximum (38.86 mg/100 g) anthocyanins content was retained in ALP with vacuum as compared to gunny bag (33.88 mg/100 g) during storage.

The *anardana* showed a significant decrease in ascorbic acid during the entire storage period which might be due to its oxidation into dehydroascorbic acid followed by hydrolysis and further oxidation into furfural [22]. Better conditions inside ALP with vacuum might have restricted the participation of ascorbic acid in various oxidation reactions. Whereas, highest permeability of gunny bags towards oxygen might have led towards the highest rate of ascorbic acid degradation during storage. A significant decrease in anthocyanins content of *anardana* might be attributed to their susceptible nature towards oxidative losses caused by air, moisture, temperature and light. Product stored under refrigerated temperature conditions retained more anthocyanins and ascorbic acid as a result of slower rate of oxidation reactions under low temperature conditions. ALP with vacuum retained more anthocyanins of *anardana* as compared to gunny bags. This might be due to the opaqueness of aluminium foil in the ALP to light and impermeability of the packaging material to oxygen, water vapours and vacuum inside the pouch that prevented photo-oxidation of anthocyanins. Similar decreasing trend of ascorbic acid and anthocyanins content of *anardana* during storage have also been observed by Bhat et al. [15], Sharma and Thakur [16], Sharma et al. [18] and Singh and Kingsley [20].

3.1.6 Starch and total fibres

Data in Fig. 1i elucidates that there was a significant decrease in starch content from 2.95 to 2.61 %. The overall effect of storage conditions, keeping other factors constant, shows that higher (2.83 %) starch content was retained in refrigerated storage conditions as compared to ambient conditions (2.68 %). Data in Fig. 1j indicate that there was a general decrease in total fibres content of *anardana* from 3.52 to 3.19 %. The minimum (3.26 %) and maximum (3.40 %) total fibres content was found in ambient and refrigerated storage conditions, respectively. The overall effect of packaging material reveals that maximum (3.48 %) total fibres content of *anardana* was found in ALP with vacuum as compared to gunny bags (3.13%).

The total fibres content of *anardana* decreased slightly during storage period of 12 months which might be attributed to breakdown and depolymerization of polysaccharides into monosaccharides. The other reason for the decrease in total fibres content of *anardana* might be due to the absorption of moisture from the surroundings which led to the decrease in the total fibres content on weight basis. Above results for starch and total fibres are in conformity with the earlier findings of Thakur et al. [23] in solar tunnel dried wild pomegranate arils.

3.1.7 NEB (Non enzymatic browning), HMF (Hydroxymethyl furfural) and furfural

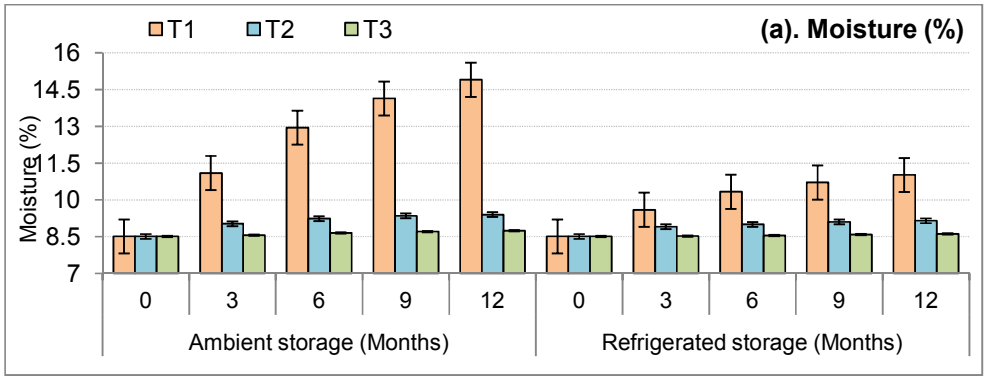
An appraisal of data (Fig. 1k) reveal that there was a general increasing trend in NEB of *anardana* from 0.042 to 0.127 during storage. Further, while comparing the overall effect of storage conditions it was found that lower (0.062) NEB was found under refrigerated storage conditions as compared to ambient (0.102) storage conditions. The overall effect of packaging materials indicates that minimum (0.058) NEB was observed in ALP with vacuum as compared to gunny bags (0.112). Critical look of the data in Fig. 1l shows that HMF of *anardana* increased from 0.91 to 7.35 ppm, higher (5.34 ppm) was found in ambient storage conditions and lower (2.61 ppm) in refrigerated

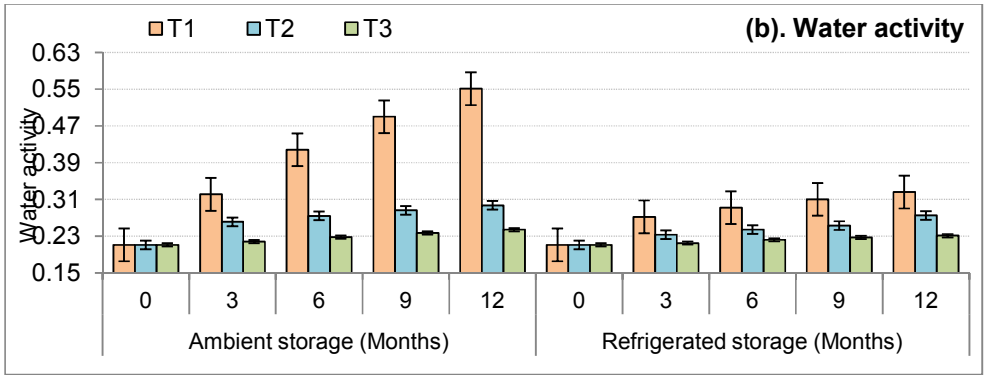
storage conditions. While comparing the overall effect of packaging materials on HMF of *anardana* indicates that minimum (1.99 ppm) HMF was found in ALP with vacuum as compared to gunny bags (6.02 ppm). Scrutiny of data presented in Fig. 1m indicates that furfural of *anardana* increased from 13.06 to 50.00 ppb, lower (24.73 ppb) was found in refrigerated storage conditions and higher (36.77 ppb) in ambient storage conditions. The minimum (21.30 ppb) furfural was recorded in *anardana* packed in and ALP with vacuum as compared to gunny bags (41.53 ppb) while comparing the overall effect of packaging materials on furfural of *anardana*.

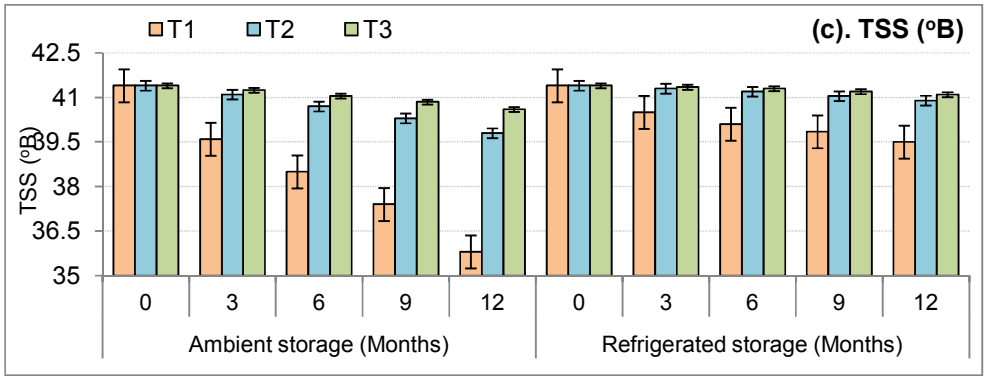
The increase in nonenzymatic browning of dried arils might be due to, the reaction between aldehydes, ketones groups of reducing sugars with amino acids, peptides and proteins (Maillard reaction). The HMF content of arils increased during storage which might be attributed to the acid catalyzed degradation of reducing sugars or as an intermediate product of non enzymatic browning reactions. The increase in furfural content of *anardana* during storage might be due to degradation of ascorbic acid by oxidation/reduction and intermolecular rearrangement reactions which further led to the formation of dehydroascorbic acid and furfural. Present results are in conformity to the results of Bhat et al. [15] and Sharma and Thakur [16] in *anardana* prepared from wild pomegranate fruits.

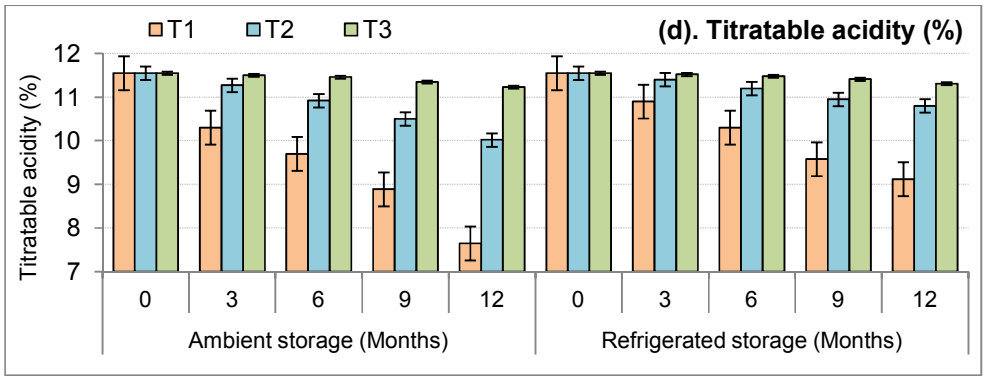
3.1.8 Residual SO_2

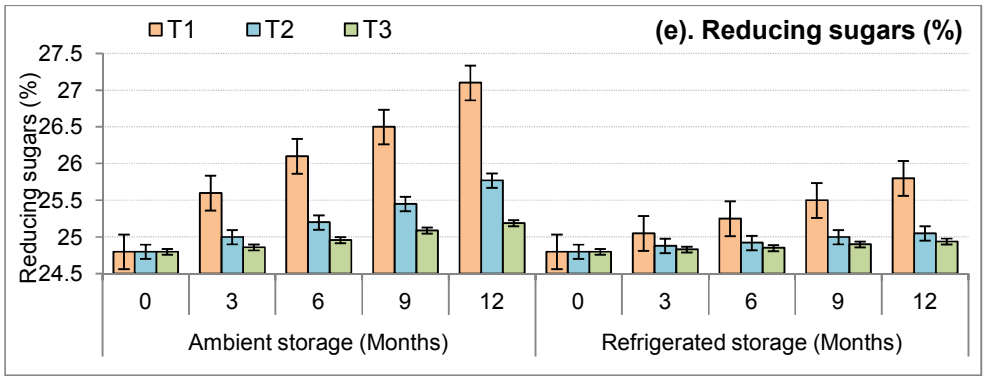
Data in Fig. 1n indicate that there was a general decreasing trend of sulphur dioxide of *anardana* during storage. The overall effect of storage period on sulphur dioxide of *anardana* reveals that there was a significant decrease in sulphur dioxide from 240.19 to 165.23 ppm. The lower (191.06 ppm) and higher (200.61 ppm) sulphur dioxide were found in ambient and refrigerated storage conditions, respectively. The overall effect of packaging material reveals that maximum (227.36 ppm) sulphur dioxide was recorded in *anardana* packed in ALP with vacuum as compared to gunny bags (142.88 ppm).

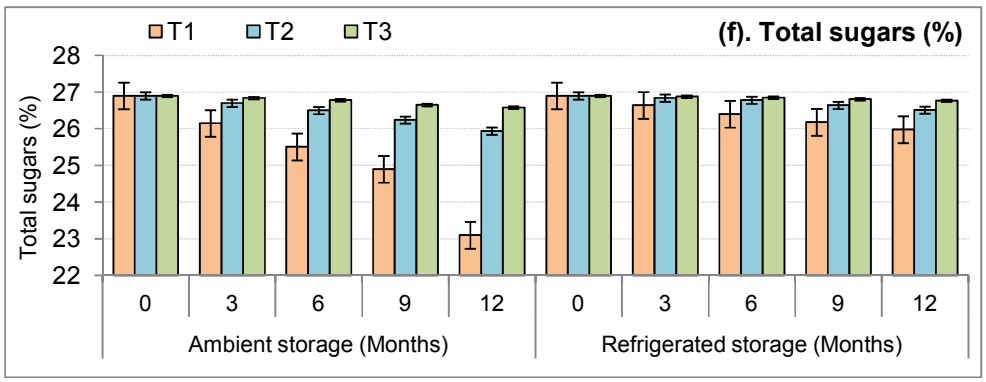


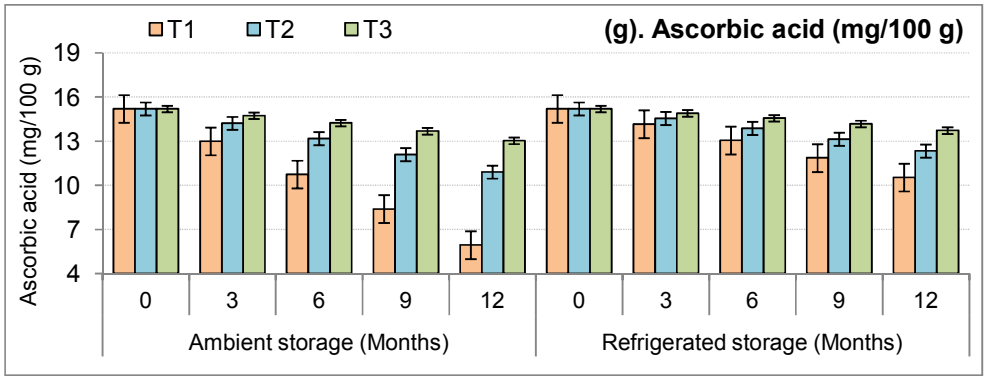


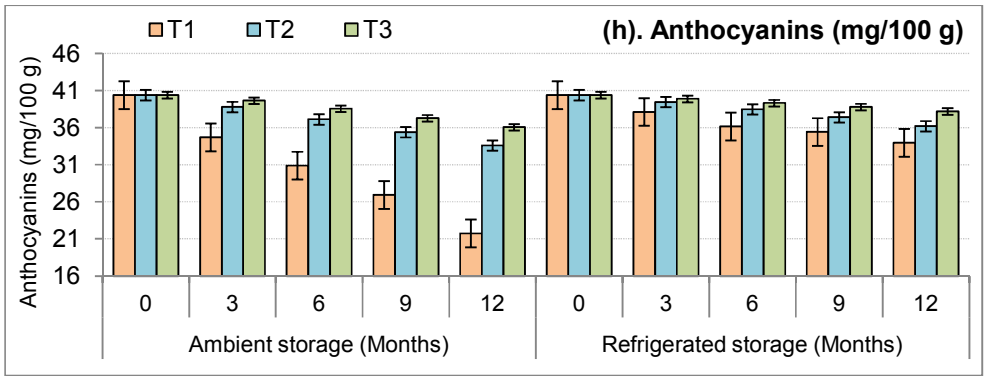

T1
T2
T3
(c). TSS (ºB)
TSS (ºB)
42.5
41
39.5
38
36.5
35
0
3
6
9
12
Ambient storage (Months)
Refrigerated storage (Months)

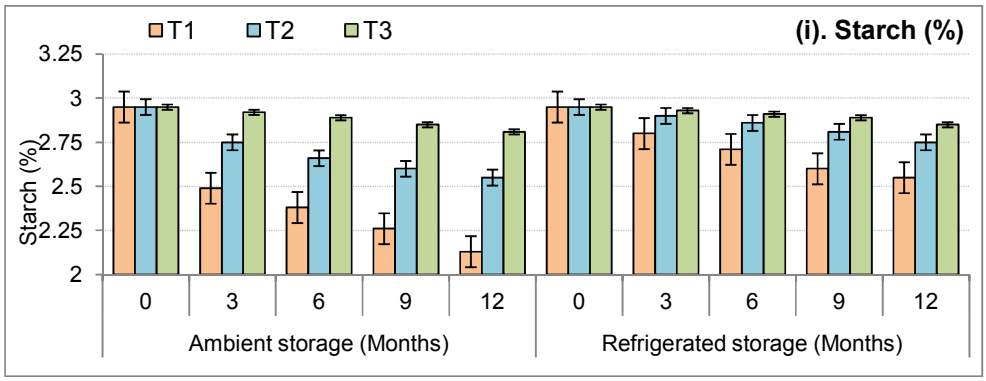

T1
T2
T3
(d). Titratable acidity (%)
Titratable acidity (%)
12
11
10
9
8
7
0
3
6
9
12
Ambient storage (Months)
Refrigerated storage (Months)

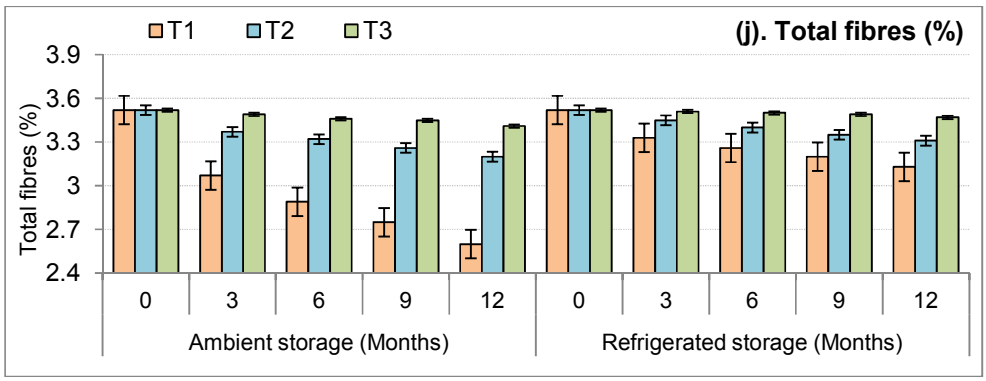

T1
T2
T3
(e). Reducing sugars (%)
Reducing sugars (%)
27.5
27
26.5
26
25.5
25
24.5
0
3
6
9
12
Ambient storage (Months)
Refrigerated storage (Months)


T1
T2
T3
(f). Total sugars (%)
Total sugars (%)
28
27
26
25
24
23
22
0
3
6
9
12
Ambient storage (Months)
Refrigerated storage (Months)


T1
T2
T3
(g). Ascorbic acid (mg/100 g)
Ascorbic acid (mg/100 g)
19
16
13
10
7
4
0
3
6
9
12
0
3
6
9
12
Ambient storage (Months)
Refrigerated storage (Months)


T1
T2
T3
(h). Anthocyanins (mg/100 g)
Anthocyanins (mg/100 g)
46
41
36
31
26
21
16
0
3
6
9
12
0
3
6
9
12
Ambient storage (Months)
Refrigerated storage (Months)


T1
T2
T3
(i). Starch (%)
Starch (%)
3.25
3
2.75
2.5
2.25
2
0
3
6
9
12
0
3
6
9
12
Ambient storage (Months)
Refrigerated storage (Months)


T1
T2
T3
(j). Total fibres (%)
Total fibres (%)
3.9
3.6
3.3
3
2.7
2.4
0
3
6
9
12
0
3
6
9
12
Ambient storage (Months)
Refrigerated storage (Months)

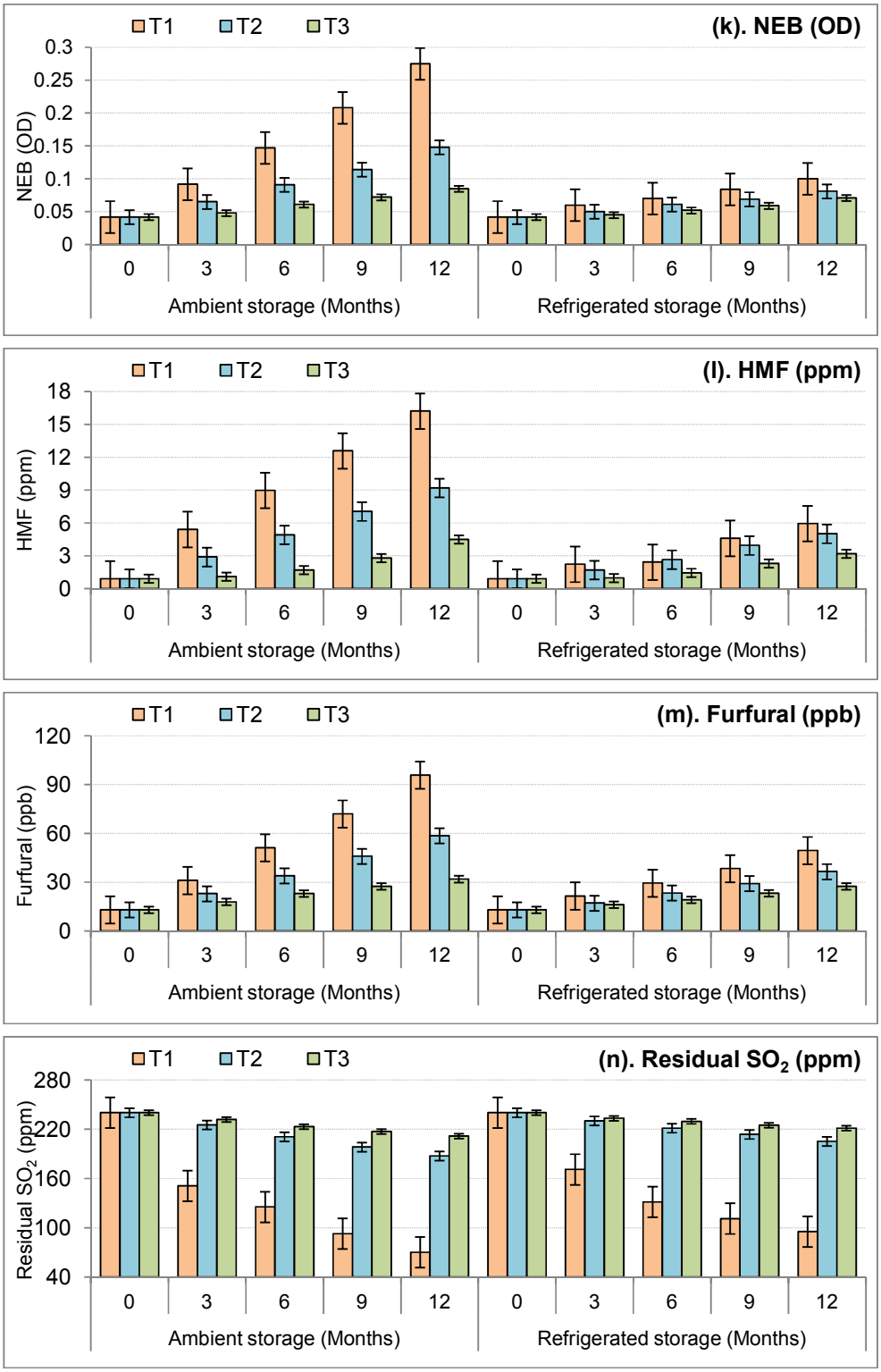


Fig. 1(a-n). Effect of storage on the physico-chemical characteristics of *anardana* prepared under mechanical cabinet drier

(T_1: Gunny bags, T_2: Aluminium laminated pouch and T_3: Aluminium laminated pouch with vacuum; Error bars indicates standard error of the average)

Significant reduction of residual SO_2 in *anardana* was observed during storage which might be due to its escape from the packaging material. The other possible reason of the decrease in SO_2 content might be due to its participation in oxidation process during storage. *Anardana* stored under refrigerated conditions retained higher SO_2 which might be due to the slower rate of oxidation reactions under low temperature conditions. The retention of higher SO_2 in ALP might be due to minute permeable nature of the ALP which hindered the exchange of gases and created a better barrier for the removal of SO_2. A similar trend of decrease in residual SO_2 of *anardana* during storage has also been observed earlier in solar tunnel dried wild pomegranate arils [23].

3.2 Sensory Characteristics

Data in Fig. 2a shows that during storage a general decrease in colour scores of *Anardana* prepared in mechanical cabinet drier. The overall effect of storage period indicates that colour

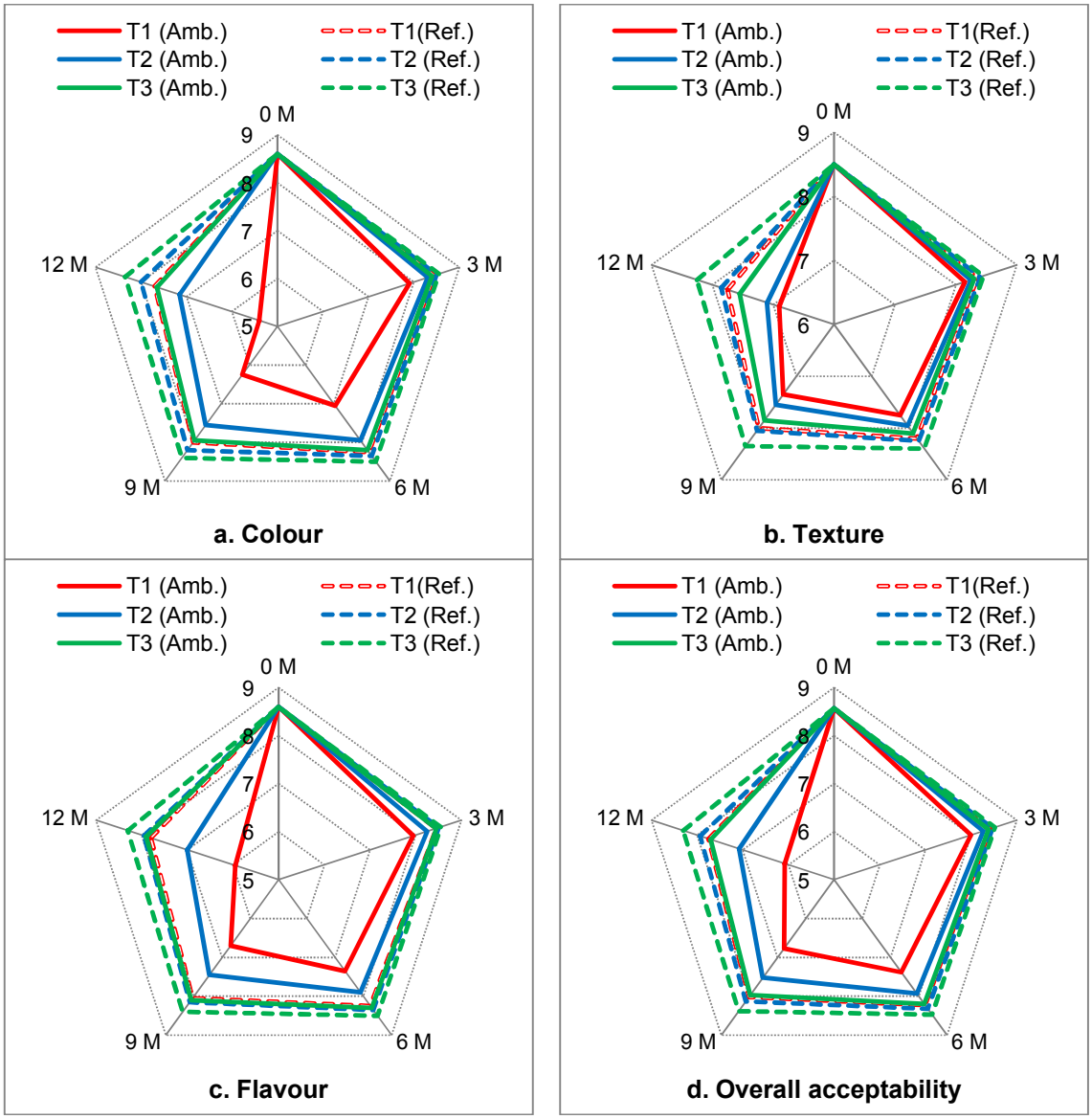


Fig. 2(a-d). Effect of storage on the sensory characteristics scores of *anardana* prepared under mechanical cabinet drier

(T_1: Gunny bags, T_2: Aluminium laminated pouch and T_3: Aluminium laminated pouch with vacuum; M: Months; Amb.: Ambient and Ref.: Refrigerated)

prepared in mechanical cabinet drier. The overall effect of storage period indicates that colour scores decreased from 8.60 to 7.38. While comparing overall effect of storage conditions, it was observed that colour scores were retained higher (8.34) in refrigerated conditions as compared to ambient conditions (7.70). The overall effect of packaging material on colour scores of the product shows that it was retained higher (8.32) in and ALP with vacuum as compared to gunny bags (7.62). The data in Fig. 2b indicates that the texture scores of *anardana* decreased from 8.50 to 7.57 retained higher (8.25) in refrigerated storage conditions and lower (7.89) in ambient storage conditions. While comparing the overall effect of packaging materials higher (8.23) scores were recorded in *anardana* packed in ALP with vacuum as compared to gunny bags (7.95). An appraisal of data Fig. 2c reveals that flavour scores decreased from 8.60 to 7.48. While comparing overall effect of storage conditions, it was observed that flavour scores were retained higher (8.34) in refrigerated conditions as compared to ambient conditions (7.81). The overall effect of packaging material on flavour scores of the product shows that it was retained higher (8.37) in ALP with vacuum as compared and gunny bags (7.77). The overall acceptability scores of *anardana* (Fig. 2d) decreased from 8.57 to 7.47, retained higher (8.31) in refrigerated storage conditions and lower (7.80) in ambient storage conditions. The higher (8.30) and lower (7.78) overall acceptability scores were recorded in *anardana* packed in ALP with vacuum and gunny bags, respectively while comparing the overall effect of packaging materials on overall acceptability scores during storage.

The colour scores of *anardana* exhibited significant decrease during storage which might be due to the loss of natural colour pigments including anthocyanins as a result of which judges awarded the lower scores to the product as compared to initial scores. Other reason could be the development of browning pigments due to non-enzymatic browning reactions. These changes in the colour of the product might have forced the judges to award the lower scores to the product as compared to the initial scores. Significant decrease in texture score of *anardana* was observed during storage which could be due to the absorption of moisture by the product leading to the softening of the product. This might have forced the judges to award the lower scores to the product as compared to the initial scores. The flavour scores of the *anardana* have decreased significantly during storage which could be due to the loss of various chemical constituents mainly responsible for the flavour of the product. The loss of sugar and acid blend might also be responsible for change in flavour of the product as a result of which judges awarded the lower scores to the product as compared to initial scores. The overall acceptability scores of *anardana* exhibited significant decrease during storage which might be due to reduction in colour intensity as a result of degradation of anthocyanins. Distortion/disruption of texture as well as the loss of flavour compounds of the product could also have attributed towards the poor scores of the product during storage. Similar trend of decrease in above sensory scores scores have also been observed by Bhat et al. [15] in *anardana* packed in ALP under ambient and refrigerated temperature conditions, Sharma and Thakur [16] in *anardana* in ALP and PEP stored under ambient temperature conditions and Grande et al. [21] in *anardana* from Ganesh cultivar packed in polyethylene pouch stored under ambient temperature conditions.

4. CONCLUSION

Anardana prepared in mechanical cabinet drier could be stored safely for a period of twelve months under both storage conditions and packaging materials with minimum changes in chemical and sensory attributes. However, comparatively fewer changes in *anardana* packed in ALP with vacuum and stored under refrigerated storage conditions were observed as compared to ALP and gunny bags.

ACKNOWLEDGEMENTS

The authors are thankful to Dr. YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh 173230, for providing support for the study

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/59361