

s detected by

Description	Concentration by peak area [%]
d vanilla	5.9
tty, waxy	4.9
ic, pungent	2.6
fatty odor,	
ste	5.0
hy, green	2.0
	2.6
	3.3
aty, floral,	
	1.1
atty, floral,	
	16.2
axy	0.9
	1.8
oky	1.9
	3.2
nolic	1.7
	1.3
inge peel	9.1
fragrant,	
e	0.4
	1.6

ist A Cosmetic Ingredient. Industry 134 (2) 1984, pp 1, 116
 : Aardestrup, I., Mellerup, stensen, J.: The effects of rum lipids and lipoproteins rolesterolemic and mildly emic humans. NutraCos 3

Determination shelf life of raw dried pistachio nuts

Nasser Sedaghat^{1*}, Alli Mortazavi¹, Inteaz Alli², Eby Noroozi²

¹Dept. of Food Science, Univ. of Ferdowsi, Mashhad, Iran - ²Dept. of Food Science & Agr. Chemistry, Univ. of McGill, Quebec, Canada.

*E-mail : sedaghat@um.ac.ir

Introduction

The kernel of pistachio is a rich source of oil (50 - 60 %) and contain linolenic and linoleic fatty acids, essential for human diet and oleic acid (Maskan and Karatas, 1998). Pistachio nuts dried to 4-6% moisture are very stable and could held for up 12 months at temperatures as high as 20 °C without significant losses in quality attributes (Kader et al, 1982). Shelf life is defined as the period of time under defined conditions of storage, after manufacture or packaging. (IFST, 1993). There are several established approaches such as ASLT, Sensory Evaluation, Instrumental Measurements, Chemical, Physical property and Microbiological tests for estimating shelf life of foods. Sensory evaluation by a trained panel usually best approximates the overall quality state of the food even. The time at which a large percentage of panelist judge the food as being at or beyond that level is the end of shelf life. (Labuza and Schmill, 1988). The objectives of this work was to evaluate the sensorial changes of raw dried pistachio nuts stored at vari-

ous conditions in order to detect the quality parameters and estimate the shelf life of this product.

Materials and methods

Pistachio nut samples. The raw dry pistachio nut (Ohadee variety) samples with an average moisture content of about 5% (wet basis) initially were supplied from Rafsanjan Pistachio Factory in Iran.

Sensory evaluation. Sensory evaluation was performed using descriptive analysis and affective testing (Ston and Sidel, 1985). A sensory score of 2.5 was taken as the cut off for acceptability and termination of shelf life.

Statistical analysis. The results were compared by multifactor analysis of variance. Means of the groups were compared using the least significant difference (LSD) multiple range test using a Statgraphics plus, 2000. Differences among sample means were reported to be significant when $p < 0.05$. and Sigma Plot 8 soft ware used for drawing plots of linear regression for prediction shelf life of sample pistachio nuts (Kubala and Cacula, 1974).

Results and discussion

Sensory evaluation. Table 1 shows the results of LSD Multiple Range Test for taste, texture and overall acceptability; all factors (O_2 concentration, storage time and temperature) affected sensory properties. Increase of storage time and temperature showed negative effects on sensory attributes, while but with decrease of O_2 concentration showed a positive effect.

Shelf life prediction models. Temperature, the single most important environmental factor, influences all mechanisms of food spoilage, so the effects of temperature must be evaluated in all shelf life studies (Dominic Man 2002). Data of multiple linear regression and estimated shelf life of pis-

tachio nuts at various conditions are depicted in table 2 respectively, at all storage temperatures (5,20,35,45 °C). The initial score for overall acceptability of raw dried pistachio nuts decreased in all three types of oxygen percent (21% and < 2%) after 12 weeks of storage and maximum shelf life was 284 days for the sample stored at < 2% O_2 and 5 °C . Minimum shelf life was 127 days for sample of stored at 21 % O_2 and 45 °C. The shelf life prediction curves for raw dried pistachio nuts at different storage temperature showed in Fig. 1. It is clearly seen in Fig. 1 that increase at storage temperature and oxygen percent decrease shelf life of raw dried pistachio nuts . For estimating the best fitting model data fit to the multiple linear regression , first order , second or-

Table 1. The results of LSD multiple range test for taste, texture and overall acceptability of raw dried pistachio nuts at $\alpha=0.05$ level, data represent a 5-point hedonic scale ranging from 1(bad) to 5 (excellent)

Variables	Levels	Count	Taste LS mean	Texture LS mean	Overall acceptance LS mean
Storage temperature(°C)	5	150	3.60 ^a	3.75 ^a	3.36 ^a
	20	150	3.48 ^{ab}	3.56 ^{ab}	3.17 ^{ab}
	35	150	3.39 ^{ab}	3.38 ^b	3.16 ^b
	45	150	3.29 ^b	3.10 ^c	3.10 ^b
O_2 Concentration (%)	21	200	3.37 ^c	3.32 ^d	3.17 ^c
	8	200	3.33 ^c	3.37 ^d	3.14 ^c
	<2	200	3.60 ^d	3.66 ^e	3.29 ^c
Storage time (weeks)	4	120	3.93 ^e	4.02 ^f	3.39 ^d
	6	120	3.62 ^f	3.57 ^g	3.25 ^{de}
	8	120	3.40 ^g	3.41 ^{gh}	3.23 ^{de}
	10	120	3.20 ^{gh}	3.26 ^h	3.13 ^{ef}
	12	120	3.01 ^h	2.98 ⁱ	2.99 ^f

Values within a column followed by the same letter are not significantly different at the 95% confidence level

arious conditions are 2 respectively, at all res (5,20,35,45 °C). r overall acceptability hio nuts decreased in oxygen percent (21,8 12 weeks of storage elf life was 284 days red at < 2% O₂ and 5 elf life was 127 days ed at 21 % O₂ and 45 prediction curves for io nuts at different re showed in Fig. 1. o Fig. 1 that increase rature and oxygen shelf life of raw dried r estimating the best fit to the multiple list order, second or-

Table 2. The linear model shelf life equations, R² and estimated shelf life pistachio nuts at various storage conditions.

Temperature (°C)	O ₂ %	Model equation	R ²	Shelf life (Weeks)
5	21	Y=3.64-0.035X	0.942	32.5
	8	Y=3.66-0.035X	0.720	33.1
	< 2	Y=3.92-0.035X	0.942	40.5
20	21	Y=3.48-0.045X	0.920	21.7
	8	Y=3.32-0.035X	0.942	23.4
	< 2	Y=3.64-0.035X	0.942	32.5
35	21	Y=3.44-0.045X	0.920	20.8
	8	Y=3.52-0.05X	0.925	20.4
	< 2	Y=3.62-0.05X	0.926	22.4
45	21	Y=3.5-0.055X	0.916	18.1
	8	Y=3.58-0.055X	0.916	19.6
	< 2	Y=3.56-0.05X	0.892	21.2

exture and overall data represent a 5-cellent)

ure LS mean	Overall acceptance LS mean
75 ^a	3.36 ^a
56 ^{ab}	3.17 ^{ab}
38 ^b	3.16 ^b
10 ^c	3.10 ^b
32 ^d	3.17 ^c
37 ^d	3.14 ^c
66 ^e	3.29 ^c
02 ^f	3.39 ^d
57 ^g	3.25 ^{de}
41 ^{gh}	3.23 ^{de}
26 ^h	3.13 ^{ef}
98 ⁱ	2.99 ^f

it at the 95% confidence

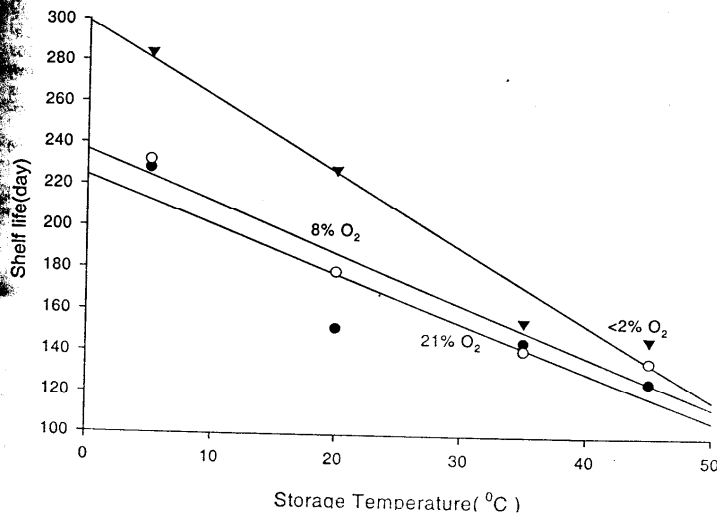


Fig 1.-Shelf life prediction curves for raw dried pistachio nuts at different storage temperature.

der and exponential decay. The R^2 value of regression analyses were used to select the best fitting model from among them and the second order function had a best fit with $R^2 > 98$ at all oxygen percent condition levels (21, 8, & < 2% O_2). Our results showed a significant effect of O_2 % on the sensory attribute (taste, texture) of raw dried pistachio nuts. Similar results were obtained by Kader et al (1982). Blakistone (1998) reported that flushing with N_2 is currently commonly used to reduce residual O_2 in packs containing cashews, pistachios, mixed nuts and dried fruit. Maskan and Karatas (1998) reported that differences in peroxide values due to storage conditions were not significantly different during 6 months of storage for pistachio nuts and he showed that the pistachio nuts had a high stability.

Conclusion

We found that raw dried pistachio nuts had a good shelf life for storage at all storage condition, but use of cold storage and lower oxygen percent can be extended shelf life. High oleic Acid

content, natural antioxidant such as tocopherols and low moisture gave a good shelf life and stability to raw dried pistachio nuts.

References

- Blakiston, B.A. (1998). *Principles and applications of Modified Atmosphere Packaging of foods*, Blackie Academic and professional, an imprint of Thomson Science, London, UK. P 175.
- Dominic, M. (2002). *Shelf life*, Blackwell science LTD, UK, London, WC1N 2BS, pp 10.
- IFST (1993). *Shelf life of foods-Guidelines for its determination and prediction*, Institute of food science and technology, UK, London.
- Kader, A.A., Heintz, C.M., Labavitch, J.M., & Rae, H.L. (1982). *Studies related to the description and evaluation of pistachio nuts quality*. *J. Amer. Soc. Hort. Sci.* 107(5): 812-816.
- Kubala, J.J., Gacula, J.R., & Moran, M.J. (1977). *Data analysis: Regression analysis with repetition of the independent variable*, *J. of Food Science*. Vol 39. p 209-210
- Labuza, T.P., & Schmidl, M.K. (1988). *Use of sensory data in the shelf life testing of foods: principals and graphical methods for evaluation*. *Cereal Food World*, 33 (2), p 193-200.
- Maskan, M., & Karatas, S. (1998). *Fatty acid oxidation of pistachio nuts stored under various atmospheric conditions and different temperatures*. *J. Sci. Food Agric.* 77, 334-340
- Ston, H. & Sidel, J.L. (1985). *Sensory evaluation practices*, Academic press, Orlando, pp 227.