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Effect of Storage Period on the Quality of Pecan Kernels Kept under Vacuum.[1]

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ABSTRACT

Vacuum packed kernels of Mahan, Desirable, Stuart, Delmas, and Schley, pecan varieites, were stored at −18, 0, 10, and 21°C for six and thirteen months. Quality was evaluated by chemical, physical, and organoleptic panel tests. Prolonging the storage period from 6 to 13 months had significantly increased rancidity and reduced moisture and oil content of the kernels. Texture was unaffected, but flavor, color, and product acceptance had deteriorated after 13 months of storage. The subjection of kernels stored for 13 months to room temperature had significantly enhanced the development of rancidity within a period of 15 days. No impacts of the different storage temperatures could be found, as to their effects on the subsequent shelf-life of kernels.

INTRODUCTION

Pecans, *Carya illinoensis* Wag., are known to deteriorate in storage (2,4). However, deterioration due to rancidity development is not so great in cold storage (6). The shelf-life of pecans has been extended by the use of sealed containers, such as, moisture proof cellophane, cardboard cartons, or glass jars (2,3,4,7). Storage of nuts in gas tight containers or with inert gas was also tried, but the shelf-life was found to be one third of the period reported for vacuum (3,5,6,7). This experiment was conducted in order to study the effect of storage period on the quality of pecan kernels kept under vacuum, and to investigate the influence of different storage temperatures on subsequent shelf-life of pecans, once brought out of the storage.

MATERIALS AND METHODS

Mahan, Desirable, Stuart, Delmas, and Schley pecan varieties were mechanically shelled, using a hand cracker. Kernels from each variety were wrapped separately in

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polyethylene bags, and canned under 25 lbs/square inch vacuum. Several cans from each variety were placed in temperature controlled rooms at −18, 0, 10 and 21°C. Six and thirteen months later, samples were brought out of the storage rooms to room temperature, via gradual increase in temperature. The quality of pecans after each storage period, was evaluated by the different methods shown below. After 13 months of storage, kernels from the different storage temperatures, were kept at room temperature for two weeks, in order to study the effect of storage temperature on the subsequent shelf-life of shelled pecans. The characteristics studied and methods used for quality evaluation were as follow.

1. Color — The Gardner sensitivity automatic color-difference meter, model AC-1, was used. Color was evaluated by the light reflectance of two kernels exposed to the light of the color difference meter.
2. Texture — Texture of the kernels was determined by their resistance to shear, using the L.E.E. Kramer Shear Press, Model SP-12 IMP.
3. Oil content — Oil was extracted from the kernels with ether from a weighed ground sample using soxhlet apparatus, for 16 hours. Oil content was expressed as percentage of oil.
4. Moisture content — Percentage of moisture was determined by dehydration of a known weight ground sample of two pecan kernels, in vacuum oven at 70°C, for 24 hours.
5. Rancidity — Rancidity of the oil was evaluated by simple titration of the free fatty acids in the oil, expressed as oleic acid (1).
6. Product acceptance — The product acceptance of the kernels was organoleptically tested, utilizing Desirable, Stuart and Schley varieties, for their availability in abundant amounts. The following scoring system was employed to express product acceptance in regard to flavor, color, and texture.

   9 Like extremely
   8
   7 Like slightly
   6
   5 Neither like nor dislike
   4
   3 Dislike slightly
   2
   1 Dislike extremely

Data was statistically analyzed using the analysis of variance, and the Duncan's Multiple Range Test. The five varieties were treated as one group in the statistical analysis, in order to investigate the over-all effect of the two storage periods on quality and shelf-life of pecans.

RESULTS AND DISCUSSION

Results are presented in Tables 1, 2, and 3, and Figures 1 and 2. As the storage period of pecans was extended from 6 to 13 months, moisture content of kernels dropped from 2.87% to 2.24%, and the oil content from 65.73% to 62.43% (Table 1). This loss in moisture and oil content during storage was statistically significant.

Rancidity, expressed in percent free fatty acids was significantly developed during storage. It increased from 0.11% to 1.30% as storage was extended from 6 to 13 months. Texture, measured by the shear response, was not affected in storage, which might have been due to the storage under vacuum.

Table 1 Effect of storage period on the quality of pecan kernels stored for 6 and 13 months under vacuum

	Means							
Period of storage	% moist.	% oil	Sh. R.	% FFA	Flavor[a]	Color[a]	Texture[a]	Product[a] acceptance
6 months	2.87a	65.73a	5.24a	0.11b	6.93a	6.82a	7.13a	6.83a
13 months	2.24b	62.43b	4.91a	1.30a	6.25b	7.10b	7.10a	6.23b

a, b at any one column are significantly different at 5% level of probability.
Sh. R = Shear response.
% FFA = % Free fatty acids (Rancidity).
[a]Pecans panel scores.

Table 2 Effect of room temperature on pecan kernels, previously stored under vacuum for 13 months

	Means			
Days after removal from storage	% moisture	% oil	Shear response	% Free fatty acids
0	2.46b	65.86ab	5.26ab	1.35c
3	1.87d	64.59bc	4.95b	1.37c
6	2.03cd	66.24a	5.11ab	1.37c
9	2.48b	64.73bc	5.25ab	1.57b
12	2.67a	64.06c	5.42a	1.76a
15	2.17c	64.81bc	5.32a	1.76a

a, b, c, d at any one column are significantly different at 5% level.

Table 3 Effect of −18°, 0, 10, and 21°C on subsequent shelf-life of shelled pecans, previously stored in vacuum tins for 13 months[a]

		Means of measurements after removal from storage					
Measurement	Temp. (°C)	0 Days	3 Days	6 Days	9 Days	12 Days	15 Days
Moisture	−18	2.65	2.12	2.07	2.70	2.86	2.21
	0	2.34	1.91	2.14	2.52	2.70	2.27
	10	2.47	1.71	2.01	2.44	2.52	2.12
	21	2.38	1.75	1.89	2.26	2.52	2.06
% Oil	−18	67.46	65.50	68.27	66.48	64.81	65.75
	0	64.80	64.05	65.20	64.36	64.71	63.99
	10	65.73	64.81	64.52	64.07	64.78	64.92
	21	65.46	63.98	66.97	64.01	61.92	64.56
Shear response	−18	5.11	5.02	5.37	5.43	5.56	4.98
	0	5.28	4.94	5.34	5.13	5.38	5.63
	10	5.23	4.91	4.92	5.26	5.21	5.32
	21	5.41	4.91	4.79	5.10	5.50	5.34
% Free fatty acids	−18	0.84	0.82	0.87	1.16	1.17	1.18
	0	0.89	0.96	0.99	1.21	1.28	1.35
	10	1.34	1.37	1.25	1.37	1.85	1.75
	21	2.31	2.39	2.35	2.52	2.66	2.76

[a]The statistical interaction between temperatures and dates did not show any significance.

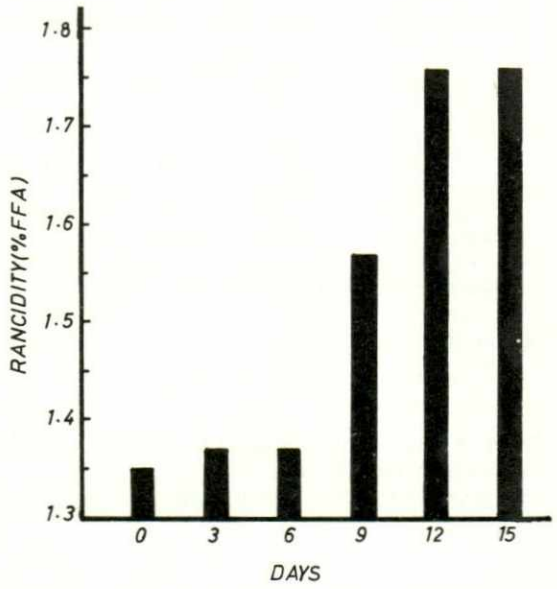

Fig. 1. Rancidity development in pecans as brought out of storage to room temperature for different periods.

The organoleptic panel test on Desirable, Stuart, and Schley varieties, showed a decline in flavor, color, and product acceptance after 13 months of storage. Texture, tested organoleptically, gave similar results to the shear response. It was statistically un-affected in storage (Table 1).

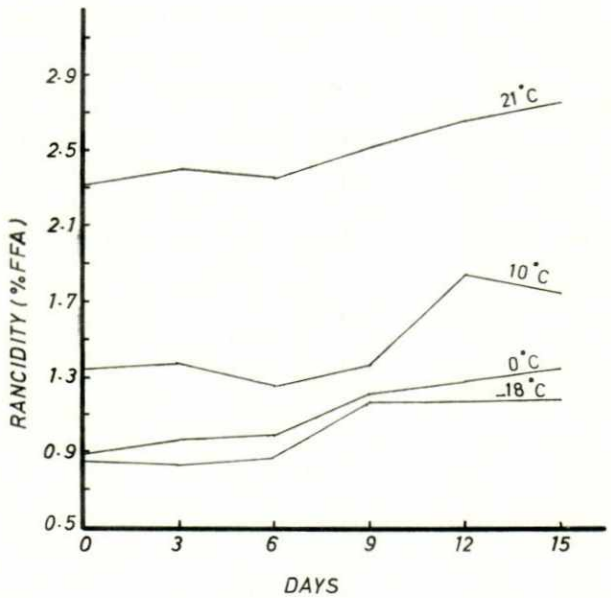

Fig. 2. Effect of storage temperature on the rancidity of pecans brought out of storage to room temperature for different periods.

Pecans brought out of the different storage rooms, after 13 months, had shown rapid deterioration in quality, when kept at room temperature. Measuring rancidity at three days interval for a period of two weeks showed a significant development of rancidity, starting the ninth day at room temperature (Table 2 and Fig. 1). Moisture content, oil content, and texture of pecan kernels had shown fluctuating changes during the 15 days of observation at room temperature.

The impacts of different storage temperatures on the subsequent shelf-life of pecans were statistically non-significant (Fig. 2 and Table 3).

It can be concluded that pecan kernels of good quality attributes, with the exception of texture, could not be maintained for a long period. Although pecans were stored under vacuum, decline in quality and deterioration of the kernels had taken place, when storage was extended from 6 to 13 months. Pecans, stored for 13 months showed a rapid development of rancidity, as they were exposed to room temperature for two weeks. This might have been due to a stimulated enzymatic activity, that was checked in storage under vacuum.

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تأثير مدة التخزين علي نوعية ثمار البكان المقشرة والمحفوظة تحت التفريغ

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المستخلص

ثمار البكان المقشرة والمحفوظة تحت التفريغ من أصناف ميهان ، ديزايرابل ، ستيوارت ، دلماس ، وسلاي ، تم حفظهم في درجة حرارة — ١٨°م ، صفر ، ١٠°م ، ٢١°م لمدة ٦ و١٣ شهراً . وبتحليل الثمار بالطرق الكيميائية والطبيعية وباختبارات التذوق ، تبين أن زيادة مدة التخزين من ٦ إلى ١٣ شهرا قد رفع من نسبة تزنخ الثمار وقلل نسبة الرطوبة ومحتوي الزيت فيها . أما من حيث الصفات الظاهرية فلم يتأثر تماسك الثمار — في التخزين ، ولكن الطعم واللون وقبول الثمار قد انخفضت نوعيتهم بعد ١٣ شهراً من التخزين . وعند تعريض ثمار البكان التى كانت تحت التخزين لمدة ١٣ شهرا لدرجة حرارة الغرفة ، لوحظ ان ذلك قد اسرع من تزنخ الثمار خلال فترة لا تتجاوز ١٥ يوما بعد اخراجها من التخزين ، هذا ولم يلاحظ أي اختلاف بين درجات الحرارة المختلفة المستعملة من حيث تأثيرها على ثمار البكان بعد اخراجها من التخزين وتعريضها لدرجة حرارة الغرفة العادية .