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FOOD STORAGE EFFECTS

The Effect of Storage on the Total Lipides and the Fatty Acid Composition of Potatoes

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The total crude lipides and free fatty acid compositions of two varieties of potatoes were studied to determine changes during storage at 40° F. In both varieties, the total amount of lipide extracted did not change significantly with storage, but the fatty acid composition of each variety was altered. During storage, Pontiac potatoes showed a marked decrease in linoleic acid and an increase in palmitic acid, whereas Ontario potatoes showed a decrease in both palmitic and linolenic acids. Fatty acids containing more than 18 carbons were present in both varieties in significant quantity, and these increased in quantity during storage.

DURING POTATO STORAGE, many changes occur in the chemical composition of the potato. It is likely that fatty acids are among the compounds undergoing change. Relatively little information is available on the nature of the fatty acids of potatoes and the changes these undergo during storage.

Although the amount of lipide is small, approximately 0.10% on the fresh weight basis as found by Lampitt (*8*), its importance cannot be judged solely by its quantity.

Hendel (*5*) found that a portion of the potato lipide was bound to other materials. He obtained 0.15% on the dry weight basis with ether extraction, and an additional 0.20% with ethanol extraction. Highlands *et al.* (*6*) extracted approximately 0.17% fat on the dry weight basis from air-dried and from vacuum-dried potatoes using petroleum ether. The fatty acids in this material consisted of about 40% linoleic, 30% linolenic, 5% oleic, and 25% saturated acids. From these observations, one would expect potato fat to be relatively susceptible to oxidative deterioration, a fact confirmed by experience with potato flour (*1, 5*) and potato granules (*2*).

In this study, determinations were made for total lipides and fatty acid compositions of two varieties of potatoes stored for 2 weeks and 16 weeks.

Method

Two varieties of potatoes, Pontiac and Ontario, grown near Ithaca, N. Y., were used. The fatty acid composition of the lipides in these potatoes was determined after 2 weeks and again after 16 weeks of storage at 40° F. Approximately 8 pounds of each variety of potato were sampled at each storage period.

Potato slices including the peel were frozen, lyophilized in a Stokes freeze-dryer, and ground in a Wiley mill through a 40-mesh screen. The method of Lee and Mattick (*9*) for the extraction of lipides in peas was adapted for use with potatoes.

A 40-gram sample of dehydrated potatoes was combined with a solvent consisting of chloroform and methanol (2:1) and stirred for 3 hours under nitrogen with a magnetic stirrer. The solution was then filtered through sintered glass and the residue taken up in fresh solvent and stirred again for $1\frac{1}{2}$ hours and filtered. The filtrates from the two extractions were then combined. For the first extraction, 10 ml. of solvent per gram of sample was used and for the second, 5 ml. per gram.

The filtrate was freed of water-soluble impurities by a modification of the method of Folch, Lees, and Stanley (*3*). A solution of 0.034% magnesium chloride was added to the filtrate so that the ratio of chloroform, methanol, and magnesium chloride was 8:4:3. The solutions were shaken together and stored under nitrogen overnight in a freezer. The following day, the upper phase was drawn off by suction, discarded, and the interface washed twice with small amounts of "pure solvents' upper phase." This was obtained by shaking together chloroform, methanol, and magnesium chloride in the proportions 8:4:3 and collecting the upper phase.

The solvent was removed in a rotary evaporator, and the samples were stored under vacuum over phosphorus pentoxide until they reached constant weight.

The lipides were hydrolyzed using concentrated hydrochloric acid and the

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Table I. Crude Lipide Extracted from Pontiac and Ontario Potatoes after Storage

Storage Time	Pontiac, % D.W.[a]	Ontario, % D.W.
2 weeks	0.74	0.81
	0.75	0.80
16 weeks	0.73	0.72
	0.68	0.73

[a] The weight of lipide is expressed as per cent of the dry weight of the potato.

fatty acids esterified with dimethoxy propane. Samples were stored in a freezer under nitrogen until identified by gas chromatography.

A Barber-Colman Model 10 gas chromatograph employing a β-ray ionization detection cell containing 56 μc. of radium-226 was used to separate the methyl esters of the fatty acids. The techniques described by James (*7*) and Hawke *et al.* (*4*) using the relative retention volumes on a polar and nonpolar stationary phase and establishing a grid using known acids were employed to identify the fatty acids. The acids were quantitated by peak-area integration. This technique has been found to have a standard deviation of $\pm 0.25\%$ (*10*).

Results and Discussion

The amount of total lipide extracted from Pontiac and Ontario potatoes before and after storage is given in Table I.

In both varieties, the amount of lipide extracted after 16 weeks of storage was only slightly less than after 2 weeks, indicating that the total amount of lipide is not greatly affected by storage.

The fatty acid composition of the lipide extracted in both varieties before and after storage is given in Table II.

In this study, varieties differed greatly in their fatty acid composition. Shortly after harvest, Pontiac potatoes were higher than Ontario potatoes in palmitic and linoleic acids, but lower in stearic, oleic, linolenic, and arachidic acids.

The fatty acid composition of both varieties changed during storage. Pontiac potatoes showed a marked decrease in linoleic acid and a definite increase in palmitic and linolenic acids. There appears to be an increase in the acids of chain length greater than 18 carbons.

Ontario potatoes showed relatively little change in linoleic, but a marked decrease in palmitic and linolenic acids on storage. Potato varieties appear to differ not only in their initial lipide content but also in changes of their fatty acid composition with storage.

Table II. Effect of Storage Time on Fatty Acid Composition of Lipides in Pontiac and Ontario Potatoes

	Pontiac		Ontario			Pontiac		Ontario	
Acids[a]	2 Weeks, %[b]	16 Weeks, %	2 Weeks, %	16 Weeks, %	Acids[a]	2 Weeks, %[b]	16 Weeks, %	2 Weeks, %	16 Weeks, %
7:Br	0.2	...	...	trace	16:0	25.5	39.7	17.6	12.2
7:0	...	...	...	0.5	16:1	0.1	0.7	0.8	1.8
8:Br	...	...	0.4	...	16:2	trace	...	0.7	0.2
9:0	trace	trace	0.2	trace	17:0	trace	trace	0.4	0.6
9:1	0.9	...	...	...	17:1	trace	0.8	0.1	0.1
10:Br	...	...	0.1	...	18:0	2.2	4.9	8.2	11.1
10:0	trace	trace	...	0.2	18:1	0.8	1.2	1.7	2.8
11:Br	...	...	0.3	0.3	18:2	50.7	7.2	27.5	27.9
11:0	0.1	0.2	trace	trace	18:3	15.9	37.4	37.2	32.2
11:1	trace	trace	0.1	0.1	19:0	trace	trace	trace	trace
11:2	...	...	...	trace	20:0	1.0	2.2	2.4	3.9
12:0	0.1	0.2	0.1	0.1	20:1	...	0.8	...	...
12:1	trace	trace	...	trace	20:2	0.1	...	0.3	0.3
12:2	trace	0.6	0.2	0.3	21:0	...	trace	0.2	0.5
13:0	0.2	...	...	...	21:1	...	trace	...	...
13:1	trace	0.1	...	0.1	21:2	...	trace	...	...
13:2	trace	...	...	trace	22:0	0.3	...	0.6	1.2
14:0	0.2	0.7	0.3	0.5	22:2	0.1	...	...	...
14:1	trace	...	trace	trace	23:Br	...	trace	...	...
14:2	...	0.2	...	trace	23:0	...	0.4	0.2	0.8
15:0	1.2	1.2	0.4	0.8	24:0	...	...	0.7	1.3
15:1	0.1	trace	0.2	0.2	24:1	0.4	...	...	...
15:2	trace	trace	trace	trace	24:2	...	1.6	...	...

[a] The first number refers to the number of carbon atoms in the fatty acid, the second number to the number of double bonds. The symbol (Br) refers to branching.
[b] Values expressed as mole per cent based on peak-area integration. Trace refers to anything less than 0.1%.

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