Additional Data on the Storage Stability of Milled Flaxseed

Sir:

In a paper published recently we evaluated the storage stability of milled flaxseed samples during controlled storage for 4 mon (1). After this paper had been accepted for publication, we tested milled flaxseed samples that had been stored in warehouse conditions at ambient temperatures for up to 20 mon. The samples were derived from different batches of flax, each of which had been ground and placed in storage at different times. Samples were stored in loosely closed plastic bags and protected from light.

Assessment of quality parameters demonstrated the resistance of this oilseed to oxidative deterioration (Tables 1 and 2). Linolenic acid was within normal variability range for this type of seeds, although a lower amount of this fatty acid was observed in the seed stored the longest time (Table 1). This difference is most likely attributable to the flaxseed variability rather than to oxidative deterioration (2).

The contents of tocopherols were similar in all samples, suggesting that these antioxidants were not used or were in some way recuperated from oxidized forms (3). The lack of changes in this group of components indicates that flaxseed has a very efficient protective system against oxidative degradation despite having a very high content of linolenic acid and low amount of tocopherols.

High levels of free fatty acids (FFA) are present in immature or poorly stored oilseeds. FFA can stimulate oxidative deterioration of oils or oilseeds by enzymatic and/or chemical oxidation to form off-flavor components. An elevated amount of FFA was observed in both stored samples, and an extremely high value of nearly 10% was found in the sample stored for 11 mon (Table 2). Development of this high level of FFA was likely due to the presence of sufficient moisture, or possibly damaged seed in this particular sample of stored ground seed, to allow lipolytic activity to occur during storage. Even at this high level of FFA, oxidation of these acids did not occur as described by peroxide value, but a higher level of off-flavor components was observed in this sample (Table 2). The unusual nature of this sample was highlighted by the sample stored for 20 mon that did not develop extremely high levels of FFA.

TABLE 1
Composition of Fatty Acid and Tocopherol in Stored Flax Samples

	Percentage						Tocopherols
Sample	C16:0	C18:0	C18:1	C18:2	C18:3	SAT[a]	(ppm)
Fresh	5.41	2.79	18.43	14.39	58.80	8.20	396
11 mon	5.66	4.02	15.32	17.31	57.25	9.68	356
20 mon	5.07	3.26	23.28	13.56	54.32	8.33	383

[a]SAT = C16:0 + C18:0.

TABLE 2
Free Fatty Acid Content, Peroxide Value, and Off-Flavor Formation

Sample	Free fatty acids (%)	Peroxide value (meq/kg)	Off-flavor components (ppm)
Fresh	0.44	3.2	0.79
11 mon	9.70	2.4	1.55
20 mon	2.82	3.4	0.72

Peroxide values in all samples were very low, indicating either a low level of oxidation or that oxidation had taken place and peroxides had decomposed. Conjugated dienes, primary oxidation products, were not detected in the stored milled flaxseed samples, but trace amounts of conjugated trienes were found at the detection level of the procedure (data not presented). This assessment also suggests good oxidative stability of milled flaxseeds.

Decomposition products of hydroperoxides may form off-flavor/rancid components. Analysis for these showed low amounts of off-flavor components in the stored milled flaxseed samples. Similar levels of off-flavor components were found in samples of milled flaxseed stored for 4 mon (1). The sample with the high level of FFA showed twice the amount of rancid components compared to other samples. FFA usually oxidize at a faster rate than triglycerides (4), and the higher level in this sample may have contributed to the increase in off-flavor components (Table 2).

Results of this study further suggest that milled flaxseed is a remarkably stable product when stored at conditions with limited access to oxygen and light, especially when the high levels of linolenic acid and low amount of tocopherols in the oilseed are considered.

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