ACCESSORY APPARATUS AND TECHNIQUE

165. Abbott, F. R., Rev. Sci. Instruments *13*, 187 (1942). The use of fusible alloy in vapor diffusion pumps. (CA *36*, 3398.)
166. *Bancroft, F. E., and Miller, C. W. (to General Electric Co.), U. S. 2,249,450, Jul. 15, 1941, appl. Mar. 8, 1940. Condensation pump suitable for operation with "Apiezon" oil. (CA *35*, 6488.)
167. *Burrows, G., and Metropolitan-Vickers Electrical Co., Ltd., Brit. 475,062, Nov. 12, 1937, appl. May 12, 1936. Diffusion pumps. (CA *32*, 2794.)
168. *Carlson, W. A. (to General Mills, Inc.), U. S. 2,244,939, Jun. 10, 1941, appl. May 9, 1940. Vacuum connection for high-vacuum apparatus. (CA *35*, 5754.)
169. **Distillation Products, Inc.*, and Hickman, K. C. D., Brit. 531,745, Jan. 9, 1941, appl. Aug. 1, 1939. Cascade diffusion pumps for producing high vacua. (CA *36*, 4.) (Cf. ref. 187.)
170. *Eastman Kodak Co. (to Kodak, Ltd.), Brit. 514,820, Nov. 20, 1939, appl. May 11, 1938. High-vacuum condensation or diffusion pumps. (CA *35*, 4250.)
171. *Embree, N. D. (to Distillation Products, Inc.), U. S. 2,150,676, Mar. 14, 1939, appl. Oct. 8, 1937. High vacuum.
172. Friesen, S. v., Rev. Sci. Instruments *11*, 362 (1940). Large molecular pumps of the disk type. (CA *35*, 345.)
173. Friesen, S. v., Arkiv. Mat. *Astron.* Fysik *27B*, No. 11, 7 pp. (1940). A vacuum-meter combination for pressures between 1and 10^{-6} mm. Hg. (CA *35*, 2039.)
174. Garner, L. P., Rev. Sci. Instruments *8*, 329 (1937). Machined metal stuffing box seals adapted to high vacuum technique. (CA *31*, 7704.)
175. Hickman, K. C. D., J. Applied Phys. *11*, 303 (1940). Trends in design of fractionating pumps. (CA *34*, 3951.)
176. *Hickman, K. C. D. (to Eastman Kodak Co.), Brit. 513,586, Oct. 17, 1939, appl. Mar. 11, 1938. Producing vacua. (CA *35*, 2041.) (Similar to U. S. 2,150,685, K. C. D. Hickman.)
177. *Hickman, K. C. D. (to *Eastman Kodak Co.*), *Brit.* 514,766-67-68, Nov. 16, 1939, appl. May 14, 1938. High-vacuum condensation or diffusion pumps. (CA *35*, 4250.) (Similar to U. S. 2,153,189, K. C. D. Hickman.)
178. *Hickman, K. C. D. (to Distillation Products, Inc.), U. S. 2,206,093, Jul. 2, 1940, appl. Jan. 4, 1939. Vacuum pump. (CA *34*, 7151.)
179. *Hickman, K. C. D., and Baxter, J. G. (to Distillation Products, Inc.), Can. 403,495, Mar. 17, *1942*, appl. Sept. *30*, *1939*. Preservation of glyceride oils and their fractions. (CA *36*, 3692.) (See ref. 180.)
180. *Hickman, K. C. D., and Baxter J. G. (to Distillation Products, Inc.), U. S. 2,282,054, May 5, 1942, appl. Oct. 5, 1938. Preserving glyceridic oils, fats and vitaminic vacuum-distillates from decomposition by oxidation. (CA *36*, 5957.) (See ref. 179.)
181. *Litton, C. V. (to Mackay Radio and Telegraph Co.), U. S. 2,289,845, Jul. 14, 1942, appl. Jan. 12, 1939. High-vacuum pump of the vapor condensation type. (CA *37*, 287.)
182. Lockenvitz, A. E., Rev. Sci. Instruments *8*, 322 (1937). A self-fractionating oil-diffusion pump. (CA *31*, 7704.)
183. Morse, R. S., Rev. Sci. Instruments *11*, 277 (1940). Baffles for oil-diffusion pumps. (CA *34*, 7148.)
184. Morse, R. S., and Bowie, R. M., Rev. Sci. Instruments *11*, 91 (1940). A new-style ionization gage. (CA *34*, 3579.)
185. *Morse, R. S. (to Distillation Products, Inc.), Brit. 537,673, Jul. 1, 1941, appl. Jun. 22, 1940. High-vacuum pumps. (CA *36*, 1820.) (Cf. ref. 187, U. S. 2,245,216.)
186. *Morse, R. S. (to Distillation Products, Inc.), Brit. 539,175, Aug. 29, 1941, appl. Jun. 22, 1940. High-vacuum pumps. (CA *36*, 3402.) (Cf. ref. 187, U. S. 2,245,215.)
187. *Morse, R. S. (to Distillation Products, Inc.), U. S. 2,245,215-16, Jun. 10, 1941, appls. Sept. 29, 1939 and Oct. 11, 1939 resp. High-vacuum pumping apparatus. (CA *35*, 5754.) (Cf. refs. 186 and 185 resp.)
188. Müller, R. H., Ind. Eng. Chem., Anal. Ed. *12*, 571 (1940). American apparatus, instruments and instrumentation. (CA *34*, 7661.)
189. Prausnitz, P. H., Chemicker-Ztg. *63*, 110 (1939). New apparatus out of Jena glass.
190. *Sykes, C., Bancroft, F. E., and Metropolitan-Vickers Electrical Co., Ltd., Brit. 477,013, Dec. 20, 1937, appl. Jun. 20, 1936. Condensation vacuum pumps operating with organic fluid. (CA *32*, 4393.)

Fat Acid Composition of Linseed Oil From Different Varieties of Flaxseed[1]

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The quantity of some chemical constituents in different varieties of the same crop may vary greatly. Plant breeders recognize the importance of production for specific compounds, as well as for total crop yields. Perhaps more emphasis is given to specific compounds in food crops than in a crop like flaxseed which is grown primarily for oil, but here also we find varietal differences.

Plant breeders have relied upon the iodine number as the criterion of the quality of linseed oil. Varietal differences in the iodine number of linseed oils have been repeatedly demonstrated in this laboratory. Dillman and Hopper (1) found the iodine number of oils from Redwing and Linota to average 10 points higher than oils from Rio and Bison when each of the four varieties was grown for several crop years at widely separated locations. Sometimes there is a difference of as much as 20 points between high and low iodine number producing varieties when grown under apparently identical conditions.

Attempts have been made to account for these differences in the iodine number by determining the fat acids of the oil. Gross and Bailey (2) found higher oleic acid and lower linolenic acid in oils from Bison than in oils from Abyssinian. Dillman and Hopper (1) recently reported the composition of a group of oils from Linota, Redwing, Bison and Rio. They found the highest percentage of saturated acids in Rio oils, the highest percentage of oleic acid in Bison oils and higher linolenic acid in Redwing and Linota oils than in Rio and Bison oils. Their results were based on analyses carried out in 1929, 1930, and 1931. Many refinements in thiocyanometric technique, as well as an improved method for the determination of the saturated acids, have been made since the above mentioned work was carried out. The composition of linseed oils, when calculated from empirical thiocyanogen numbers by using modified Kaufmann equations (3, 4, 5), differs greatly from that reported earlier. When calculating the composition of oils for analytical results supplied by the laboratories of Archer-Daniels-Midland Company, Dillman and Hopper (1) chose constants recommended by Riemenschneider, Swift and Sando (6) for 0.1 *N* thiocyanogen solutions.

The properties of a drying oil should depend more upon the fat acid composition than upon the total number of double bonds, as measured by the iodine number. Now that methods for the analysis of an oil like linseed have been improved so that the results appear to be near true values, it would seem that more complete analyses may be necessary for an evaluation of the many available products. The object of the present investigation is to determine whether or not there are varietal differences in the fat acid composition of linseed oil other than those which might be predicted from the iodine number.

A number of linseed oil samples[2] (pressed from finely ground seed) were selected for analysis. The

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[2] Many of the flaxseed samples were obtained through the cooperative studies with A. C. Dillman, Associate Agronomist, Division of Cereal Crops and Diseases, Bureau of Plant Industry, United States Department of Agriculture. Others were from trials of the Agronomy Department of the North Dakota Station.

TABLE 1

Composition of Oil from Four Varieties of Flaxseed

Location grown	Iodine No.	Thiocyanogen No.	Unsaponifiable	Composition of Glycerides			
				Saturated	Oleic	Linoleic	Linolenic
REDWING			*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Corvallis, Ore.	196.5	124.6	.93	8.6	17.1	14.3	60.0
St. Paul, Minn.	181.8	117.3	.98	10.0	22.8	15.5	51.7
Sheridan, Wyo.	173.2	113.7	1.06	10.2	27.6	15.0	47.2
Lincoln, Neb.	171.6	110.9	.92	10.1	25.0	22.4	42.5
Nappan, Novia Scotia	201.7	125.7	.84	8.8	12.1	17.8	61.3
Brookings, S. Dak.	177.1	114.2	1.06	10.1	23.5	19.1	47.3
Salt Lake City, Utah	189.7	121.6	.90	9.6	20.1	12.9	57.4
Ottawa, Ont.	191.7	121.8	.86	8.6	18.5	16.9	56.0
Bozeman, Mont.	187.6	119.1	1.01	8.8	19.1	19.6	52.5
Moccasin, Mont.	181.6	118.0	1.14	9.6	24.5	13.4	52.5
Saskatoon, Sask.	195.1	122.9	.95	8.4	16.1	18.4	57.1
Union, Ore.	190.6	121.8	1.13	9.1	19.6	14.3	57.0
Newell, S. Dak.	180.5	116.3	1.08	9.6	23.0	17.6	49.8
Fargo, N. Dak.	178.2	115.5	.98	9.5	24.7	17.2	48.6
Average	185.4	118.8	.99	9.4	21.0	16.7	52.9
BISON							
Corvallis, Ore.	182.4	116.8	.94	9.0	21.8	19.8	49.4
St. Paul, Minn.	162.8	107.8	.88	11.3	30.3	18.1	40.3
Sheridan, Wyo.	161.5	106.4	.92	10.5	30.1	22.3	37.1
Lincoln, Neb.	155.4	103.6	.86	11.7	32.5	21.1	34.7
Nappan, Novia Scotia	196.0	123.7	.96	8.9	16.0	16.2	58.9
Brookings, S. Dak.	174.4	112.6	1.00	9.6	24.6	21.5	44.3
Salt Lake City, Utah	179.8	114.5	.72	9.7	20.7	22.6	47.0
Ottawa, Ont.	179.8	117.4	.82	9.2	26.1	13.5	51.2
Bozeman, Mont.	177.0	114.6	1.02	9.7	24.6	18.2	47.5
Moccasin, Mont.	163.4	109.8	1.02	10.5	33.5	13.4	42.6
Saskatoon, Sask.	187.0	120.4	1.03	8.7	22.2	14.6	54.5
Union, Ore.	191.4	121.0	.98	8.5	17.6	19.4	54.5
Newell, S. Dak.	171.5	112.1	1.37	9.7	27.4	18.8	44.1
Fargo, N. Dak.	164.7	107.4	1.06	10.5	33.8	11.7	44.0
Average	174.8	113.4	.97	9.9	25.8	17.9	46.4
LINOTA							
Corvallis, Ore.	190.4	122.0	1.02	7.8	21.1	15.6	55.5
St. Paul, Minn.	179.0	115.9	1.10	8.8	24.8	18.2	48.2
Sheridan, Wyo.	174.0	112.2	1.16	9.0	24.8	23.2	43.0
Lincoln, Neb.	170.6	110.2	1.10	9.2	25.6	24.8	40.4
Nappan, Novia Scotia	202.8	127.2	.91	7.3	14.2	16.7	61.8
Brookings, S. Dak.	176.2	113.0	1.23	8.2	23.8	25.1	42.9
Salt Lake City, Utah	189.6	121.1	.89	8.5	20.1	16.3	55.1
Ottawa, Ont.	190.4	121.6	.82	7.8	20.4	16.9	54.9
Bozeman, Mont.	188.2	120.2	1.14	8.1	20.6	18.0	53.3
Moccasin, Mont.	179.2	116.4	1.26	8.5	25.6	17.2	48.7
Saskatoon, Sask.	196.6	124.8	1.15	7.2	18.2	16.1	58.5
Union, Ore.	192.3	120.4	1.08	8.3	15.5	23.0	53.2
Newell, S. Dak.	181.6	114.6	1.15	8.5	19.3	26.8	45.4
Fargo, N. Dak.	176.9	115.1	1.10	8.8	26.1	17.9	47.2
Average	184.8	118.2	1.08	8.2	21.5	19.7	50.6
RIO							
Corvallis, Ore.	186.6	118.6	.98	8.9	19.5	19.8	51.8
St. Paul, Minn.	161.6	107.2	.89	14.6	28.7	12.8	43.9
Sheridan, Wyo.	165.4	108.4	.92	13.9	26.3	15.4	44.4
Lincoln, Neb.	155.8	104.2	.96	14.5	31.2	14.7	39.6
Nappan, Novia Scotia	194.7	122.2	.82	10.3	14.2	17.0	58.5
Brookings, S. Dak.	172.2	112.4	1.09	13.3	24.7	12.7	49.3
Salt Lake City, Utah	175.0	115.0	.76	12.6	26.0	9.1	52.3
Ottawa, Ont.	180.4	115.6	.89	12.1	20.3	15.7	51.9
Bozeman, Mont.	177.8	116.4	.99	11.7	25.3	9.8	53.2
Moccasin, Mont.	161.9	106.9	1.15	13.5	28.5	16.2	41.8
Saskatoon, Sask.	189.4	119.2	1.10	10.3	15.9	19.5	54.3
Union, Ore.	178.2	113.3	.96	11.6	19.5	21.1	47.8
Newell, S. Dak.	172.4	110.4	.97	12.7	21.4	20.7	45.2
Fargo, N. Dak.	162.9	107.8	.91	13.8	28.6	13.9	43.7
Average	173.8	112.8	.96	12.4	23.6	15.6	48.4

samples were selected so that, as far as possible, differences in composition due to environmental factors would be ruled out. Climatic factors, particularly temperature while the seed ripens (1), determine to a large extent the iodine number of linseed oil.

The analytical methods used have been described previously (3). In order to gain precision the thiocyanogen absorption number has, in most cases, been determined with two or more solutions. Fat acid composition is reported in terms of the glycerides, but, to simplify the discussion, references to them will be made by name of the individual fat acids.

In Table I the composition of 14 oils from each of four varieties, Redwing, Linota, Bison and Rio, are shown. Each group of four was grown at the same location in the same year. The unsaturation of the oils from flax grown at the several stations differs so that there is a wide range in iodine number of oils from each variety.

The composition of oils from the above named varieties and of samples from four additional varieties is shown in Table 2. Some of the oils are from different varieties grown at several locations the same crop year, while others are from a single variety grown at the same location in each of several crop years. The latter oils are indicated in Table 2 by giving the year grown. These results permit some comparison of varieties, and also show variations in composition of oils from a single variety when grown in different crop years at one station.

Discussion

The comparison of varieties grown under similar conditions (Table 1) shows unexpected differences in average composition. One would predict that the higher iodine number oils, those from Redwing (185.4) and Linota (184.8) would, on the average, contain more of the unsaturated acids, linolenic and linoleic, and less saturated and oleic acid, than oils from Bison (174.8) and Rio (173.8). This in general is the case, but the amount of each of the fat acids does not always follow the order predicted from the iodine number.

Linota oils contain the lowest percentage of saturated acids (8.2%) and Rio oils the highest (12.4%). This difference of 4.2 percentage points is surprisingly large considering the small amount of saturated acids in linseed oils. The iodine number of the oils from Linota average 11 points higher than those from Rio, but Redwing oils with an average iodine number of 0.6 of a point higher than Linota oils contain 9.4% saturated acids. Bison, with an average iodine number only 1 point higher than Rio, contain 2.5 percentage points less saturated acids. Saturated acids have been determined in fat acids of linseed oil and in the oils themselves with excellent results (3) so there seems to be no doubt that these differences are significant.

Oils from Bison are highest in oleic (25.8%) and those from Redwing lowest (21.0%). Oils from Linota are not significantly different in oleic acid content from those of Redwing, and oils from Rio are intermediate.

Linota oils contain, on the average, more linoleic acid than oils from the other varieties. The differences among oils from Rio, Redwing and Bison are probably not significant. The probable error in the determination of linoleic acid by the method used is approximately twice that of oleic and linolenic acids.

Because linolenic acid is the most unsaturated acid in linseed oil it might be assumed that the linolenic acid content would vary directly with the iodine number. There are differences, however, which the iodine number does not reveal and the linolenic acid content of the four groups does not fall in the same rank as the iodine number. Redwing oils average 52.9% and Linota oils average 50.6%, yet the difference in iodine number is only 0.6 point. The iodine number of Bison oils is 1 point higher than Rio oils, yet the linolenic acid content of Bison oils is 2 percentage points lower. The difference of 6.5 percentage points between Redwing and Bison oils is greater than might be predicted from the iodine numbers.

The number of analyses of B. Golden (Table 2) may be too small for comparison, but the results indicate that this variety may have a fat acid composition quite different from that of the four varieties shown in Table 1. B. Golden yields an oil with an iodine number about equal to that of Redwing and Linota. Saturated acids average higher than in Bison oils which have a lower iodine number. Linoleic acid averages lower, and linolenic acid higher, than in other varieties. The two B. Golden oils from the 1942 crop are unusually high in linolenic acid and low in linoleic acid. They are from a group of five oils from B. Golden grown in 1942 which contain the largest amount of linolenic acid and lowest amount of linoleic acid in any of approximately 150 oils examined in this laboratory.

The average iodine numbers of the oils from the four varieties, Linota, Redwing, Bison and Rio, reported by Dillman and Hopper (1), are very close to those of the same varieties shown in Table 1, so it would be predicted that the average fat acid composition in each of the two sets of data would be close. This is the case. Saturated acids in Table 1 average approximately 2.5 percentage points higher than those of Dillman and Hopper, but this is expected since their values were obtained by the Twitchell lead-salt method and those in Table 1 by the Bertram method. We find somewhat greater varietal differences in fat

TABLE 2

Composition of Oil from Several Varieties of Flaxseed

Location grown	Variety	Iodine No.	Thiocyanogen No.	Unsaponifiable	Composition of Glycerides			
					Saturated	Oleic	Linoleic	Linolenic
				Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Edmonton, Alta.	Redwing	197.5	125.0	.87	8.1	16.8	15.2	59.9
Calingula, Calif.	Redwing	189.6	120.0	.75	9.1	17.8	19.1	54.0
St. Paul, Minn. (1933)	Redwing	184.2	119.4	1.06	10.3	23.1	11.3	55.3
St. Paul, Minn. (1937)	Redwing	158.9	106.2	1.04	10.9	32.9	18.6	37.6
Bozeman, Mont. (1934)	Redwing	183.8	119.0	.88	9.6	23.4	13.2	53.8
Bozeman, Mont. (1935)	Redwing	188.2	119.8	1.05	10.4	18.5	15.6	55.5
Fargo, N. Dak. (1939)	Redwing	182.3	117.5	1.06	9.2	23.0	16.8	51.0
Average		183.5	118.1	.96	9.7	22.2	15.7	52.4
Edmonton, Alta.	Bison	191.9	122.0	.92	8.5	18.7	16.6	56.2
Calingula, Calif.	Bison	186.8	120.5	.72	9.3	22.2	13.0	55.5
St. Paul, Minn. (1937)	Bison	149.2	101.2	1.04	10.7	37.0	21.9	30.4
Bozeman, Mont. (1935)	Bison	173.2	114.4	.94	11.6	28.0	10.1	50.3
Fargo, N. Dak. (1936)	Bison	146.6	100.6	1.34	12.7	38.1	16.7	32.5
Fargo, N. Dak. (1937)	Bison	179.6	115.5	1.02	9.6	22.8	19.1	48.5
Fargo, N. Dak. (1938)	Bison	184.6	118.4	.95	9.2	21.5	17.2	52.1
Fargo, N. Dak. (1939)	Bison	168.3	111.1	1.14	9.6	29.9	17.6	42.9
Fargo, N. Dak. (1941)	Bison	156.3	104.4	1.03	11.3	32.9	20.3	35.5
Average		170.7	112.0	1.01	10.3	27.9	16.9	44.9
Edmonton, Alta.	Linota	199.2	125.0	.80	7.3	15.1	19.0	58.6
Calingula, Calif.	Rio	181.2	114.8	.68	11.5	18.3	20.5	49.7
Fargo, N. Dak. (1939)	Rio	165.2	108.4	1.10	13.6	26.7	15.6	44.1
Edmonton, Alta.	Buda	196.0	124.6	.90	7.4	18.5	15.5	58.6
Edmonton, Alta.	Crown	196.0	123.7	1.06	8.0	16.6	17.5	57.9
Edmonton, Alta.	Walsh	190.6	118.9	.74	9.3	14.5	24.1	52.1
Fargo, N. Dak. (1935)	B. Golden	180.0	115.8	.91	11.2	21.8	15.8	51.2
Fargo, N. Dak. (1939)	B. Golden	179.4	116.1	.97	10.9	23.3	14.5	51.3
Fargo, N. Dak. (1941)	B. Golden	169.0	110.6	.97	12.1	26.6	16.1	45.2
Fargo, N. Dak. (1942)	B. Golden	198.1	126.9	.81	9.6	18.3	6.9	65.2
Fargo, N. Dak. (1942)	B. Golden	194.6	125.2	.96	9.3	20.1	8.2	62.4
Average		184.2	118.9	.92	10.6	22.0	12.3	55.1

acid composition, but when these are large they appear in both sets of data. The rank, as well as the amount, of each fat acid in the oils of the four varieties, with the exception of linoleic acid in Rio oils, shows exceptionally good agreement. Where the results of Dillman and Hopper differ from those reported herein is in the range of each of the fat acids. Their range in iodine number is 41.0 points compared with 47.4 points in Table 1, so we would expect to find a wider range in fat acids. This is not the case. They find a greater range in each fat acid. This is particularly evident in the case of linoleic acid where they report values from a low of 2.3% to a high of 39.6%.

The group of oils from Redwing and from Bison in Table 2 permit a comparison between these two varieties in addition to that in Table 1. Not all of the oil samples in Table 2 are from seeds grown under comparable conditions, but, when the fat acids of the Bison group in Table 1 is compared with the Redwing group in Table 1, and when the Bison group in Table 2 is compared with the Redwing group in Table 2, the differences in fat acid composition (summarized in Table 3) are consistent.

Iodine numbers of the Bison and Redwing groups not only average lower in Table 2 than in Table 1, but the difference of the iodine number (Redwing minus Bison) between the groups is greater by 2.2 points in Table 2 than in Table 1. Oleic acid of Bison oils average 5.7 percentage points lower than Redwing oils in Table 2 and 4.8 percentage points lower in Table 1. Linolenic acid average 7.5 percentage points higher than Bison oils in Table 2 and 6.5 percentage points higher in Table 1. The saturated, oleic, and linolenic acid content of each of the two groups of oils from the same variety differs by an amount approximately that predicted by the iodine number.

Although an equal number of samples of the same variety were not grown under similar growing conditions, the comparison of Bison and Redwing oils in Table 2 appears to be as satisfactory as the comparison in Table 1.

The composition of oil from each variety varies greatly, but within varieties there is a close relationship between composition and the iodine number. The lowest iodine number of oils from each variety is from those grown at Lincoln, Neb. Oleic acid averages highest in these same oils. The lowest linolenic acid in each variety is in this group. Iodine numbers of the oils of each variety rank highest in those grown at Nappan, Nova Scotia. The lowest oleic and highest linolenic acid content of oils from each variety is in this group. The relationship of fat acid composition to iodine number is more evident in Table 1 than in the results of Dillman and Hopper (1).

Wide variations may occur in the composition of the oil from a single variety grown at the same location in different crop years (Table 2). Note that Redwing grown at St. Paul, Minn., in 1937 differed greatly in composition from the sample grown in 1933. At Fargo, we have determined the composition of oil from Bison grown during five different years. The linolenic acid content was almost 20 percentage points higher, and the oleic almost 17 percentage points lower, in the oil from the 1938 crop than from the 1936 crop. This range in fat acids is not to be interpreted to indicate anamolous composition due to growing conditions in different seasons. The values are in line with the iodine numbers of the oils.

TABLE 3

	Average Iodine Number	Average Composition of Glycerides			
		Saturated	Oleic	Linoleic	Linolenic
TABLE 1		*Pct.*	*Pct.*	*Pct.*	*Pct.*
Redwing	185.4	9.4	21.0	16.7	52.9
Bison	174.8	9.9	25.8	17.9	46.4
Difference (Redwing minus Bison)	10.6	— 0.5	— 4.8	— 1.2	6.5
TABLE 2					
Redwing	183.5	9.7	22.2	15.7	52.4
Bison	170.7	10.3	27.9	16.9	44.9
Difference (Redwing minus Bison)	12.8	— 0.6	— 5.7	— 1.2	7.5

Summary and Conclusions

The fat acid composition of 14 oils from each of four varieties, Redwing, Linota, Bison and Rio, was determined. Each group of four was grown at the same location in the same year. Other analyses include the composition of oils from four additional varieties and of oils from Bison, Redwing and B. Golden grown at the same location in several crop years. Varietal differences in the saturated, as well as oleic, linoleic and linolenic acids, were found. There was not only a wide range in the amount of oleic, linoleic and linolenic acids in oils from each variety grown at different locations, but also in oils of a single variety grown at the same location in different crop years. Fat acid distribution in linseed oils bears a definite relationship to the iodine number but there are significant varietal differences, which cannot be predicted from the iodine number.

REFERENCES CITED

1. Dillman, A. C., and T. H. Hopper. U. S. D. A. Technical Bulletin No. 844, April, 1943.

2. Gross, R. A., and C. H. Bailey. Oil and Soap *14*, 260-3 (1937).

3. Painter, E. P., and L. L. Nesbitt. Ind. Eng. Chem., Anal. Ed., *15*, 123-8 (1943).

4. Rose, W. G., and G. S. Jamieson. Oil and Soap *18*, 173-4 (1941).

5. Mitchell, J. H. Jr., H. R. Kraybill, and F. P. Zscheile. Ind. Eng. Chem., Anal. Ed., *15*, 1-3 (1943).

6. Riemenschneider, R. W., C. E. Swift, and C. E. Sando. Oil and Soap *18*, 203-6 (1941).