Composition of the Oil of the American Black Walnut

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THE oil used in this investigation was expressed from the black walnut meat and shell particles which are a by-product of the shelling plants. One two-quart sample was sent by the Smalley Shelling Company at Sulphur Springs, Arkansas, who had the V. D. Anderson Company of Cleveland express it with their laboratory expeller. Another two-quart sample was received from D. C. Ingraham, chemist for the Durkee Famous Food Plant at Berkeley, California, who expressed the oil from material sent him by the Arkansas Company, using a laboratory hydraulic press. A sample of the hydraulic press cake was also submitted. The original material from the shelling plant was found by Mr. Ingraham to contain 55.8 percent of oil. Mr. Mayne R. Coe of the Bureau of Chemistry and Soils examined the cake and found that it contained 6.13 percent moisture, 49.31 percent proteins, 23.16 percent fat, 10.13 percent nitrogen free extract, 6.17 percent fiber and 5.10 percent ash. It is evident that this material contained a comparatively small quantity of shell particles. On the basis of 6 percent residual oil, which would be expected with a commercial press, the protein content of the press cake would be about 60 percent.

Heretofore, the oil has received but little attention and that has been confined to the determination of a few of its characteristics. L. F. Kebler (J. Franklin Institute, 151, p. 394, 1901) reported iodine numbers of 141.4 and 142.7, saponification values of 190.1 and 191.5, and specific gravity at 15° C. of 0.9215.

From the characteristics of the oils given in Table I it will be observed that the two samples examined by us differed somewhat and that the iodine numbers (135.1 and 140.5) showed the greatest variation. The iodine numbers indicate that it belongs to the lower range of drying oils.

The chemical and physical characteristics which were determined on the oils expressed by expeller and hydraulic presses are given in Table 1.

TABLE I.
Chemical and Physical Characteristics.

	Expeller Oil	Hydraulic Oil
Refractive index at 25° C.	1.4730	1.4731
Iodine number (Hanus)	135.1	140.5
Thiocyanogen value (Kaufmann)	86.0	....
Saponification value	193.5	191.5
Acid value	7.8	9.7
Unsaponifiable matter, per cent	0.42	....
Iodine No., unsaponifiable matter	103.7	....
Saturated acids (corr.), per cent	5.53	5.24
Unsaturated acids (corr.), per cent	88.14	88.96

Unsaturated Acids

The percentages of oleic, linoleic and linolenic acids in the oil were calculated in the customary manner from the iodine and thiocyanogen values and the quantity of unsaturated fatty acids of the expeller oil. The results are given in Table 2.

TABLE 2.
Unsaturated Acids

	Per cent	Per cent in oil
Oleic	38.70	34.1
Linoleic	53.12	46.8
Linolenic	8.18	7.2
	100.00	88.1

Saturated Acids

The saturated acids separated from the saponified expeller oil by the lead salt ether method were esterified with anhydrous ethyl alcohol in the presence of dry hydrogen chloride gas (J. Chem. Soc., 42, p. 1200, 1920). The esters, amounting to 69.1 grams, after being freed from solvent and moisture, were fractionally distilled under a pressure of 1.5 mm. from a Ladenburg fractionation flask. Five fractions were collected, and from the results of their analysis, the composition of each was determined by methods previously described (J. Amer. Chem. Soc. 46, p. 775, 1924). The final results calculated from the analytical data are given in Table 3.

TABLE 3.
Saturated Acids

	Per cent	Per cent in oil
Myristic	7.84	0.43
Palmitic	59.52	3.29
Stearic	31.99	1.77
Lignoceric	.65	.04
	100.00	5.53

The acids were recovered from the ester fractions and the small undistilled residue by saponifying them with alcoholic potash and decomposing the soaps with hydrochloric acid. They were collected and completely separated from potassium chloride and any free hydrochloric acid by remelting them with hot distilled water in the usual manner and were subjected to fractional crystallization from ethyl alcohol. Lignoceric acid was found only in the acids from the undistilled residue of the esters along with a small quantity of stearic acid.

The acids from the five distilled ester fractions which were isolated and identified in each case confirmed the deductions previously made from the mean molecular weights of the saturated esters.

The composition of the oil in terms of glycerides is given in Table 4.

TABLE 4.
Percentages of Fatty Acids as Glycerides

Glycerides of:	
Oleic	35.6
Linoleic	48.6
Linolenic	7.4
Myristic	0.4
Palmitic	3.4
Stearic	1.8
Lignoceric	0.04

It was found that saponification of the oil with an aqueous caustic soda solution gave a firm soap. Although no experiments were made, the oil could undoubtedly be used particularly along with some stronger drying oil in connection with the manufacture of paint and varnish. After suitable refining, it would be useful as a salad and cooking oil. The press cake could be used as feed for poultry.

Applications for Referee Certificates

(Second Notice)

Mr. T. G. Weiss of the Barrow-Agee Laboratories, Shreveport, Louisiana, has applied for a referee certificate reading on the analysis of meal and oil.

Mr. W. F. Beedle of Geo. W. Gooch Laboratories, Ltd., Los Angeles, California, has applied for a referee certificate reading on the analysis of meal and oil.