American Cherry Kernel Oil

(A Contribution from the Oil, Fat and Wax Laboratory, Bureau of Chemistry and Soils, U. S. Department of Agriculture)

By GEORGE S. JAMIESON AND SAMUEL I. GERTLER

OWING to the very rapid expansion of the cherry canning industry in the United States in recent years, attention is being paid to the utilization of the separated pits. Heretofore they have been considered valueless and have in many cases been a source of expense due to the charges for hauling them away from the plants. At present it is estimated that more than a hundred million pounds of sour cherries are canned annually in the States of Michigan, New York, and Wisconsin. Also, several other States are now producing and canning sour cherries. For those not familiar with the canning industry, it may be added that sweet cherries are usually packed without the removal of the pits. The pits, which amount to from 12 to 15 per cent of the fruit, consist of about 28 per cent kernel and 72 of shell. The oil content of the kernels ranges from about 32 to 40 per cent. If all the pits separated at the canning plants were utilized for oil, the annual production would amount to more than four million pounds of oil.

Although Rabak *(U. S. Dept. Agric. Bull. 350)* showed in 1916 that a valuable oil could be obtained from cherry pits, no attempt was made to express the oil until 1926. Since that time increasing quantities of the oil have been obtained, and in 1929 the production amounted to about 68,000 pounds. It appears probable that the present production will be doubled within the next year or two. The oil is being used in the manufacture of various cosmetics, for some pharmaceutical preparations and as a salad oil, for which purposes it appears to be well adapted. Contrary to Lewkowitsch's *(6 Ed. Vol. 2,* p. 286*)* statement in regard to the European cherry oil, the American product is reported to have good keeping qualities.

In many respects, cherry kernel oil is similar to that from almond, apricot and peach kernels, but has a somewhat different composition as shown by its higher iodine number, which is 110-122, whereas the range of the iodine number for these other kernel oils is from 93 to 109. Previous to the present investigation only the characteristics of cherry kernel oil have been recorded and these were chiefly of European oils, the majority having been determined on small samples of oil, extracted by solvents from the kernels of various kinds of cherries. In certain parts of Europe cherry kernel oil has been prepared on a small commercial scale for many years. There, the first pressing from sound kernels is used for edible purposes, and that obtained from the second pressing or from damaged kernels is used in making soap or as an illuminant in rural districts.

In view of the growing interest in this country both in the production and the utilization of cherry kernel oil, this laboratory has undertaken a more comprehensive study of it than heretofore attempted. For this purpose, samples of both crude and refined oil were kindly furnished by the Cherry Oil Company, Sturgeon Bay, Wisconsin. This firm cracks and separates the kernels from the shells by mechanical means instead of resorting to the procedure which is common practice, particularly in Europe, that is, separating by means of a saline solution, the specific gravity of which is adjusted so that the shells float and the kernels sink. The practice of this firm obviates several steps, namely, the use of a flotation bath, and the washing and drying of the separated kernels, which is a decided advantage over the older procedure. The kernels are crushed and the oil expressed by means of the expeller. As the crude oil has a slight but characteristic odor and flavor it is refined and deodorized before being placed upon the market.

Rabak *(loc. cit.)* has shown that the press cake contains a glucoside of the amygdalin type similar to that found in almond, apricot, and peach kernels, and that the volatile oil obtained, after hydrolysis of the glucoside, is similar to that from the other kernels. The experiments made by Rabak in 1915 indicated that about 1 pound of volatile oil could be obtained from 100 pounds of press cake. Further study will be made to determine the quantity of volatile oil available in the press cake from the modern oil expeller and whether or not it would be profitable to undertake its recovery. The press cake, which contains 30 per cent or more of proteins, is stated to be used in mixture with other feeding stuffs as a cattle food. Also, it can be used as a fertilizer.

Characteristics of the Oil

THE crude oil is dark golden yellow. It has a distinct nut-like odor and a slightly bitter taste. The refined oil, which is of a pale straw color, has a pleasant bland flavor.

The following color readings (Lovibond Scale) were made in each case with a column of oil 5.25 inches in depth: Crude oil, 35 yellow and 4.5 red; refined oil, 15 yellow and 1.5 red.

The chemical and physical characteristics of the samples of oil are given in Table I. The percentages of saturated and unsaturated acids were determined by the lead-salt ether method *(J. Assoc. Offic. Agric. Chemists, 11,* 303, 1928*)*, and corrections were made for the small quantity of unsaturated acids that is precipitated and weighed with the saturated acid fraction. The percentage of unsaturated acids has also been corrected for the unsaponifiable matter that remains with the unsaturated acid fraction.

TABLE I
CHEMICAL AND PHYSICAL CHARACTERISTICS

	Crude Oil	Refined Oil
Specific Gravity 25/25°	0.9176	0.9183
Refractive index at 25°	1.4742	1.4740
Acid value	4.39	0.09
Iodine number (Hanus)	118.7	115.8
Saponification value		190.7
Reichert-Meissl value		0.3
Polenske number		0.2
Unsaponifiable matter, %	0.66	0.5
Saturated acids, corrected, %		7.7
Unsaturated acids, corrected, %		87.
Iodine number of unsaturated acids		127.9

Unsaturated Acids

FROM the iodine number of the oil and the percentage of unsaturated acids, the iodine number of the latter was calculated to be 133.1. This value was used in the calculation of the oleic and linolic acids in the oil with the following results:

	Unsaturated Acids %	In Oil %	As Glycerides %
Oleic Acid	53.88	46.85	48.9
Linolic Acid	46.12	40.11	41.9

Saturated Acids

THE saturated acids which were separated from the oil by the lead-salt ether procedure were esterified with absolute methyl alcohol in the presence of dry hydrogen chloride gas *(Jour. Amer. Chem. Soc. 1920, 42,* 1200*)*. The dry solvent free esters (94.3 grams) were fractionated under a pressure of 8 mm. from a 500 cc. Claisson distilling flask. The four fractions as well as the undistilled residue were redistilled from a 150 cc. Ladenburg fractionation flask. The six fractions which were obtained were analyzed, and their composition was determined as previously described *(J. Amer. Chem. Soc. 46,* 775 [1924]*)*. The results given in Table II were calculated from the analytical data obtained.

TABLE II

Acids	Acids in Oil %	Acids as Glycerides %
Myristic	0.19	0.2
Palmitic	4.04	4.2
Stearic	2.79	2.9
Arachidic	0.72	0.7

The acids were recovered from the methyl ester fractions and the undistilled residue by saponifying them with alcoholic potash and decomposing the soaps with hydrochloric acid. The acids were collected and completely separated from the potassium chloride and the excess of hydrochloric acid by remelting them several times with water in the usual manner.

Myristic, palmitic, stearic, and arachidic acids were isolated from various fractions by fractional crystallization from ethyl alcohol. Myristic acid was obtained from the first fraction; palmitic acid from fractions 1, 2 and 3; stearic acid from fractions 3, 4 and 5; arachidic acid from fractions 5 and 6, and the residue. The identity of the acids was established by their melting points and by observing whether or not these melting points were lowered when they were mixed with equal quantities of the respective acids the composition of which had been determined by elementary analysis. In no instance was there observed any depression of the melting point. The acids isolated from the fractions in each case confirmed the deductions previously made from the mean molecular weight of the saturated acid esters.

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

TABLE III
THE PERCENTAGES OF THE FATTY ACIDS AS GLYCERIDES

Glycerides of	Per Cent
Oleic Acid	48.9
Linolic Acid	41.9
Myristic Acid	0.2
Palmitic Acid	4.2
Stearic Acid	2.9
Arachidic Acid	0.7

Summary

THE characteristics and the percentages of the fatty acids in cherry kernel oil have been determined. The oil contains 87 per cent of unsaturated acids and 7.7 of saturated acids.

(Turn to Page 387*)*

Total Fat Determination

(*From Page* 384)

CHOCOLATE LIQUOR

Sample	New Method	A.O.A.C.*	Manufacturer's Analysis
1.	53.9 %	53.1 %	53.84%
2.	52.45%	52.25%	53.5 %
3.	53.3 %	53.3 %	—

* A.O.A.C.—Official Method of Association Official Agricultural Chemists.

CHOCOLATE LIQUOR (Cont.)

4.	52.6 %	52.64%	—
5.	53.2 %	—	53.22%
6.	52.7 %	—	52.72%
7.	54.2 %	54.23%	—
8.	55.9 %	55.3 %	—
9.	55.1 %	—	55.2 %
10.	53.6 %	—	53.6 %

COCOA POWDER

11.	26.4 %	26.6 %	—
12.	22.7 %	22.9 %	22.9 %
13.	22.9 %	22.87%	23.88%
14.	9.9 %	—	9.73%
15.	13.5 %	—	13.5 %
16.	22.4 %	—	22.04%
17.	20.5 %	—	20.2 %

SWEET CHOCOLATE COATING

18.	36.3 %	36.7 %	—
19.	36.4 %	36.21%	36.24%
20.	36.8 %	36.83%	—
21.	35.1 %	35.35%	—
22.	39.1 %	38.73%	—
23.	34.2 %	—	34.67%
24.	35.0 %	—	34.9 %
25.	35.5 %	—	35.8 %

MILK CHOCOLATE COATING

Note. Due to the difference in gravity between milk fat and cocoa butter a correction must be applied to the results on this material, usually 0.3%, but sometimes higher if a large amount of milk solids have been incorporated. This correction which is added to the result is determined by analysis of the product and remains constant for that particular grade of coating.

26.	35.3 %	35.5 %	—
27.	34.5 %	34.1 %	34.51%
28.	33.5 %	33.9 %	—
29.	35.3 %	35.53%	35.6 %
30.	34.8 %	34.93%	—
31.	41.6 %	41.69%	—
32.	33.6 %	—	33.68%
33.	33.3 %	33.24%	33.19%
34.	32.9 %	32.93%	—

EXPELLER CAKE

35.	11.5 %	11.43%	—
36.	11.5 %	11.33%	—
37.	9.5 %	9.69%	—
38.	11.4 %	11.26%	—

COTTONSEED MEAL

Sample	A.O.C.S.*	New Method
A	4.05%	4.1 %
D	8.2 %	8.1 %
C-12	6.25%	6.15%
C-16	6.02%	6.1 %
55	5.98%	5.9 %
C-13	6.21%	6.2 %
B	4.55%	4.4 %
50	6.0 %	6.0 %
51	5.76%	5.75%
C-14	6.25%	5.95%
C-15	6.17%	6.1 %

*A.O.C.S.—Official method of the American Oil Chemists Society.

REFERENCES

1. Welman, *Zeitschr. Offentl. Chemie 1900,* p. 304.
2. J. Hanus, *Zeit. Unters. Nahr, Gen. 1906* 11 p. 738.
3. A. Kreutz, *Zeit. Unters. Nahr. Gen. 1908* 15 p. 680; *16,* p. 584.
4. Heller, *Apoth.-Zeit.* 1916 *31,* p. 330.
5. W. D. Kooper, *Zeit. Unters. Nahr. Gen.* 1915 *30,* p. 461.
6. Hughes, *Chemical News* Aug. 1919, CXIX, 1041.

6a. S. B. Phillips, *Analyst* 1916, p. 122.

7. A. Heiduschka and F. Muth, *Chemiker-Zeitung* 1928, No. 90.
8. Richter, *Zeit. Unters. Nahr. Gen.* 1912, *24,* p. 312.
9. Herty et. al. *J. Ind. Eng. Chem.* Vol. 1, 1908.
10. David Wesson, New Optical Method for Determining Oil in Oil-Mill Materials. *Cotton Mill Press* 4(3) : 70-73, 1920.
11. D. A. Coleman and H. C. Fellows, *U. S. Dept. Agriculture Tech. Bull.,* No. 71, 1928.

Cherry Kernel Oil

(*From Page* 372)

The saturated acids consist chiefly of palmitic and stearic acids, along with small quantities of arachidic and myristic acids, whereas the unsaturated fraction consists of oleic and linolic acids.

The refined oil, after being held for more than a year, was found to be in excellent condition, indicating that it has good keeping qualities. The results of the investigation made on cherry kernel oil indicate that it should prove useful as a high grade salad oil, and because of its similarity to almond oil it should be suitable for use in the manufacture of cosmetics.

Dr. Amando Clemente and Miss Adelaido Bendana, both of the Chemistry Department of the University of the Philippines, have announced the discovery of a new process for decolorizing coconut and cottonseed oils which is said to produce water-white oils.

The manufacturing plant of the Oil Products Company, producers and refiners of vegetable oils, at Singac, New Jersey, was completely destroyed by fire recently. Early estimates placed the loss at more than $50,000.