needles, m. p. 41–41.5°. No picrate could be obtained in methanol or benzene solution.

Anal. Calcd. for $C_{10}H_6BrCl$: C, 49.70; H, 2.50. Found: C, 50.03; H, 2.60.

4-Methyl-7-(6′-chloro-1′-naphthoyl)-hydrindene.—The Grignard reagent from 3 g. of 1-bromo-6-chloronaphthalene and 0.32 g. of magnesium, prepared by starting the reaction with a few drops of *n*-butylmagnesium bromide solution and then refluxing overnight under nitrogen, was treated with a solution of 2 g. of 4-methyl-7-cyanohydrindene and refluxed for five hours. The product was worked up as described above and distilled, the desired ketone constituting the chief fraction, b. p. 300° at 20 mm.; yield 2.5 g. (63%). The substance formed small, colorless plates, m. p. 92–94°, from methanol.

Anal. Calcd. for $C_{21}H_{17}OCl$: C, 78.62; H, 5.34. Found: C, 78.97; H, 5.14.

3-Chloro-20-methylcholanthrene (XI).—Pyrolyzed in a bath at 400° for fifteen minutes, 2.25 g. of the above ketone gave, after rough distillation, purification in benzene solution by chromatographic adsorption and crystallization from the filtrate, 0.7 g. (33%) of the chlorohydrocarbon, m. p. 194–196.5°. Recrystallized from benzene, the compound formed yellow needles melting at 197–198.8°. No picrate was obtained in benzene or alcohol, but a rather easily dissociated **di-trinitrobenzene compound** crystallized from benzene–ligroin in the form of brilliant scarlet-red prisms, m. p. 165.5–166.5°.

Anal. Calcd. for $C_{21}H_{15}Cl$: C, 83.29; H, 4.99. Found: C, 83.26; H, 5.40. Di-trinitrobenzene compound, calcd. for $C_{21}H_{15}Cl \cdot 2C_6H_3O_6N_3$: N, 11.52. Found: N, 11.21.

3-Cyano-20-methylcholanthrene.—A mixture of 0.45 g. of the chloro compound XI, 0.15 g. of cuprous cyanide, and 5 cc. of pyridine in a sealed tube was warmed on the steam-bath until liquid and the tube was shaken well and heated for twenty-four hours at 200–220°, with one removal for further shaking. The cooled mixture was extracted with benzene and the solution was washed with ammonia solution, water and dilute acid, filtered from a brown precipitate, washed with concentrated salt solution and concentrated. There was obtained 0.36 g. (84%) of crystalline product, m. p. 211–217°. After several recrystallizations from benzene the substance formed small yellow needles, m. p. 243–251°.

Anal. Calcd. for $C_{22}H_{15}N$: C, 90.07; H, 5.15; N, 4.77. Found: C, 89.56; H, 5.56; N, 4.52.

Summary

The general method developed in this Laboratory for the synthesis of cholanthrene and certain of its alkyl derivatives has been found satisfactory for the synthesis of the 3-methoxy and 3-chloro derivatives of methylcholanthrene. The functional substituents withstand the drastic conditions of the pyrolysis in the final step, and the chief limitation in the application of the method is that the 6-substituted 1-bromonaphthalenes required as starting materials are rather difficultly accessible. 1-Bromo-6-chloronaphthalene, required for one of the syntheses of the present work, was prepared for the first time from β-nitronaphthalene. 1,6-Dibromonaphthalene was found unsuitable for use in the synthesis of cholanthrenes because, in the reaction with magnesium, it is attacked first in the 6(β)-position rather than at the 1(α)-bromo atom.

CONVERSE MEMORIAL LABORATORY
CAMBRIDGE, MASSACHUSETTS

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Characteristics and Composition of Papaya Seed Oil

BY HARRY W. VON LOESECKE AND ARTHUR J. NOLTE

The papaya (*Carica papaya*) is a melon-like fruit found growing in most tropical countries. Under ordinary conditions, the average yield of fruit per tree from commercial plantings is about 22.7 to 45.4 kg. (50 to 100 pounds). The fruit varies greatly in shape and size and may be from 10 cm. (4 inches) up to 51 cm. (20 inches) in diameter and weighing as much as 4.5 kg. (10 pounds), with an average weight of about 2 kg. (4.5 pounds). The skin is smooth, and when ripe is orange in color. The flesh varies from a light yellow to a deep salmon pink, and possesses a distinctive odor and flavor suggestive of butyric acid.

Each fruit contains about 1500 round, black, wrinkled seeds each enclosed in a gelatinous membrane. The individual seeds weigh about 0.09 g., contain 85% moisture and constitute approximately 7% of the weight of the fruit. The seeds have a distinct cress-like taste and are said to be anthelmintic, emmenagogic and carminative. They are also said to be eaten as a delicacy and as a quencher of thirst.[1]

No published data could be found relative to the composition of the fatty oil in the seeds with the exception of a paper by Peckholt[2] who deter-

(1) Scott, "The Papaya," *Fla. State Dept. Agri. Bull.* **32** (1931).
(2) Peckholt, *Ber. Pharm. Ges.*, **13**, 366 (1903).

mined the oil content of the seeds and a few of the oil characteristics. The present work was therefore undertaken to supply more detailed information. The seeds used were obtained from commercial plantings of fruit in South Central Florida.

The air dried seeds, upon analysis, gave the ollowing

Moisture, %	7.47
Water sol. ash, %	3.83
Water insol. ash, %	4.02
Total ash, %	7.85
Protein (N × 6.25), %	27.20
Fat (ether extract), %	25.29
Undetermined, %	32.19

Preparation of the Oil.—The oil was prepared by extracting the dried, ground seeds with petroleum ether at room temperature. The extracted seeds still contained 6.1% residual oil. The solvent was removed by distillation, the oil warmed to 48–54° (120–130°F.) under a vacuum to remove the last traces of solvent, and then filtered using infusorial earth. The oil thus obtained contained 1.58% of volatile constituents.

Physical and Chemical Examination.—The oil, prepared as described above, possessed a yellow color in thin layers and a brownish color in moderately thick layers. It had a distinct cress-like odor and taste. The chemical and physical properties of the oil are given in Table I, the results being corrected for volatile constituents and are the mean of two or more values determined by the usual procedures.[3] The Reichert–Meissl and Polenske numbers show very small amounts of glycerides of volatile acids, which fact is also confirmed by the Hehner value. The low acetyl value indicates very small quantities of diglycerides, hydroxy acids and higher alcohols.

Examination of Unsaturated Acids.—The unsaturated acids were separated by the lead salt–ether method and dried in a current of carbon dioxide. The iodine number of the unsaturated acids was 89.8, the neutralization value 197.3 and the mean molecular weight 284.3.

TABLE I

CHEMICAL AND PHYSICAL CHARACTERISTICS OF PAPAYA SEED OIL

Specific gravity, 20°/20°	0.9091
Refractive index, $n^{20}D$	1.4666
Acid value	3.05
Saponification value	189.5
Iodine no. (Hanus)	72.6
Unsaponifiable matter, %	1.32
Unsaturated acids, % (corr.)	78.63
Saturated acids, % (corr.)	16.97
Iodine no. of unsatd. acids	89.8
Reichert–Meissl no.	1.05
Polenske number	0.20
Acetyl value	3.8
Hehner value (corr. for unsaponifiable matter)	95.9

(3) Association of Official Agricultural Chemists, "Methods of Analysis," Washington, D. C., 4th ed., 1935, pp. 404–418.

Bromine was added to the unsaturated acids according to Eibner and Muggenthaler.[4]

No ether insoluble hexabromides were obtained which indicates the absence of linolenic acid.

Since only linoleic and oleic acids are present in the unsaturated acid fraction, the percentage of these acids was calculated by the formula given by Lewkowitsch[4] (p. 574) with the following results

	In unsatd. acids, %	Original oil, %	Glyceride in original oil, %
Linoleic	2.71	2.13	2.22
Oleic	97.29	76.50	79.94
	100.00	78.63	82.16

Examination of the Saturated Acids.—The saturated acids were esterified with absolute methyl alcohol and dry hydrogen chloride, the methyl esters separated from the methyl alcohol, washed with water and sodium bicarbonate. The mixed methyl esters (32.51 g.) were subjected to fractional distillation *in vacuo* with results given in Table II.

The iodine numbers and saponification values of the different fractions were determined, and the mean molecular weights of the esters calculated according to the method of Baughman and Jamieson.[5] The results are given in Table II. The mean molecular weight of the first fraction precludes the presence of any acids in the series lower than palmitic. This fact is confirmed by the low Reichert–Meissl and Polenske numbers and Hehner value of the original oil. The mean molecular weight of the residue does not indicate the presence of an acid higher than arachidic.

In order to test the correctness of the data in Table II, the acids were isolated from the different fractions by saponifying the esters, acidifying with hydrochloric acid, washing the liberated fatty acids with water until free from chlorides, and fractionally crystallizing from 95% ethyl alcohol.

Palmitic Acid.—(M. p. 62.6–63°) Fractions 1, 2 and 3, were combined and the fatty acids liberated as described above. After repeated crystallization from 95% ethyl alcohol, an acid crystallizing in needles and melting at 61 to 62.5° was obtained. This was considered sufficient evidence of the presence of palmitic acid.

Stearic Acid.—(M. p. 69.3–71°) Fractions 4 and 5 were treated as in the case of palmitic acid, obtaining pearly laminae melting at 67.5 to 71.0° which was considered proof of the presence of stearic acid.

Arachidic Acid.—(M. p. 76–77°) was isolated from the residue from which an acid melting at 75–77° was obtained.

The composition of the saturated acids, calculated according to Baughman and Jamieson's method,[5] is given in Table III.

Volatile Oil in Seeds.—After the fatty oil had been extracted from the seeds, it was noticed that when they were boiled with water the steam possessed a pungent cress-like odor. A quantity (1.4 kg.) of the extracted seeds was subjected to steam distillation until the distillate no longer came over milky. The distillate was saturated with so-

(4) Lewkowitsch, "Chemical Technology and Analysis of Oils, Fats and Waxes," 6th ed., Vol. I, 1921, p. 585.

(5) Baughman and Jamieson, THIS JOURNAL, **42**, 156 (1920).

TABLE II

RESULTS OF ANALYSES OF FRACTIONS OBTAINED BY DISTILLING METHYL ESTERS OF SATURATED ACIDS OF PAPAYA SEED OIL

Fractions	Temp., °C.	Pressure, mm.	Iodine no.	Sap. value of esters of satd. acids	Esters of unsatd acids, %	Esters of satd. acids, %	Mean mol. wt. of esters of satd. acids	Composition of the esters of saturated acids: Methyl palmitate, %	Methyl stearate, %	Methyl arachidate, %
1	132–160	5–6	18.2	203.9	20.47	79.53	275.1	82.92	17.08	
2	160–165	5	19.4	201.6	22.56	77.44	278.2	71.88	28.12	
3	165–170	6	20.2	200.7	23.51	76.49	279.5	67.26	32.74	
4	170–175	5	26.3	187.3	30.60	69.40	299.5		96.07	3.93
5	175–181	5	28.3	183.7	32.93	67.07	305.4		75.00	25.00
Residue			39.3	182.4	45.73	54.27	307.6		67.14	32.86

TABLE III

SATURATED ACIDS IN PAPAYA SEED OIL

Acids	Yield: Grams	Yield: %	Acids in oil, %	Glycerides in oil, %
Palmitic	15.62	67.18	11.38	11.94
Stearic	7.20	30.96	5.25	5.49
Arachidic	0.43	1.85	0.31	0.32
			16.94	17.76

dium chloride and a few oily droplets were found floating on the surface. The liquid was still milky and was therefore shaken with ether, the ether extract washed with water, dried with sodium sulfate and excess ether removed by distillation. A dark amber oil with a pungent odor was obtained. When highly diluted, it had a cress-like odor similar to that of the seeds. The yield amounted to 1.3 g. or 0.09% based on the weight of the seeds, a quantity too small to make an extended investigation of its chemical and physical properties. It is hoped more may be obtained for further studies. The seeds are said[6] to contain a glucoside, *caricin* which resembles *sinigrin* (potassium myronate, $KC_{10}H_{18}O_{10}NS_2$). By the reaction of caricin with myrosin, an enzyme also present in the seeds, a volatile pungent substance, suggestive of mustard oil, is produced. Possibly this oil is responsible for the cress-like taste of the seeds.

(6) U. S. Dispensatory, 20th Ed., 1918.

Summary

A study has been made of the composition of the glycerides of papaya seed oil, which consist of 11.94% palmitic acid; 5.49% of stearic acid; 0.32% of arachidic acid; 79.94% of oleic acid and 2.22% of linoleic acid.

Besides the fatty oil in the seeds there is also a volatile oil present to which the characteristic cress-like odor of the seeds is due. The unsaponifiable matter amounts to 1.32%.

WINTER HAVEN, FLA. RECEIVED SEPTEMBER 30, 1937

[CONTRIBUTION FROM THE BURROUGHS WELLCOME & CO. U. S. A. EXPERIMENTAL RESEARCH LABORATORIES]

Isomeric Amyl Ureas and Derived Barbitals[1]

BY JOHANNES S. BUCK AND AXEL M. HJORT

With a view to pharmacological study, the complete series of eight amyl ureas and eight 1 - amyl barbitals (1 - amyl - 5,5 - diethylbarbituric acids) have been prepared. Both types are hypnotics, and, by keeping the pharmacologically-active groups constant, the effects of variation in the structure of the amyl groups can be observed. In addition, the two series will give a direct comparison between the hypnotic effects of the ureas and barbituric acids, in pairs. The two 5-alkyl groups were selected as ethyl groups partly to avoid oily products and also to avoid possible complications which might arise from the presence, in some cases, of two asymmetric carbon atoms. In the compounds described below, where an asymmetric carbon atom is present, it is the optically inactive *dl* form which is referred to. Such compounds are indicated by *dl*.

(1) This work is part of a joint research being carried out in collaboration with a pharmacological group at the above Laboratories.

Experimental

The isomeric amyl ureas were prepared as described below. The last four have not been previously recorded.

n-Butylcarbinyl urea (*n*-amyl urea) was prepared from the amine hydrochloride and potassium cyanate,[2] also from the amine and nitrourea;[3] m. p. 100°.

Isobutylcarbinyl urea (isoamyl urea)[4] was prepared as above; m. p. 96°.

Dimethylethylcarbinyl urea (*t*-amyl urea) was made both by the Wurtz method[5] and by the Schneegans method;[6] m. p. 160°.

(2) DeBeer, Buck and Hjort, *J. Pharmacol.*, **52**, 216 (1934).
(3) *Cf.* Davis and Blanchard, THIS JOURNAL, **51**, 1790 (1929).
(4) Dixon, *J. Chem. Soc.*, **67**, 556 (1895).
(5) Wurtz, *Ann.*, **139**, 327 (1866).
(6) Schneegans, *Arch. Pharm.*, **231**, 675 (1893).