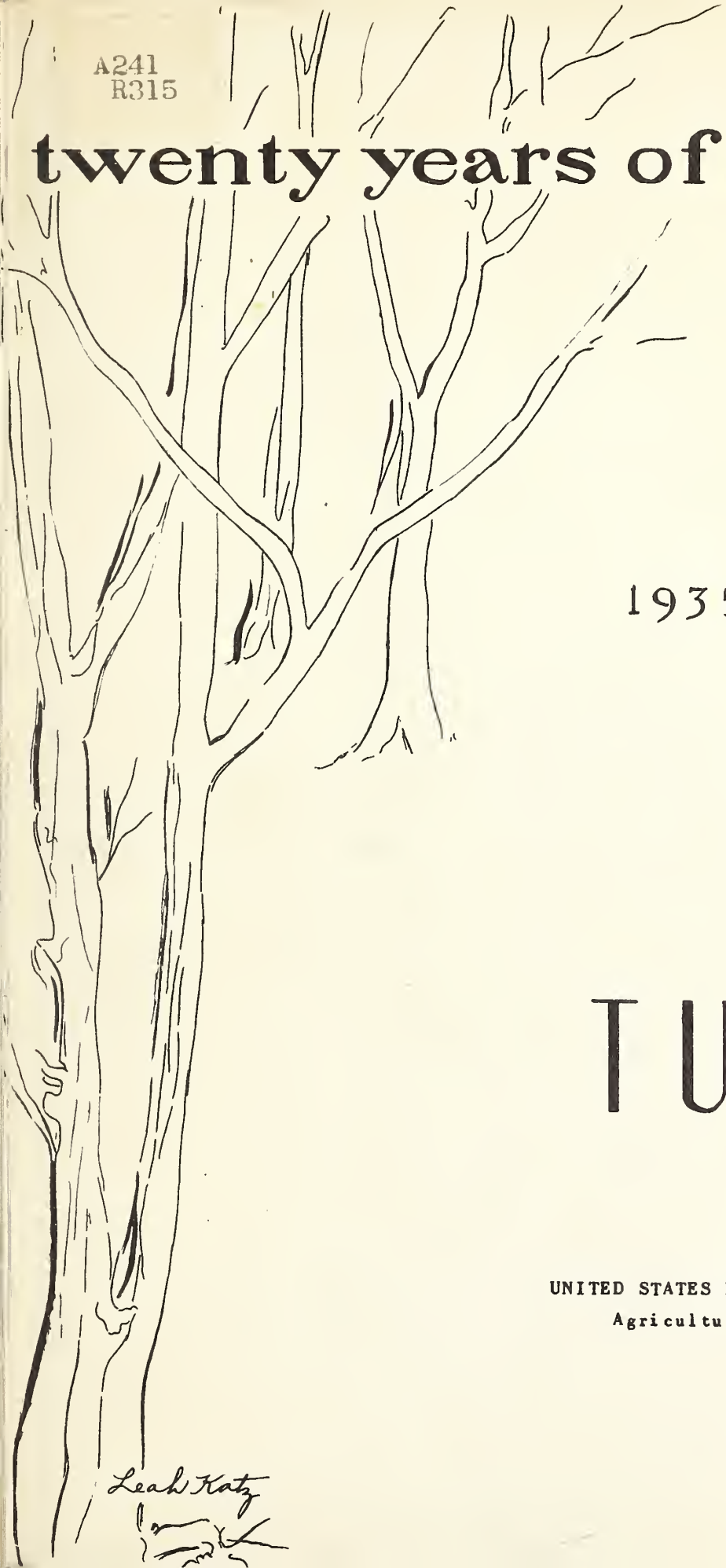
twenty years of research



1935-1955

TUNG

UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Service

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE
SOUTHERN UTILIZATION RESEARCH AND
DEVELOPMENT DIVISION

AN ABSTRACT BIBLIOGRAPHY OF PUBLICATIONS REPORTING RESEARCH ON THE CHEMISTRY, PROCESSING, AND UTILIZATION OF TUNG

1935-1955

Compiled and Edited

by

MARIE A. JONES,
NOVEMBER 1956

THE GREATER PART OF THE ABSTRACTS PRESENTED HERE WERE TAKEN FROM "ABSTRACT BIBLIOGRAPHY OF THE CHEMISTRY AND TECHNOLOGY OF TUNG PRODUCTS, 1875-1950" BY RALPH W. PLANCK AND FRANK C. PACK, OF THE SOUTHERN REGIONAL RESEARCH LABORATORY, AND DOROTHY B. SKAU, NEW ORLEANS BRANCH, U. S. DEPARTMENT OF AGRICULTURE LIBRARY. IN 1953 THE BIBLIOGRAPHY RECEIVED THE OBERLY AWARD, GIVEN BIENNIALLY BY THE AMERICAN LIBRARY ASSOCIATION FOR THE BEST BIBLIOGRAPHY ON AN AGRICULTURAL SUBJECT.

SOUTHERN UTILIZATION RESEARCH AND DEVELOPMENT DIVISION

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Southern Regional Research Laboratory
1100 Robert E. Lee Boulevard
New Orleans 19, Louisiana

This laboratory conducts research on utilization of cotton, cottonseed, rice, tung, peanuts and other oilseeds, sugarcane, sweetpotatoes, and other products of Southern agriculture, and on fundamental chemistry and process engineering and development applicable to utilization of these products. Field stations are:

Sugarcane Products Laboratory, Houma, Louisiana
Tung Oil Laboratory, Bogalusa, Louisiana
Naval Stores Station, Olustee, Florida
Citrus Products Station, Winter Haven, Florida
Food Fermentation Laboratory, Raleigh, North Carolina
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For information on any of the lines of research being conducted in the Southern Utilization Research and Development Division, you are invited to write or visit the Southern Regional Research Laboratory, or the field station immediately concerned with the product in which you are interested.

AIMS OF TUNG RESEARCH CHANGE TO MEET CHANGING CONDITIONS

During some twenty years that the U. S. Department of Agriculture has been engaged in research on tung, aims have changed greatly to meet some radical changes in market conditions. When the tung industry was established in this country, about 1930, paints and other protective coatings were based almost entirely on oils, and tung held an apparently secure position because of its excellent properties as a drying oil. At that time, however, modern methods of handling and processing were unknown, although the tung industry in China was centuries old. Today, production of tung oil has been modernized, a development to which Department of Agriculture research has made many contributions, but synthetic resins have replaced natural oils to a great extent, and indications are that this trend will continue. Efforts are now directed toward finding new uses for tung oil and its derivatives, and developing improved products to maintain its position in present fields of utilization.

The first commercial plantings of tung in the United States were made in 1925, and the first shipment occurred in 1932, when two tank cars were shipped from Gainesville, Fla. Research by the Department of Agriculture began in Washington, D. C., shortly afterward, and a paper on the composition of American tung oil was published in 1935 by R. S. McKinney and G. S. Jamieson; Dr. McKinney is now head of the U. S. Tung Oil Laboratory at Bogalusa, La. Dr. Jamieson, who is now retired, is the author of "Vegetable Fats and Oils", a standard text on the composition of these materials, as well as a large number of scientific papers on the subject.

By 1938 interest in this new crop was so great, and production had expanded so much, that Congress appropriated funds for establishment of tung oil laboratories at Gainesville, Fla., and Bogalusa, La. In 1948 the work was consolidated at the Bogalusa laboratory. Later this laboratory became a part of the Southern Utilization Research and Development Division, and since that time tung investigations have been carried on both at Bogalusa and the Southern Regional Research Laboratory in New Orleans, La.

During the early years, much attention was given to determining the effect of cultural factors, such as soil and fertilizer, on the content, quality, and physical and chemical characteristics of the oil in tung fruit. This work was done in cooperation with production research scientists of the Agricultural Research Service.

Effects of various methods of drying tung fruit and the hulled nuts and meal, and of various conditions of storage were studied in order to define conditions for minimum deterioration of oil. A new procedure of hulling the moist fruit in the field was found to minimize oil losses in the hulling process. Effects of moisture and shell in tung meal, and of preheating the meal, on efficiency of tung oil expression were investigated, as was the efficiency of various solvents and their effects on oil quality in solvent extraction. Some work was done on the use of tung meal in animal feeds after treatment to reduce toxicity. Methods for sampling and

analyzing tung fruit for moisture and oil content were developed and are now in use in the tung industry. A rapid method was developed whereby the oil content of tung fruit and its byproducts can be determined accurately at the mill. Using these methods, a study was made of the processing of tung fruit, wherein losses of oil in the various byproducts were determined, and it was found that the total oil recovered was in good agreement with that indicated by the analysis of the fruit. Methods of analysis were also devised to determine the quality of tung oils, and their content of alpha- and beta-eleostearic acid. These developments and others were reported in a number of publications which are abstracted in this bibliography.

In an effort to extend utilization of tung oil into new fields, research is being directed now toward the development of chemical derivatives which may find application in resins, plastics and other synthetic materials. Late in 1955 a contract was let by the Department of Agriculture, through the Southern Utilization Research and Development Division, to the Naugatuck Chemical Division of the U. S. Rubber Company for investigation of the possibilities of incorporating tung oil and its derivatives into polyester resins. Extensive studies have been undertaken on the chemical structure and reactions of eleostearic acid. Adducts have been prepared by the Diels-Alder reaction with maleic anhydride, beta-propiolactone, acrylonitrile, and fumaronitrile, and are being tested as plasticizers for vinyl resins.

Some protective coatings prepared with tung oil fatty acids and epoxy resins show excellent qualities in early evaluations, with good color and resistance to water, alkalies and organic solvents, high gloss and good mar resistance, and unusual properties of adhesion. The tendency of tung oil to gel during cooking in the preparation of paints and varnishes has been a handicap; during investigations on the preparation of coatings, it was found this tendency can be controlled by the addition of zinc resinate. This tendency may also be turned to advantage to introduce non-drying but potentially fungicidal acids in protective coatings to provide built-in resistance to damage from mildew and other fungi.

While this work is still in its comparatively early stages, several publications are included in this bibliography, and more will become available as time goes on.

The economic position of tung would be improved also by more profitable outlets for the meal remaining after extraction of the oil. The heat-stable, ether-soluble toxin from tung kernels is being isolated and characterized in studies now in progress, and means for its destruction in the meal investigated. If this can be done economically, feed outlets might give better financial returns for the meal.

C O N T E N T S

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Single copies of available reprints may be obtained without cost from: Southern Utilization Research and Development Division, 1100 Robt. E. Lee Blvd., New Orleans 19, La., or U. S. Tung Oil Laboratory, Bogalusa, La.

Purchase copies of patents from: U. S. Patent Office, Washington, D. C. (25¢ per copy).

No.

1. THE OIL CONTENT OF TUNG PRODUCTS BY A RAPID PETROLEUM NAPHTHA METHOD.
McKinney, R. S., and Holmes, R. L.
J. Am. Oil Chemists' Soc. 31, 172-74 (1954)

The oil content of wet or dry tung fruit, press cake, and filter cake can be determined rapidly and accurately by use of an improved analytical method. Results are in good agreement with those obtained by 4-hour extraction with petroleum ether by the Official Method of the American Oil Chemists' Society. In the new procedure, a finely ground sample of the tung material is mixed for 10 minutes in twice its weight of a high-boiling petroleum naphtha. The solution of oil is filtered off, and its specific gravity determined. Oil content is estimated, either by reference to specific-gravity percentage tung oil tables or to curves prepared by the researchers.

2. LOSS OF OIL IN HULLING TUNG FRUIT IN THE FIELD AND AT THE MILL
McKinney, R. S., Holmes, R. L., Minor, J. C., and *Potter, G. F.
J. Am. Oil Chemists' Soc. 30, 83-85 (1953)

Methods for analyzing commercial tung hulls for oil have been developed. Samples of hulls from mill and field operations were collected and analyzed. Loss of oil when the fruit was hulled varied from 0.6% to 7.3%, with an average loss of 2.7% based on the total amount of oil in the fruit. Differences in loss between grove and mill hulling were not significant. With a loss of 2.7% of the oil in hulling, a recovery of 87.9% oil on the hulled nuts would be equivalent to a recovery of 85.5% oil on the whole fruit.

3. TUNG HULLS AND PRESS CAKE
Holmes, R. L., and McKinney, R. S.
AIC-357, 14 pp. (1953) Processed

Complete information is given on the chemical composition of commercial hulls (a mixture of outer hulls, inner hulls, and shell) and the press cake produced in each of the 14 tung mills operating in the United States, and on the amounts available from domestic production. Some hulls are used in mixed fertilizers; as a source of additional organic matter in the growing of tung trees; and as a mulching material for ornamental shrubs. All press cake is sold as fertilizer. Extended uses are needed in a rapidly growing Southern tung oil industry. About 72,000 tons of hulls and about 21,000 tons of press cake were available in 1952. At present, existing uses appear to offer the best outlets.

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* Bureau Plant Industry, Soils and Agricultural Engineering, USDA.

4. CHEMICAL COMPOSITION OF TUNG HULLS AND SCREW-PRESS CAKE
Holmes, R. L., Minor, J. C., and McKinney, R. S.
Proc. Am. Tung Oil Assoc. 1952 42-48

The outer hull, inner hull, and shell of fresh tung fruit and of fruit weathered up to 6 months were analyzed for pentosans, lignin, cellulose, a-cellulose, nitrogen, potash, phosphoric acid, ash, hot-water solubles, alcohol-solubles, copper, iron, and manganese, to obtain information on the possible utilization of the byproduct hulls from tung mills. Twenty-five samples of cake, one or more from each of the 14 mills operating in the United States, were analyzed for oil, crude fiber, pentosans, nitrogen, ash, phosphoric acid, and potash.

5. REPORT OF THE SEED AND MEAL ANALYSIS COMMITTEE, 1951-52. TUNG SUB-COMMITTEE
McKinney, R. S., et al
J. Am. Oil Chemists' Soc. 29, 604-6 (1952)

Methods for obtaining representative samples of tung fruit, and preparing and analyzing these samples, are recommended.

6. COMPARISON OF THE WHOLE FRUIT AND COMPONENT METHODS OF ANALYSIS OF TUNG FRUIT
Pack, F. C., Holmes, R. L., and McKinney, R. S.
Proc. Am. Tung Oil Assoc. 15 (2), 31-9 (1949); J. Am. Oil Chemists' Soc. 27, 164-6 (1950); C. A. 44, 6170 (1950)

The effect of H_2O content and fineness of grinding on the percentages of oil extd. by the whole fruit method were investigated and the results compared with those by the component method. No differences were found in the oil content when samples of fruit were ground with plate spacings from 0.004 to 0.012 in. but the results were lower with plate spacings of 0.020 in.. No difference was found in the percentages of oil by the component and whole fruit methods when the results were calcd. on the basis of the original sample. The av. percentage of H_2O obtained by the 2 methods differ. Analyses of tung fruit by either method give reliable results over a wide range of H_2O content. From C. A.

7. AN ANALYSIS OF TUNG HULLS AND HULLING
McKinney, R. S., Holmes, R. L., and Minor, J. C.
Proc. Am. Tung Oil Assoc. 1950, 23 (abstract)

Methods for analyzing commercial tung hulls for oil content have been developed. Samples of tung hulls from mill and grove hulling operations have been collected and analyzed. The recovery of oil in hulling was found to vary from 93% to 98% with an average recovery of 97.5%.

With an oil recovery of 97.5% in the hulling operation, an oil recovery of the hulled nuts of 87.7% is required to equal an oil recovery of 85.5% on the whole tung fruit. Abstract by the authors.

8. REPORT OF THE SEED AND MEAL ANALYSIS COMMITTEE (1949)
Hopper, T. H., et al.
J. Am. Oil Chemists' Soc. 27, 21-4 (1949); C. A. 44, 2262 (1950)

The specifications of the methods for sampling tung fruit, for analysis of tung fruit, for the phys. analysis of the fruit for components, and for the analysis of tung kernels are described in detail. It is recommended that these methods be continued as tentative. From C. A.

9. COLLABORATIVE ANALYSIS OF TUNG FRUIT BY THE WHOLE FRUIT AND COMPONENT PROCEDURES
McKinney, R. S.
Proc. Am. Tung Oil Assoc. 1949 (II), 25-30

Collaborative studies on six lots of tung fruit varying widely in content of moisture, hull, and oil have shown good agreement for the oil content when analyzed by either the whole fruit procedure or by the component procedure adopted as a tentative method for the analysis of tung fruit by the American Oil Chemists' Society. These collaborative analyses have shown that it is unnecessary to make any correction in the oil content of tung fruit analyzed by the whole fruit procedure as no significant difference has been found between the results obtained by this procedure and those obtained by the component procedure. The highly significant differences observed in the results reported for the moisture content have indicated that serious errors may be encountered by calculating the oil content of tung fruit to a moisture-free basis. From the author's summary.

10. A NEW PROCEDURE FOR THE ANALYSIS OF TUNG FRUIT
McKinney, R. S., Halbrook, N. J. and *Agee, G. W.
J. Am. Oil Chemists' Soc. 25, 265-7 (1948); C. A. 42, 7994 (1948)

Greater accuracy than that of either the component or carpel procedure for determining the moisture and oil content of tung fruit was desired. The procedure developed employs a sample sufficiently large to be representative. Collaborative studies indicated that to obtain results

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* Barrow-Agee Laboratories, Inc., Memphis, Tennessee.

similar to those of the component procedure, a correction of 0.37% must be subtracted from the oil content obtained with Wiley-Bauer ground fruit but no correction appears to be necessary in the case of Wiley-Raymond ground material. Results of collaborative analyses are presented in several tables.

11. A PROGRESS REPORT ON THE SAMPLING AND ANALYSIS OF TUNG FRUIT
McKinney, R. S. Halbrook, N. J., and *Agee, C. W.
Proc. Am. Tung Oil Assoc. 1948, 66-71; C. A. 42, 7065 (1948)

Estn. of oil content of tung fruit by the whole-fruit procedure was not found to be adversely influenced by the use of the forced-draft oven method instead of the Bidwell-Sterling method for detg. the moisture content. Collaborative analyses showed that a correction of 0.30% must be subtracted from the oil content obtained with the Wiley-Bauer ground fruit to agree with analyses by the component procedure. Tests on moist tung fruit and its components indicate that there is no appreciable increase in the amount of extractive material obtained from the hulls and shells of moist fruit in comparison with that obtained from the hulls and shells of air-dry fruit. From C. A.

12. THE PURCHASE OF TUNG FRUIT ON THE BASIS OF DRY KERNEL CONTENT
Holmes, R. L., and Pack, F. C.
Proc. Am. Tung Oil Assoc. 1947, 24-7

This paper is a study of the accuracy of calculating the oil content of tung fruit from the percent dry kernels and the average oil content of dry kernels. The extreme averages for groups of samples (each group limited to a restricted locality for one year) * * * were 61.99% and 68.75% for oil in dry kernel, although individual samples varied more widely. The average kernel content of dry fruit is about 33%. While Table I shows this method of determining the oil content of fruit to be fairly reliable, the purchase of large amounts of tung on a dry kernel basis without checking upon the oil content of dry kernels for that particular location and year would seem an unnecessary risk--at least, until more is known about the variation of oil content of kernels. For large amounts of tung, enough samples (10 or 20 taken at random from a plantation) should be carefully analyzed for the per cent oil in dry kernels, and the average of these analyses used to calculate the oil content of the fruit from the dry kernel content. For smaller lots of tung, an average for that area could be used. Excerpts from the article.

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* Barrow-Agee Laboratories, Inc., Memphis, Tennessee.

13. SAMPLING OF TUNG FRUIT AT THE MILL
Holmes, R. L., and Pack, F. C.
Proc. Am. Tung Oil Assoc. 1946, 40-6; C. A. 40, 6269 (1946)

The purpose of this paper is to emphasize the importance of proper sampling and to indicate requirements of adequate sampling procedures for tung fruit. Data indicate that to obtain values within 0.5% of the true av. oil content of a lot, a 100-fruit sample would be necessary. For values within 0.25%, a 400-fruit sample would be required. In paying for tung fruit, rounding off to the nearest 0.5% for oil would appear as accurate as ordinary sampling would justify. Samples should represent all portions of a load. It seems desirable to take a larger sample and reduce this to the desired size by quartering. From C. A.

14. METHODS OF ANALYSIS USEFUL IN EVALUATING TUNG FRUIT
McKinney, R. S., and Oglesbee, R. E.
Proc. Am. Tung Oil Assoc. 1946 (I), 1-5; Tung World 1 (3), 14-15; C. A. 40, 5577 (1946)

The evaluation of tung fruit arriving at the mill depends upon three factors, namely, the amount of foreign matter present, the percentage of moisture, and the percentage of oil in the tung fruit. Foreign matter should be removed from the tung fruit when it arrives at the mill and its weight added to the tare. Then every effort should be made to secure as representative a sample as possible of the lot of clean tung fruit. For the determination of the oil and moisture content of tung fruit, it is believed that the procedures being developed by the Subcommittee on Tung Fruit of the American Oil Chemists' Society will yield the most reliable and accurate results. From the paper. Analytical results obtained independently by seven collaborators on two different samples of tung fruit are tabulated and examined statistically.

15. RELATION BETWEEN OIL CONTENT AND KERNEL CONTENT OF TUNG FRUIT. HULLING TUNG FRUIT ON THE FARM
McKinney, R. S.
Oil, Paint & Drug Reptr. 144 (3), 3, 69-70 (1943); C. A. 37, 5265 (1943)

A graph, derived from actual detns., for the % oil content of tung fruit vs. % kernel content of tung fruit, is presented as a means for the rapid detn. of the value of a given lot. A study of sampling directions for peanuts suggested that tung fruit be drawn from 25 bags of a load of fruit or at 25 intervals during the unloading operations.

A modified English walnut huller was used for removing hulls. Studies of the rate of drying of the seed indicated that elevated temps. greatly increased the rate. From C. A.

16. SOME PROBLEMS OF INTEREST TO TUNG PRODUCERS
McKinney, R. S., Rose, W. Gordon, and Kennedy, Angus B.
Proc. Am. Tung Oil Assoc., 1943, pp. 62-77

Information is given on the grading of tung fruit on the basis of its kernel content. It was found that the percent oil equals 0.6036 times the percent kernels. The standard air of estimate was calculated to be 0.83% oil and the probable air to be 0.58% oil. Information was also given on the hulling of tung fruit using an English walnut huller and on the drying of hulled tung fruit at ambient temperature and at 100°C. Data was also given on the solvent extraction of dehulled tung fruit, tung press cake containing 5.3% oil and about 20.6% oil.

17. RAPID METHOD FOR THE DETERMINATION OF OIL IN TUNG FRUIT
McKinney, R. S. and Rose, W. G.
Oil & Soap 18, 25-7 (1941); C. A. 35, 2736 (1941)

The undried tung kernels are ground twice in a "Russian" food grinder No. 1 (the 16-tooth cutter is used); and 5 g. is then ground in a mortar with 2 g. of fine sea sand. With an accurate pipet 5 ml. of acetylene tetrabromide is added and the mass triturated for 5 min. and allowed to stand for 10 min. and the trituration repeated. A 65-mm. 60°-angle funnel is fitted by a cork into a 1-in. Pyrex test tube having a side arm for suction. A 25-mm. perforated porcelain filtering disk is placed in the funnel and a 27-mm. filter paper is cut and put on the disk. Suction is applied at the side-arm tube. The tung-kernel solvent mixt. is poured on the filter paper and the soln. filtered, and its d. detd. at room temp. in a 2-ml. Gay-Lussac sp. gr. bottle. The percentage of tung oil in the soln. is obtained from a reference curve at a particular temp. and from this is obtained the percentage in the kernels. From C. A.

18, ANALYSIS OF TUNG FRUIT
McKinney, R. S. and Freeman, A. F.
Oil & Soap 16, 151-2 (1939); C. A. 33, 8046 (1939)

In tung fruits in a closed container the moisture distributes itself evenly between individual fruits. The oil can be extd. completely from tung kernels if they are reground with sand. The moisture can be removed from ground tung kernels and also the solvent from the extd. tung oil by heating to 100° in a vacuum oven with 28-29 in. of vacuum. From C. A.

19. A NOTE ON THE ANALYSIS OF TUNG FRUITS
McKinney, R. S. and Jamieson, G. S.
Oil & Soap 13, 71 (1936); C. A. 30, 3259 (1936)

The fruits were grown under different conditions in Mississippi. Six samples gave the following av. analysis: wt. of fruit 24.8 g., nuts in fruits 55.8, kernels in nuts 60.7, kernels in fruits 33.9, H_2O in kernels 2.3, oil in kernels 62.7% and I no. of oil (Wijs) 164.5. From C. A.

20. THE DETERMINATION OF MOISTURE IN TUNG FRUIT
Holmes, R. L., Minor, J. C., and McKinney, R. S.
J. Am. Oil Chemists' Soc. 29, 425-27, (1952), Proc. Am. Tung Oil Assoc. 1951, 18-26

Six methods for making this determination are compared. The highest, and probably most reliable, moisture values were obtained by drying the ground fruit in the vacuum oven at 101° 2.5 hours under 12-mm. pressure, and by the Karl Fischer titration method. The vacuum oven method is simpler and generally preferable. Results obtained in the forced-draft oven method were low because of oxidation of the oil in the samples. For routine analysis, heating the ground sample in a hot air blower for 15 minutes at 126.7° (260° F.) and adding a correction of 1.35% to the percentage of moisture obtained gives sufficiently accurate values for factory control purposes.

21. THE EQUILIBRIUM MOISTURE CONTENT OF TUNG FRUIT AND ITS COMPONENTS AT DIFFERENT RELATIVE HUMIDITIES
Holmes, R. L., McKinney, R. S., and Minor, J. C.
J. Am. Oil Chemists' Soc. 28, 218-220 (1951)

Tung fruit and its products tend to assume a moisture content in equilibrium with that of the surrounding atmosphere. Moist, broken seed produced by the usual commercial hulling operations will develop free fatty acids rapidly and heat spontaneously unless dried to about 10% moisture. Equilibrium moisture contents at 25° determined for the whole tung fruit, the outer hull, inner hull, shell, kernel, and seed of the fruit, and on cake from continuous screw presses, at nine different relative humidities, and for varying periods of storage.

22. THE EQUILIBRIUM MOISTURE CONTENT OF TUNG FRUIT AND ITS COMPONENTS AT DIFFERENT RELATIVE HUMIDITIES
Holmes, R. L., McKinney, R. S., and Minor, J. C.
Proc. Am. Tung Oil Assoc. 1950, 24-36

The equilibrium moisture contents at 25° were determined for the whole tung fruit, the outer hull, the inner hull, shell, kernels, and seed of the fruit, and on the cake from continuous screw presses at 9

different humidities. The relative humidities were maintained by enclosing saturated solutions of different salts in dessicators in a room maintained at constant temperature. Summary by the authors.

23. MOISTURE RELATIONSHIPS IN TUNG FRUIT AND SEEDS
Holmes, R. L. and Pack, F. C.
Proc. Am. Tung Oil Assoc. 1948, 57-65; C. A. 42, 6891 (1948)

Equil. moisture contents of tung seeds and kernels were established when in contact with air of different relative humidities. As the relative humidity was increased from 45.2 to 100.0%, the moisture in the seeds increased from 7.92 to 11.16% and in the kernels from 4.80 to 11.53%. The effect of temp. on moisture content was slight for a given relative humidity. The acid value of the oil from the seeds and kernels remained low, 0.7 or less at all relative humidities even after 2 months storage at 71.6° F. with the exception of kernels stored at 100% relative humidity. The rate of absorption of moisture by whole tung fruit, seeds, and kernels was also detd. It was found that moisture penetrates to the kernel slowly. After soaking either whole fruit or seeds in water for 24 hrs. the moisture in the kernels increased only up to about 8% from and original 4%. Kernels soaked for 24 hrs. with the shells removed increased to over 33%. From C. A.

24. MOISTURE DETERMINATIONS ON TUNG FRUIT AND ITS COMPONENTS FOR CONTROL PURPOSES
Freeman, A. F.; Pack, F. C.; and McKinney, R. S.
Oil & Soap 20, 203-4 (1943); C. A. 39, 19551 (1945)

By means of a special dryer in which the sample is dried for only 5-15 min. in a blast of hot air (at 260° F.), H_2O in tung fruits, meal, kernels, seeds, and hulls can be detd. sufficiently accurately for routine control purposes. From C. A.

25. MOISTURE DETERMINATIONS ON TUNG FRUIT AND ITS COMPONENTS FOR CONTROL PURPOSES.
Freeman, A. F., Pack, F. C., and McKinney, R. S.
Proc. Am. Tung Oil Assoc. 1942, 25-29; Oil & Soap 20, 203-4 (1943); C. A. 39, 1551 (1945)

By means of a special dryer in which the sample is dried for only 5-15 min. in a blast of hot air (at 260° F.), H_2O in tung, fruits, meal, kernels, seeds and hulls could be detd. sufficiently accurately for routine control purposes. From C. A.

26. EFFECT OF MOISTURE ON GRINDING OF TUNG KERNELS AND SOLVENT EXTRACTION OF MEAL

Freeman, A. F., Pack, F. C., and McKinney, R. S.
Oil & Soap 21, 328-30 (1944); Proc. Am. Tung Oil Assoc. 1944, 43-52; C. A. 39, 432 (1945)

Data are presented to show the effects of moisture on grinding tung kernels and on solvent extn. of oil from meal. The data indicate that the efficiency of oil extn. can be increased by vacuum drying ground kernels before extn. The state of comminution obtainable on grinding the kernels is dependent on the moisture content; above 9% moisture the efficiency of grinding and extn. decreases progressively with increase of moisture content. The most efficient grinding is obtained with material of 6 to 9% moisture. In general progressively poorer grinding is obtained on tung kernels with moisture ranging downward from 6%. Six tables of results are given. From C. A.

27. MOISTURE CONTENT OF TUNG FRUIT FROM ITS ELECTRICAL RESISTANCE

McKinney, R. S.
Oil & Soap 18, 188-9 (1941); C. A. 35, 7735 (1941)

Two parallel holes are bored in a tung fruit longitudinally 1 in. apart and 1/2 in. deep. The two terminals from the ohmmeter are inserted and, by use of the max. amt. of internal resistance in the ohmmeter, the resistance of the fruit to the passage of the small d.c. is read. The moisture content of the tung fruit is est. from either a table or a curve. A moisture content of 37.2% shows a resistance in ohms of 16,000 while 6.3% moisture gave a reading of infinity in ohms. 21 references. From C. A.

Drying
and
Storage

28. THE RATE OF DEVELOPMENT OF ACIDITY IN STORED TUNG SEEDS AND KERNELS

Holmes, R. L., Minor, J. C., and McKinney, R. S.
J. Am. Oil Chemists' Soc. 30, 137-39 (1953)

The acid values of the oil in samples of whole tung seeds and whole and chopped kernels of high, medium, and low moisture contents after storage (sealed in tin cans) for different intervals in incubators maintained at 25°, 31°, and 38° were determined. Higher temperatures greatly increased the rate in chopped kernels, but had slight effect with oil of the whole seeds and whole kernels. The oils in whole seeds containing 7% and 12% moisture (stored for 4 weeks) and seeds containing 17% moisture (stored for 2 weeks) developed free fatty acids equivalent to acid values of 2.0 or less. Acid values of oils never exceeded 8.0 after storage for 13 weeks. Whole kernels developed even less free

fatty acids than whole seeds, stored under similar conditions. Acid values in oil in chopped kernels of 5% and 7% moisture, after storage for 12 days was less than 8.0; but with a moisture of 12% acid value was more than this in less than a week.

29. EFFECT OF DRYING AND STORING TUNG SEEDS ON QUALITY OF THE OIL AND MILLING CHARACTERISTICS OF THE SEEDS.
Holmes, R. L., Pack, F. C., and *Gilbert, S. G.
J. Am. Oil Chemists' Soc. 24, 311-14 (1947); C. A. 41, 7135-6 (1947)

Hulled tung seeds were dried at 2 temps. in Dec. and Jan. and put in storage in bags along with similar seeds not artificially dried. Bi-monthly tests were made on a com. screw press. The acid value of oil in the intact seeds put in storage at 10% H_2O in early Dec. and late Jan. had risen from 0.5 to 0.8-1.5 by the following Apr. Intact seeds dried to about 10% H_2O at 158° F. and about 172° F. processed in the screw press as well the following Apr. as they did when put in storage in early Dec., and there was no deterioration in the quality of the oil. Intact seeds which were dried from 26% H_2O to about 10% in late Jan. at 155-212° F. did not process efficiently after 2 months storage, nor did the material stored at the same time without artificial drying. From C.A.

30. PROGRESS REPORT ON DRYING AND STORAGE OF TUNG SEEDS
Holmes, R. L., and Pack, F. C.
Proc. Am. Tung Oil Assoc. 1947, 1-11

The experimental data of this paper were supplemented by further research and reported in "Effect of Drying and Storing Tung Seeds on Quality of the Oil and Milling Characteristics of the Seeds" by Holmes, R. L., Pack, F. C., and Gilbert, S. G. (J. Am. Oil Chemists' Soc. 24, 311-4 (1947)

31. PRELIMINARY STUDIES ON THE STORAGE OF TUNG FRUIT AND SEED
McKinney, R. S., and Oglesbee, R. E.
Proc. Am. Tung Oil Assoc. 1945, 48-51

Notable changes have been found to occur in the oil and protein contents of fruit held under common storage during the summer and fall months. Studies on tung fruit have indicated that it may be possible to hold the fruit in cold storage until fall, without appreciable changes in these constituents. These results have indicated that it may be possible to express the oil from tung fruits kept in cold storage at about 42° F. during the summer months; whereas, it has been found difficult, if not impossible to do so with tung fruit kept in normal storage into summer months. From the summary of the paper.

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* Bureau of Plant Industry, Soils, and Agricultural Engineering, USDA.

32. DRYING OF HULLED TUNG NUTS
McKinney, R. S., Pack, F. C., and Oglesbee, R. E.
Proc. Am. Tung Oil Assoc. 1945, 52-4

Certain generalizations can be made concerning the drying of hulled tung nuts for expeller operation: (1) Drying carried out at a temperature in excess of about 210° F. is very questionable. While it is true oil quality is not seriously impaired by temperatures as high as 285° F. and the yield by solvent extraction is not greatly decreased by drying temperatures as high as 230° F., there is evidence that hulled tung nuts heated much above 210° F. will not form a cake in the expeller, (2) The passage of the hulled material through the drier should be at a constant rate so that the discharged product will be uniform with respect to moisture and the drying time can be controlled, and (3) Direct contact between the material being dried and the heating elements of the drier should be avoided, as after such contact at high temperatures the dried material had a glazed transparent appearance and a strong cooked odor, indicating that the material had been over-heated. This is of particular importance where a drying oil such as tung is involved. From the summary of the article.

33. THE DEHYDRATION OF TUNG FRUIT
McKinney, R. S. and Freeman, A. F.
Proc. Am. Tung Oil Assoc. 1941, 13; C. A. 37, 6476; Oil, Paint & Drug Reptr. 140 (6), 5, 36 (1941)

A variety of drying methods were tried on tung fruit. Solar driers were too slow to be practicable, but at higher temps. moisture is removed more rapidly. A flash drier was considered unsuitable owing to the necessity of passing fruit through the drier twice, with resulting injury. Under favorable conditions the fruit can be dried to 30% in the field, and this drying can be completed in ventilated barns. The use of heated air to speed up drying in the barns was tried. Rough moisture content tests could be made on the kernels by an elec. cond. method and on the meal by drawing air at 130° through the meal for 10 min. and noting loss in weight. From C. A.

MEAL

34. DETOXIFICATION AND TOXICOLOGICAL STUDIES ON TUNG MEAL
Mann, G. E., Hoffman, W. H., and *Ambrose, A. M.
J. Agr. Food Chem. 2, 258-63 (1954)

Contents of protein and carbohydrates of tung meal indicate that it would be valuable as a feed for cattle -- if a reliable procedure

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* Western Utilization Research Branch, ARS, USDA.

could be developed to detoxify it completely on a large scale. Rats were fed tung press cake and meal, oil and protein -- before and after treating the materials by procedures described in the literature for removing or inactivating toxic substances present in tung products. Results were correlated with variables involved in production of the tung products. Press cake obtained by a commercial screw-press process-- involving exposure to high heat -- became almost completely detoxified only after it was extracted with ethyl alcohol -- indicating the presence of a toxic component stable to heat, as reported by other investigators, but extractable by ethyl alcohol. A hexane-extracted meal could not be detoxified completely by a combination of autoclaving and extraction with ethyl alcohol.

35. TUNG MEAL IN RATIONS FOR GROWING CHICKS
*Davis, G. K., *Mehrhof, N. R., and McKinney, R. S.
Poultry Sci. 25, 74-9 (1945); C. A. 40, 3511 (1946)

The toxicity of tung meal prevents its use as a source of protein in poultry diets. At 10 and 15% levels, both the heat-treated and the raw meal caused high mortality in chicks, while at all levels above 5% feed utilization was greatly reduced. Toxicity was not destroyed by autoclaving at 22 lb. for 90 min. Toxicity was also retained in heat-treated, 40-mesh screenings. From C. A.

36. EFFECT OF TUNG MEAL IN RATIONS FOR GROWING CHICKS
*Davis, G. K., *Mehrhof, N. R., and McKinney, R. S.
Fla. Agr. Expt. Sta. Ann. Rept. 1944-45, 61 (1945)

The tung meal proved toxic, whether raw or heated, and caused heavy mortality at the 10 and 15% levels. At the 5% level the tung meals interfered with feed utilization. From the report.

37. CHICK FEEDING EXPERIMENTS WITH SOLVENT-EXTRACTED TUNG-OIL MEAL
*Rusoff, L. L., *Mehrof, N. R., and McKinney, R. S.
Poultry Sci. 21, 451-4 (1942); C. A. 36, 7173 (1942)

Exptl. results of feeding solvent-extd. tung-oil meal to growing chicks at levels of about 5-20% of the ration indicated that it was unpalatable, but there was no definite evidence of toxicity. Com. tung-oil meal is toxic and should not be used for feeding purposes. From C. A.

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* Florida Agricultural Experiment Station.

38. APPLICATION OF INFRARED SPECTROPHOTOMETRY TO FATTY ACID DERIVATIVES
O'Connor, R. T.
J. Am. Oil Chemists' Soc. 33, 1-13 (1956)

History and application of infrared spectroscopy as a tool for qualitative identification, quantitative determinations, and the elucidation of chemical structures of fatty acid materials are reviewed. One of the tables lists 100 absorption bands employed in the application of infrared spectroscopy to fatty acid chemistry. Literature is grouped according to field of application, and 127 references are included.

39. INFRARED ABSORPTION SPECTRA
O'Connor, R. T.
J. Am. Oil Chemists' Soc. 32, 624-33 (1955)

Infrared absorption spectrophotometry is one of the fifteen major branches of analytical spectroscopy. Absorption of infrared radiation to produce vibrational-rotational band spectra is discussed theoretically, and the manner in which these spectra are used for qualitative detection and quantitative determination of organic molecular moieties by group frequency correlations is described. The outstanding application of infrared absorption spectroscopy to fat and oil chemistry has been the detection and determination of cis and trans fatty acids, esters, glycerides, etc. The methods are described, with several illustrations and applications of the technique to hydrogenation and autoxidation studies. Applications of infrared absorption spectroscopy to autoxidation, rancidity, and drying oil properties are described and miscellaneous applications in investigations of glycerides, lipides, and phospholipides cited. The important contributions of infrared spectroscopy to investigations of polymerization and copolymerization reactions and to the elucidation of the molecular structure of fat and oil compounds have been mentioned again with several illustrations. Miscellaneous uses of infrared absorption spectroscopy by the fatty acid chemist are described, including use of the oxirane ring bands; methods for quantitative determination of hydroxyl, ketone, ester, etc., groups, the position of double bonds in fatty acid type compounds, and the use of infrared spectra to determine chain length. The interesting potential uses of the "fingerprint" techniques to augment these "group frequency" types of investigations are described.

40. ULTRAVIOLET ABSORPTION SPECTROSCOPY
O'Connor, R. T.
J. Am. Oil Chemists' Soc. 32, 616-24 (1955)

An elementary, theoretical discussion of ultraviolet absorption, with particular emphasis on the type of problems its particular characteristics enable it to solve, has been presented. The experimental measurements and methods, both for qualitative detection and for quantitative determinations, are discussed. The simple analysis of alpha-eleostearic acid in fresh tung oil is described as an example of a single-component determination. The alpha- and beta-eleostearic acid contents of partially isomerized tung oils are used to illustrate the technique and calculations of a multi-component analysis. An extension of this multi-component technique, where the measured ultraviolet absorption must be chemically produced, is described and illustrated by the popular simultaneous determination of polyunsaturated fatty acids in vegetable and drying oils. Applications of ultraviolet absorption methods to studies of (1) hydrogenation, (2) autoxidation, (3) vitamin content, (4) drying mechanisms, (5) refining, bleaching, and deodorization processes, and (6) detection and determination of unusual constituents have been described to illustrate the wide scope of applications of this technique in the chemistry of fats and oils.

41. AN IMPROVED HEAT TEST APPARATUS FOR TUNG OIL
Pack, F. C.
ASTM Bull. 191, 49-50 (1953)

The construction of an improved oil bath of rugged and dependable design for the Browne Heat Test is described. The bath embodies adequate heat capacity, insulation, electrical heating, mechanical agitation, and precise automatic temperature control. The improved bath allows the gelation time of tung oil samples to be checked with good precision.

42. DETERMINATION OF THE FATTY ACID COMPOSITION OF PARTIALLY HYDROGENATED TUNG OILS
Planck, R. W., Pack, F. C., Heinzelman, D. C., Stansbury, M. F., and O'Connor, R. T.
J. Am. Oil Chemists' Soc. 30, 598-9 (1953)

Recently developed spectrophotometric methods for the determination of linoleic and conjugated dienoic acids in the presence of large amounts of eleostearic acid have been applied to determine the fatty acid composition of a series of progressively hydrogenated tung oils.

Utilizing hydrogen-iodine values and independently obtained values for saturated fatty acids, it has become possible to calculate concentration of isolinoleic and of monoethenoic acids. Use of these methods gives a more complete and accurate knowledge of the fatty acid composition of a partially hydrogenated tung oil, or mixture of other oils containing the same types of components, than has been obtainable by previously published spectrophotometric methods. They are also much less time-consuming than solvent fractionation methods. Data are presented which show the changes in fatty acid composition occurring during the hydrogenation (170°, 5 p.s.i.g. H_2 0.1% Ni) of a domestic tung oil from an iodine value of 231 to 78.

43. A HALOGENATION METHOD FOR THE DETERMINATION OF THE TOTAL UNSATURATION OF TUNG OILS AND OF ELEOSTEARIC ACIDS.
Planck, R. W., Pack, F. C., and Goldblatt, L. A.
J. Am. Oil Chemists' Soc. 30, 417-19 (1953)

A new modification of the Rosenmund-Kuhnhenn method has been developed for determining the total ethylenic unsaturation of tung oil and of eleostearic acids. An essential feature of the method is the addition of mercuric acetate to the oil before addition of the Rosenmund-Kuhnhenn reagent, in contrast to the Benham-Klee modification in which the Rosenmund-Kuhnhenn reagent is added first.

44. IMPROVED APPARATUS AND METHODS FOR QUANTITATIVE HYDROGENATION
Pack, F. C., and Planck, R. W.
J. Am. Oil Chemists' Soc. 30, 461-463 (1953)

Improved apparatus and techniques for the measurement of olefinic unsaturation by quantitative hydrogenation are described. These involve use of Mason's sample-introducing device, of n-alkyl esters of mono-basic fatty acids as solvents, and of palladium-carbon catalysts, thereby speeding up the determinations, improving their precision, and extending their utility. The validity of the new apparatus and techniques was established through measurements of the unsaturation in tung oil.

45. DETERMINATION OF THE TOTAL UNSATURATION OF TUNG OIL BY CATALYTIC HYDROGENATION
Pack, F. C., Planck, R. W., and Dollear, F. G.
J. Am. Oil Chemists' Soc. 29, 227-28 (1952)

The use of catalytic hydrogenation as a quantitative method for the measurement of total unsaturation in tung oil and related products containing conjugated unsaturation, has been investigated. The

apparatus, which comprises essentially a gas burette, manometer, and reaction vessel, is relatively simple, is constructed entirely of glass, and employs an externally mounted magnetic agitator. The weighed sample and platinum catalyst are suspended in glacial acetic acid during hydrogenation. In the case of tung oil and partially hydrogenated tung oil, heating of the reaction vessel is necessary to complete the hydrogenation. "Hydrogen Iodine Values" representing the total unsaturation in domestic and imported tung oils, alpha- and beta-eleostearic acids, the residual unsaturation in partially hydrogenated tung oils, and the unsaturation of other organic materials are reported. Tung oil and eleostearic acid gave "Hydrogen Iodine Values" of approximately 240 and 271, respectively. Analytical hydrogenation as described is particularly well suited for the determination of unsaturation in conjugated systems.

46. STUDIES ON THE REFRACTIVE INDEX AND DISPERSION OF AMERICAN TUNG OIL.
Holmes, R. L., and Pack, F. C.
J. Am. Oil Chemists' Soc., 25, 163-7 (1948); C. A. 42, 4767 (1948)

The dispersion and n of tung oil are so far above those of other common oils that both are valuable criteria for identification purposes. Mixts. of tung oil with another vegetable oil, except oiticica and other rare conjugated oils, can be analyzed to within 0.5% from n for either the Na or the Hg line if the n of the sep. oils are known. The mixts. can be analyzed from the dispersion to within about 1% of the correct compn. if the dispersions of the sep. oils are known. If the adulterating oil is not known, the adulteration can be more closely estd. from the depression of the dispersion than from the depression of n. When tung oil is bodied by heat the n for the Na and Hg lines and the dispersion fall rapidly and continuously to the point of gelation, but the changes are so similar that no worthwhile addnl. information is obtained by detg. more than one n. The fact that n decreases as viscosity increases suggests the use of the n in controlling the bodying of tung oil. Other things being equal, the n for the Hg line should give more accurate information on tung oil than that for the Na line, because of the greater changes in the n for the Hg line on adulteration or heating. A correlation coeff. of 0.83 was found for n with the diene no. of tung oil. A lower coeff. of correlation was found for n with the I no., but the latter would probably be higher if a more accurate method for the detn. of the I no. of tung oil were available. 23 references. From C. A.

47. A STUDY OF THE ELLIS-JONES MALEIC ANHYDRIDE METHOD AND ITS USE IN TESTING TUNG OIL
McKinney, R. S., Halbrook, N. J., and Rose, W. G.
Oil & Soap 19, 141-3 (1942); C. A. 36, 6360 (1942)

Four tables of results are given. The maleic anhydride value obtained for a mixt. divided by the maleic anhydride value of the tung oil (70.6) gives a fair approximation of the percentage of tung oil in the various mixed samples of tung with linseed or perilla oil. On calcg. from the values obtained, it appears that the presence of 10% of linseed oil in tung oil will lower the maleic anhydride values to 63.8. This value is lower than that of any authentic sample of tung oil. The detn. of maleic anhydride may serve as a means for detecting and roughly estg. adulteration of tung oil. From C. A.

48. THE EFFECT OF HYDROXYL GROUP AND ACETYLATION ON THE APPARENT DIENE VALUES OF SOYBEAN AND VEGETABLE OILS
Bickford, W. G., Dollear, F. C., and Markley, K. S.
Oil & Soap 15, 256-9 (1938); C. A. 33, 421 (1939)

Diene values (D nos.) of 12 org. compds. and 18 oil samples are tabulated. Some of the av. D. nos. by the Ellis 3-hr. reflux toluene method and Kaufmann 20-hr. sealed-tube toluene method, resp., are anthracene 140.3, 140.2 (calcd. 142.5); acetone glycerol 19, 8.6; ethylene glycol 87.5, 57.8; glycerol 79, 53.5; Me ricinoleate 16.6, 3.1; Me acetylricinoleate 2.8, 0.2; a, a'-distearin 0, 0; castor oil (I) 10, 3.2; acetylated I 1.0, 0.2; oiticica oil (II) 56.0, 54.5; acetylated II 51.3, 45.0; tung oil (III) 67, 64.2; acetylated III 62.9, 56.4; extd. soybean oil A (IV) 1.7, 0.7; acetylated IV 16.3, 8.2; edible soybean (V) 0.7, 2.0; and acetylated V 1.8, 6.0. From C. A.

49. A FURTHER STUDY ON THE COMPOSITION OF AMERICAN TUNG OIL WITH SPECIAL REFERENCE TO THE LINOLEIC ACID CONTENT
McKinney, R. S., and Jamieson, G. S.
Oil & Soap 15, 30-2 (1938); C. A. 32, 3173 (1938)

The complete sepn. of eleostearic acid from linoleic acid by the irradiation and crystn. of tung oil fat acids was found almost impossible. The application of several cold alk. permanganate oxidation procedures to samples of tung oil fat acids indicated the presence of less than 1% of linoleic acid. A study of the reaction of maleic anhydride with alpha- and beta-eleostearic acids and with the alpha-eleostearic acid glyceride present in tung oils showed that this reagent does not react with them quantitatively but only to 86.6% of

the theoretical amt. The eleostearic acid content of a tung oil can be calcd. by dividing its diene value by 78.4, the detd. diene value of pure eleostearic acid. By this method 2 samples of American tung oil were found to contain 85.5 and 89.4% of eleostearic acid. Alpha-eleostearic acid and the mixed fat acids from tung oil when exposed to the air quickly undergo a change to form an extremely sticky material whose use as an adhesive for insecticides will soon be detd. From C. A.

50. JAPANESE TUNG OIL
McKinney, R. S., and Jamieson, G. S.
Oil & Soap 14, 2-3 (1937); Brit Chem. Abstracts 1937, B, 940

The kernels formed 63.9% of the seeds of Aleurites cordata and contained 67.5% of oil. The expressed oil, which did not gel in the Browne heat test, but solidified on treatment with $SbCl_3$ in $CHCl_3$, had d_{25}^{25} 0.9313, n^{25} 1.5059, acid val. 0.6, sap. val. 190-2, I val. (Rosenmund-Kuhnhenn, 1/2 hr.) 145.2, SCN val. 80.9, saponifiable matter (I val. 105.5) 0.57%. The oil contains about 70.5% of eleostearic acids, 18.5% of oleic acid, and 6.2% of saturated acids (Bertram). No evidence of linoleic or linolenic acid could be found. Allowing 1/2 hr. for reaction, the Rosenmund-Kuhnhenn method gives I vals. for the oil or for pure beta-eleostearic acid (I) (viz., 182.4 = 2 double linkings) which are independent of the amount of oil used for the test. the SCN val., 91.2, of pure (I) corresponds with one double linking. From Brit. Chem. Abstracts.

51. THE COMPOSITION OF AMERICAN TUNG OIL
McKinney, R. S., and Jamieson, G. S.
Oil & Soap 12, 92-3 (1935); C. A. 29, 4190, 5290 (1935)

The consts. found on a sample of Florida tung oil were: n_{25} 1.5165, sapon. no. 193.6, I no. (Rosenmund-Kuhnhenn) 162.0, I no. (Hanus) corrected 246.9, thiocyanogen no. 82.75, percentage of insol. fat acids 95.4, satd. acids 4.40, unsatd. acids 90.6, unsaponifiable matter 0.47%, I no. of unsaponifiable matter 74.0. The compn. of the oil was: eleostearic acid 72.8, oleic acid 13.6, satd. acids 4.9, volatile substances 3.4, glyceryl radical 4.7 and unsaponifiable matter 0.5%. From C. A. 4190

In C. A. 29, 4190, the compn. of the oil as given is for the figures of van Loon. The percentage in terms of glycerides as found by the authors was: eleostearic acid 94.1, oleic acid 0.8, satd. acids 4.6 and unsaponifiable matter 0.47. From C. A.

52. MATERIALS BALANCE IN A TUNG OIL MILL
Holmes, R. L., Hoffpauir, C. L., McKinney, R. S., and Freeman, A. F.
J. Am. Oil Chemists' Soc. 32, 282-85 (1955)

This is a report of a materials balance study made in a commercial tung mill under normal operating conditions. The object was to establish a method of making a materials balance test as a check on methods of analysis of tung products for oil, and to determine the location and extend of oil losses. Results indicate that methods of analysis and sampling were accurate. Losses were found to occur principally in particles of kernel occluded to hulls, and in screw-press cake. Repressing filter-press cake by adding it back to ground nuts entering the press was not proved to be economical. Screw-press cake should be analyzed for oil as soon as possible after extrusion for accurate results.

53. SOLVENT EXTRACTION METHODS STUDIED
Molaison, L. J., Wellborn, W. A., and D'Aquin, E. L.
Tung World 6 (11), 8, 9, 14 (1952)

Pilot-plant batch solvent extraction of shell-free tung kernels with commercial hexane yielded a sizeable quantity of light-colored, shell-free, defatted tung meal for use in research on its properties. The oil obtained was very light in color, of good quality, and met the A.S.T.M. specifications for tung oil.

54. EFFECT OF SHELL CONTENT AND STORAGE ON EXPELLING OF TUNG NUTS
Holmes, R. L., and Pack, F. C.
Oil & Soap 23, 314-16 (1946); C. A. 41, 299-300 (1947)

Expeller tests were made on ground tung nuts contg. all of the shell (33%) at the time of hulling and after the nuts had been stored for 1 or 2 months. Comparative tests were also made on material contg. about 24% shell from regular mill operation. One test was made on hand-shelled kernels entirely free from shell. Meal contg. all of the shell not only processed satisfactorily, but the recovery of the oil from such material was somewhat higher than from material contg. about 2/3 of the shell. The amt. of oil expelled per hr. was about the same in both cases. The kernels completely cleaned of shell expelled very inefficiently. In general, with the particular type of expeller used, a considerable amt. of shell in the meal is essential for efficient expelling. Bags of nuts with hulls removed but with shells intact showed no deterioration after 2 months' storage. From C. A.

55. THE APPLICATION OF CONTINUOUS SOLVENT EXTRACTION TO TUNG OIL
Holmes, R. L., and Pack, F. C.
U. S. Dept. Agr., Bur. Agr. Ind. Chem. AIC-116, 16 pp. (1946); C. A. 41, 2588-9 (1947) Processed

The present status of solvent extn. and factors to be considered in adopting this method for tung oil production are presented. Certain problems are indicated that will require future study and solution before a complete solvent-extn. process for tung oil can be developed and recommended. The only solvents for tung oil about which enough is known to permit consideration for operation are the straight-chain-hydrocarbon fractions which boil at 140° to 248° F., and the chlorinated hydrocarbons, dichloro- and trichloroethylene. From C. A.

56. STUDIES IN THE EXPRESSION OF OIL FROM TUNG FRUIT
McKinney, R. S., Halbrook, N. J., and Oglesbee, R. E.
Oil & Soap 21, 353-7 (1944); C. A. 39, 822-3 (1945)

Tests indicate that best results in yield of crude and filtered oil by an expression procedure are obtained with a tung meal contg. 4.2% H_2O and 20% shell. The drying of tung meal with an initial air temp. of 320° F. appears to affect adversely the yield of filtered oil from the expeller process. It was found difficult to obtain efficient oil expression from tung meals contg. filter cake. In one test with this material the resulting press cake was high in oil content, while in another test the crude tung oil contained about twice as much foots as was present in crude tung oil from tung meal contg. no filter cake. The expression of tung oil from a tung meal consisting of ground old tung kernels and tung shell was found difficult. This difficulty appeared to be due partly to the fact that the meal from old kernels will not plasticize under heat and pressure. When these kernels were mixed with new ones no difficulty was experienced. Hulling the moist tung fruit in the grove does not interfere with the expression of the oil of the moist dehulled tung fruits are properly dried before pressing. A process was developed for producing a clear tung oil by treatment of the crude oil with a chem. agent to ppt. certain non-oil constituents in the crude tung oil followed by either pressure filtration or centrifugation. When tung oil filter cake was mixed with an equal amt. of tung press cake, over 98% of the oil could be extd. by petroleum solvents. The amt. of foots in crude tung oil can be detd. by filtering 100 g. of the oil at 80° after stirring for 10 min. at this temp. with 1 g. of diatomaceous filter aid through a steam-jacketed Buchner funnel, taking as the end point the time when the last of the oil is absorbed by the filter paper. The filter cake is weighed and analyzed for oil and moisture. Two tables of results are given. From C. A.

57. SOME VARIATIONS IN SOLVENT-EXTRACTED TUNG OILS RESULTING FROM THE SOLVENTS EMPLOYED

McKinney, R. S., and Oglesbee, R. E.
Proc. Am. Tung Oil Assoc, 1945, 43-7; C. A. 39, 4498 (1945).

Extn. of tung oil with petroleum naphthas on lab. and continuous pilot-plant scales indicates that the source and type of naphtha fraction used may affect the quality of oil recovered. One heptane fraction yielded oil which was solid at room temp., while heptane from another source yielded oil that was almost entirely liquid at ice-box temp. Hexane fractions yield oils liquid at room temp. and solid in the cold. Petroleum-naphtha-extd. tung oils make spar varnishes only slightly inferior to those prepd. from expressed American tung oil. Trichloroethylene as an extractant yields oil of excellent quality. From C. A.

58. EFFECT OF MOISTURE ON GRINDING OF TUNG KERNELS AND SOLVENT EXTRACTION OF MEAL

Freeman, A. F., Pack, F. C., and McKinney, R. S.
Oil & Soap 21, 328-30 (1944); Proc. Am. Tung Oil Assoc. 1944, 43-52; C. A. 39, 432 (1945)

Data are presented to show the effects of moisture on grinding of tung kernels and on solvent extn. of oil from meal. The data indicate that the efficiency of oil extn. can be increased by vacuum drying ground kernels before extn. The state of the comminution obtainable on grinding the kernels is dependent on the moisture content; above 9% moisture the efficiency of grinding and extn. decreases progressively with increase of moisture content. The most efficient grinding is obtained with material of 6 to 9% moisture. In general progressively poorer grinding is obtained on tung kernels with moisture ranging downward from 6%. Six tables of results are given. From C. A.

59. HULLING AND EXPRESSION OF OIL FROM TUNG FRUIT

McKinney, R. S. and Oglesbee, Ruby E.
Proc. Am. Tung Oil Assoc., 1944, pp. 87-97.

Information was given on the hulling of tung fruit in a modified walnut huller and in an experimental tung fruit huller built under the direction of Dr. O. A. Brown of the Tillage Machinery Laboratory, Auburn, Alabama. Tests indicated that hulling the moist tung fruit in the grove will not interfere with the expression of the oil if the dehulled tung fruit are properly dried before pressing. It was found difficult to obtain efficient oil expression from tung meals containing filter cake. The expression of oil from tung meal consisting of ground old tung kernels and shell was found difficult if not impossible. When these kernels were mixed with new kernels no difficulty was experienced in expressing the tung oil from the meal.

60. SOLVENT EXTRACTION OF TUNG OIL
Rose, W. G., Freeman, A. F., and McKinney, R. S.
Ind. Eng. Chem. 34, 612-14 (1942); C. A. 36, 3688 (1942)

Ground tung kernels or tung press cake was extd. in a large lab. extractor (35 lb. capacity). All of the oil (5.36% was extd. from the expeller press cake, but it was necessary to free the marc of solvent, regrind and then re-ext. it to obtain all the oil from the ground tung kernels. The extd. oil isomerized to solid beta-eleostearin, but can be rendered permanently liquid by heating at 200° for 30 min. Heat-treated oil extd. from tung press cake had a viscosity of 6.5 poises, iodine value (Wijs) 145.7, Browne heat test 13 min. and n_D^{25} 1.5097. From C. A.

61. CONTINUOUS PROCESS FOR SOLVENT EXTRACTION OF TUNG OIL
McKinney, R. S., Rose, W. G., and *Kennedy, A. B.
Ind. Eng. Chem. 36, 138-44 (1944); C. A. 38, 1652 (1944)

The Kennedy continuous extractor employed consists of a series of semi-circular sections fitted with perforated paddles to transfer the tung meal being extd. from one section to the next in a direction opposite to the gravity flow of the miscella. Small pilot plant studies gave extn. efficiencies of 99% or better from tung press cake or from tung kernels or seeds prepd. for extn. by attrition grinding, or preferably by the formation of minute flakes in a roller mill. If proper precautions were taken to prevent free fat acid formation, the oil extd. from tung seeds or kernels was of high quality, judged by its characteristics and by exposure tests made on varnishes prepd. from it with phenolic resins. Oil extd. from tung press cake is of poorer quality but is regarded as acceptable to the paint and varnish industry. From C. A.

62. SOLVENTS IN EXTRACTION OF TUNG OIL
Freeman, A. F., Pack, F. C., and McKinney, R. S.
Ind. Eng. Chem. 35, 1156-9 (1943); Proc. Am. Tung Oil Assoc. 1943, 57-61; C. A. 37, 6913 (1943)

Of 33 solvents tried, the following were satisfactory as to b.p. and properties of the extd. oil: hexane, petr. naphthas, cyclohexane, C_6H_6, n-heptane, methylcyclohexane, $CHCl_3$, isopropyl ether and $AcOC_2H_5$.

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* The Wolf Company, Chambersburg, Pennsylvania.

Higher-b. naphthas, $C_6H_5CH_3$ and $C_6H_4(CH_3)_2$ might be used with better solvent-stripping facilities. Halogenated compds. might be used if decompn. of solvent and halogenation of drying oil can be prevented. From C. A.

63. THE PROCESSING OF TUNG FRUIT FOR OIL
McKinney, R. S., and Halbrook, N. J.
Oil & Soap 19, 182-5 (1942); C. A. 37, 271 (1943)

The processing of tung fruit is discussed. Studies made indicate that the loss of oil in processing the fruit can be prevented while the kernels are moist and pliable; but the dehulled tung fruits are then too high in moisture for efficient expression of the oil. Adequate drying equipment for tung meal is the solution. High temps. should be avoided, 205° F. being the max., as beyond this the character of the meal is unfavorable to good oil expression. From C. A.

64. PROBLEMS IN THE FIELD OF TUNG-OIL EXTRACTION
McKinney, R. S.
Oil, Paint & Drug Reptr. 140 (4) 5, 33-4 (1941); C. A. 37, 6475-6 (1943)

In the past it has been the practice to allow the tung fruit to dry under the trees before shipping to the mill for dehulling, but widely varying moisture contents result. Various types of dehulling devices for use on the farms have been tested, the best probably being that used in the mills. Drying is a difficult problem, as the method must be cheap and the moisture content must be controlled to give maximum oil yield. Drying in ventilated barns is being tested. Brief reference is made to possibility of solvent extn. of the ground nuts. Many problems remain to be solved. From C. A.

65. TUNG-OIL EXTRACTION BY A SOLVENT PROCESS
Freeman, A. F., and McKinney, R. S.
Proc. Am. Tung Oil Assoc. 1941, 38; Oil, Paint & Drug Reptr. 140, (5) 5, 38, 45 (1941); C. A. 37, 6476 (1943)

Com. tung oil is now produced entirely by pressing, but higher yields can be secured by solvent extn. Pilot-plant tests (batch) indicated that oil yields were reduced by channeling when the ground kernel was extd. This could be remedied by using alternate layers of ground kernel and coarse gravel in the extractor, thus securing 98.3% oil removal. Similar efficiency of oil removal was secured with unground press cake, but ground press cake also gave trouble with channeling.

Extraction

The best solvents appeared to be a hexane fraction boiling from 63 to 70° and a petroleum fraction boiling from 54 to 71°. A heptane fraction was satisfactory but difficult to remove. Vacuum removal of solvent appeared to be satisfactory. The solid oil produced by this process can be permanently liquefied by heating at 250° for 30 min. From C. A.

Properties
and
Utilization
Investigations

66. NEW TUNG OIL DERIVATIVES
Hoffmann, J. S., and Bickford, W. G.
ARS-72-7, 16 pp. Processed. December 1956.

To extend the utilization of tung oil and improve its economic status, chemists at the Southern Regional Research Laboratory are engaged in research on the development of new chemical derivatives of the oil which may find application as specialty products. The chief constituent of tung oil is the glyceride of alpha-eleostearic acid, a straight chain 18-carbon fatty acid that contains a special arrangement of alternating single and double bonds known as a conjugated triene system. Alpha-tung oil or its component alpha-eleostearic acid may be readily converted to the beta-isomer, which also contains a conjugated triene system. These very active systems of double bonds react in a readily predictable fashion with a great number of different organic compounds, referred to as dienophiles, by what is known as the Diels-Alder Reaction. This particular reaction has been used to advantage in preparing new chemical derivatives of tung oil for use in the manufacture of plastics. This paper describes the isomerization of alpha to beta tung oil, preparation and determination of the chemical structures of highly pure eleostearic acids, alcoholysis of tung oil for the production of various esters, the reactions of these materials with maleic anhydride, beta-propiolactone, acrylonitrile, and fumaronitrile as dienophiles, and the results obtained on testing the ester adducts as plasticizers for vinyl resins.

67. REACTION OF METHYL ALPHA-ELEOSTEARATE WITH MERCURIC ACETATE
Planck, R. W., O'Connor, R. T., and Goldblatt, L. A.
J. Am. Oil Chemists' Soc. 33, 350-53. (1956)

Methyl alpha-eleostearate has been reacted with mercuric acetate in acetic acid solution. Carrying out the reaction below room temperature gave products having the highest mercury content. Even these products were relatively unstable, gradually decomposing to produce mercury or mercurous acetate or both at room temperature. A typical product obtained at 10°C. is a viscous, pale yellow oil, insoluble in petroleum ether but soluble in alcohol, ether, and chloroform.

Each C_{18} chain contained, on the average 1.4 acetoxymercuri-groups (CH_3COOHg—), 1.5 acetoxyl groups attached directly to the carbon chain and 0.4 double bonds. For each mole of mercuric acetate added to the methyl eleostearate approximately one mole of mercuric acetate was reduced to mercurous acetate and a double bond in the ester chain was oxidized to an oxygen-containing group of undetermined structure. Treatment of the acetoxymercuri-, acetoxy-ester with aqueous chlorides or bases yielded the corresponding chloromercuri- or hydroxymercuri-derivative. Refluxing the acetoxymercuri-, acetoxy-ester in alcoholic potassium hydroxide saponified all the ester linkages and removed the acetoxymercuri-groups with the formation of an equal number of double bonds, most of which are present in conjugated trans-trans systems. The Marvel-Rands chromatographic procedure was modified to permit determination of total acetoxyl groups and of acetoxyl groups attached to mercury atoms. Acetoxyl groups of the latter kind can also be determined by direct titration with standard base.

68. NEW AND IMPROVED SURFACE COATINGS USING TUNG OIL
Goldblatt, L. A., and *Hopper, L. L., Jr.
Am. Tung News, 7 (10), 6-8 (1956)

Possibilities of new and improved surface coatings utilizing tung oil, tung oil fatty acids, or other tung oil derivatives, are being investigated. Progress has been made along several lines. These include: (1) The use of zinc resinate to retard gelation, making it safer and more convenient to use tung oil in numerous formulations, a procedure being evaluated for commercial use. (2) Utilization of the great reactivity of tung oil to introduce nondrying but potentially fungicidal acids such as propionic or undecylenic in protective coatings to provide built-in resistance to fungi. (3) Preparation and evaluation of a series of vehicles made from commercial epoxy resins and tung oil fatty acids and other long chain fatty acids such as those derived from tall oil or dehydrated castor oil. (4) Development of a vehicle containing tung oil and safflower oil for use in exterior house paints.

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* Fellow, National Tung Oil Marketing Cooperative, Inc,

69. THE REACTION OF ACRYLONITRILE AND FUMARONITRILE WITH ALPHA- AND BETA-ELEOSTEARATES. PLASTICIZER PROPERTIES OF THE n-BUTYL ESTERS OF THE ADDUCTS

Hoffmann, J. S., O'Connor, R. T., Magne, F. C., and Bickford, W. G.
J. Am. Oil Chemists' Soc. 33, 410-14 (1956)

Acrylonitrile and fumaronitrile have been employed as dienophiles in the Diels-Alder reaction with butyl alpha- and beta-eleostearates, and infrared and ultraviolet spectra determined for the addition product as well as for the dienophiles.

The adducts have been tested as primary plasticizers for vinyl resins and compared with dioctyl phthalate. The fumaronitrile adducts were found to be superior to the acrylonitrile adducts with regard to compatibility, although the acrylonitrile adducts are satisfactory when employed as secondary plasticizers in conjunction with tricresyl phosphate. The plastics containing the acrylonitrile adducts were found to excel those containing the fumaronitrile adducts in modulus and brittle point.

70. NEW TUNG OIL DERIVATIVES

Hoffmann, J. S., and Bickford, W. G.
(IN PRESS) ARS-72-7

In order to extend the utilization of tung oil and improve its economic status, chemists at the Southern Regional Research Laboratory are engaged in research on the development of new chemical derivatives of the oil which may find application as specialty products. The chief constituent of tung oil is the glyceride of alpha-eleostearic acid, a straight chain 18-carbon fatty acid which contains a special arrangement of alternating single and double bonds known as a conjugated triene system. Alpha-tung oil or its component alpha-eleostearic acid may be readily converted to the beta-isomer, which also contains a conjugated triene system. These very active systems of double bonds react in a readily predictable fashion with a great number of different organic compounds, referred to as dienophiles, by what is known as the Diels-Alder Reaction. Advantage has been taken of this particular reaction in preparing new chemical derivatives of tung oil for use in the manufacture of plastics. This paper describes the isomerization of alpha to beta tung oil, preparation and determination of the chemical structures of highly pure eleostearic acids, alcoholysis of tung oil for the production of various esters, the reactions of these materials with maleic anhydride, beta-propiolactone, acrylonitrile and fumaronitrile as dienophiles, and the results obtained on testing the ester adducts as plasticizers for vinyl resins.

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71. A SIMPLIFIED METHOD FOR THE PREPARATION OF ALPHA- and BETA-ELEOSTEARIC ACIDS AND A REVISED SPECTROPHOTOMETRIC PROCEDURE FOR THEIR DETERMINATION
Hoffmann, J. S., O'Connor, R. T., Heinzelman, D. C., and Bickford, W. G.
(IN PRESS) (Submitted to J. Am. Oil Chemists' Soc.)

Simplified methods for the preparation of pure alpha- and beta-eleostearic acids are described. These procedures involve saponification of alpha- and beta-tung oils under mild conditions, followed by direct crystallization of the liberated acids at -20° from ethanolic solution. Only one recrystallization from ethanolic solution at +5° was required to produce the pure acids.

Absorptivities obtained from measurements of the ultraviolet absorption revealed an alpha-eleostearic acid of about 7% higher purity than had heretofore been obtained. This has necessitated a revision of the equations used in the ultraviolet procedure for the simultaneous determination of the alpha- and beta-isomers. Equations for the determination of each isomer from both cyclohexane and ethanol are reported. Equations are also given for an independent determination of total eleostearic acid, and for the determination of one isomer in the absence of the other. Infrared absorption spectra in the rock salt region from 2-15 microns have been measured from potassium bromide discs. These solid-state or crystalline spectra reveal, in addition to the prominent bands assigned to characteristic groupings of the eleostearic acid molecule, the progression bands by means of which carbon chain length can be computed.

72. THE PREPARATION OF EPOXY RESIN ESTERS CONTAINING TUNG OIL FATTY ACIDS
Goldblatt, L. A., and *Hopper, L. L., Jr.
Presented at 130th Meeting, Atlantic City, N. J., Sept. 1956.
Am. Chem. Soc., Div. of Paint, Plastics, and Printing Ink Chemistry, Papers 16(2), 229-232 (Sept. 1956)

Development of methods for incorporating tung oil fatty acids in epoxy resin esters is reported. The usual cooking procedures or schedules normally used for preparing epoxy esters of long chain

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* Fellow, National Tung Oil Marketing Cooperative, Inc.

acids cannot be used with tung oil fatty acids because gelation occurs while the acid value is still quite high, and the products would generally not be gasproof. Epoxy resin-tung oil fatty acid esters of rather low acid value can be prepared by replacing part of the tung oil fatty acids with less reactive long chain fatty acids and use of a two-stage cooking procedure. Use of zinc resinate facilitates preparation of such esters of low acid value. Tung oil methyl esters may also be used with zinc resinate to produce epoxy resin esters of low acid value and good pigment wetting properties. The products have properties similar to epoxy resin esters of other long chain fatty acids but retain about two thirds of the triene conjugation present in the tung oil fatty acids used. Preliminary evaluation indicates that the epoxy resin esters incorporating tung oil fatty acids are useful for the same general purpose as the esters of other long chain fatty acids. They dry very rapidly to give extremely hard finishes but lack the flexibility and are darker in color than similar formulations with dehydrated castor fatty acids. Replacement of some of the long chain fatty acids with potentially fungicidal acids, such as propione acid imparts some fungicidal activity.

73. THE REACTION OF BETA-PROPIOLACTONE WITH ALPHA- and BETA-ELEOSTEARATES AND PLASTICIZER PROPERTIES OF DERIVED ESTERS

Hoffmann, J. S., O'Connor, R. T., Magne, F. C., and Bickford, W. G. J. Am. Oil Chemists' Soc. 32, 533-38 (1955)

Beta-propiolactone has been employed as the dienophile component in the Diels-Alder reaction with alpha- and beta-eleostearates. The ethyl and n-butyl esters of the mixed fatty acids of alpha- and beta-tung oil, containing about 75% eleostearates, were reacted with beta-propiolactone at 200° for a period of 1.5 hours. Spectral analyses indicated nearly quantitative conversion of the reactants to the expected Diels-Alder products. The adducts were esterified in their reaction mixtures with the appropriate alcohols to produce the corresponding di-esters. Fractional crystallization of the free dicarboxylic acids, yielded isomers melting at 113° and 85°. These isomers differ only in the position of the carboxyl group on the cyclohexene nucleus of the adduct. The di-ethyl and di-butyl esters of both the alpha- and beta-eleostearic acid adducts and their hydrogenated derivatives were intercompared as primary plasticizers for vinyl type resins. The hydrogenated di-esters of the beta-eleostearic acid adducts were found to be the most effective.

74. THE EFFECT OF EXTENDED STORAGE ON THE PROPERTIES OF TUNG OIL
Holmes, R. L., and Pack, F. C.
J. Am. Oil Chemists' Soc. 31, 96-98 (1954)

A controlled storage experiment was designed to gather data that would support or negate some generalizations that tung oil is difficult to store, and similar statements in the literature. Tung oil stored in clean, well-filled gallon containers at the end of 3 years still met ASTM specifications. Storage locale (indoor, outdoor, sheltered, or unsheltered containers) and the coating on containers were less important than protection of the stored oil from atmospheric oxygen. The most pronounced effect of prolonged storage on tung oil is a shortening of the heat test (gel time at 282°). Uncontaminated tung oil does not spontaneously isomerize during storage.

75. THE PHYSICAL AND CHEMICAL CHARACTERISTICS OF COMMERCIAL TUNG OILS
Holmes, R. L., Pack, F. C., Minor, J. C., and McKinney, R. S.
Proc. Am. Tung Oil Assoc. 1953, 56-61
Also published under title: THE CHARACTERISTICS OF DOMESTIC TUNG OILS
J. Am. Oil Chemists' Soc. 31, 417-18 (1954)

Information on the variation in the physical and chemical characteristics of commercial tung oils has been sought to provide the industry with a means of evaluating effects of processing conditions on quality of oil, and perhaps enable improvement in quality by modification of methods of processing. Characteristics that depend upon the eleostearic acid content -- heat test; refractive index; dispersion; and hydrogen iodine value -- were investigated on 116 samples of tung oil (86 from domestic and 30 from foreign mills). Averages on 74 domestic screw-pressed are: total eleostearic acid, 78.7% (the alpha form 77.7%; and the beta form, 1.2%); refractive index at 25°, 1.5174; acid value 1.0; heat test, 11.8 minutes; Wijs iodine number, 162.2; specific gravity 25°/25°, 0.9364; viscosity, at 25°, stokes 2.2 poises; unsaponifiable matter, 0.38%; volatile matter 0.07%; saponification value, 192.0.

76. THE INFRARED SPECTRA AND THE STRUCTURAL RELATIONSHIPS BETWEEN ALPHA- AND BETA-ELEOSTEARIC ACIDS AND THEIR MALEIC ANHYDRIDE ADDUCTS
Bickford, W. G., DuPre', E. F., Mack, C. H., and O'Connor, R. T.
J. Am. Oil Chemists' Soc. 30, 376-81 (1953)

Evidence for the existence of two maleic anhydride adducts of beta-eleostearic acid is presented. The structure of alpha- and beta-eleostearic acids are verified (through the interpretation of data obtained by infrared spectroscopy as well as chemical means). The

alpha form is 9-cis, 11-trans, 13-trans octadecatrienoic acid and the beta form is 9-trans, 11-trans, 13-trans octadecatrienoic acid. Complete infrared spectra are presented for authentic samples of alpha- and beta-tung oil, China wood oil, oiticica oil, and alpha- and beta- eleostearic acids.

77. BINARY FREEZING-POINT DIAGRAMS FOR ALPHA- AND BETA-ELEOSTEARIC ACIDS WITH EACH OTHER AND WITH ACETAMIDE

Mod. R. R., Skau, E. L., and Planck, R. W.
J. Am. Oil Chemists' Soc. 30, 368-71 (1953)

Complete binary freezing-point data have been obtained for each of the polymorphic modifications of acetamide with alpha-eleostearic acid and beta-eleostearic acid, and for alpha-eleostearic acid with beta-eleostearic acid. In the light of previously published data the fact that all of these systems are of the simple eutectic type suggests that the tendency of the long-chain fatty acids to form 1:1 molecular compounds with acetamide and with each other decreases as the degree of unsaturation increases. The fact that the heat of fusion of beta-eleostearic acid, 13.2 kcal. per mole, calculated from the freezing-point data is greater than that for the alpha acid, 10,5 kcal. per mole, corroborates the conclusion that the beta acid is the trans-trans-trans modification.

78. A METHOD FOR THE DETERMINATION OF LINOLEIC ACID AND CONJUGATED DIENOIC ACIDS IN MATERIALS CONTAINING ELEOSTEARIC ACIDS

O'Connor, R. T., Heinzelman, D. C., Pack, F. C., and Planck, R. W.
J. Am. Oil Chemists' Soc. 30, 182-86 (1953)

A method based on modification of the equations of Method Cd 7-48 of the American Oil Chemists' Society (limited to "animal and vegetable fats containing only small amounts of preconjugated material,") is presented for determining linoleic acid in materials containing alpha-, beta- and mixtures of alpha and beta-eleostearic acids, oleic acid, and saturated acids. It is limited to samples which do not contain nonconjugated trienoic acids (linolenic) acids. Several mixtures of cottonseed and dehydrated castor oil of known composition, to which varying amounts of alpha- and beta- and mixtures of alpha- and beta-eleostearic acids were added were analyzed by the method. Comparison of these values with those calculated from the known composition of the mixtures showed that the proposed method gives reasonable results. The method has been applied to analyze foreign and domestic tung oils.

79. DILATOMETRIC INVESTIGATIONS OF FATS. VII. MELTING DILATION AND POLYMORPHISM OF AN ALPHA AND BETA TUNG OIL

Singleton, W. S., O'Connor, R. T., Murray, M., and Pack, F. C.
J. Am. Oil Chemists' Soc. 29, 452-54, (1952)

Three polymorphic forms of beta tung oil were established on the basis of their melting points and x-ray diffraction spacings. The interplanar or "d" spacing of each form was calculated from the diffraction lines of the x-ray photographs. The expansibilities of an alpha tung oil and the three polymorphic forms of the beta oil were determined for both the solid and liquid states, and the melting dilations were calculated. The absolute densities of the alpha and beta tung oils were determined, and the absolute specific volumes of all samples at several temperatures over the range of melting were calculated and graphically recorded.

80. THERMAL PROPERTIES OF FATS AND OILS. VIII. SPECIFIC HEATS, HEATS OF FUSION, AND ENTROPY OF ALPHA AND BETA TUNG OILS

Ward, T. L., Singleton, W. S., and Planck, R. W.
J. Am. Oil Chemists' Soc. 29, 155-57 (1952)

Three different melting points of the beta tung oil were observed, each dependent upon the rate of cooling. Equations were developed to express in cals./g./°C. the specific heats of the stable forms of tung oil.

Alpha tung oil	
Solid state (-184° to -43°C.)	$C_p = 0.404 + 0.001\ t$
Liquid state(9° to 80°C.)	$C_p = 0.463 + 0.0011\ t$
Beta tung oil	
Solid state (-178° to 27°C.)	$C_p = 0.390 + 0.0013\ t$
Liquid state(67° to 87°C.)	$C_p = 0.489 + 0.00016\ t$

The liquid glycerides present at any temperature in the melting range were estimated from the data for the heat contents of the oils. The rate of liquid phase formation at constant heat input of both alpha and beta tung oils, unlike that of cottonseed and peanut oils, increased sharply during the final 10° of the interval owing to the greater homogeneity of the glycerides of the former.

81. STABILITY OF ELEOSTEARIC ACID DURING STORAGE

Planck, R. W., Pack, F. C., and Heinzelman, D. C.
Proc. Am. Tung Oil Assoc. 1950, 37-46

Samples of freshly-prepared alpha- and beta-eleostearic acids have been stored under varying conditions of temperature, light, air and solvents and the amounts of unchanged eleostearic acid determined by spectro-

photometric examination. Exposure of the dry crystalline acids to the air at temperatures from 4° to 35° resulted in their conversion into viscous liquid products only partially soluble in cyclohexane. Storage at 4° improved the stability of the alpha-eleostearic acid exposed to air. The beta-isomer was quite stable under these conditions. No measurable changes occurred in the alpha-acid when stored at -40° in the presence of air. The influence of light on either acid is relatively slight. Samples stored in evacuated ampoules in the presence or absence of light at temperatures from -40° to 35° were quite stable. Beta-eleostearic acid, made into pastes with ethanol and stored in completely filled containers, generally was stable both in the presence and absence of light at temperatures from 4° to 35°. Ethanol solutions of alpha-eleostearic acid refluxed for one hour and beta-eleostearic acid refluxed for 23 hours showed no change in composition. Summary by authors.

82. THE SPECTROPHOTOMETRIC DETERMINATION OF THE ALPHA- AND BETA-ISOMERS OF ELEOSTEARIC ACID IN TUNG OIL

O'Connor, R. T., Heinzelmann, D. C., McKinney, R. S., and Pack, F. C. J. Am. Oil Chemists' Soc. 24, 212-16 (1947); C. A. 41, 4931 (1947)

The presence of beta-eleostearin in tung oil interferes with the spectrophotometric detn. of alpha-eleostearic acid. Cyclohexane was used as the solvent for the detn. of extinction coeffs. for the alpha- and beta-isomers obtained from tung oil. Absorption measurements were made with a Beckman quartz spectrophotometer with 1-cm. cells contg. portions of the freshly prepd. acids dissolved in the solvent and dild. to approx. 0.005 g. per l. Optical ds. were measured every 0.5 mu from 265 to 280 mu and the corresponding extinction coeffs. calcd. from the Bouger-Beer law equation. Absorption curves of the 2 pure isomers and fresh and irradiated tung oil show the differences between the isomers are not great. The method of binary analysis by spectrophotometric measurement consists simply of making measurements at 2 different wave-length positions and solving 2 Bouger-Beer law equations simultaneously. The percentage of the distribution of the alpha- and beta-eleostearic acids of tung oil and the complete absorption curves of each being available, an absorption curve based on the analytically detd. percentage compn. and the value of the extinction coeffs. of the pure components at each wave length throughout the spectrum can be calcd. If against such a curve the actual curve of the tung oil is plotted, the 2 curves will be identical, provided the percentage compns. have been correctly distributed between the 2 absorbing components. Repeated detns. of alpha- and beta-eleostearic acids in tung oil show that a reproducibility of within about 1% is attainable. Sample 1: Alpha, 47 to 48%; Beta, 24 to 25.5%. Sample 2: Alpha, 49.1 to 50.3%; Beta, 24.8 to 25.9%. From C. A.

83. THE TIME REQUIRED FOR THE GELATION OF TUNG OIL AT DIFFERENT TEMPERATURES
Pack, F. C., and Holmes, R. L.
Proc. Am. Tung Oil Assoc. 1947, Pt. I, 21-3; C. A. 42, 386 (1948)

Gelling tests with a good grade American tung oil indicate that gelation takes place by heating with a steam coil at 80 lbs. pressure/sq. in. for 24 hrs. or for 12 hrs. at 140 lb./sq. in. From C. A.

84. PREPARATION OF TUNG OIL-PHENOLIC RESIN VARNISHES
McKinney, R. S., and Morris, N. J.
Proc. Am. Tung Oil Assoc. 1947, 18-20

Studies were made of methods for preparing short-, medium-, and long-oil varnishes from phenolic resin and straight tung oil and from phenolic resin and mixtures of tung oil and linseed oil. These studies have indicated that, because of the reactivity of American tung oil, special care must be employed in using it in the preparation of straight phenolic resin varnishes. The results of tests on these varnishes indicate that long-, medium-, and short-oil varnishes prepared from phenolic resin and tung oil gave films that were much more resistant to the passage of water than did varnishes of equivalent oil length made with both tung oil and linseed oil, that the use of linseed oil in combination with tung oil reduced the alkali resistance of the films, and that short-oil varnishes prepared from phenolic resin and straight tung oil or a 50:50 mixture of tung oil and linseed oil yielded films that were brittle and lacking in elasticity. From the Summary of the article.

85. SPECTROPHOTOMETRIC DETERMINATION OF ALPHA-ELEOSTEARIC ACID IN FRESHLY EXTRACTED TUNG OIL DETERMINATION OF EXTINCTION COEFFICIENTS IN OIL SOLVENTS
O'Connor, R. T., Henzelman, D. C., Freeman, A. F., and Pack, F. C.
Ind. Eng. Chem., Anal. Ed. 17, 467-70 (1945); C. A. 39, 4498 (1945)

The characteristic absorption in the ultraviolet of the triene conjugation of alpha-eleostearic acid provides a rapid means for its detn. in freshly extd. tung oil. The optical d., E, of a soln. of approx. 0.005 g. per l. of tung oil is detd. with the Beckman spectrophotometer at the point of max. absorption, 271 mu in cyclohexane and 270 mu in isooctane. Percentage of alpha-eleostearic acid = (E/alpha)(100/cl) where alpha is the extinction coeff. (av. 168.6 in cyclohexane and 169.8 in isooctane), c is the concn. of tung oil in g. per l, and l is the length of the cell in cm. About 4% adulterant in tung oil can be detected by this method. Extinction coeffs. of pure alpha-eleostearic acid were measured in EtOH, cyclohexane, isooctane, and heptane. Previous discrepancies in the value of the extinction coeff. are explained by changes which take place in the acid on storage. From C. A.

86. EFFECT OF FERTILIZERS ON OIL CONTENT OF TUNG FRUITS
*Potter, G. F., *Kilby, W. W., *Bahrt, G. M., Freeman, A. F., Pack, F. C., and McKinney, R. S.
Proc. Am. Tung Oil Assoc. 1943, 38-49

In some cases applications of potassium had an effect of increasing the percentage of oil in the kernels and in the whole fruit. In other experiments no measurable effects were obtained. These variations may be due to variations in the potassium-supplying power of the soils. Tung trees require a high level of available potassium in the soil for normal tree growth and yield of oil. Fertilizing with liberal quantities of potassium is advisable.

87. THE EFFECTS OF ZINC AND OTHER TRACE ELEMENTS ON OIL CONTENT OF TUNG FRUITS
*Bahrt, M., Jones, R., *Angelo, E., Freeman, A. F., Pack, F. C., and McKinney, R. S.
Proc. 10th Ann. Convention Am. Tung Oil Assoc. and United Tung Growers' Assoc. 1944, 98-101; C. A. 39, 2611 (1945)

Soil applications of 100 lb. per acre of $ZnSO_4$ in 2 tung orchards increased the oil content of tung fruit from approx. 19.5 to 20.5% even though there were no typical Zn-deficiency symptoms present. In 2 other orchards no significant increase in oil content was obtained with the $ZnSO_4$ treatment. Fruit from plots treated with salts of Ba, Co, Cu, Mg, B, V, and Mn at different locations showed no significant differences in oil content. From C. A.

P A T E N T S

88. INORGANIC IODIDE CATALYZED TUNG OIL ISOMERIZATION
Pack, F. C., and Planck, R. W.
U. S. Pat. No. 2,760,968. (August 28, 1956)

A process for inducing, by the addition of catalytic amounts of inorganic iodides (which may be removed after a short contact time), a rapid cis to trans isomerization of alpha-eleostearates to beta-eleostearates.

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* Division of Fruit & Vegetable Crops, Bureau of Plant Industry, Soils, and Agricultural Engineering, USDA.

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The isomerization process finds utility in the exploitation of the dissimilar physical and chemical properties of the eleostearates (alpha and beta).

89. ALKYL IODIDE CATALYZED TUNG OIL ISOMERIZATION
Goldblatt, L. A.
U. S. Pat. No. 2,744,123 (May 1, 1956)

A process for isomerizing alpha-eleostearates to beta-eleostearates by use of catalytic amounts of alkyl iodides.

90. TREATED TUNG OIL
McKinney, R. S.; Rose, W. G.; and Freeman, A. F.
U. S. Pat. No. 2,277,342 (March 24, 1942); C. A. 36, 5039 (1942)

A clear oil is prepd. by subjecting a "petr. ether" solvent-extd. tung oil to a temp. of at least 200° for about 30 min. From C. A.

91. ALKALOID COMPOUND
McKinney, R. S.
U. S. 2,139,839 (Dec. 13, 1938); C. A. 33, 2285 (1939)

Fatty acids derived from drying oils such as tung, linseed, fish or soybean oil, by reaction with alkaloids such as nicotine, quinine, or strychnine (suitably in a common solvent such as EtOH), form water-insol. compds., the nicotine compds. being suitable for insecticidal use, the strychnine compds. for poisoning predatory animals or as a medicine, and the quinine compds. for use as the free alkaloid, especially for use in antisunburn ointments. From C. A.

92. ADHESIVES
McKinney, R. S.
U. S. Pat. No. 2,104,491 (Jan. 4, 1938); C. A. 32, 1856 (1938)

Alpha-eleostearic acid may be used with materials such as those applied to vegetable growths. From C. A.

GENERAL

93. REVIEW OF RESEARCH ON TUNG OIL AND MEAL AT SURB.
Altschul, A. M.
Am. Tung News 6(12), 10-11 (1955)

Although tung production is presently at a low level, research is being continued in preparation for the time when production returns to normal. This research is along four lines: fundamental studies on the chemistry of major constituents of tung oil; new formulations; incorporation in polyester resins, and detoxification of tung meal. Progress on each of these lines of research, and prospective advantages for the tung industry are discussed briefly.

94. CHEMICAL RESEARCH ON TUNG OIL
Dollear, F. G., and Altschul, A. M.
Proc. Am. Tung Oil Assoc. 1954, 15-17

This is a resume of research being done by the Southern Utilization Research Branch on tung products. Trends in uses of drying oils are being surveyed by the Battelle Memorial Institute under contract. Research is being carried out on fatty acids of tung oil for use in alkyd resins. Some derivatives of tung oil and its fatty acids have been made, and it is thought they might be useful in polyester resins, protective coatings, or agricultural chemicals. Another possible new use for tung oil is in the polyesters. Work on toxic materials in tung meal has continued. Samples of tung oil and alpha and beta eleostearic acid are still being sent out for pharmaceutical testing. Perhaps the most pleasing development of the year has been in the field of industry-research relations, with close cooperation throughout.

95. OILSEED RESEARCH AT SRRL: A PROGRESS REPORT
Kime, J. A.
Oil Mill Gaz. 59(2), 34-37(1954)

The major emphasis in oilseed research is on cottonseed, but research is underway also on peanuts, tung, and minor oil-bearing substances such as sesame and rice bran. Major lines of research on cottonseed have been as follows: Composition and properties of seed, as affected by environment and variety; laboratory-scale investigations of cooking; cooperative program to extend use of meal into poultry and swine feeds; development of laboratory test to measure nutritive value of meal; production of lighter-colored oils; development of aceto and other modified glycerides for food and nonfood use; new industrial products from cottonseed oil fatty acids; technical assistance to the industry in the commercial application of the filtration-extraction process; processing research to improve hydraulic and screw pressing methods, and improvement in methods of cleaning cottonseed and linters at oil mills. The major effort is on problems associated with food utilization of peanuts: Fundamental study of the constituents involved in staling. Optimum conditions for the production of high-quality peanut butter have been established. Development of new methods of utilizing tung oil in protective coatings and of new industrial products based on the unique structure of tung oil fatty acids is sought.

96. WHAT CAN CHEMICAL RESEARCH DO FOR TUNG OIL?
Dollear, F. G.
Ann. Proc. Am. Tung. Oil Assoc. 1953, 62-66 (1954)

Tung oil offers possibilities for combination with many other chemical compounds to form new materials of potential value. The conjugated unsaturation of tung oil renders it reactive with organic compounds

such as butadiene, quinones, maleic anhydride, acrolein, cyclopentadiene, and dimethyl cyclopentadiene, through a Diels-Alder type reaction. The ester group of the glyceride molecule allows ester interchange reactions with other alcohols, acids, or esters. For example, tung oil might be combined with glycols, starch, cellulose, fatty acids from other oils. Some research has been done on these types of compounds. Data on properties, reactions during heat bodying, methods of chemical modification of tung oil would be quickly applied by industry to the development of new products. Promising outlets for tung oil derivatives are in plastics and plasticizers and biologically active chemicals.

97. RESEARCH IN THE BUREAU OF AGRICULTURAL AND INDUSTRIAL CHEMISTRY ON UTILIZATION OF TUNG
Freeman, A. F.
Ann. Proc. Am. Tung Oil Assoc. 1953, 52-55 (1954)

Current and future research by this Laboratory on the utilization of tung is reviewed. Decreased use of tung oil for manufacture of protective coatings has forced emphasis on chemistry of the fatty acids as an approach towards developing new uses in the oil -- their beneficial properties, etc., but research will be done also to determine a materials balance in mill operations, and on production of tung press cake suitable for use as a feed. Work to date has established the chemical structures of the alpha- and beta-eleostearic acids (about 75-80% of tung oil). Various chemical modifications of tung oil have been made and are being tested. Progress has been made in preparing mercury derivatives of eleostearic acid, and the usefulness of such compounds is to be tested. Improvements in processing have resulted from previous research, and analytical methods have been developed, including determinations of oil, moisture, eleostearic acids; total unsaturation.

98. TUNG OIL REVIEW, 1951-1952
Planck, R. W.
J. Am. Oil Chemists' Soc. 30, 587-91 (1953)

During 1951 and 1952 more than 250 books, articles, and patents dealing with the chemistry and technology of tung oil and other tung products appeared in the technical and trade literature. Information culled from 205 of these sources comprises this review.

99. BROAD ASPECTS OF TUNG UTILIZATION RESEARCH
Altschul, A. M., and Freeman, A. F.
Proc. Am. Tung Oil Assoc. 1952, 49-54

Processing research is needed on mill analyses for materials balance of oil throughout processing; processing procedures to increase the yield of oil; means to reduce costs; and methods of preventing or minimizing deterioration of stored fruit and stored hulled fruit.

Utilization research is needed on improved methods of compounding tung oil in final products, to aid its competitive position in the protective-coating industry; data on tung oil and its fatty acids, to lead to new uses which would take full advantage of the chemical structure of its unique constituent, eleostearic acid; identification of the minor constituents of tung oil, to reveal, possibly, valuable products for industrial or pharmaceutical purposes; and the development of new and improved uses for the hulls and meal.

100. SCIENTISTS REVIEW USDA'S TUNG PRODUCTS RESEARCH. FIND OPPORTUNITY FOR INVESTIGATION OF NEW TUNG PRODUCTS "ALMOST UNLIMITED". SAY ECONOMIC FACTORS WILL GOVERN DEVELOPMENTS
Dollear, F. G., and Altschul, A. M.
Tung World. 6(11), 6,7,13,14(1952)

Accomplishments and progress being made in research on tung at this Laboratory and at its field station, the U. S. Tung Oil Laboratory, are reported. The work is directed toward greater use of tung products through improvements in methods of processing and handling, improvements of the properties of the oil and meal, and the development of new or expanded outlets. Some of the research is intended to be of immediate, practical benefit to the industry, some is fundamental research, intended to solve long-range problems.

101. VEGETABLE OILS' RISING PRESTIGE
Markley, K. S.
Southwest Report 4(4), 10-11, (1952) (Condensation of a talk made at the Southwest Regional Meeting, Amer. Chem. Soc., Austin, Texas, December 1951, as winner of the 1951 Southwest Regional Award.)

The following crops account for about 90 percent of all the vegetable oils of commerce: Coconut, peanuts, cottonseed, soybean, rape, mustard, linseed, olive, palm, sesame, sunflower, palm kernel, tung, and babassu. Production statistics are given for each of these materials. Research to realize the potentialities of sesame seed is mentioned.

102. RESEARCH INVESTIGATIONS OF U. S. TUNG OIL LABORATORIES
McKinney, R. S.
Cotton Gin and Oil Mill Press. 52(12), 16, 18, 36, 38 (1951)
Tung World. 6(4), 10-11, 15, 17, 19-20, 22. (1951)

This article reviews briefly the development of the American tung oil industry and the contributions of the U. S. Tung Oil Laboratory from 1939 to 1950 that led to solving some of the problems facing a new industry based on an exotic and unknown crop. These contributions

embrace the whole gamut of problems from harvested fruit to the crude oil and its byproducts, and include drying, storage, and analysis of the fruit; hulling, storage and milling of the seed; analysis and evaluation of the oil; analysis and utilization of byproducts, and various related activities.

103. CURRENT RESEARCH ON TUNG OIL AT THE SOUTHERN REGIONAL RESEARCH LABORATORY
Planck, R. W., and Pack, F. C.
Proc. Am. Tung Oil Assoc. 1951, 28-31

Research on tung oil is being carried out on the modification of tung oil by hydrogenation and by interesterification with other drying oils. In order to analyze partially hydrogenated tung oils modifications have been made in existing methods for (1) the measurement of total unsaturation by quantitative hydrogenation and (2) the spectrophotometric determination of polyunsaturated acids. Measurements of specific heats from -175° to 76° (-283.0 to 168.8° F.), heats of fusion, and other thermal properties were carried out on both normal (alpha) and on isomerized (beta) tung oils to furnish thermodynamic data for use in studying the isomerization reaction. Physical and chemical constants have been measured on a variety of domestic and imported tung oils.

104. THE DOMESTIC TUNG-OIL INDUSTRY
McKinney, R. S., and Holmes, R. L.
U. S. Dept. Agr. Ybk. "Crops in Peace and War," 1950-51, 584-591

The history of the development of the production and processing of the fruit of the tung tree is reviewed. Methods of drying and hulling the fruit and for expressing the oil are described. The marketing of the fruit and the analytical procedures used to determine the percentage of its oil content are discussed. The uses of tung oil and the by-products of tung oil production, tung hulls and tung press-cake meal, are listed. Studies of the chemistry of tung oil and some methods developed for determining its constituents are reported.

105. TUNG INDUSTRY BEGAN 50 YEARS AGO
McKinney, R. S.
Tung World 6 (4), 10-11, 15, 17, 19-20, 22 (Sept. 1951), 6 (5), 14-15 (Oct. 1951)

The author reviews achievements in tung research accomplished by the Bur. of Agricultural and Industrial Chemistry from 1938-1951. Investigations were made on the drying and storage of fruit and seeds, mechanical expression of oil, solvent extraction of oil, sampling and analysis of fruit, chemistry of tung oil, utilization of tung oil in paints and varnishes, utilization of tung press cake meal, and the utilization of tung hulls. 42 references.

GENERAL

106. VEGETABLE OIL CROPS AS FOOD, FEED, AND INDUSTRIAL RAW MATERIALS
Markley, K. S.
Cotton Gin and Oil Mill Press 52 (11), 18-21, 47-53 (May 26, 1951)

The major vegetable oil crops of the world are reviewed with information on their production, on the extraction, properties and uses of the oils obtained from them, and on the value and uses of their byproducts. These include soybeans, cotton, peanut, corn, olives, coconut, oil palms, flax, tung, and castor seed. Tung oil, obtained from the fruit of Aleurites fordii and A. montana, has been produced in China since the 12th century. Plantings on a commercial scale, started in the United States about 1923, have increased producing about 11,000 tons of oil in 1949. Plantings in Argentina, Brazil, and Paraguay have also been successful. By 1952, Argentina alone is expected to produce 30,000 tons of tung oil. The surplus from Latin America is finding a ready market in the United States where it is used in varnishes, electrical insulation, wallboard, caulking compounds, gaskets, and waterproofed fabrics.

107. ABSTRACT BIBLIOGRAPHY OF THE CHEMISTRY AND TECHNOLOGY OF TUNG PRODUCTS. 1875-1950
Planck, R. W., Pack, F. C., and Skau, D. B.
AIC-317, 811 pp. in 4 pts. (1952) Processed

Nearly 3000 articles and patents relating to the tung tree, the processing of its fruit, and the chemistry and technology of the oil and meal, which have appeared throughout the world over the past 75 years, have been compiled and abstracted. Volumes I and II cover two-thirds of the total 2233 articles and one-third of the 735 patents. Volume III covers the remaining articles and patents. Volume IV consists of an author index, a numerical index of patents, and a subject index.

108. SOUTHERN TUNG TREES PROVIDE A NEW OIL INDUSTRY
McKinney, R. S.
Southern Chemist 10 (3), 95-100 (Nov., 1950)

A general review of the historical, economic, and technological aspects of the tung industry in the U. S.

109. INFORMAL REMARKS AT AMERICAN TUNG OIL ASSOCIATION MEETING, OCT. 11, 1950, BILOXI, MISS.
Markley, K. S.
Proc. Am. Tung Oil Assoc. 1950, 20-2

Research on tung fruit and tung oil is being conducted by the Bureau of Agricultural and Industrial Chemistry of the U. S. Department of Agriculture at the U. S. Tung Oil Laboratory at Bogalusa, La., and at the Southern Regional Research Laboratory at New Orleans, La.

110. TUNG OIL
McKinney, R. S.
U. S. Dept. Agr. Bur. Agr. Ind. Chem. AIC-94, 13 pp. (1946): C. A. 41, 2256 (1947) Processed

A review of the production, uses, and chem. and phys. properties of tung oil, together with statistical data on its consumption, imports, and prices in the U. S. in stated years. 65 references. From C. A.

111. FAT AND OIL RESOURCES OF LATIN AMERICA
Markley, K. S.
In "Plants and Plant Science in Latin America," Franz Verdoorn, ed. Chronica Botanica Co., Waltham, Mass., 1945, pp. 211-218; Oil Mill Gaz. 51, (6) 9, 11, 23-30 (1946); C. A. 41, 4319 (1947); Biol. Abstracts 20, 193, Abs. No. 1644 (1946)

Distribution, economics, importance, and uses of the following South American oils are briefly discussed: babassu, coconut, cohune, noli, corozo, dende palm, oiticia, Garcia nutans, garampara, cocoa, ucuuba, castor, linseed, tung, sunflower, cottonseed, peanut, and a miscellaneous group. From C. A.

112. MISCELLANEOUS STUDIES AT THE GAINSVILLE TUNG-OIL LABORATORY
McKinney, R. S.
Proc. 10th Ann. Convention, Am. Tung Oil Assoc. and United Tung Growers Assoc. 1944, 59-63; C. A. 39, 2890 (1945)

Tests indicate the possibility of prepg. a moldable plastic from solvent-extd. tung meal. Solvent-extd. tung meal and press cake with and without autoclaving for 2 hrs. with steam at 25 lb. pressure were used in feeding tests with chickens. The materials not autoclaved were definitely toxic. With autoclaved tung-oil press cake in the diet up to 30% the chickens did not lose weight but they looked unhealthy. A new clarification process for crude tung oil is suggested in which sodium bisulfite is used to ppt. the nonoil constituents. Tests showed the new process to be better in certain respects than the diatomaceous earth filter aid now used in the tung-oil mills. From C. A.

113. STUDIES IMPROVING TUNG OIL
McKinney, R. S.
Fla. Grower 56(4), 18, 21; Biblio. of Agr. 11, No. 5707 (1947)

Results of tung processing and utilization investigations at the two USDA tung oil laboratories, in Gainesville, Fla., and Bogalusa, La., are reviewed. Among the subjects discussed are effects of moisture content on oil recovery; solvent extraction of tung oil; and possible uses for byproducts of tung oil production, such as residual meal and hulls.

114. PRODUCTION OF FLORIDA TUNG OIL.
McKinney, R. S.
Florida Highways 2 (3), 8-10, 18-19 (Feb. 1943)

Information was given on the development of the tung oil industry in Florida including commercial acreage plantings and production of tung oil in Florida from 1929 to 1932 and in the South from 1934 through 1940. Information was also given on the uses of tung oil, on studies to increase the yield of tung oil by the use of solvent extraction, and on the development of more profitable tung oil byproducts.

Research Achievement Sheets

Color of Solvent-Extracted Cottonseed Oil Improved by Research.
Res. Achvt. Sheet 149(C). (Processed) February 1952

Improved Methods for Analyzing Tung Fruit Adopted Widely.
Res. Achvt. Sheet 153(C). (Processed) April 1952

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