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Some of the Constituents of the Tuber of "Coquí" (*Cyperus Rotundus L.*)

I. Preliminary Examination of the Tuber and Composition of the Fatty Oil

*By Conrado F. Asenjo**

"Coquí" is the common name given in Puerto Rico to a sedge, perennial by long tuber-bearing rootstocks. It is known in English-speaking countries under the name of nut grass. This sedge is not restricted to this particular tropical area but, on the contrary, it is widely distributed all over the tropical and sub-tropical belts. Often it becomes a pernicious weed (1). Botanically, the plant has been identified as *Cyperus rotundus* L., family Cyperacea (1). The only other plant of this genus to have been phytochemically studied to any extent is *Cyperus esculentus* L. (2).

The tubers of "coquí" are easily available in the fruit markets of Puerto Rico. Our supply came from San Juan, Puerto Rico. When fresh, these tubers have an aromatic odor and possess a bitter-cool taste. In color they are dark brown on the outside and whitish or yellowish within. They have an ovoid shape, measuring from 0.5 to 1.5 cm. in diameter. Each tuber weighs, when fresh, from 1 to 3 Gm.

A water infusion, prepared by boiling the whole tuber, has been used in Puerto Rico for a long time in the treatment of kidney and urinary disorders. It is the common belief that this infusion stimulates diuresis and dissolves urinary stones.

Although the drug is known from very old (3)—the *Kupeiros* of the Greeks—and has been, in the past, official in several pharmacopœias,[1] the literature does not reveal any chemical or pharmacological investigations, either of the tuber[2] or of any other part of the plant. A gross pharmacognostical examination of this tuber has been made by Goebel-Kunze (5).

The present investigation deals with the air-dried drug and consists of an attempt to elucidate the chemical composition of this tuber.

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[1] The Pharmacopœias, in which *C. rotundus* L. tuber is official, are:

Country	Edition	Date
Danish	1	1772
French	1	1818
Mexican	1	1874
"	2	1884
"	3	1896
"	4	1904

It is also recorded in the Chinese Pentsaos, according to Stuart (4), under the name of Hsiang-futzu.

[2] The volatile oil from the tuber has been examined by several investigators. We shall deal with it in a future publication.

EXPERIMENTAL

Table I.—Proximate Analysis of "Coquí" Tuber (Average of Three Determinations)

Constituent	Per Cent Wet Basis	Per Cent Dry Basis
Moisture	48.73	...
Nitrogen free extract	42.06	82.10
Protein (N × 6.25)	1.87	3.63
Ether extractive	1.20	2.31
Crude fiber	4.04	7.86
Ash	2.10	4.10

Extraction with Selective Solvents.—The tubers were dried at 80° C. in a circulating air oven for about 24 hours. Then they were comminuted in a Wiley mill to particles about 10 mesh. The moisture content of this material averaged 9.4 per cent and the ash content, 3.56 per cent. Triplicate determinations were performed in percolators, using continuous extraction. The petroleum ether extractive averaged 2.3 per cent, the ether extractive, 0.8 per cent, and the alcoholic extractive, 17.7 per cent. The mark left, after extracting with the above solvents, was subjected to extraction with boiling water, but a mucilaginous mass resulted.

The Fatty Oil.—After subjecting the petroleum ether extractive to steam distillation to get rid of the volatile oil, the non-volatile fraction left in the flask was recovered with ether.[1] The oily substance remaining, after evaporating the ether, had a specific gravity of more than one, and amounted to 82.5 per cent of the petroleum ether extractive. When shaken with petroleum ether, only part of this oil went into solution, leaving behind a resinous brown mass. After evaporating the petroleum ether, a lighter oil was obtained which had the following constants (6): sp. gr. at 20° C.—0.9500; ref. ind. at 20° C.—1.4967; iodine no. (Hanus)—87.95; sap. no.—134.30; acetyl no.—63.30; unsap. %—22.80; acid no.—35.20.

Waxy Neutral Substance.—After saponifying the oil and neutralizing the mixture with acetic acid, a waxy substance separated, which would not dissolve either in acid or alkaline solutions. This substance was easily purified by dissolving it in hot alcohol and recovering from the cold solvent. To remove the last traces of color, it was shaken with hot dilute HNO_3 and then refluxed with acetone. On cooling the acetone, a white, amorphous, waxy precipitate separated, which melted sharply at 97–98° C. and burned with a smoky flame, leaving no ash. It amounted to about 2.7 per cent of the oil.

Unsaturated Acids.—The unsaturated acids were separated by the lead salt-ether method (7). Identification of the unsaturated acids was effected by means of their bromo addition compounds and their separation by the use, in turn, of ether and petroleum ether. The precipitate obtained from the ethereal solution, m. p. 182° C., after being recrystallized from ether, indicates the presence of linolenic acid (hexabromide of linolenic acid, m. p. 182° C.). The petroleum ether solution yielded, after standing in the ice-box, a precipitate which melted after recrystallization at 114° C., indicating the presence of linolic acid (tetrabromide of linolic acid, m. p. 114° C.). The residual fraction was debrominated by refluxing the alcoholic solution with zinc dust. The zinc oleate formed was decomposed with sulfuric acid into oleic acid and zinc sulfate. A drop of the oleic acid recovered was dissolved in a few cc. of concentrated sulfuric acid. On superimposing a diluted alcoholic solution of vanillin, a violet-colored ring appeared at the interface of the two solutions. This is a specific color test for oleic acid. The remainder of the oleic acid was oxidized with 10 per cent alkaline potassium permanganate. A white crystalline precipitate was obtained which melted after several recrystallizations from alcohol at 130° C. (dihydroxystearic acid, m. p. 131.5° C.).

Saturated Acids.—A separation of the saturated acids was performed by taking advantage of the selective solubility of the lead salts in boiling ethyl alcohol. The insoluble part of the lead salts was separated by filtration. The sparingly soluble lead salts yielded an acid, m. p. 66–70° C., after several recrystallizations. This acid has a waxy consistency and is probably stearic acid, m. p. 69.3° C. Because of the small amount obtained, no further attempts were made to characterize it. The soluble lead salt yielded an acid with a melting point of 53–54° C. after recrystallization. This melting point agrees with that of myristic acid, m. p. 53.8° C.

Glycerol.—The aqueous solution left after the liberation of the fatty acids was evaporated, as far as possible, on the steam bath. A few drops of this syrup gave, when heated with potassium bisulfate, a faint odor of acrolein.

Unsaponifiable Matter.—A preliminary examination of the unsaponifiable matter shows that it contains 5.5 per cent sterols when estimated by the digitonide procedure. On acetylation, a small amount of crystals, melting at 125–128° C., was obtained (α_2 sitosterol acetate, m. p. 124–126° C.).

SUMMARY

1. The history, distribution, botanical classification and folk uses of the tuber of *Cyperus rotundus* L. are given.

2. The proximate analysis of the tuber is reported; also the yield of extractives when treated with selective solvents.

3. The principal constants of the fatty oil were determined. This oil contains, besides a large amount of unsaponifiable

[1] The water left, after shaking out the ether-soluble part, gave a strong Fehling's test for reducing sugars. This suggests the presence of a glycoside in the original petroleum ether extractive. This glycoside is probably broken up into its sugar and aglucone during the process of steam distillation.

matter, a neutral waxy substance, m. p. 97–98° C.; glycerol; linolenic; linolic; oleic; myristic and, possibly, stearic acid.

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Notes on Mexican Drugs—I. Zapote borracho (*Lucuma salicifolia* Kunth, Sapotac.)

*By Marcel Bachstez and Altagracia Aragon**

In his book, "Magische Gifte," V. A. Reko (1) describes the intoxicating effects of a peculiar Mexican fruit. This fruit, "Zapote borracho" ("drunk zapote"), is when unripe yellowish green, when ripe dull orange-yellow with yolk-yellow pulp. It can be bought in the markets of Oaxaca, Tehuacan, Puebla, and at times in Mexico City.

As the fruit is frequently eaten and no investigation appears to have been made of its constituents, it was decided to undertake such an investigation to determine if it contains any active principles.

"Zapote borracho" is identified as *Lucuma salicifolia* Kunth. The literature on the plant is very limited and is mainly devoted to the botanical aspect. Wilson Popenoe devotes in his "Manual of Tropical and Subtropical Fruits" (2) only a few lines to the fruit. He points out its similarity to the "canistel," which grows in the Florida Keys and in Cuba, but he does not give any information on its composition or its physiological action.

From our investigations, it can be stated that neither glycosides nor alkaloids are present. Extensive inquiries have also convinced us that this frequently eaten fruit has no harmful properties. It is probable that the popular Mexican name for the fruit, "Zapote borracho" ("drunk zapote"), has reference to the musty, alcoholic smell

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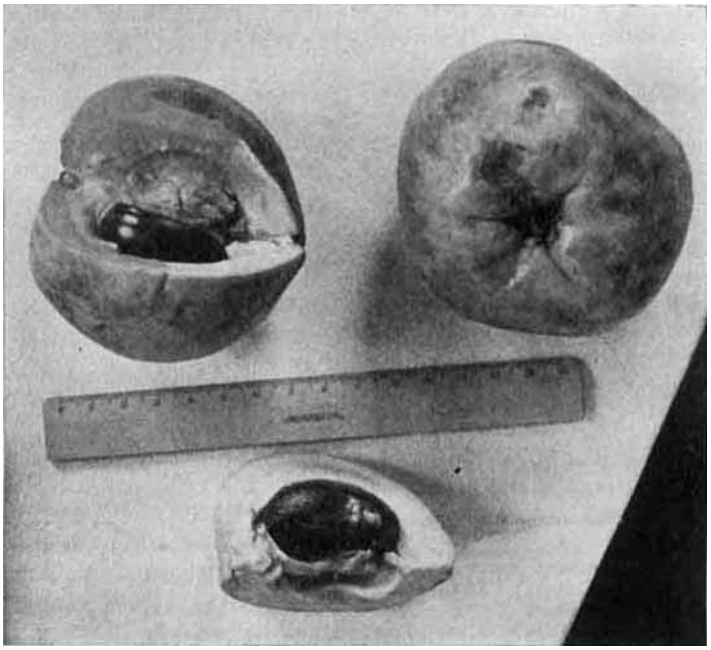

Fig. 1.