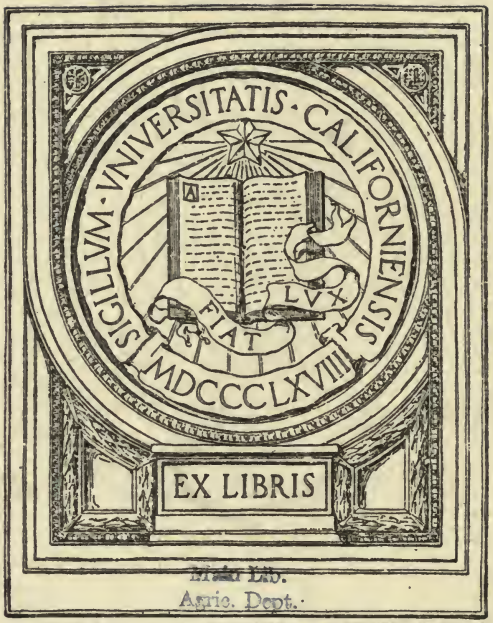
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H. W. WILEY, Chief of Bureau.

ANALYSIS OF THE MEXICAN PLANT TECOMA MOLLIS H. B. K.

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The plant material used for the following analysis was submitted to the U. S. Department of Agriculture by Mr. Carl Lumholtz with the information that the inhabitants of certain parts of Mexico use it to a considerable extent in the treatment of disease and it was thought that an examination might reveal the presence of some valuable medicinal constituents which would warrant the suggestion that the plant be introduced into some of the Southern States for cultivation.

IDENTIFICATION OF THE PLANT.

No common name by which the plant is known locally has been reported. On submitting a specimen of the plant consisting of flower, fruit, stems, and leaves to the U. S. National Museum it was identified as *Tecoma mollis* H. B. K.; family *Bignoniaceæ*. The specimen is now in the Herbarium of the U. S. National Museum, where there are several others of this same plant. According to Hemsley[1] this plant is also found in Colombia, Peru, and Chile, and is known by the following synonyms: *Tecoma sorbifolia* H. B. K., *Tecoma stans γ velutina DC.*, *Stenolobium molle*, and *Bignonia tecomoides DC.* A careful examination of the literature dealing with medicinal plants failed to reveal any recorded investigation of this plant under the names enumerated above. It is possible, however, that some observations may have been reported under a local or common name and for this reason have been overlooked.

ANALYSES BY THE METHODS OF DRAGENDORFF AND PARSONS.

For this analysis the leaves only were used, being reduced to a No. 40 powder. The odor was slightly aromatic and the taste a mild, persistent bitter, suggesting the so-called "bitter principles" contained in a number of plants. A preliminary examination indicated the absence of alkaloids and other readily recognizable bodies commonly present in medicinal plants. It was thought, however, that a more careful analysis following the schemes of Dragendorff and of Parsons might disclose the constituent of the plant in which resided the useful qualities that it was supposed to possess.

Analyses were therefore made simultaneously by these two methods. Twenty grams of the air-dried material were extracted in all cases with

[1] Biologia-Centrali Americana 1882, *2*, 496.

approximately ten times the amount of solvent. The moisture was determined at 110° C and amounted to 6.73 per cent. The ash, taken in a muffle furnace, amounted to 5.74 per cent and was alkaline to litmus paper. The water-soluble portion amounted to 49.33 per cent and contained chlorids, sulphates, phosphates, salts of calcium, magnesium, potassium, and sodium. Water acidulated with hydrochloric acid dissolved 46.15 per cent of the ash, containing salts of iron, aluminum, magnesium, calcium, and phosphates. The nitrogen, estimated by the Kjeldahl-Gunning method, amounted to 2.07 per cent.

RESULTS OBTAINED BY THE DRAGENDORFF METHOD OF ANALYSIS.

The results of the analysis by the method of Dragendorff, slightly modified, are as follows:

	Per cent.
Moisture	6.73
Petroleum ether extract[1]	1.65
Ether extract	4.29
Portion soluble in water (probably an acid resin), 1.33 per cent.	
Portion insoluble in water but soluble in alcohol (consisting of chlorophyl and resin), 2.96 per cent.	
Absolute alcohol extract	8.46
Portion soluble in water, 7.60 per cent:	
Tannin, extractive, etc., 7.26 per cent.	
Sugar, etc., 0.34 per cent.	
Portion insoluble in water (acid resin), 0.86 per cent.	
Water extract	17.90
Total acidity required 34.4 cc N/10 KOH (phenolphthalein).	
Inorganic bodies, 2.83 per cent.	
Mucilaginous substance, 1.26 per cent.	
Glucoses, acids, and extractives, 13.81 per cent.	
Dilute alkali extract (cold)	4.19
Mucilaginous substance, 3.32 per cent.	
Probably albuminoids, 0.87 per cent.	
Dilute acid extract (cold)—organic and inorganic material	8.48
Fiber, cellulose, etc	48.64
Total	100.34
Ash	5.74
Nitrogen	2.07

The petroleum ether extraction was accomplished in a Soxhlet apparatus and was continued daily for about five days in order to obtain uncolored petroleum ether in contact with the sample. The petroleum ether extract left, on evaporation, a pale yellow residue which yielded an acid solution when dissolved in alcohol. This solution, after being titrated with standard potassium hydroxid, was filtered and the insoluble portion transferred to a flask and saponified by boiling about three hours with standard alkali, using a reflex condenser.

[1] An acid, oily residue, which required 3 cc N/10 alkali to neutralize the acid and 4.5 cc N/10 alkali to saponify the fats, after separating the acid portion.

The plant material remaining in the Soxhlet apparatus was allowed to dry and about 200 cc of ethylic ether placed in the flask of the apparatus. The ethereal extract was colored green and about ten days were required for complete extraction. On treating the residue obtained from the ethereal extract by evaporation with water, the aqueous solution was acid to phenolphthalein and contained a resin which was found to be soluble in alcohol, partially soluble in ether, and which reduced Fehling's solution. This residue was carefully tested for all the substances enumerated by Dragendorff as likely to appear at this point, but no indication of anything other than resin was obtained. On account of the small amount of the residue (0.2675 gram = 1.33 per cent) its physiological action was not tested. That portion of the residue of the ethereal extract not soluble in water was tested physiologically by mixing about one-half gram of the material with meat and feeding it to a cat. The animal experienced no noticeable inconvenience from this large dose, and it is to be concluded that the medicinal virtues of the plant do not reside in the water-insoluble ether extract.

The alcoholic extraction of the plant material was effected in a stoppered Erlenmeyer flask, using 200 cc of absolute alcohol and the sample remaining after the ether extraction. The flask was shaken by hand at intervals during five weeks, after which time the solution was filtered through a dry filter and the plant material washed sufficiently with absolute alcohol to remove the total alcoholic extracted portion. The washings were received in a separate vessel. The tannin was determined by treating the residue obtained from an aliquot portion of the alcoholic extract with water and adding lead subacetate to the filtered aqueous solution. The precipitate obtained was washed, dried, and weighed, after which the organic material was incinerated and the lead remaining weighed, the loss being stated as tannin and extractives. The water-insoluble portion of the residue obtained from the alcoholic extract was a black, amorphous mass corresponding to 0.86 per cent of the plant. This residue was completely soluble in dilute ammonia and appeared to be a portion of the same resin which the ether had failed to remove in the previous extraction of the plant. Although the material extracted by alcohol appeared to be principally tannin, it was thought desirable to test its action on a cat. The dose administered, however, as was to be expected, produced no evident unusual physiological action.

The water extract of the sample was made in the same flask which had been used for the alcoholic extraction. Two hundred cc of water and the dried plant material remaining after the alcoholic extraction were used. At the end of twenty-four hours the aqueous solution was filtered through a dry filter, the plant material washed several times with water and the washings discarded. An aliquot portion of the filtrate was titrated with standard alkali. The total extracted material and ash were determined in another portion of the filtrate. The muci-

laginous material was precipitated from a fresh portion of the aqueous solution. The filtrate from the mucilaginous material strongly reduced Fehling's solution, indicating, therefore, according to Dragendorff, the presence of glucoses, acids, and extractives. A portion of the residue obtained by evaporation of the aqueous extract to dryness was also given to a cat, and, as before, no evident ill effects were produced.

The dilute alkali and dilute acid extracts were obtained by successively extracting the plant material with 200 cc of the cold menstruum in each case. After the dilute acid extraction the material remaining was dried and weighed.

From the results of the physiological tests given in the previous paragraphs, it may be concluded that *Tecoma mollis* contains no constituents capable of powerful action, and it also appears probable that the plant contains no ingredient of exceptional medicinal virtue.

RESULTS OBTAINED BY THE PARSONS METHOD OF ANALYSIS.

The results obtained by the analysis made according to the Parsons method, modified as stated below, are as follows:

	Per cent.
Moisture	6.73
Benzol extract	4.81
Soluble in water, 0.19 per cent.	
Soluble in dilute acid, 0.06 per cent.	
Soluble in 80 per cent alcohol, 3.15 per cent:	
Chlorophyl, 1.17 per cent.	
Resins, 1.98 per cent.	
Insoluble in 80 per cent alcohol:	
Wax, fats, fixed oils, 1.41 per cent.	
Alcoholic extract (with approximately 90 per cent alcohol)	29.26
A. Soluble in absolute alcohol:	
(*a*) Soluble in water, 10.77 per cent.	
(*a'*) Tannin, etc., precipitated by lead subacetate, 4.41 per cent.	
(*a''*) Extractives, etc., 6.36 per cent.	
(*b*) Insoluble in water, 9.11 per cent.	
(*b'*) Soluble in dilute hydrochloric acid, 0.53 per cent.	
(*b''*) Soluble in dilute ammonium hydrate—acid resin, 8.58 per cent.	
B. Insoluble in absolute alcohol:	
(*a*) Soluble in water—tannin and extractives, 7.97 per cent.	
(*b*) Insoluble in water—resin extractives, 1.41 per cent.	
Cold water extract	4.72
Organic part (gum), 3.16 per cent.	
Inorganic part (SO_4, Ca, Fe, PO_4, etc.), 1.56 per cent.	
Acid extract (hot)	24.61
Starch and isomers, 14.98 per cent.	
Acid extractive (not starch), 9.63 per cent.	
Alkali extract (hot)	21.49
Cellulose	10.71
Total	102.33

The benzol extraction of the 20-gram sample of ground *Tecoma mollis* leaves was made in a continuous extraction apparatus which allowed the condensed vapors to percolate through a layer of the plant material about three inches thick. About 200 cc of benzol were used and the extraction continued four days. On evaporating the benzol an almost black residue was obtained. The portion of this residue recorded as soluble in water and in dilute acid was amorphous and gave no indications of alkaloids or glucosides. It resembled very much the resin found in the alcohol-soluble portion of this residue.

The statements given in the usual outlines of the Parsons method found in text books are not clear as to just how the alcoholic extraction of the plant should be accomplished. It is not certain whether the required 12 to 14 hours' continuous extraction, as stated, is to be performed in the cold by percolation, or in a closed flask using a definite ratio of plant material to solvent, or by some other convenient method. In the present case it was decided to use the same continuous extraction apparatus as employed for the benzol extraction, placing 80 per cent alcohol in the flask of the apparatus. It was of course recognized that by this plan the extraction would actually be made with alcohol of a concentration higher than 80 per cent. In order to determine approximately just what strength of alcohol this would be, a blank experiment was made, using 83 per cent alcohol in the flask, and a test tube in the position occupied by the sample. In this way it was found that the condensed alcohol collected in the test tube had a specific gravity of 0.8226 and thus corresponded to 91 per cent alcohol. Therefore by using 80 per cent alcohol in the flask the plant was actually extracted with approximately 90 per cent alcohol.

The examination of the residue obtained by evaporating the alcoholic extract was made by treating this residue with absolute alcohol, thus separating it into two portions, each of which was further separated by treatment with water into a soluble and an insoluble portion. This procedure proved rather unsatisfactory, since the absolute alcohol separation yielded two portions which appeared almost identical in all respects except their solubility in absolute alcohol. The time required, therefore, to make the separation was almost doubled, without a corresponding improvement in the results.

COMPARISON OF THE FIGURES OBTAINED BY THE TWO METHODS OF ANALYSIS.

A comparison of the figures obtained by the two methods of analysis shows that the quantity of material extracted by benzol in the Parsons method corresponds in a measure to the amount removed by both the petroleum ether and ethylic ether extractions in the Dragendorff method. In the latter case, however, the two solvents give a separation which is clearly advantageous from an analytical standpoint. It will be observed that the alcoholic extract of the Parsons method yields a result which

agrees fairly well with the absolute alcohol and water extract together of the Dragendorff method. Here again the use of the two solvents has resulted advantageously, in that a very clear separation of the tannin on the one hand and the glucoses, extractives, etc., on the other, has been effected.

With regard to the remaining steps of the two analyses, the conditions vary materially in the two cases and the wide differences obtained are naturally to be expected.

CONCLUSIONS.

The results of the analytical work described in the preceding pages show that *Tecoma mollis* contains no alkaloid or other well characterized plant constituent of medicinal importance. It is probable that the virtues attributed to it are associated in some way with the persistent bitter taste which the plant is found to possess. The bitter ingredient appears principally in the alcoholic and aqueous extracts. Plants such as gentian, taraxacum, quassia, etc., possessing a similar bitter taste are recognized as having a stimulating and tonic effect on the human system and it is probable that the physiological action of *Tecoma mollis* may be of a similar character.

In regard to the advantages possessed by the two methods of analysis, it appears that in the case of *Tecoma mollis* at least the Dragendorff method is to be preferred. With this method the solvents employed effect a better separation of the constituents than do those used in the Parsons method.

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