A—Two-gram samples of potassium and sodium tartrate, in very small crystals, were ignited in porcelain evaporating dishes of about 160 cc. capacity and when a white residue was obtained, titrated as directed by the U. S. P. with half-normal sulphuric acid.

The assay indicated the presence of 74.061 per cent of K Na $C_4H_4O_6$.

B—Two-gram samples from the same container were ignited as in *A* and to the cooled residue there was added an excess (35 cc.) of half-normal sulphuric acid and the dish and contents placed on a steam-bath and stirred with a glass rod until all soluble matter was in solution, cooled, two drops methyl orange indicator added and the unacted upon acid determined by titration with half-normal sodium hydroxide.

The assay indicated the presence of 75.712 per cent of K Na $C_4H_4O_6$.

The results by both methods are far apart not withstanding the fact that the duplicates showed remarkably close agreement among themselves.

SUMMARY

1. In the assay of alkali salts of organic acids the U. S. P. should direct that a dish be used in place of a crucible, as it now does for the ashing, as this procedure would not only aid in ashing the material but the titration could be made without transferring.

2. In place of directly titrating the ash as it now does, the U. S. P. should direct that an excess of half-normal sulphuric acid be added to the ash, the dish and contents placed on the steam-bath, stirred until all soluble matter is in solution, cooled, methyl orange added and then titrated with half-normal sodium hydroxide until all unacted upon sulphuric acid is neutralized.

The writer wishes to acknowledge his indebtedness to Berl S. Alstodt for his assistance in making many of the assays.

CONTRIBUTION FROM THE CHEMICAL LABORATORY, BROOKLYN COLLEGE OF PHARMACY, LONG ISLAND UNIVERSITY, BROOKLYN, N. Y.

CHEMICAL STUDIES OF THE FRESH JUICE OF THE MAGUEY PLANT.—(MANSO FINO, KARW).*

A PRELIMINARY REPORT.

BY HERMAN D. JONES.[1]

PAPER NO. I.

The two groups of Agaves, occurring in Mexico, have been previously classified as (1) the amoles, and (2) the magueys. There are three varieties of magueys, pita, mescal and pulque, and of the last named variety the species, Agave Atrovirens,

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[1] The writer is indebted to Don Javier Torres Rivas, of Mexico City, for permission to collect, on his hacienda, the juice used in this investigation, and to Sr. Javier de la Barra for his coöperation during the two years of work in Mexico, while on leave of absence from the Alabama Polytechnic Institute.

Karw, is one of the most important for producing a good quality of sweet sap or aguamiel. Plants of this species, grown at Ometusco in the State of Mexico, furnished the aguamiel used in the studies herein described. This species is known to the natives as *Maguey manso fino.*

For reproduction, the small plants which spring from the roots of older ones are removed to a nursery when about three or four years old. After three to five years' cultivation here, they are moved to their permanent field location and on an average, the plants are twenty to thirty years old before production of sap is completed.

Many investigations have been undertaken to determine the specific therapeutic value of the maguey juice. A summary of a large number of these has been given by Colin (1) and need not be reviewed here. In his investigations Colin isolated a light tan, crystalline compound which he studied for its anti-syphilitic properties and in this he thought he was able to observe some therapeutic value.

For the past three years there have been in progress both chemical and therapeutic investigations of the fresh juice of the *maguey manso fino, Agave Atrovirens,* Karw, and of its effect in experimental nephrities. Some of the chemical results thus far obtained are set forth in this communication. The preliminary results of the other lines of investigation will be submitted for publication at an early date.

ANALYSIS OF FRESH AGUAMIEL.

Specific gravity	1.0545
Equivalent in degrees Baumé	7.5000
Total acids, as acetic acid	0.1980%
Water	87.3700%
Total solids	12.6300%
Glucose (by Benedict's method)	1.0700%
Invert sugar (by Benedict's method)	11.1200%
Total sugar (by Benedict's method)	12.1900%
Sucrose calculated from glucose and invert sugar	10.7864%
Protein (Nitrogen × 6.25)	0.5680%
Alcohol precipitate	2.8100%
Ether extract	0.0209%
Ash (mineral matter)	0.2470%
Ash (soluble in water)	0.1149%
Ash (insoluble in water)	0.1316%
Alkalinity of ash-soluble	0.07 cc.
	N/10 HCl per Gm. aguamiel

MINERALS.

Iron and aluminum as Al_2 and Fe_2O_3	0.0370%
Phosphorus as P_2O_5	0.0450%
Calcium as CaO	0.0028%
Magnesium as MgO	0.00147%
Potassium as K_2O	0.0570%
Silica	0.0240%
Lithium	Traces
Manganese	Traces
Cobalt	Traces
Nickel	Traces
Silver	Traces
Strontium	Traces
Rubidium	Traces
Cesium	Traces
Barium	Traces
Titanium	Traces
Mercury	Traces
Chromium	Traces

(Formic and acetic acids have been found, along with traces of propionic and lactic acids. Lobato gives the name "Agavic" to the acid which he thinks gives to the agumiel its agreeable taste. Boussingault reports the presence of malic acid but up to this time, the writer has been unable to detect its presence.)

Aguamiel from the *maguey, manso fino,* is a saccharine, slightly acid liquid, colorless or translucent when first removed from the plant, this depending on the amount of gum present as an emulsion. It has a sweet, pleasant acid taste and an odor peculiar to the maguey. This gum in the fresh juice is easily precipitated, is viscous and insipid. Its reactions, in general, are similar to the ordinary reactions

of gums. By nitric acid, it is oxidized to mucic acid. When precipitated with alcohol or acetone, it is white and amorphous; on drying, it becomes elastic and finally, when all water has been removed, it can be powdered. It gives some reactions which would lead one to think it gum arabic and, at the same time, will respond to tests for bassorin. It is partially soluble in water, the soluble portion responding to gum arabic tests and the insoluble to bassorin tests. If overheated, it is converted into glucose. Following is an analysis of the fresh aguamiel obtained from a few plants. The magneto-optic method developed by Allison (2) was used in identifying all the minerals, especially those occurring only in traces. Later, spectrographic methods were used in determining these metals and the two methods checked satisfactorily.

In an effort to preserve the aguamiel so that it would not ferment, it was found that this could be done by using 1 cc. of formaldehyde per 6000 cc. of fresh juice for a period of 24 to 36 hours without any change in acidity or any gas formation. It can be preserved also by concentrating to a density of 1.35 to 1.38, equivalent to 38° to 39° Baumé, under 20 lbs. vacuum and 35° to 38° C. If the density falls slightly under 38° Bé., slow fermentation takes place, thereby increasing the acidity of the concentrate. If it is slightly over 39° Bé., the sugar crystallizes, reducing the gravity, and fermentation again sets up. When concentrated under these conditions, the fresh juice remains practically unchanged, only the excess water and a portion of the more volatile acids being removed.

When the formaldehyde is used as a preservative before concentrating the fresh juice, it is completely removed by vacuum distillation process, the fuchsin-sulphate tests being used to test the concentrate for its presence in a large number of samples. The following is an analysis of the fresh syrup concentrated from about ten thousand litres of aguamiel, collected from plants covering a large area. The results, therefore, show variations due to the variations of soil, climate and rainfall.

Analysis of Agave Concentrate, February 6, 1929, Batch A.		Minerals.	
Specific gravity	1.3590%	Iron and aluminum as Al_2O_3 and Fe_2O_3	0.3020%
Equivalent in degrees Baumé	38.3000%	Phosphorus as P_2O_5	0.6090%
Total acids as acetic acid	0.2400%	Calcium as CaO	0.0380%
Water	29.4700%	Magnesium as MgO	0.0140%
Total solids	70.4300%	Potassium as K_2O	0.8240%
Glucose (Benedict's method)	9.0560%	SiO	0.0510%
Invert sugar (Benedict's method)	50.1760%	Copper as metallic copper	Traces
Total sugar (Benedict's method)	59.2320%	Lithium	Traces
Sucrose (calc. from gluc. inv. sugar)	48.6707%	Manganese	Traces
Protein (Nitrogen × 6.25)	2.8560%	Cobalt	Traces
Alcohol precipitate	5.5700%	Nickel	Traces
Ether extract	0.1900%	Silver, Mercury	Traces
Ash mineral matter	2.0400%	Strontium, Rubidium	Traces
Ash soluble in water	1.1250%	Chromium, Barium, Titanium	Traces
Alk. ash sol. Gm. agmel $N/10$ HCl	0.42 cc.	Caesium	Traces

BIBLIOGRAPHY.

(1) G. G. Colin, "A Contribution to the Chemistry, Pharmacology and Therapeutics of Agave Salmeana," Jour. A. Ph. A., 17 (1928), 1182.

(2) Fred Allison and E. J. Murphy, "A Magneto-Optic Method of Chemical Anslayis," *J. A. C. S.*, 52 (1928), 10.