Summary

1. The action of chlorohydrins on amino-aryl arsonic acids has been investigated, and the properties of the resulting compounds and some of their derivatives have been described.

2. The condensation of ethylene dibromide with *p*-arsanilic acid has been studied, and the neutral sodium salt prepared.

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[CONTRIBUTION FROM THE DEPARTMENT OF CHEMICAL HYGIENE, JOHNS HOPKINS UNIVERSITY]

ANALYSIS OF THE JERUSALEM ARTICHOKE[1]

BY A. T. SHOHL

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The Jerusalem artichoke, *helianthus tuberosus*, has long been known and used as an article of food. The common books on food analysis and food values do not, however, list it.

There is an analysis by Strauss[2] and one by Langworthy[3] to which the reader is referred for a further description of the occurrence, habits and methods of preparing the Jerusalem artichoke for table use.

This investigation was undertaken with the idea of establishing the importance of the Jerusalem artichoke in the treatment of diabetics, but suitable clinical material has not been available. The following analysis is published in the hope of suggesting such use to others.

It is well known that this tuber contains large amounts of inulin, a carbohydrate which on hydrolysis yields levulose. Inulin in the form of "Topinambur" (Jerusalem artichoke) was used in the treatment of diabetes as early as 1851 by Bouchardat.[4] Külz[4] in 1874 showed that inulin was burned in the body, since diabetics excreted none in the feces. Inulin has fallen into disuse since Sandmeyer,[4] 1894, showed that dogs with partial removal of the pancreas could not utilize inulin and Mendel,[4] 1908, objected to its use because there are no enzymes in the body to split it. Inulin is, however, hydrolyzed by dil. acids. That there is enough acid in the gastric juice to split it has been shown by Chittenden,[5] Lewis[6] and Okey.[7]

Strauss[8] has reopened the question and found that inulin was well

[1] Read at the Rochester meeting of the American Chemical Society, 1921.

[2] Strauss, *Ther. Gegen.*, **52**, 347 (1911).

[3] Langworthy, *U. S. Dept. Agr. Bull.*, **468** (1917).

[4] Cited by Goudberg, Ref. 9.

[5] Chittenden, *Am. J. Physiol.*, **2**, xvii (1898).

[6] Lewis, *J. Am. Med. Assoc.*, **58**, 1176 (1912).

[7] Okey, *J. Biol. Chem.*, **39**, 149 (1919).

[8] Strauss, *Berl. klin. Wochschr.*, **49**, 1213 (1912).

utilized in severe cases of diabetes with acidosis. Goudberg[9] examined the feces of the same cases and found no inulin. He also made metabolism studies with inulin and found increased production of carbon dioxide. The problem of the use in diabetes of 15 or 20 g. of inulin as Jerusalem artichoke is quite different from that in metabolism studies of 150 or 200 g. of pure inulin. The utilization of small amounts would make a great difference in diabetes, but very little in general nutrition. Even if the Jerusalem artichoke were inert, it would still be useful in making palatable diets of suitable bulk for diabetics on greatly restricted food intake. If suitable clinical studies confirm the work of Strauss as does our limited experience and that of Joslin and Root,[10] that there is no increased sugar elimination in diabetes; and if at the same time metabolism experiments show increased utilization of carbohydrate as demonstrated by Goudberg, Jerusalem artichoke should become a valuable adjunct in the dietetic treatment of diabetes.

Analysis

Inulin was prepared from tubers obtained in December and January, when storage is most abundant. Plimmer's method[11] was used. The material was a white powder, soluble in hot water and precipitated by 50% alcohol. Fehling's test gave no reduction before inversion, but positive reduction after inversion. After inversion levorotation was increased.

The juice of the artichoke was expressed and its Sörensen value (P_H) by the colorimetric method of Clark[12] was found to be 5.0. The antineuritic properties have been tested in this Laboratory by Miss M. Koch and the material was found to contain water-soluble B in scant amounts.

The tubers were pared before analysis and the "edible portion" was 69% of the weight as purchased. The analysis was performed according to the methods of the Official Agricultural Chemists and the results given in Table I have been compared with those given by Strauss[8] and Langworthy.[3] The agreement is close.

TABLE I

PERCENTAGE COMPOSITION OF THE EDIBLE PORTION OF JERUSALEM ARTICHOKE

%	Moisture	N × 6.25 Protein	True protein	Fat	Carbohydrate	Fiber	Ash
Strauss.....	72.62	1.97	0.81	...	13.08	...	1.89
Langworthy....	78.7	2.5	..	0.2	17.5	0.8	1.1
Shohl.....	79.0	3.1	0.9	0.2	15.5	0.8	1.1

The carbohydrate was determined by extracting either the fresh vegetable or the air-dried material for 72 hours with boiling water. The extract

[9] Goudberg, *Z. exptl. Path. Therap.*, **13**, 310 (1913).

[10] Joslin and Root, *J. Am. Med. Assoc.*, **80**, 1727 (1923).

[11] Plimmer, "Practical Organic and Biochemistry," London, **1915**, p. 213.

[12] Clark, "The Determination of Hydrogen Ions," Williams and Wilkins Co., **1921**.

was hydrolyzed by refluxing for 2 hours with 10% of hydrochloric acid. The levulose was determined by Benedict's method.[13] Fifty mg. of dextrose is equivalent to 52 mg. of levulose. The carbohydrate content was found to be 15.5%.

The nitrogen determination of the extract made as described above shows that of the nitrogen listed as "protein" 71.5% is readily water-soluble and hence not protein. The amino acid nitrogen determined by Van Slyke's method[14] is 27.5% of the water-soluble nitrogen.

Summary

Analysis of the Jerusalem artichoke shows that it contains 15.5% of inulin. Of the total nitrogen, 71.5% is water-soluble. It contains but small amounts of water-soluble B vitamin. Its use in the treatment of diabetes should be reinvestigated. Analysis, clinical experience and a single experiment in metabolism indicate that the Jerusalem artichoke is a valuable adjunct in the dietetic treatment of diabetes.

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[CONTRIBUTION FROM THE CHEMICAL LABORATORY OF CLARK UNIVERSITY, NO. I, 31]

REACTIONS OF STRONGLY ELECTROPOSITIVE METALS WITH ORGANIC SUBSTANCES IN LIQUID AMMONIA SOLUTION. IV. ACTION OF THE ALKALI METALS ON TRIPHENYLMETHYL AND ITS COMPOUNDS

BY CHARLES A. KRAUS AND T. KAWAMURA

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The triphenylmethyl group is the first example discovered of a class of compounds exhibiting certain characteristic properties. What attracted particular notice in the first instance was the fact that these compounds appeared to form an exception to the quadrivalence of the carbon atom. These groups, however, possess many other properties which serve to distinguish them, as well as their compounds, from other organic compounds. Thus, compounds of the triphenylmethyl group with the halogens exhibit electrolytic properties in solutions in certain solvents, while the groups also yield compounds with strongly electropositive metals, such as sodium, the properties of which characterize them as exceptional. We now know that many other elements yield compounds resembling the triphenylmethyl group as, for example, lead,[1] tin,[2] mercury[3] and nitrogen,[4] although the properties of these groups have not been extensively investigated.

[13] Benedict, *J. Am. Med. Assoc.*, **57**, 1193 (1911).

[14] Van Slyke, *J. Biol. Chem.*, **12**, 275 (1912).

[1] Rügheimer, *Ann.*, **364**, 53 (1909).

[2] E. Krause, *Ber.*, **54**, 2060 (1921); **55**, 888 (1922).

[3] Kraus, THIS JOURNAL, **35**, 1732 (1913).

[4] H. Weiland, *Ber.*, **48**, 1078, 1098, 1112 (1915).