THE COMPOSITION OF CHERRY GUM

(Abstract—Preliminary Analyses)

E. J. Petry

INTRODUCTION

In giving aid to some research on the origin of cherry gum (3) the writer was struck by the lack of data on the constituents of this pathological material. It seemed that more definite knowledge about these constituents would aid materially in such histo-chemical studies of gummosis as that referred to. Complete analyses, it was thought, might also have diagnostic value in pointing out causes of a malady which in certain regions brings about considerable losses.

That cherry gum is a complex mixture of cell constituents, which presents a formidable problem to the chemist, has been recognized by Czapek (4) and others. It was not therefore expected, by means of the preliminary analyses here reported, to identify and determine quantitatively all of the chemical bodies present in small quantities in this plant product. Nevertheless, the determination of the proximate principles and of pentosans and hexosans by methods lately worked out by Tollens and others promised to give a better working basis for the pathologist and histo-chemist, by revealing what bodies are present in sufficient amounts to influence the mass action and colloidal properties in the staining reactions which are so necessary in gummosis studies.

Cherry Gum, (Syn.: Germany, Prunoideengummi, Amygdaleen-fummi, Kirschgummi, Gummi nostras: France, Gomme du Pays,) includes a very wide range (10) of true gums, whose character and composition vary considerably. This is to be expected of a commercial article, which in Europe, at least, may be obtained from several species of cherry (10); e. g., Prunus avium L., Prunus cerasus L., Prunus domestica L., Prunus puddum Roxb.; several species of almond; e. g., Amygdalus communis L., Amygdalus leiocarpus Boiss., Amygdalus spartioides; and from the peach, Amygdalus persica L. Other genera, species, and varieties, including the plums and apricots, often furnish quantities of gum, which go by the above names in commerce.

In Europe, cherry gum is used mostly in the dyeing industry and to adulterate (6) gum arabic; while in Asia (Afghanistan et al.), besides these uses, it is collected and eaten by the natives (1).

In some of these uses a wide range of qualities is permissible, while in others more select grades, especially as regards color, are required. The so-called solubility, perhaps second as regards commercial value, is undoubtedly due to its colloidal nature. There is no doubt that it possesses as large and variable amounts of pentosans and hexosans as were found in other gums by O'Sullivan (9). Several solubility or dispersion tests performed by the writer showed great differences among samples of different origin, even when the original water-content was taken into consideration. Solubilities of oven-dry samples, and those dried at lower temperatures in vacuo, varied likewise. It is therefore believed that complete analyses of the numerous samples collected would have shown wide divergences in their pentosan and hexosan content. However, the limited opportunities at this time made it possible to analyze only a few relatively pure samples.

MATERIALS AND METHODS

The materials for the chemical analyses here reported consisted of colorless samples produced (1) by trauma, i. e., bruising, and (2) by chemical irritation, i. e., by dilute sulphuric acid applied to the bark of branches several inches in thickness. Their solubilities, as tested out upon natural, oven-dried, and vacuum-dried samples, did not vary significantly, hence no marked correlation between solubility and chemical composition was found. This is perhaps due to the great chemical similarity of these samples, as noted later.

The samples, in the form of clear stalactites, were collected from the under sides of branches of a variety of Prunus avium L., or common sweet cherry, during the summer of 1910. They were kept in glass-stoppered bottles, in a cool, moderately humid room. Samples numbers 6, 7, 10 and 14 were selected for analysis because each was available in large amount, thus permitting duplicate tests. Num-

ber 6 was produced by washing the bark with a 10 per cent. solution of sulphuric acid, while numbers 7, 10, and 14 were produced by mildly hammering the bark. Numbers 6 and 14 were from one tree, while numbers 7 and 10 were from another growing in a somewhat different soil.

The methods of analysis used were briefly as follows:

1. After weighing out large samples, they were dried to constant weight in vacuo at temperatures lying between 70° and 80°C. After re-weighing, the gum was ground fine enough to pass a 50-mesh (per inch) sieve, and was then stored in tightly stoppered bottles.

2. Total moisture and ash were then determined by the use of 2-gram samples in duplicate, according to the official method for food analysis (11). The calcium oxide of the ash was in several cases found to be over 50 per cent of the total ash.

3. The nitrogen was determined by the use of 2-gram samples in duplicate, according to the official Gunning method (11). The results were calculated to protein (N x 6.25 = Protein), and are found in Table I.

4. The ether extract was made by the use of cartridge extractors, according to the official method (11), 3-gram samples being used in duplicate.

5. The galactan was estimated from the ether extraction residues, according to the provisional method adopted by the A. O. A. C. (11); the amount of galactan present being calculated from the mucic acid found (mucic acid x 1.33 x 0.9 = galactan).

6. The araban was estimated according to the provisional method (Kober (8)) of the A. O. A. C. (11). The newer method of estimation of Boddner (2) was also used, the results being compared with those of the first method in Table II.

The arabinose was also estimated directly by hydrolysis, according to the method of Kiliani (7), 2 per cent, sulphuric acid being the catalyzer used. By special precautions, a nearly pure arabinose, with the following constants, was obtained: (1) Melting point 155° to 160° C.; (2) Rotation (d) 18°/D 103.85—104.20°; (3) Melting point of araban—p—brom-phenylhydrazone, 197.5° to 199° (average of 5 determinations 198.14°). The quantitative determination of arabinose in sample 14 by this method checked very satisfactorily with the official methods used.

7. Methyl pentosans were estimated by the method of Ellet and Tollens (5).

8. Reducing sugars were estimated by the provisional Allihn method of the A. O. A. C. (11). Fresh suspensions of gums gave little or no reduction of copper. After inversion by hydrochloric acid (11), positive results were obtained, but the reducing bodies were not identified. The very slow hydrolysis of the gum in the Kiliani method mentioned above indicated that small amounts of easily hydrolizable disaccharides were present.

9. Several of the commoner tests for tannin showed only minute traces present in some samples. The samples analyzed and tabulated showed no tannin.

10. Starch and cellulose tests showed the samples to be free from these compounds.

11. The pectin and other acid residues probably make up the largest part of the unestimated constituents. In Table I they are therefore derived by difference.

TABLE I. CONSTITUENTS OF CHERRY GUM

Constituents Estimated	Samples, Causes of Formation and Amounts of Constituents		
	Sulphuric Acid Stimulation	Traumatic, by bruising	
	Sample 6	Sample 7	Sample 14
Araban	55.40 %	62.30 %	53.22 %
Methyl-pentosan	8.52 "	9.52 "	8.78 "
Galactan	9.26 "	8.86 "	9.88 "
Reducing sugars	3.11 "	2.18 "	3.00 "
Ether extract	0.52 "	0.91 "	0.70 "
Protein (Nx6.25)	3.78 "	4.22 "	4.36 "
Ash	5.21 "	6.65 "	6.44 "
Water	12.13 "	11.20 "	10.53 "
Pectic and other acid residues	2.07 "	5.16 "	3.09 "
Totals	100.00 "	100.00 "	100.00 "

TABLE II. COMPARATIVE AMOUNTS OF ARABAN BY DIFFERENT METHODS

Method	Sample 10*. Araban	Sample 14. Araban
Krober	52.50 %	63.22 %
Boddner	52.23 "	63.01 "
Differences	.27 %	.21 %

* This sample was caused by bruising and was taken from the same tree (another branch) which furnished sample 7 in Table I, above.

SUMMARY AND CONCLUSIONS

The samples of cherry gum for which the most complete chemical analyses are here reported were produced either by chemical stimulation (sulphuric acid), or by trauma (hammer bruising). Other samples of traumatic origin, where the disturbing material remained in the wound, were highly colored; e. g., by iron stained black; and by copper, greenish-black. Bark and wood constituents apparently caused yellowish or a brownish (hadromal?) coloration.

Solubility experiments showed considerable differences in samples of different origin, both as to species of cherry and cause of gummosis. More research as to exact causes, and more precise methods as to water content, and colloidal technique, than could here be undertaken, are needed before reliable data upon these points can be obtained. In respect of the constituents determined for samples 6, 7, and 14, the solubilities could be correlated in general, as they were very similar.

The following general differences between samples produced by acid stimulation and traumatic stimulation, as shown in Table I, may be worthy of note: Acid irritation seems to produce more araban than bruising in the same tree (samples 6 and 14), while the methyl pentosan and galactan are slightly lower. Ether extract, protein and ash content are also lower, due to acid stimulation, while the hygroscopic (air dry) moisture is only slightly higher. That there may be considerable variation between two trees may be seen by a comparison of the analyses of samples 7 and 14, where the pentosan and galactan constituents, as well as

reducing sugars, show considerable variations which have no systematic relationship. Since branches having a southeastern exposure are the sources of all these samples, the differences in these trees of the same age can hardly be attributed to nutrition or carbon metabolism. It is possible that the ash constituents and protein are more easily transported from the center of activity when sulphuric acid is the disturbing factor.

Concerning the question of staining for pathological study, it is doubtful whether the slight differences here noted, in the amounts of the different carbohydrates, would have any notable effect. However, it is possible that gums due to parasitic action of bacteria or fungi might have widely different amounts of carbohydrates, and in sufficiently differing proportions, to affect the staining reactions. These could be checked by chemical analyses till some law of correspondence could be ascertained.

In such preliminary work as here undertaken, it is often of interest to use several methods for the estimation of a constituent, as a means of control. The newer, and in some respects better, method of Boddner for the estimation of araban, gave very closely agreeing results with those obtained by the Krober method, as shown in Table II. Sample 10 was taken from another part of the same tree which furnished sample 7, and its analysis here indicates that the gum from a given tree, when produced by the same cause (in this case trauma by bruising), may be expected to have practically identical composition.

In general, the production of gum, in the case of trauma, may be looked upon as a protective response, in which hydrolyzing enzymes are active. It is doubtless a case of destructive distribution of these enzymes by mixing of the protoplasm and rupture of cell walls. It is therefore of interest to see that chemical irritation may produce similar products in so nearly similar amounts; and leads irresistibly, in view of the dissimilarity of the two traumatic cases, to the idea that permeability for these enzymes is here, as well as in cases of parasitic gummoses, greatly heightened.

LITERATURE CITED

1. Aitchison. Zeitschrift d. osterr. Apothekerver: p. 29, 1881.
2. Boddner. J. f. Landw: 58:262, 1910.
3. Butler, O. A Study of Gummosis of Prunus and Citrus with Observations on Squamosis and Exanthema of the Citrus: Ann. Bot. 25: 1—, 1911.
4. Czapek, F. Biochemie d. Pflanzen; 1:554, 1905.
5. Ellet u. Tollens. J. f. Landw; 53:13, 1905.
6. Hofmeister, C. Ber. d. Deut. Bot. Ges; 16:239, 1898.
7. Kiliani. Ber. d. Deut. Chem. Ges.; 37: 1210, 1904.
8. Krober. J. f. Landw. 48:379, 1900.
9. O'Sullivan. Chem. News. 48: and 64:271.
———————. Chem. Soc. 1884, p. 41; and 1891, p. 1029.
———————. Chem. Centr. 1890, pp. 316 and 584.
———————. Chem. Centr. 1892, p. 137.
10. Wiesner, J. D. Rohstoffe d. Pflanzenreichs. 1: pp. 74,-107, 197, et al., 1900.
11. Wiley, H. W. (Editor) Official and Provisional Methods of the Association of Official Agricultural Chemists; U. S. Dept. Agr. Bull. No. 107 (Rev.) 1910.