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THE COMPOSITION OF EIGHT *ACACIA* GUM EXUDATES FROM THE SERIES *GUMMIFERAE* AND *VULGARES**

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Key Word Index—*Acacia*; Leguminosae; gum exudates; protein; glucose; chemotaxonomy; hybrid.

Abstract—An analytical study has been made of gum specimens from *Acacia hebeclada*, *A. kirkii*, *A. newbrownii* and *A. reficiens* (all of the series *Gummiferae*) and of *Acacia erubescens*, *A. fleckii*, *A. mellifera* ssp. *mellifera* and *A. mellifera* ssp. *detinens* (all of the series *Vulgares*). The data obtained give further support for the main chemotaxonomic differences between the *Gummiferae* and *Vulgares* species recorded previously. In addition, two of the species studied have exceptional features; the gum exudate from *A. hebeclada* contains 9.4% of nitrogen; that from *A. erubescens* contains 12% of glucose.

INTRODUCTION

The chemical compositions of the gum exudates from nearly 90 *Acacia* species are now known; the names of the species concerned have been listed recently [2] in series according to Bentham [3] under the subgenera of Vassal [4]. In continuation of the search in this laboratory for *Acacia* gums with unusual chemical features worthy of full structural investigation in the future, this report presents the analytical data obtained for eight *Acacia* species whose gum exudates had not been studied previously. In addition to revealing the existence of *Acacia* gums containing glucose and unusually high nitrogen contents, the analytical data obtained from this form of phytochemical survey are useful for chemotaxonomic purposes.

* Part 55 of the series "Studies of Uronic Acid Materials". For Part 54, see ref. [1].

RESULTS AND DISCUSSION

The analytical data obtained for the eight species studied are shown in Table 1. The four species belonging to the *Gummiferae* have highly positive specific optical rotations; the species belonging to the series *Vulgares* have strongly negative rotations. This substantiates a

Table 1. Analytical data for *Acacia* gums*

	Gummiferae				*Vulgares*			
	Acacia hebeclada	*Acacia reficiens*	*Acacia newbrownii*	*Acacia kirkii*	*Acacia fleckii*	*Acacia erubescens*	*Acacia mellifera* ssp. *detinens*	*Acacia mellifera* (Vahl) Benth. (Sudanese)
Moisture (%)	12.5	11.7	13.0	10.8	12.5	13.2	12.1	8.7
Ash (%)	n.d.	2.4	4.2	1.4	4.0	3.9	3.6	2.9
Nitrogen (%)	9.4	0.65	0.14	0.09	0.58	1.08	1.3	1.45
Hence protein (%) (N × 6.25)	59	4.1	0.88	0.56	3.6	6.8	8.1	9.1
Methoxyl (%)	2.5	1.7	0.50	0.93	0.47	1.4	0.82	1.7
Specific rotation, $[\alpha]_D$, degrees	+28	+89	+43	+54	−32	−31	−45	−56
Intrinsic viscosity, $[\eta]$, ml g^{-1}	13	12	13	8	13	8	21	23.5
Molecular weight, MW × 10^5	n.d.	3.77	3.65	2.08	4.15	2.0	10.4	4.1
Equivalent weight	521	1117	777	1817	918	874	822	843
Hence uronic anhydride (%)	33.8	15.8	22.6	9.7	19.2	20.1	21.4	20.9
% Sugar composition after hydrolysis:								
4-*O*-Methylglucuronic acid	15.0	10.1	3.0	5.6	2.8	8.4	4.9	10.2
Glucuronic acid	18.8	5.7	19.6	4.1	16.4	11.7	16.5	10.7
Galactose	44	41	45	36	39	39	44	43
Glucose	—	—	—	—	3	12	—	—
Arabinose	14	35	27	46	25	17	25	27
Rhamnose	8	8	7	8	14	12	9	9

* Collected in Namibia by Mr. Willy Giess, SWA Herbarium.

possible chemotaxonomic correlation that was noted previously [5].

The data presented for the two subspecies of *A. mellifera*, from widely differing geographical locations, indicate that the compositions of their gum exudates are extremely similar. The major difference recorded involves the MWs of the two specimens; this was also the major difference found in a recent study [1] of the variation between 15 different samples of *A. karroo* gum from widely different African locations. *Acacia laeta* has long been suspected to be a natural hybrid between *A. senegal* and *A. mellifera* [6]: the data now available for *A. mellifera* gum allow comparisons to be made with that published previously for the gums from *A. laeta* [7] and *A. senegal* [8]. The compositions of the three species are closely similar; it is interesting that, where differences occur, the values of the relevant parameters for *A. laeta* gum are intermediate between those for *A. mellifera* and those for *A. senegal*. This is further evidence that closely related *Acacia* ssp. give gum exudates that are closely similar in composition [1, 9, 10].

The gums from *A. fleckii* and *A. erubescens* have been found to contain glucose, as confirmed by the specific test involving glucose oxidase [11]. The presence of glucose in plant gums, first detected in the gum from *Anacardium occidentale* [11], may not be as uncommon as was at first supposed.

The most interesting feature of the analyses reported, however, concerns the remarkably high nitrogen content (9.4%) found for *A. hebeclada* gum. Until other very recent work, in which a nitrogen content of 7.2% was reported [12] for the gum from *A. torulosa* (*Juliflorae*), a nitrogen content of 1.66% [13] was the highest recorded for an *Acacia* gum. Previous studies [14] have shown the nitrogen content of the gums from *Acacia* and other genera to be proteinaceous in origin; attempts to free *Acacia* gum polysaccharides from proteinaceous matter without causing extensive degradation to the gum molecules were not successful [14]. It is important that the rôle played by the proteinaceous material in the production of the physico-chemical properties that are characteristic of the gum exudates should be clarified and that the existence of any direct polysaccharide–protein covalent linkage should be investigated. The relatively small protein content (< 10%) in the *Acacia* gums studied previously did not make such experiments particularly attractive, but knowledge of the existence of *Acacia* gums containing 7–9% of nitrogen, indicative of a possible protein or polypeptide content of 40–55%, now makes the study of such materials a matter of urgency.

EXPERIMENTAL

Origin of gum specimens. Gum exudates from the following species belonging to the series *Gummiferae* were collected on 6 September, 1975, at Otjitambi, District Outjo, Namibia, by Mr. W. Giess (SWA Herbarium, Windhoek): *Acacia hebeclada* DC., *A. reficiens* Wawra and *A. newbrownii* Burtt Davy; gum from *A. kirkii* Oliver was collected by Mr. Giess on 4 September, 1975, at Otjovasandu, District Outjo. Gum exudates from the following species belonging to the series *Vulgares* were collected as follows: *A. fleckii* Schinz and *A. erubescens* Welw. ex Oliver by Mr. H. D. von Alvensleben at Kumkauas, District Grootfontein, on 29 September, 1975; *A. mellifera* ssp. *detinens* (Burch.) Brenan by Mr. W. Giess at Otjitambi, District Outjo, on 6 September, 1975; and *A. mellifera* (Vahl.) Benth. ssp. *mellifera* Brenan at Gardud Forest Reserve, Republic of the Sudan, on 20 March, 1978, by Mr. A. G. Seif-el-Din, Gum Research Officer, Republic of the Sudan.

Analytical methods. The standard analytical methods have been described [15]. The quantities of gum available for analysis were small; the amount available from *A. erubescens* did not allow determinations of ash nor MW to be made. The extraction of glucose, and its specific identification by means of glucose oxidase, has been described [11].

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