

The Carbohydrates in Birchwood

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In a recently published paper Gustafsson *et al.*¹ have determined the carbohydrate composition of 20 different wood species, all of which were found to contain galactan, glucosan, mannan, araban and xylan. Shortly afterwards Jones and Schoettler² found L-rhamnose in a hydrolyzate of Trembling Aspenwood. Quite recently Björkqvist and Jörgensen³ found small amounts of galactose and rhamnose in hydrolyzates of *Betula pubescens*, *Betula verrucosa* and *Populus tremula*.

We have repeated our work concerning the two above mentioned birch species and investigated samples from trees grown in widely different locations. The samples consisted of normal wood as well as of tension wood. Extracted wood flour was hydrolyzed according to Hägglund *et al.*⁴. The hydrolyzates were deacidified with ion exchangers and evaporated to a smaller volume in vacuo after which the sugars in the hydrolyzates were examined by means of paperpartition chromatography. The chromatograms were quantitatively evaluated according to a photometric method

developed by Gustafsson *et al.*⁵. Some of the determinations were checked by extracting the chromatographically separated sugars with water and determining the sugar content of the extracts using Somogyi's reagent. The agreement between the different methods was good. The relative pentose destruction was observed according to Sundman *et al.*⁶ and the results expressed as polysaccharides in percentage of the total amount of carbohydrates are given in Table 1.

In normal wood the carbohydrate composition seems to be fairly constant and is the same for *B. pubescens* and *B. verrucosa*. The high content of xylan is characteristic. Tension wood contains more galactan and glucosan but less xylan than normal wood. This difference between normal wood and tension wood has previously been shown for *Eucalyptus regnans*⁷, and according to Jayme *et al.*⁸ tension wood of poplar contains less pentosans and more cellulose than normal wood of the same species. Considering that birch may contain considerable amounts of tension wood, analyses of average samples, representative of a whole birch trunk, often give lower xylan and higher glucosan contents than the above mentioned figures for normal wood.

In a separate series of experiments birch wood was subjected to a mild hydrolysis. In the hydrolyzates the above mentioned

Table 1.

Trunk N:o	Species	Kind of wood	Galactan %	Glucosan %	Mannan %	Araban %	Xylan %
1	<i>Betula pubescens</i>	Normal wood	2.2	59.8	0.7	0.8	36.5
2	»	»	2.6	57.6	0.9	0.9	38.0
3	»	»	2.5	55.2	3.0	1.0	38.3
3	»	Tension wood	11.6	73.5	0.4	Traces	14.5
4	»	Normal wood	2.5	54.1	2.5	0.9	40.0
4	»	Tension wood	9.6	71.6	0.5	Traces	18.3
5	» <i>verrucosa</i>	Normal wood	2.3	56.7	1.5	0.9	38.6
6	»	»	2.0	58.8	2.0	0.9	36.3
7	»	Tension wood	8.0	69.0	0.7	0.2	22.1

sugars and small amounts of rhamnose and some other not yet identified compounds could be detected.

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The Structure of Dibromocyclohexane of M.P. 49°

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When 1,4- or 1,3-cyclohexanediol is treated with HBr, two solid substances are obtained, one melting at 112°, the other at 49°. It is established beyond doubt that the former is the *trans*-1,4-derivative with both bromine atoms in α positions. Regarding the structure of the dibromide of m.p. 49°, however, conflicting viewpoints have been put forward. On the basis of rather unconvincing chemical arguments, it has been suggested that the substance is 1,2- or 1,3-dibromocyclohexane¹, 1-bromomethyl-3-bromocyclopentane² and 1,4-*cis*-dibromocyclohexane³. In 1938 the substance was investigated in this laboratory, using the visual method of electron diffraction. The

diffraction data made it seem probable that the substance was 1 α 3 α -dibromocyclohexane⁴. We have recently re-examined the substance, now using the sector method of electron diffraction. Considerable experimental difficulties were encountered and the diagrams obtained were not quite satisfactory. However, they seem to indicate that our earlier suggestion may be incorrect and that the substance probably is 1 α 4 ϵ -dibromocyclohexane. The experimental $\frac{\sigma(r)}{r}$ - curve is reproduced in Fig.

1, and appears to exhibit peaks due to both ϵ - and α -bonded bromine atoms. To account for the position of the maxima IV–VII, it is, however, necessary to assume certain deformations in the ideal 1 α 4 ϵ structure. The dotted curve in Fig. 1 and the interatomic distances given below have been computed from a model in which the carbon ring of the ideal 1 α 4 ϵ structure is flattened by increasing the tetrahedral angles C₄–C₃–C₂ and C₄–C₅–C₆ by 5°, the other valency angles being kept unchanged. Deformations are found also in other compounds containing ϵ -bonded halogen atoms, and are believed to be due to repulsion between these atoms and the nearest ϵ -bonded hydrogen atoms. The general agreement between experimental and theoretical curves is satisfactory, but maximum VII is much lower than should be expected. In the calculations a C–C distance of 1.54 Å and a C–Br distance of 2.01 Å were used. The maxima are interpreted as follows:

Position of max. (in Å)	Calc. interatomic distances (in Å)
I	1.53 C ₁ –C ₂ 1.54
II	2.02 C ₁ –Br ₁ 2.01
III	2.90 C ₁ –Br ₂ $\alpha\epsilon$ 2.91
IV	3.48 C ₁ –Br ₃ ϵ 3.45
V	4.24 C ₁ –Br ₃ α 4.30
VI	4.85 C ₁ –Br ₄ ϵ 4.11
VII	5.47 Br ₁ α –Br ₄ ϵ 4.87 5.52