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POLYSACCHARIDES FROM *Zingiber officinale*

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Ginger, *Zingiber officinale* Roscoe (Zingiberaceae), is a perennial herbaceous plant, a valuable foodstuff, and a medicinal plant, the rhizomes of which contain essential oil (1-3%), lipids (6-8%), amino acids, vitamins (nicotinic acid, vitamin A), and up to 50% starch.

Despite the wide use of ginger rhizome [1], detailed information about its chemistry is lacking. The goal of our research was to study the polysaccharides because this group of biologically active compounds possesses a broad spectrum of pharmacological activity and determines the properties of aqueous drug formulations.

The polysaccharides were studied by the previously described method [2]. Lipophilic substances were isolated by treating raw material with $CHCl_3$. Then sugars soluble in alcohol (SSA, 3.3%) were isolated in fractions. Descending PC on Filtrak FN 11,12 paper using *n*-BuOH:Py:H_2O (6:4:3) was performed. Monosaccharides were identified by development with anilinium acid phthalate (for hexoses) and alcoholic urea (for ketoses). The SSA contained arabinose, glucose, and fructose.

The residual raw material was extracted successively with cold and hot water (1:3 ratio), twice for each. The extracts were evaporated, precipitated with alcohol (1:3 ratio), and separated into WSPS-C and WSPS-H, respectively.

Then residual raw material was used to isolate pectinic substances (PS) using a mixture of oxalic acid and ammonium oxalate (0.5%) at 70°C twice (1:3 ratio). Extracts were combined, dialyzed against water, evaporated, and precipitated by alcohol (1:3 ratio). The resulting PS precipitate was separated and dried.

Hemicelluloses (HC) were isolated by extraction with base solution at room temperature twice (1:3 ratio). Extracts were neutralized with acetic acid, dialyzed against water, evaporated, and precipitated by alcohol (1:3 ratio). The resulting precipitate was centrifuged, washed with alcohol, dehydrated by acetone, and dried.

Table 1 gives the yields of hydrocarbons. It can be seen that the dominant polysaccharide in ginger rhizome was WSPS-H.

The monosaccharide composition of the isolated polysaccharides was established by full acid hydrolysis, which was performed for WSPS-C and WSPS-H using H_2SO_4 (1 N) for 10 h at 100°C; for PS and HC, H_2SO_4 (2 N) for 48 h at 100°C. This produced monosaccharide units, the compositions of which were investigated by PC and GC [3] (Table 1). The GC studies used the aldononitrile acetates [4].

WSPS-C, cream-colored powder; WSPS-H, light-brown powder. Both WSPS fractions gave a positive reaction for starch and contained galactose and glucose as the principal components. Therefore, these polysaccharides were glucogalactans and galactoglucans.

PS, white powder, insoluble in water, positive reaction with iodine. The C_f (46.8%) and C_e (1.08%), and λ (2.25%) were established by titration [5]. Therefore, PS were low-esterified pectins. The IR spectrum (ν_{max}, cm^{-1}) of PS exhibited absorption bands at 719, 851, 1022, 1235, 1377, 1455, 1615, 1651, 1682, 1728, 2853, 2922, and 3000-3400, characteristic of PS.

HC, brown powder, insoluble in water, very soluble in base, positive reaction with iodine, like the other fractions. IR spectrum (ν_{max}, cm^{-1}): 722 (CH), 974 (pyranose CO), 1155 (pyranose CO + glycoside CO), 1377 (CCH + COH), 1462 and 1614 ($\alpha \leq 200$ cm^{-1}), 2909 (CH).

Based on the results for the carbohydrate components of *Z. officinale*, the PS and WSPS fractions are considered the most promising for pharmacological research.

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TABLE 1. Monosaccharide Composition of Polysaccharides from *Zingiber officinale* Rhizome

Polysaccharide	PS yield, %	Ratio of monosaccharide units					
		Rha	Xyl	Ara	Glc	Gal	UAc
WSPS-C	7.33	-	-	1.0	9.14	23.4	-
WSPS-H	24.6	-	Tr.	1.0	36.6	19.5	-
PS	7.66	Tr.	1.0	1.1	1.8	2.86	+
HC	5.4	1.0	17.4	2.14	26.5	8.0	+

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