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FLAVONOIDS FROM LEAVES OF *Pyrus communis*, *Malus sylvestris*, AND *Malus domestica*

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Flavonoids form one of the most common groups of phenolic compounds and are widely distributed in the plant world. Hydroxyls in their molecules are responsible for their antioxidant activity, which is considered one of the required properties of drugs for treating such diseases as cancer, atherosclerosis, hypertension, infarct, etc. Flavonoids have a variety of effects on the human organism. They exhibit capillary strengthening, antioxidant, antiradiation, antitumor, anti-inflammatory, antiatherosclerotic, spasmolytic, hypotensive, estrogenic, and bactericidal activities. The main property of these compounds is their low toxicity and more often the lack of it [1, 2].

We investigated leaves of common pear *Pyrus communis* L., wild apple *Malus sylvestris* L., and domestic apple *M. domestica* Borkh. varieties Antonovka, Glory, and Whitesap, which are widely used in folk medicine to treat various pathologies. The goal of our work was to isolate and identify flavonoids from these types of raw material [2].

Ground and air-dried raw material was extracted with ethanol (50%) in a 1:10 (material:extractant) ratio. The aqueous alcohol extracts were combined and evaporated in vacuo to an aqueous residue. The resinous precipitate that formed on standing contained chlorophyll and was removed. The aqueous solution was treated successively with $CHCl_3$, ethylacetate, and butanol. The ethylacetate and butanol fractions were evaporated to dryness and chromatographed over a polyamide column (d, 1.5; h, 50 cm) with elution by $CHCl_3$ and a $CHCl_3$:EtOH mixture with a gradually increasing concentration of the latter to 20%. Thus, we isolated 18 compounds of flavonoid nature [3].

The structures of the isolated compounds were elucidated using physicochemical, chemical, and biochemical analytical methods (PC and TLC; UV, IR, and PMR spectroscopy; optical activity; melting points; acid and enzymatic hydrolysis) [3].

The products from acid hydrolysis of compound **2** contained according to chromatographic and physicochemical methods (acetylation, methylation, alkaline degradation, melting point, direct and differential UV spectroscopy using ionizing and complexing reagents) the aglycon phloretin; **6**, apigenin; **8**, luteolin; **10**, kaempferol; and **12**-**16**, quercetin. Compound **16** contained glucose and rhamnose; **2**, **6**, **8**, **10**, and **14**, glucose; **12**, galactose; **13**, rhamnose; and **15**, arabinose. The structures of the carbohydate substituents were elucidated using enzymatic hydrolysis by rhamnodiastase and grapevine snail enzyme.

Acid hydrolysis of **1**, **3**, **4**, **5**, **7**, **9**, **11**, **17**, and **18** enabled them to be assigned as flavonoid aglycons. Their structures were elucidated by chromatography; alkaline degradation; acetylation; methylation; UV, IR, and PMR spectroscopy; and melting point [3-7].

Thus, the investigations of the compounds isolated from leaves of pear and apple varieties identified them as the following.

1, $C_{15}H_{14}O_5$, mp 257°C, λ_{max} 225, 286 nm; 3-(4-hydroxyphenyl)-1-(2,4,6-trihydroxyphenyl)-1-propanone or phloretin;

2, $C_{21}H_{24}O_{10}$, mp 170-171°C, λ_{max} 225, 286 nm; 1-[2-(*β*-D-glucopyranosyl)-4,6-hydroxyphenyl]-3-(4-hydroxyphenyl)-1-propanone or phloridizin;

3, $C_{15}H_{13}O_3$, mp 174-176°C, λ_{max} 280 nm; D-3,5,7,3′,4′-pentahydroxyflavane or (+)-catechin;

4, $C_{15}H_{13}O_5$, mp 243-245°C; L-3,5,7,3′,4′-pentahydroxyflavone or (-)-epicatechin;

5, $C_{15}H_{10}O_5$, mp 345-346°C, λ_{max} 275, 321, 401 nm; 5,7,4′-trihydroxyflavone or apigenin;

6, $C_{21}H_{20}O_{10}$, mp 228-230°C, λ_{max} 272, 343 nm; apigenin-7-*O*-*β*-D-glucopyranoside or cosmosiin;

7, $C_{15}H_{10}O_6$, mp 327-328°C, λ_{max} 255, 318, 350, 410 nm; 5,7,3′,4′-tetrahydroxyflavone or luteolin;

8, $C_{21}H_{20}O_{11}$, mp 257-259°C, λ_{max} 257, 352 nm; luteolin-7-*O*-*β*-D-glucopyranoside or cinaroside;

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9, $C_{15}H_{10}O_6$, mp 276-278°C, λ_{max} 366, 266 nm; 3,5,7,4′-tetrahydroxyflavone or kaempferol;

10, $C_{21}H_{20}O_{11}$, mp 175-176°C, λ_{max} 375, 270 nm; 5,7,4′-tetrahydroxyflavone 3-*O*-β-D-glucopyranoside or astragalin;

11, $C_{15}H_{10}O_7$, mp 310-312°C, λ_{max} 375, 268, 256 nm; 3,5,7,3′,4′-pentahydroxyflavone or quercetin;

12, $C_{21}H_{20}O_{12}$, mp 235-236°C, λ_{max} 350, 255, 265 nm; 5,7,3′,4′-pentahydroxyflavone 3-*O*-β-D-galactopyranoside or hyperoside;

13, $C_{21}H_{20}O_{11}$, mp 182-185°C, λ_{max} 355, 257 nm; 5,7,3′4′-pentahydroxyflavone 3-*O*-β-D-rhamnopyranoside or quercitrin;

14, $C_{21}H_{20}O_{12}$, mp 227-229°C, λ_{max} 355, 267, 256 nm; 5,7,3′,4′-pentahydroxyflavone 3-*O*-β-D-glucopyranoside or isoquercitrin;

15, $C_{20}H_{18}O_{11}$, mp 220-222°C, λ_{max} 358, 257 nm; 5,7,3′,4′-pentahydroxyflavone 3-α-L-arabinofuranoside or avicularin;

16, $C_{27}H_{30}O_{16}$, mp 189-192°C, λ_{max} 362, 268, 258 nm; 5,7,3′,4′-pentahydroxyflavone 3-*O*-β-D-glucopyranosyl-6-*O*-α-L-rhamnopyranoside or rutin;

17, $C_{16}H_{12}O_7$, mp 167-170°C, λ_{max} 370, 265, 254 nm; 3,5,7,4′-tetrahydroxy-3′-methoxyflavone or isorhamnetin;

18, $C_{15}H_{10}O_8$, mp 352-354°C, λ_{max} 374, 272, 254 nm; 3,5,7,3′,4′,5′-hexahydroxyflavone or myricetin.

Thus, apigenin, luteolin, kaempferol, and myricetin were isolated for the first time from leaves of *P. communis*, *M. sylvestris*, and *M. domestica*, which can be used as taxonomic markers to identify the genera *Malus* L. and *Pyrus* L.

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