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The influence of the extraction conditions on the quality of extracts of common plantain (*Plantago major* L.)

INTRODUCTION

Plants of the genus *Plantago* (plantain) have been used as medicinal plants for over four thousand years. One of the most common species of this genus in Poland is common plantain (*Plantago major* L.). Its leaves are used in folk medicine for the treatment of gastrointestinal disorders and for wound healing.

In the present study the usefulness of herb and underground organs of common plantain as a source of phenolic compounds was evaluated and the influence of extraction conditions on the effectiveness of isolation of these compound was determined.

RESULTS

le 1. Technological performance herb extraction (%)

MATERIALS AND METHODS

The study was carried out in the 2014 year.

The raw materials were obtained from the population of common plantain grown at the experimental field of the Dept. of Vegetable and Medicinal Plants. Herb was collected at the stage of flowering, and roots in autumn. The raw materials were dried at 35 °C. Three extraction methods (extraction under reflux, Soxhlet-type extraction in Büchi B-811 extraction system, and ultrasound-assisted extraction), four extraction media (water, ethanol 100%, ethanol 70%, and ethanol 40%), and two raw material to solvent ratios (1:10 and 1:20) were applied. Each variant of extraction was evaluated in respect of the technological efficiency and the efficiency of isolation of tannins, phenolic acids, and flavonoids. The biologically active compounds was determined according to the method described in Pharmacopoea VIII (2008).

Raw material/ Solvent		Soxh	Under reflux				Ultrasound-assisted					Mean for					
	Water	EtOH	EtOH	EtOH	Water	EtOH	EtOH	EtOH	Water	EtOH	EtOH	EtOH	\\/ator	EtOH	EtOH	EtOH	Mean for raw material/solvent
		40%	70%	100%	vvater	40% 70	70%	100%		40%	70%	100%	Water	40%	70%	100%	
1:10	16.5	32.7	26.9	16.8	5.0	11.9	12.8	9.1	8.8	9.2	14.9	9.0	10.1	17.9	4.8	11.6	14.5 B
1:20	32.3	35.6	22.2	22.9	16.7	20.3	19.9	12.8	16.2	19.0	10.7	6.3	21.7	30.0	20.5	14.0	19.6 A
Mean	24.4b	34.2a	24.6b	19.8c	10.8a	16.1a	16.4a	10.9a	12.5b	14.1a	12.8b	7.7c	15.9	21.5	17.9	14.5	
Mean for extraction	25.7 A				13.6 B					11	8C	•					•

Table 2. Content of poliphenolic acids in herb (mg·100 g s.m⁻¹)

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Raw material/ Solvent		Soxh		Under	Ultrasound-assisted					Mean for	D. G						
	Water	EtOH	EtOH	EtOH	Matar	EtOH	EtOH	EtOH	Water	EtOH	EtOH	EtOH	Water	EtOH	EtOH	EtOH	Mean for raw material/solvent
		40%	70%	100%	Water	40%	70%	100%		40%	70%	100%		40%	70%	100%	
1:10	16.5	32.7	26.9	16.8	5.0	11.9	12.8	9.1	8.8	9.2	14.9	9.0	10.1	17.9	4.8	11.6	14.5 B
1:20	32.3	35.6	22.2	22.9	16.7	20.3	19.9	12.8	16.2	19.0	10.7	6.3	21.7	30.0	20.5	14.0	19.6 A
Mean	24.4b	34.2a	24.6b	19.8c	10.8a	16.1a	16.4a	10.9a	12.5b	14.1a	12.8b	7.7c	15.9	21.5	17.9	14.5	
Mean for extraction	25.7 A				13.6 B					11	.8C						1

Table 3. Content of flavonoids in herb (mg·100 g s.m⁻¹)

Raw material/ Solvent		Soxl	Under reflux				Ultrasound-assisted]	Mean for	Maan fan naw				
	Water	EtOH	EtOH	EtOH	Water	EtOH	EtOH	EtOH	Water	EtOH	EtOH	EtOH	Water	EtOH	EtOH	EtOH	Mean for raw material/solvent
		40%	70%	100%		40%	70%	100%		40%	70%	100%		40%	70%	100%	
1:10	0.35	0.57	0.83	1.55	0.37	0.64	0.95	4.61	0.17	0.73	1.61	10.25	0.30	0.65	1.13	5.47	1.89 B
1:20	0.57	1.59	1.06	2.40	0.32	0.55	1.05	8.97	0.12	0.73	1.44	8.24	0.34	0.96	0.89	6.54	2.25 A
Mean	0.46c	1.08b	0.95bc	1.98a	0.35d	0.60c	1.00b	6.79a	0.15d	0.73c	1.53b	9.25a	0.32	0.81	1.01	6.00	
Mean for extraction		1.12	. C	2.18 B					2.9	1 A	•						

CONCLUSION

- 1. The highest technological efficiency was characteristic for the Soxhlet-type extraction with ethanol 40% and 1:20 raw material to solvent ratio.
- 2. Phenolic acids were extracted most efficiently with the same method but with ethanol 70% used as a solvent, whereas flavonoids were better extracted with ethanol 100%.

