THE INFLUENCE OF TIME AND STIRRING OF EXTRACTION AND DIFFERENT SOLVENT ON CONCENTRATION OF FLAVONOIDS

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In the last decade, a healthy lifestyle has become popular in the world so people are increasingly willing to use products made from natural plant materials. Scientists carry out a variety of research to find out which plant material is rich in vitamins, antioxidants and other useful active substances necessary for the human body. Most often studied and analysed are medicinal plants, which abound in Lithuania. Rowan, Sorbus aucuparia L., that is widespread in Lithuania attributed to medicinal plants and that have medicinal characteristic [1].

On the data basis of various, scientific articles [2–3] there are carotenoids, flavonoids, and organic acids (succinic, malic and citric), various vitamins (C, E, K, P), essential oils, leaven, carbohydrates, minerals (Zn, Fe, Mg and Mn compounds) in rowan berries. In O. Ragažinskienė [4] and in other literature sources are indicated the concentrations of the various active substances in fresh rowan berries which are identified during the investigation such as: carotenoids up to 65.0 mg / 100 ml; vitamin C 44.5–72.5 mg / 100 ml; iodine 1.5–2.4 mg / 100 ml; vitamin E 0.6–1.6 mg / 100 ml; saccharides 4.0–7.0%; flavonoids 0.13–2.1 %; sorbic acid and sorbitol up to 3.0 %; other organic acids 1.9–2.6 %; yeast to 0.45 %.

In this experiment, the dried minced rowan berries were poured out with various concentrations of ethanol solutions, ratio 1:10. To evaluate different factors influencing the concentration of flavonoids, extracts were produced not only by changing the ethanol concentration, but by also using different stirring techniques. Stirring with a magnetic and propeller stirrers (the same stirring speed is maintained) and changing the stirring time (30 minutes and 1 hour). The results of this experiment are presented in Table 1.

Table. 1. The influence of time and stirring of extraction and different solvent on concentration of flavonoids

Concentration of ethanon	Duration											
	0,5 h						1 h					
	Stirrer						Stirrer					
	Magnetic			Propeller			Magnetic			Propeller		
	$\bar{X}^*$	$S^2_x \cdot 10^{6\,**}$	$S_x \cdot 10^{6\,***}$	$\bar{X}^*$	$S^2_x \cdot 10^{6\,**}$	$S_x \cdot 10^{6\,***}$	$\bar{X}^*$	$S^2_x \cdot 10^{6\,**}$	$S_x \cdot 10^{6\,***}$	$\bar{X}^*$	$S^2_x \cdot 10^{6\,**}$	$S_x \cdot 10^{6\,***}$
	Average concentration of flavonoids, %											
50%	0,043	1,53	0,77	0,040	0,43	0,21	0,074	3,31	1,66	0,071	0,57	0,28
60%	0,050	2,71	1,35	0,048	0,04	0,02	0,091	0,68	0,34	0,084	3,24	1,62
70%	0,069	2,60	1,30	0,062	2,28	1,14	0,126	1,53	0,77	0,118	0,32	0,16
80%	0,155	0,10	0,01	0,151	0,32	0,16	0,250	0,04	0,08	0,219	1,74	0,09
96%	0,304	0,60	0,30	0,286	2,81	1,40	0,492	1,32	0,66	0,488	1,39	0,69

* – $\bar{X}$ – Average concentration of carotenoids, %
** –S^2_x– Variance
*** – S_x – Standard deviation

The table shows the data, that when ethanol concentration increases the concentration of flavonoids increases too. During extraction using a magnetic stirrer we receive a higher concentration of flavonoids than stirring with propeller stirrer. The highest concentration of flavonoids was found, as an extract produced using 96 % ethanol, stirring for 1 hour with a magnetic stirrer (0.492 %), lowest – using 50 % ethanol and stirring for 0.5 hour with propeller stirrer (0.040 %). Stirring extract for 1 hour concentration of flavonoids is almost twice as high on average as stirring for 30 minutes. It can be concluded that stirring accelerates extraction, but by extraction with stirring 1 hour maximum concentration of flavonoids was not reached and in order to get optimal results, the experiment should be continued with a longer stirring time.

Preparation of extraction by stirring is not the only way to produce extraction, to find out which extraction method is optimal taking in to account flavonoid concentration, extraction time, temperature, berries processing ways and extractor concentration. Extraction with a Soxhlet apparatus has also been tested, but the experiment has not been completed therefore, no results can be provided.

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[2] M. Olszewska. et al., 2008. Separation of quercetin, sexangularetin, kaempferol and isorhamnetin for simultaneous HPLC determination of flavonoid aglycones in inflorescences, leaves and fruits of three Sorbus species. Journal of Pharmaceutical and Biomedical Analysis, vol. 48, p. 629–635. Prieiga per internetą: https://doi.org/10.1016/j.jpba.2008.06.004.
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