Study of the Production of Secondary Metabolites in Shoot and Callus Cultures and Field Grown Plants of Hop

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Introduction: Biotechnology offers the possibility of using cells, tissues, organs or the whole organisms growing *in vitro* for the production of chemical compounds. The *in vitro* plant cultures are able to produce and accumulate a lot of secondary metabolites (Matkowski, 2008). Polyphenols (for example cumarins, flavonoids, tannins, stilbens, hydroxylderivates of cinnamic acid, etc.), alkaloids, terpenoids, and steroids (Namdeo, 2007) can be attractive for the use in practice.

Secondary metabolites produced by the plant organ cultures are very similar to the secondary metabolites of mother's plants (Luczkiewicz et al., 2005). For the production of flavonoids, the callus cultures were prepared from many plants, e. g. Milk thistle (S*ilybum marianum* L.), St. Johnswort *(Hypericum perforatum L.)*, Dandelion *(Taraxacum officinale* L.*)*, Drosophyllum *(Drosophyllum lusitanicum* L.), (Jedinák et al., 2004). Callus cultures of hop (Fowler et al., 1987) were used for the analysis of biosynthesis alpha bitter acids and for phytochemical studies (Chandra et al., 1991).

The content of biologically active substances in hop extracts is a prerequisite for the potential use of hop crops and explant cultures to produce these substances for pharmaceutical, food, or agricultural uses.

Material and Methods: The substances, secondary metabolites, were identified by the standard analytical spectrophotometric methods. We identified the concentration ranges of polyphenols, flavonoids, in cultivars of hop from the Gene Bank of the Slovak Republic, wild hop, shoot and callus cultures.

Results:

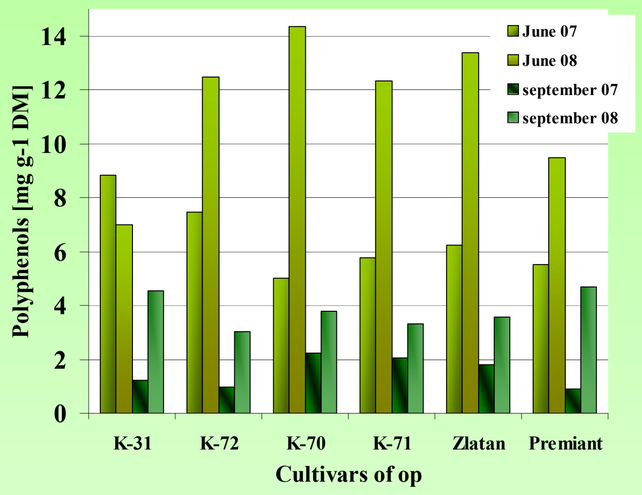

Fig. 1 Polyphenols content in hop leaves in 2007, and 2008

Tab. 1 Flavonoids content in hop leaves in 2007, and 2008

Cultivars	Flavonoids [mg g-1 DM]			
	6/07	6/08	9/07	9/08
K-31	6.37±0.51	0.24±0.02	0.65±0.02	0.1±0.01
K-72	6.31±0.49	1.43±0.05	0.48±0.02	0.2±0.01
Bor (K-70)	3.45±0.12	0.15±0.01	0.71±0.01	0.16±0.02
Sládek	3.24±0.21	0.25±0.01	0.76±0.01	0.15±0.01
Zlatan	5.03±0.22	0.14±0.01	0.61±0.01	0.13±0.01
Premiant	2.13±0.09	0.19±0.01	0.72±0.01	0.18±0.01

Tab. 2 Polyphenols and flavonoids content in shoot and wild hop

Cultivars	Polyphenols [mg.g^{-1} DM]	Flavonoids [mg.g^{-1} DM]
Premiant	2,27±0,09	1,43±0,08
Bor (K-70)	2,96±0,11	1,51±0,08
K-72	3,04±0,09	1,44±0,09
Wild Hop	4,00±0,14	0,50±0,02

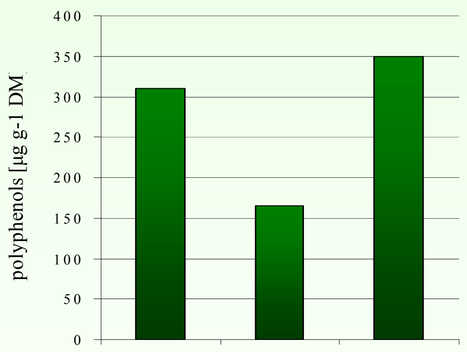

Fig. 2 Polyphenols content in callus cultures

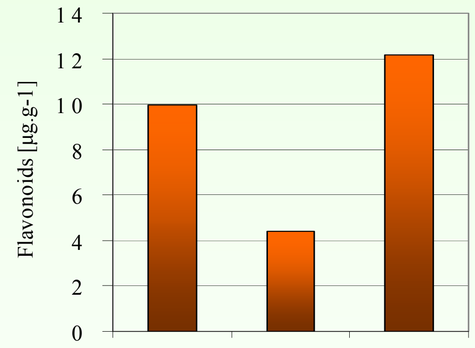

Fig. 3 Flavonoids content in callus cultures

Conclusion:

The content of polyphenols in the shoot cultures was comparable to its amount in extracts from cones of wild hops and almost a third lower than in the leaves of the field grown cultivars stored in the gene bank. The content of flavonoids was six to eight times higher in the shoot cultures than in the leaves of the field grown plants at the beginning of the growing season. The possible reason for this was the unfavourable weather condition for the formation of these metabolites in the field grown plants, because in the year in which the climatic conditions were favourable (2007), the content of flavonoids in shoot cultures was three to six times lower. The amount of secondary metabolites in callus extracts was of one order of magnitude and of two to three orders of magnitude lower than in extracts from shoot cultures, regarding polyphenols and flavonoids, respectively. Optimization of cultivation of hop tissue cultures gives the possibility to use these experimental models for studying overproduction of polyphenols or other bioactive substances.

Literature:

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