

RESEARCH PROGRAMS IN THE EDIBLE HONEYSUCKLE, THEIR RESULTS IN THE CONDITIONS OF SLOVAKIA AND OUR FUTURE INTENTIONS

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In Slovakia the edible honeysuckle has represented a new very perspective berry crop due to a nutritional value of fruit based on high accumulation of anthocyanins associated with a high content of ascorbic acid and polyphenolic compounds. Breeding process in Slovakia has been focused on selection of new cultivars characterised by large - fruited berries, regular maturation of fruit without their prematurely dropping and a high content of ascorbic acid combined with a valuable polyphenolic compounds.

In Slovakia we have 2 registrated varieties of the edible honeysuckle:

1. 'Amur' variety was selected in Research Institut of Fruit and Decorative Trees in Bojnice in 2001 from free pollination of Gerda, the Russian variety,

2. 'Altaj' was selected from the crossing of *Lonicera kamtschatica* X *Lonicera turczaninowii* in the same Institut in 2001.

1 Description of experiment area in Nitra

An experimental area (photo 1) with the edible honeysuckle at Slovak University of in Nitra was established in the autumn of 1994. Two species – *Lonicera kamtschatica* (Sevast.) Pojark cultivar Gerda / 25 and *Lonicera edulis* Turcz.ex Freyn. (photo 2) were planting at spacing 2,0 X 1,5 m using 2 – years - old seedlings from Kamtschatka. Firstly, it was evaluated influence of drip - irrigation on the nutritional value of fruit, growth dynamics, so the experimental areas was divided in the 2 equal blocks included irrigated and non - irrigated variants. Recently, the experimental area was maintained without irrigation.



Photo 1: Experimental area with 9 – year's old seedlings (MATUŠKOVIČ, 2003).



Photo 2: Shoots of *Lonicera edulis* with berries (ĎURIŠOVÁ, 2008)

In autumn 2002 genofond with 2 botanical species was extended in further 27 clones of *Lonicera kamtschatica* gifted by Herbaton Klčov s.r.o (namely LKL - 7, 20, 35, 2, 3, 5, 6, 14, 15, 16, 18, 19, 21, 31, 33, 42, 48, 49, 52, 54, 58, 60, 66, 78, 96, 102 and 103). Biological materials – clones of *Lonicera kamtschatica* were selected from hybrid seeds from Lisavenko state research Institute of Siberian Horticulture by breeders of Herbaton Klčov s.r.o., where achieved seedlings were selected and propagated by cuttings. Clones were cultivated in rows in 5 repetitions in space 1,5 X 1 m. The main guestor of the research in edible honeysuckle is prof. Ing. Ján Matuškovič, PhD. from Slovak University of Agriculture and he intensively coooperate with RNDr. Tünde Juríková, PhD. from Constantine the Philosopher University in Nitra.

The soil and climatic conditions of the position of cultivation were follows: open level, 130 m above sea level, corn processing area, clay-loam – drift, pH 6,4, mould content of 3,5%, precrop black fallow, average rainfall of 564 mm per year, the temperature in vegetation period of 16.3°C.

We also cooperate closely with Mendel University of Agriculture and Forest in Brno (Czech Republic). Their collection originated from Pavlov Research Institut VIR in Sankt Peterburg, another was delivered within the framework of cooperation with Herbaton Klčov, s.r.o. In terms of the prospects of the varieties for production in the Czech Republic the most important are following: 'Fialka', 'Altaj', 'Amur', 'Tomička', 'Nimfa', 'Vasjuganskaja' and 'Morena' (ŘEZNÍČEK et al., 2003).

2 Characteristics of state of our research in the edible honeysuckle

2 projects included the main aims of research on the edible honeysuckle:

VEGA 1/766/20 Agrobiological factors influenced the successful cultivation of apricots and honeyberry (*Lonicera kamtschatica*) (2000 – 2003)

The provided research put attention to growth dynamics, influence of irrigation regime, locality on nutritional value of two botanical species – *Lonicera kamtschatica* and *Lonicera edulis*. It was also studied the accumulation of the heavy metals and nitrates in the berries of species and water regime.

In first part we offer you a short review of all achieved results with references, in which you can find more information about tasks.

Task 1: Study of growth dynamics of the edible honeysuckle

The growth dynamics of two species of the edible honeysuckle – *Lonicera edulis* and *Lonicera kamtschatica* were evaluated during 2002 - 2005. The height of shrubs in case of *Lonicera edulis* (1,25 m) was very similar to values previously reported in Russia (1,5 m). In term of the evaluated years statistically significant differences were achieved within both species. The correlation between the observed month III - VII and the heights in these months was statistically significant ($\alpha = 0,05$) in all evaluated years and both species. The value of the coefficient of correlation range from 0,9813 to 0,9942. It means a very strong relations between the observed values of shrubs heights in the individual month statistically significant on the probal level $\alpha = 0,05$ (MATUŠKOVÍČ – JURÍKOVÁ- ANTALÍKOVÁ, 2006)

Task 2 : Study of nutritional value of *Lonicera kamtschatica* and *Lonicera edulis* berries

The berries of two species were examined for the content of dry mater, sugar, organic acids, ascorbic acid, mineral substances - K, Ca, P, Mg, Na and anthocyanins from pomace and saft. The results of our experiments refer to the exceptionally high content of ascorbic acid ranging from 28,56 up to 86,96 mg/100g, pottasium 10 175-14 764 mg/kg and anthocyanins from pomace 8, 72 - 17,36 g/ kg and saft 0,61 - 9,68

g/l. The values of ascorbic acid vary and they were statistically significantly depending on year. Similarly, only a year can be taken into account as a statistically significant factor forming content of sugar, magnesium and sodium. The content of dry matter, organic acids, potassium, calcium and anthocyanins in soft was influenced not only by year but also by species. The interaction species - year as a source of statistically significant differences is evident in case of phosphorus and organic acids. The statistically significant influence of irrigation was not confirmed from point of view all evaluated nutrients (POKORNÁ - MATUŠKOVIČ, 2006; JURÍKOVÁ – MATUŠKOVIČ, 2007a). Influence of species and irrigation was also evaluated by fuzzy c- means clustering – program FCM and according to membership degree variants were divided into two individual clusters. Results of fuzzy cluster analyses confirmed a significant differences between *Lonicera kamtschatica* and *Lonicera edulis* species and no differences between irrigated and non - irrigated variants of these species in dry matter, sugar, organic acids, ascorbic acid content (JURÍKOVÁ, MATUŠKOVIČ, 2007b). Fuzzy cluster analyses was also used to evaluate locality influence on the content of sugar, ascorbic acid, organic acids and anthocyanins in the relation to all evaluated nutrients. For these analyses there were used samples from 2 localities (with 2 different climatic conditions) of plant growing - Nitra and Bojnice over 2001 – 2003. Two botanical species – *Lonicera kamtschatica* and *Lonicera edulis* from Nitra (irrigated and non – irrigated variants), Bojnice (only non – irrigated variant) and 3 cultivars – a bitter cultivar of *Lonicera edulis*, 'Amur' and 'Altaj' from Bojnice were examined especially for the content of sugar, ascorbic acid, organic acids and anthocyanins in the relation to all evaluated nutrients. Results of fuzzy cluster analyses pointed to a significant effect of locality in term of ascorbic acid, sugar content and all nutrients evaluated together. On contrary, in case of organic acids and anthocyanins synthesis the botanical species / cultivar have played a more significant role than the locality effect. The results of our study have not confirmed the significant effect of irrigation in term of all evaluated nutrients. (JURÍKOVÁ – MATUŠKOVIČ – ŠIMKO, 2007).

Task 3: Study of heavy metals and nitrates accumulation by *Lonicera kamtschatica* and *Lonicera edulis* berries

During 2002 – 2004 it has been evaluated accumulation of heavy metals – lead, cadmium, mercury and nitrates by berries of 2 botanical species *Lonicera kamtschatica* and *Lonicera edulis*.

On the basis of obtained results we can claim increased amount of lead nearly three time more than permitted concentration in both species in 2003. In respect of cadmium it has not been exceeded the permitted concentration 0,05 mg/kg in all samples. In 2002 and 2003 we have recorded higher content of mercury in both species, which in 2002 represented more than double of permitted contents. The permitted content of nitrates - 150 mg/kg in fruit has not been exceeded during observed period 2002 - 2004 (MATUŠKOVIČ - JURÍKOVÁ, 2005).

Task 4: Observation of water regime of *Lonicera kamtschatica* and *Lonicera*

edulis

The observation of water regime of *Lonicera kamtschatica* and *Lonicera edulis* seem to be a very important part because the edible honeysuckle were introduced into new, totally different conditions for them – south Slovakia with deficit of regular percipitation. There were evaluated intensity of transpiration (stomatic and cuticular) to observe differences between irrigated and non – irrigated variants of *Lonicera kamtschatica* and *Lonicera edulis*. The results of our experiment showed that non irrigated variants of both evaluated species displayed higher values of intensity of transpiration (POKORNÁ – MARENČÍK – PODOLÁKOVÁ, 2002; MARENČÍK - POKORNÁ, 2003).

As a result of our project, monography was issued by Matuškovič et al. in 2005 with following chapters:

- a) Possibilities of *Lonicera* breeding and their results achieved within the territory of Slovakia,
- b) *Lonicera* breeding in the conditions of Czech republic,
- c) Agrobiological possibilities of *Lonicera* cultivation in Slovakia,
- d) Possibilies of *Lonicera caerulea* in utilization of secondary matabolities in food processing and pharmacy,
- e) Observation of transpiration in aspect of increasing yield and berries quality.

2 VEGA 1 (4410) 07 project entitled:“ Agrobiological aspects of the planting of edible honeysuckle, content of the nutritious matters and anthocyanins in fruits“ (2007 – 2009)

In the second project we have focused our attention to determination of anthocyanins, dry mater, organic acids, ascorbic acid, sugar, mineral matters – phosphorus, potassium, calcium, natrium, heavy metals – cadmium, lead, mercury in collection of 27 clones of *Lonicera kamtschatica*. The growth dynamics of clones has been assesed too. This project has not been completed yet, so in review we can show you only results of our preliminary observations. The most important task in this project is selection of the most perspective clones in term of content of anthocyanins, ascorbic acid.

Task 1: Evaluation of ascorbic acid and anthocyanins content in a collection of 22 clones of *Lonicera kamtschatica*

In the first part of our research we focused our attention to study a collection of 22 clones of *Lonicera kamtschatica* (Sevast) Pojark in term of anthocyanins and ascorbic acid content in the conditions of Nitra in 2005 – 2007. Results of chemical analyses and their statistical evaulation pointed to a wide variation range of anthocyanins that was the most significant in 2007 (5,96 – 19,18 g/kg), followed by 2005 (6,45 – 13,95 g/kg) and the lowest variability was characteristics for 2006 (5,86 – 10,82 g/kg). Variability of acorbic acid content had reverse order 2006 (10,02 – 92,29 mg/100 g) >2005 (24,15 – 67,98 mg/100g), > 2007 (9,71 – 46,47 mg/100g). The content of ascorbic acid and anthocyanins was statistically significantly

depending on climatic conditions (influence of year) while in term of anthocyanins as a statistically significant can be considered differences between 2005 – 2007, 2006 – 2007, difference between 2005 – 2006 was on the border of probability level $\alpha = 0.05$. For ascorbic acid content they were confirmed a statistically significant differences between years 2005 – 2006 and 2006 – 2007.

In respect of anthocyanins and ascorbic acid content clones LKL - 19 (12.21 g/kg, 48.77 mg/100g) a LKL - 18 (11.8 g/kg, 56.11 mg/100g) seem to be the most perspective (MATUŠKOVIČ et al., 2008).

Evaluated anthocyanin content in non – traditional fruit species included mulberry, cornelian berry, blackberry, blackthorn, rowan and samples of *Lonicera kamtschatica* and their clones we can claim that the edible honeysuckle seemed to be the most important source of anthocyanins (TURIANICA et al., 2008).

Task 2 Growth dynamics of clones in the conditions of Slovakia

Secondly, we evaluated the growth dynamics of set of clones *Lonicera kamtschatica* in the conditions of Nitra. The measurements of shrubs were provided twice a year (in spring and autumn) during 2003–2005. Within all clones 5 shrubs were evaluated. On the basis of the obtained results we can claim the highest increase of height in case of LKL - 21 followed by clones LKL - 16 and LKL - 5. The lowest growth increase was typical for LKL -58 and LKL - 66.

In term of statistical evaluation the year can be considered as a statistically significant factor forming a growth intensity of clones during 2003–2005. The effect of year on growing processes is strong ($\epsilon^2 = 0.96$) while the participation of year with clone influenced the growth increase in medium size ($\epsilon^2 = 0.42$). LKL - 21 and LKL - 58 in comparison with other clones are the most disperatable in term of growth increase. Within mentioned clones statistically significant differences were recorded in 7 evaluated pairs. In the same way LKL - 42 is very different from another clones as well. On the basis of all provided analysis the tested clones from point of wiew perspectivity of planting can be set up in the following order: LKL- 21, LKL - 16, LKL - 5, LKL - 42, LKL - 49, LKL - 96, LKL - 6, LKL - 60, LKL - 66 and LKL - 58 (MATUŠKOVIČ – JURÍKOVÁ, 2007).

3 Future plants in reaearch

In future we would like to extend our research on polyphenolic compounds and determination of antioxidant capacity of fruits in selected collection of *Lonicera kamtschatica* clones. This task will be solved together with Mendel University of Agriculture and Forest in Brno – Institut of chemistry and biochemistry. The preliminary results confirmed that the edible honeysuckle represents a very important source of polyphenolic compounds and the blue honeysuckle extracts are potent source of neuroprotective phenolic antioxidants (GAZDÍK et al., 2008a). Studies of GAZDÍK et al. (2008 b) also confirmed a relatively high level of antioxidative capacity due to high content of flavonoids.

4 Literature

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