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Assessment of the environmental variability of a borage strain (*Borago officinalis* L.) by cultivation in different European regions

B. Galambosi[1], T. Moilanen[2], L. Angelini[3], F. Pank[4], J. Domokos[5], P.K. Svoboda[6], S. Dragland[7]

[1]*Agrifood Research Finland - Mikkeli, Mikkeli, Finland*
[2]*Agrifood Research Finland, Kainuu Research Station, Sotkamo, Finland*
[3]*University of Pisa, Dipartimento di Agronomia e Gestione dell' Agroecosistema, Pisa, Italy*
[4]*Julius Kühn-Institut, Federal Research Centre for Cultivated Plants, Quedlinburg, Germany (retired)*
[5]*KHV Kozmetikai es Haztartasvegyipari Fejlesztö Kft, Budapest, Hungary*
[6]*The Scottish Agricultural College, Auchincruive, Ayr, Scotland UK*
[7]*The Norvegian Crop Research Institute, Apelswoll Research Centre, Division Kise, Norway.*

Corresponding author: B. Galambosi, bertalan.galambosi@surffi.fi

Abstract

To study the environmental variability, a blue flowered borage genotype (*Borago officinalis* L.) was cultivated uniformly at various sites in Europe. Four plots of 1 m^2 were established at each region of which four were situated more in the North (Scotland, Norway and two in Finland) and two more in the South (Germany and Italy). The environment had a diverging impact on borage, depending on the characteristic under study. The environment had a particularly strong influence on the seed yield with a range of 159-837 kg/ha and on the germination capacity. The variability of the plant height and the duration of the growing period were smaller. The lowest variability revealed the thousand seed weight, ratio of black seeds, seed oil content with min. 27.6 % and max. 34 %, and the oil components, including γ-linolenic acid, ranging between 18.3 and 22.5 %. Basing on the results of this experiment it can be concluded that the selection of an appropriate cultivation site has high importance in particular for the seed yield, which seems to be favoured by cultivation in the northern regions of Europe. A high content of fatty seed oil and of γ-linolenic acid as its most important component are achievable under various environmental conditions.

Keywords

Borago officinalis, growth, seed yield, seed oil, fatty acids, environmental variability

Introduction

Seeds of many plants of several families contain gamma linolenic acid (GLA), a non-saturated fatty acid with wide importance for human health. Evening primrose (*Oenothera biennis* L.) and borage (*Borago officinalis* L.) are the primary sources of GLA (Barre, 2001; Janick et al, 1989). The main producers of borage are the United Kingdom (UK) and New Zealand.

To keep pace with the changes in agriculture, interest among the growers have arisen for the possible cultivation of evening primrose and borage as alternative minor crops in South Finland (Galambosi et al., 2003). Since the biennial evening primrose cultivation has more challenges in South Finland, the interest focused on the cultivation of borage as an annual crop. The advantages of borage are its annual life cycle, higher oil content in the seeds (24-34% as compared to 14-25 % in evening primrose, as well as higher GLA proportion in the seed oil with 23 % in borage and 10.5 % in evening primrose (de Haro et al., 2002).

Although borage is endemic in the Mediterranean (Hegi, 1927), it is being cultivated successfully in different regions. UK is considered to have the best environment for reliable and profitable production of borage seed with high GLA content, due to its favourable climatic conditions during the period of seed yield and seed oil formation (Lapinskas, P., 2000, personal communication). Several companies are involved in the cultivation in the North of England around York and in East England. The climatic conditions are similarly favourable for borage in New Zealand as well (Laurence, 2004). According to Polachic (1996), high yields can be achieved under humid conditions and borage thrives well on a wide range of different soils.

The dependence of the seed oil quantity and quality on environmental conditions have been studied in several important oil crops like sunflower (Harris et al., 1978), flax (Dybing and Zimmerman, 1967), in rape (Velasco and Goffman, 1999). It is observed, that cool temperatures enhance the accumulation of unsaturated fatty acids in seed oils. Canvin (1965) has grown oil crops in a phytotron at temperatures of 10, 16, 21, and 26.5 °C in the period of seed development.

It was observed that the highest oil content in rape and flax was found at the lowest temperature and a continual decrease was observed with rising temperature. Similarly the proportions of the more highly unsaturated fatty acids in the oil of rape, flax and sunflower decreased at higher temperatures. The levels of saturated fatty acids in all of the species were not affected by changes in temperature.

The environmental impact on pharmaceutically used seed oils was studied only on a few species, mainly on evening primrose. These investigations started when the production of high quality evening primrose oil failed in Israel, due to the low GLA content of the seed oil. It was assumed that the high temperature prevailing during seed ripening was the main cause. Levy et al. (1993) observed in a phytotron experiment under high temperature a substantial reduction of GLA content and an increase of oleic acid content of the seed of evening primrose. The importance of temperatures for GLA formation was demonstrated in a comparative experiment. It was shown that the GLA content of evening primrose grown in Turkey was much lower (5.8-6.9 %) than in Germany (10 %) (Reiner et al., 1989).

All these findings show that environmental factors can influence yield, oil content and oil composition of oil crops. The aim of the present experiment was not to investigate the influence of individual ecological factors on borage but to assess the extent of the ecological variability of some important characteristics by growing one genotype in different European regions. The results provide an indication of the extent of the dependence of the individual traits on environmental conditions.

Material and methods

The phenotypic expression of the characteristics of plants results from genetic, ontogenetic, morphogenetic and environmental factors. The aim of the design of this experiment was to keep constant all these factors except the environment.

Cultivation sites

The experiment was planned for eight experimental sites representing the factor "environment" during 2002. Four of them were situated in northern parts of Europe and four in Central and Southern Europe. The experiments in Hungary and in Switzerland as locations representative for Southern Europe failed. The coordinates of the experimental sites are presented in Table 1.

Table 1 The coordinates of the experimental sites

Country	Town	Direction	Abbre-viation	Coordinates		Institute
				North	East	
Italy	Pisa	South	IT	43° 40'	10° 10'	University of Pisa, Departimento di Agronomia
Germany	Quedlinburg	South	GE	51°47'	11°10'	Federal Research Centre for Cultivated Plants
Scotland UK	Ayr	North	SC	55°28'	4° 33' W	The Scottish Agricultural College
S-Finland	Mikkeli	North	MI	60°53'	10°55'	Agrifood Research Finland, Ecological Production
N-Finland	Sotkamo	North	KA	61° 44'	27° 18'	Agrifood Research Finland, Kainuu Research Station
Norway	Kise	North	NO	64° 06	28° 20'	The Norvegian Crop Research Institute, Division Kise

Genotype and cultivation measures

A Dutch origin blue flowered borage form was used. The seeds were purchased from Hyötykasviyhdistysry in Finland and it was imported from The Netherlands (Hem Zaden B.V.). Its seed germination capacity was 72 %.

Fertilisers (NPK=50-25-25 kg/ha) were incorporated into the soil before sowing. Plot size was 1 m² with four repetitions, seed rate 15 kg/ha, row distance 50 cm, sowing depth 2-3 cm. The plots were cleaned mechanically and irrigated whenever necessary. The flowering herb was cut on the individual plots, when the first brown seeds were falling down from the lowest second and third flowers. The herb was dried on paper under shade for 8-40 days. The dried and post ripened seeds were collected, cleaned and weighted. The sowing and harvesting times are presented in Table 2.

There were big differences in the climatic conditions between the growing sites. The mean temperatures of the southern growing sites (IT, GE) were significantly higher than those of the northern sites. The mean of the cumulative values of the effective heat sums of growing seasons in IT and GE was 2341 °C, while that of the four northern locations was 1483 °C. The time used for postharvest ripening during drying under shade was different: 17 d were used in GE, 20 d in SC and 40 d in IT. In the other sites the postharvest ripening time was 8-11 d.

Table 2 Dates of sowing and harvesting and meteorological data of the experimental sites

Country	Italy	Germany	Scotland	Finland		Norway
Town	Pisa	Quedlinburg	Ayr	Mikkeli	Kainuu	Kise
Abbreviation	IT	GE	SC	MI	KA	NO
Direction	South	South	North	North	North	North
Sowing (date)	21.03	17.05	17.04	8.06	28.05	23.05
Cutting (date)	28.06	26.08	15.08	16.08	23.08	15.08
Seed collection (date)	7.08	12.09	4.09	24.08	2.09	26.08
Mean temperature of the growing season (°C)	16.7	17.1	12.1	13.9	11.2	14.9
Precipitation of the growing season (mm)	237	232	409	260	239	258
Heat sum of the growing season (°C)	2572	2109	1856	1074	1138	1864

Measurement of trait expressions

The plant height (cm) was determined before the harvest. The length of the growing period (d) represents the number of days between sowing and cutting. The yield of cleaned seeds is indicated as kg/ha. The thousand seed weights (g) were determined by weighing of 5 x 100 seeds. The germination capacity (%) was determined in 9 cm Petri dishes, on light, at 20-23 °C day and 17-19 °C night temperature, with 4 x 50 seeds. GER1 represents the results of the germination capacity test during 25 November-5 December 2002 and GER2 of the second germination capacity test during 17-31 January 2003. To evaluate the seed colour, 2 g of seeds, in two repetitions, were visually separated into fully developed deep black seeds and gray coloured seeds. The portions were weighed and the ratios were calculated. In MI only one sample of nearly 100 g mixed seeds was used for this procedure.

The quantity of seed oil and the fatty acid composition were determined in Hungary, in the laboratory of the KHV by Dr. Domokos. The seed samples were extracted in a Soxhlet extractor by petroleum ether and the fatty oil content was determined. The analysis was carried out by the standard method (ISO 5508). The oils obtained, after preparation of fatty methyl esters, were analyzed for fatty acid composition by GC. The GC parameters were: Instrument: Varian Star 3400 CX, Column: Omegawax 320 30 m x 0.32 mm, Film 2000C, Injector: Tinj= 2200C, Detector: FID, Tdet=2700C.

The investigations covered the saturated fatty acids 16:0 palmitic and 18:0 stearic; the monounsatured fatty acids 18:1 oleic, 20:1 eicosenic and 22:1(ω-9) erucic; the polyunsaturated fatty acids 18:2 linoleic and 18:3 gamma linolenic.

Statistical analyses

The statistical analyses were carried out by SAS-software (SAS-package 9.1). After testing, the normal distribution (proc univariate), the distribution of all characteristics exhibited normality, except the eicosenic and erucic acids. Normality could also not be achieved by transformation of the original values. Therefore, no statistical evaluation of the eicosenic and erucic acids has been accomplished. The variance analysis was performed by the procedure glm. The means of the cultivation regions were compared by the Tukey-Test and the means of “southern” and “northern” growing sites by the t- test. The southern locations included Italy and Germany, the northern sites Norway, Scotland and the two locations in Finland. In tables and figures, the means marked with the same letter are not significantly different at $p \leq 0.05$.

The elementary statistics of the means of the 6 different cultivation sites included mean (MEAN), minimum (MIN), maximum (MAX), standard deviation (STD), variance (VAR) and coefficient of variation (CV) (Figure 1) and has been computed by proc means. The erucic acid content of 4.10 % seemed to be an outlier and therefore erucic acid was excluded from the elementary statistics.

Results and discussion

Comparison of the variability of the traits

The coefficients of variation of the investigated characteristics are plotted in Figure 1. They indicate the extent of variability due to the influence of environmental factors. The investigations reveal that the environment has a diverging impact on borage, depending on the characteristic under study.

The environment had a particularly strong impact on the seed yield and on the germination capacity. The influence of the environment was less strong, referring to the plant height and the duration of the growing period. The environmental impact on the thousand seed weight, the ratio of black seeds, the seed oil content and its composition was comparatively low.

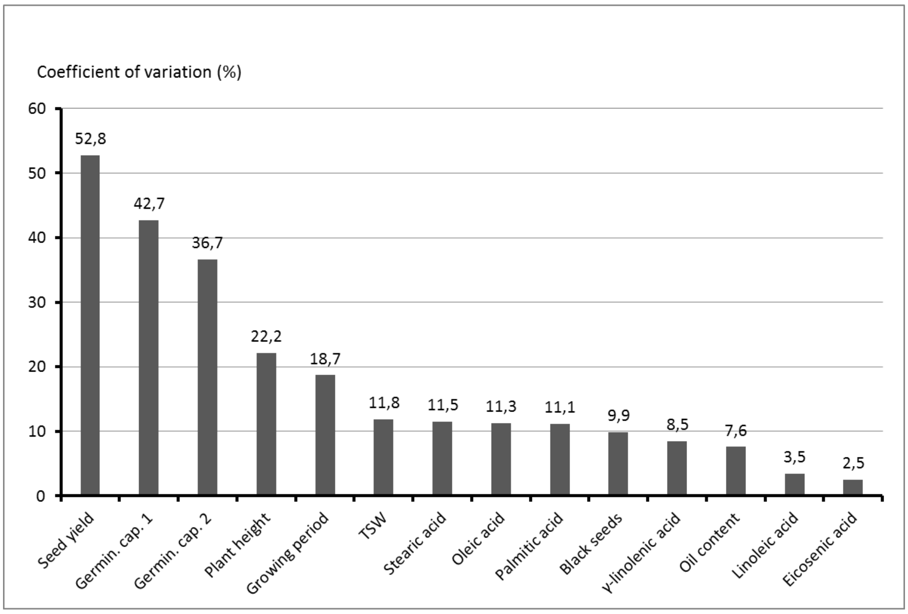

Figure 1: Coefficients of variation of the investigated characteristics

Seed yield, growth and seed quality

Seed yield

Table 3 shows data on traits characterising the growth of borage. The environment had a particularly strong influence on the seed yield. The seed yield was lowest in GE with 159 kg/ha and the highest in KA with 837 kg/ha and in SC with 735 kg/ha.

The following seed yields are reported in the literature: < 200 – 455 kg/ha by Francis and Campbell (2003) and 111-650 kg/ha by Laurence (2004) in Tasmania, 254-367 kg/ha by Simpson (1993) in Essex, England and 544 kg/ha by Gálvez and de Haro (2002) in Southern Spain. This range of the seed yield is in accordance with the observations in the present investigations.

In the present investigation, the average seed yield in the northern regions was three times higher than it was in the southern sites. These results comply with the conclusion of two borage development projects in Australia (Francis and Campbell, 2003) and in Argentina (Tremolieres et al., 1982). The authors proposed to transfer the borage cultivation areas to climatic cooler regions for increasing the seed yield and seed oil quality. Nevertheless, the cultivation of borage in Southern Spain resulted in a good yield of 544 kg/ha according to Gálvez and de Haro (2002).

Growth

The environment had also a considerable influence on the growth height and the duration of the growing period. But the coefficients of variation of these characteristics were lower in comparison to the CV of the seed yield. The plant height ranged between 90 cm in MI and 146 cm in SC. The average plant height exhibited no significant differences in the southern (116.8 cm) and the northern regions (109.5 cm). Schuster (1992) indicates a strongly varying growth height, ranging between 30 and 150 cm.

The duration of the period between seeding and harvesting was maximum 120 d in SC and minimum 69 d in MI and as an average only 10 d shorter in the northern regions in comparison to the southern ones. The reason for the short growing period in MI is the failure of the first sowing on 10th of May and the necessity to sow the borage anew on 8th June. The plants from this late sowing had an accelerated growth.

Table 3 Seed yield, plant height and the duration of the growing period

Region	Seed yield (kg/ha)	Plant height (cm)	Growing period (d)
IT	288 C	139.0 A	99
GE	159 C	94.5 C	101
SC	735 AB	145.8 A	120
MI	431 C	90.3 C	69
KA	837 A	91.2 C	87
NO	490 ABC	110.8 B	84
LSD_{Tukey}	368	12.9	
South	223 B	116.8 A	100
North	623 A	109.5 A	90
$p_{t\text{-}test}$	<0.0001	0.4920	
Elementary statistics overall			
MEAN	490	111.9	93.3
MIN	159	90.3	69
MAX	837	145.8	120
STD	258.5	24.83	17.44
VAR	6682	616.5	304.3

Seed quality

Table 4 presents data on seed quality characteristics.

The thousand seed weight (TSW) ranged between 19.2 g in KA and 14.2 g in IT. The average TSW was in the southern sites lower with 14.5 g than it was in the northern regions with 18.2. g. According to the literature the TSW of different accessions was 9-29 g (de Lisi et al., 2014; del Rio-Celestino et al., 2008; Gálvez and de Haro, 2002).

The germination capacity of the second trial (GER2) with a maximum of 82 % in MI revealed no significant differences except IT, where the germination capacity was only 20 %. The average germination capacity in the North was double in comparison to that of the South. Novák et al. (2010) determined the germination capacity of borage initially with 82.6 % and with 37.0 % after a ten years storage period.

The ratio of black seeds was highest in SC with 100 % and lowest in GE with 76 %. The seeds of the southern cultivation sites consisted of a lot of half-developed, smaller seeds, while the seeds of the Nordic cultivation sites were larger and deep black. Similar observations were recorded in Southern Spain by Gálvez and de Haro (2002). Under warm weather conditions 35 % of the harvested seeds were empty.

Table 4 Thousand seed weight (TSW), germination capacity (Ger1) and (Ger2) and ratio of black coloured seeds (Black seeds)

Region	TSW (g)	Ger1 (%)	Ger2 (%)	Black seeds (%)
IT	14.2 C	17.3 C	20.0 B	87.3 ABC
GE	14.8 C	43.3 B	56.0 A	76.0 C
SC	17.3 B	79.0 A	79.0 A	100.0 A
MI	17.9 B	70.0 A	82.0 A	91.0 AB
KA	19.2 A	43.3 B	77.0 A	98.8 AB
NO	18.4 AB	62.0 AB	73.0 A	86.1 BC
GD	1.22	20.6	26.4	12.9
South	14.5 B	30.3 B	38.0 B	81.6 B
North	18.2 A	63.6 A	77.8 A	94.4 A
$P_{t\text{-test}}$	<0.0001	<0.0001	0.0009	0.0150

Elementary statistics over all

MEAN	17.0	52.5	64.5	89.9
MIN	14.2	17.3	20.0	76.0
MAX	19.2	79.0	82.0	100.0
STD	2.004	22.39	23.7	8.91
VAR	4.016	501.41	559.5	79.37

Seed oil and its composition

The environmental impact on the oil content of the seeds and on the components of the seed oil was comparatively low (Figure 1). The differences in the studied parameters between the South-North sites were quite small and sometimes opposing. Table 5 shows the data on the oil content of the borage seeds and the composition of the fatty acids.

Oil content

The maximum of the fatty oil content of the seeds was reached in SC with 34 %. The minimum was 27.6 % in GE. The oil content in the southern cultivation sites was in average 28.9 %, while in the Nordic cultivation sites the average was significantly higher with 33.1 %. The observed range of the values of the oil content complies generally with data provided by literature with 22-38 % (Gálvez and de Haro,2002; Velasco and Goffman, 1999; Simpson, 1993).

Ratio of γ-linolenic acid

The variability of the GLA content as the most important component of the oil was comparatively low (Figure 1). It ranged between 18.3 in IT and 22.5 % in MI, but no significant differences were found between the averages in the southern (20.3 %) and the northern sites (21.2 %). The range of the GLA content of different accessions is wider with 12,6-28,6 % according to reports from literature (de Lisi et al., 2014; Mhamdi et al., 2009; Gálvez and de Haro,2002; Velasco and Goffman, 1999; Simpson, 1993).

Ratio of other oil components

There were significant differences in the other oil components between some regions. But the means of the proportion of the oil components ranged in narrow limits only. Stearic, linoleic and eicosenic acids showed no significant differences between the southern and the northern sites. Contrary to this, the portions of the palmitic and oleic acides were statistically significantly higher in the South. The content of the investigated oil components was in the range of data available from literature literature (de Lisi et al., 2014; Mhamdi et al., 2009; Gálvez and de Haro,2002; Velasco and Goffman, 1999).

Table 5 Content and composition of the fatty seed oil

Region	Oil content (%)	Fatty acids (%)						
		palmitic	stearic	oleic	linoleic	γ-linolenic	eicosenic	erucic
		C16:0	C18:0	C18:1c9	C18:2	C18:3	C20:1	C22:1
IT	30.2 C	13.8 A	4.15 B	21.1 A	33.7 B	18.3 C	3.98	1.38
GE	27.6 D	12.5 B	4.60 AB	19.3 A	36.7 A	22.2 A	3.80	2.30
SC	34.0 A	10.6 C	3.53 C	16.4 B	37.1 A	22.3 A	3.73	1.98
MI	33.1 AB	10.5 C	4.43 B	16.5 B	36.5 A	22.5 A	3.73	1.98
KA	33.3 A	10.9 C	4.30 B	17.0 B	35.5 AB	20.9 AB	3.80	4.10
NO	32.0 B	12.1 B	5.03 A	20.4 A	35.3 AB	19.2 BC	3.88	2.07
GD	1.3	0.66	0.54	1.98	2.66	2.44		
South	28.9 B	13.2 A	4.38 A	20.2 A	35.1 A	20.3 A	3.89	
North	33.1 A	11.0 B	4.32 A	17.6 B	36.1 A	21.2 A	3.78	
p t-test	<0.0001	<0.0001	0.8062	0.0016	0.1432	0.2483		

Elementary statistics over all

MIN	27.6	10.5	3.53	16.4	33.7	18.3	3.73
MAX	34.0	13.8	5.03	21.1	37.1	22.5	3.98
MEAN	31.7	11.733	4.34	18.45	35.8	20.9	3.82
STD	2.407	1.303	0.499	2.081	1.244	1.781	0.096
VAR	5.792	1.699	0.249	4.331	1.548	3.172	0.009

Conclusions

Referring to the results of the present investigation, the environment had a particularly strong impact on the seed yield and the germination capacity. The environmental influence was substantially lower on TSW, fatty oil content and its composition. This applies also to GLA, which is the most important component of the fatty seed oil.

It can be concluded that the choice of the appropriate environment has the first priority to achieve a high seed yield. Experiences reported in the literature and the findings presented in this paper suggest that the cultivation in cooler regions provides a higher seed yield. But generalizable evidence basing on scientifically sound experiments is still lacking. To check this hypothesis and to draw more reliable conclusions, a multi-year experiment series should be performed, including a selection of high performance cultivars and an adequate number of growing sites representing universe sets of the "North" and the "South" regions of Europe.

According to the presented investigations, good seed oil content and an adequate proportion of GLA are achievable under different environmental conditions. At all growing sites of this experiment, the composition of the fatty seed oil was in accordance with the requirements of Ph. Eur. (2010) (9-12 palmitic acid, 2-6 stearic acid, 12-22 oleic acid, 30-41 linolic acid, 17-27 GAL, 2.8-4.4 eicosenic acid, max. 3.0).

Besides the selection of the appropriate cultivation region and the provision of high performance cultivars, the weakest link in the production chain of borage seeds is an adequate harvest technology to collect the strongly scattering and gradually ripening seeds with low losses and low seed damages by mechanical procedures (Galambosi et al., 2014).

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References

Barre DE, 2001. Potential of Evening Primrose, Borage, Black Currant, and Fungal Oils in Human Health. Annals of Nutrition and Metabolism 45, 47–57. DOI: 10.1159/000046706.

Canvin DT, 1965. The effect of temperature on the oil content and fatty acid composition of the oils from several oil seed crops. Canadian Journal of Botany, 43(1), 63-69.

de Haro A, DominquezV, del Rio M, 2002. Variability in the content of gamma-linolenic acid and other fatty acids of the seed oil of germplasm of wild and cultivated borage (*Borago officinalis* L.). Journal of Herbs, Spices & Medicinal plants. 9 (2/3), 297-304.

de Lisi A, Montesano V, Negro D, Sarli G, Blanco E, Sonnante G, Laghetti G, 2014. Genetic diversity in *Borago officinalis* germplasm as revealed by seed oils and AFLP polymorphism. Genetic Resources and Crop Evolution, 61, 853–859.

del Rio-Celestino M, Font R, de Haro-Bailón A, 2008. Distribution of fatty acids in edible organs and seed fractions of borage (*Borago officinalis* L.). Journal of the Science of Food and Agriculture, 88, 248–255.

Dybing DC, Zimmerman DC, 1967. Fatty acid accumulation on maturing flax seeds as influenced by environment. Plant Physiology, 41, 1465-1470.

European Pharmacopoeia Online 8.2., 2014. 01/2010:2105. Borage (starflower) oil, refined. S. 1681-1682.

Francis CM, Campbell MC, 2003. New high quality oil seed crops for temperate and tropical Australia. A report for the Rural Industries Research and Development Corporation, May 2003. RIRDC Publication No 03/045, p. 27.

Galambosi B, Domokos J, Sairanen J, 2014. Experiences with different methods of harvesting borage (Borago officinalis L.). Zeitschrift für Arznei- & Gewürzpflanzen, 19, 61-66.

Galambosi B, Sairanen J, Domokos J, 2003. Effect of harvesting methods on the seed yield and oil quality of *Borago officinalis* and *Oenothera biennis* in South-East Finland. In: The 7th International Congress Phytopharm 2003: Actual problems of creation of new medicinal preparations of natural origin, Proceedings of congress, St.-Petersburg-Pushkin, Russia, July 3-5, 2003. pp. 570-574.

Gálvez C, de Haro A, 2002. First Field Trials of Borage (*Borago officinalis* L.) in Andalusia (Southern Spain=as a Source of “Biological” Gamma Linolenic Acid. Journal of Herbs, Spices & Medicinal plants, 9 (2/3), 89-93.

Harris HC, McWilliam JR, Mason WK, 1978. Influence of temperature on oil content and composition of sunflower seed. Australin Journal of Agricultural Research, 29, 1203-1212.

Hegi G, 1957. Illustrierte Flora von Mitteleuropa, Band V, Teil 3. J. F. Lehmanns Verlag, München, pp. 2230-2232.

Janick J, Simon JE, Quinn J, Beraubaire N, 1989. Borage: a source of gamma linolenic acid. In: Craker LE, Simon J E. (Eds.), Herbs, Spices and Medicinal Plants: Recent Advances in Botany, Horticulture and Pharmacology. Oryx Press, Phoenix, Arizona, USA, Vol 4., pp.145-168.

Laurence L, 2004. Borage production for oil and gamma-linolenic acid. A report for the Rural Industries Research and Development Corporation, Australia. Publication No. 04/040 Project No. UT-33A.

Levy A, Palevich D, Ranen C, 1993. Increasing gamma linolenic acid in evening primrose under hot temperatures by breeding early cultivars. Acta Horticulturae, 330, 219-225.

Mhamdi B, Wannes W A, Bourgou S, Marzouk B, 2009. Biochemical characterization of borage (*Borago officinalis* L.) seeds. Journal of Food Biochemistry, 33, 331–341.

Novák I, Riba Z, Kaliskó Á, Ferenczy A, Sárosi Sz, 2010. Investigation of the germination capacity of some medicinal plant species after ten years of cold-storage. Zeitschrift für Arznei- & Gewürzpflanzen, 15(2), 76-80.

Polachic D, 1996. Growing borage for profit. Small Farm Today, 13 (1), 45.

Reiner H, Ceylan A, Marquard R, 1989. Agronomic performance of evening primrose (*Oenothera biennis*) in Turkey and Germany. Eucarpia Congress, Göttingen, Gemany, Poster 20-5.

Schuster W, 1992. Ölpflanzen in Europa. DLG-Verlag, Frankfurt am Main, pp. 56-158.

Simpson MJA, 1993. Comparison of swathing and desiccation of borage (*Borago officinalis*) and estimation of optimum harvest stage. Annals of Applied Biology 123, 105-108.

Tremolieres A, Dubacq JP, Drapier D, 1982. Unsaturated fatty acids in maturing seeds of sunflower and rape: Regulation by temperature and light intensity. Phytochemistry 21, 41-45.

Velasco L, Goffman FD, 1999. Chemotaxonomic significance of fatty acids and tocophelors in Boraginaceae. Phytochemistry 52, 423-426.

Pepenele galben cu coarne (*Cucumis metuliferus*) – specie alimentară şi terapeutică cu posibilităţi de adaptare în arealul agroecologic Arad

Hălmăgean L., Meşter Mihaela, Zdremţan Monica, Balint Maria, Diaconescu Daniela, Ciutina V.

Rezumat: În arealul agroecologic Arad, zonă caracteristică pentru partea de vest a ţării, începând cu anul 2012 s-au întreprins o serie de cercetări privind tehnologia de cultură la pepenele galben cu coarne. Fiind o specie de curând introdusă în România, dar nestudiată în partea de vest a ţării, cercetările noastre au fost orientate pentru aclimatizarea acestei specii, elaborarea tehnologiei specifice de cultură pentru spaţii protejate şi câmp, precum şi ameliorarea speciei în direcţia obţinerii de soiuri noi cu caractere fenotipice superioare. Specia cercetată poate fi cultivată cu succes în arealul agroecologic Arad, atât în spaţii protejate cât şi direct în câmp. Fructele sunt valoroase din punct de vedere nutriţional, conţinând o serie de substanţe benefice în domeniul alimentar şi medicinal (nu conţin colesterol).

Cuvinte cheie: pepenele galben, adaptare, areal agroecologic, caractere fenotipice, colesterol.

The yellow watermelon with horns (*Cucumis metuliferus*) – food and therapeutic species with adaptation possibilities in Arad agroecological area

Hălmăgean L., Meşter Mihaela, Zdremţan Monica, Balint Maria, Diaconescu Daniela, Ciutina V.

Summary: In Arad agroecological area, the characteristic area for the west side of the country, starting with 2012 were undertaken a series of research regarding the cultivation technology of yellow melon with horns. Beeing a recent species introduced in Romania, but not studied in the west part of the country, our research were oriented for the aclimatization of this species, the development of specific cultivation technology for protected areas or field, as like the improvement of this species towards obtaining new species with superior phenotypic characters. The studied species can be successfully grown in Arad agroecological area, both in protected areas as in field, directly. The fruits are valuable from nutritional viewpoint, containing a several beneficial substances in food and medicine domain (doesn't contain cholesterol).

Key words: yellow watermelon, adaptation, agroecological area, phenotypic characters, cholesterol.

Introduction

Cucumis metuliferus is a annually species from *Cucurbitaceae* family, native from tropical and austral Africa were grows naturally in fields and in woodland areas. It is known as african cucumber with horns, mellon with horns, jelly mellon, melano, pikano or kiwano. Fruits are valuable from nutritional viewpoint because contains beneficial substances from food and medicine domain. It is appreciated by the exotic flavors amateurs and by those who want a hypocaloric diet. The fruit is poor in calories, but rich in potasium (266 mg/100 g), phosphorus (50 mg/100 g), magnesium (23 mg/100 g), calcium (17 mg/100 mg), proteins, vitamin C and doesn't contain cholesterol. The taste is a combination between cucumber and zucchini and when it's ripen, between banana, cucumber and lemon.

Materials and methods

In Arad agroecological area, the characteristic area for the west side of the country, starting with 2012 were undertaken a series of research regarding the cultivation technology of yellow melon with horns (*Cucumis metuliferus*). Beeing a new and not studied species in the west side of the country, our research were oriented for the aclimatization of this species, setting the right moment for crop field esthablishment and in protected areas, the determination of optimum space of nutrition (consistence), ways of crop esthablishment (seedling or sowing direct in the field), leading systems, of fertilization in ecological conditions, control formulas of weeds, diseases and pests.

With the exception of proposed research variants were applied in a big part the similar technology of the cucumber grown in field on high espalier and those from protected areas (they are from the same family - *Cucurbitaceae*). It was respected that in rotation, *Cucumis metuliferus* not to be back on the same surface sooner than three years, and as a precursory plant was follow after beans and peas. The basic fertilization in autumn was performed with organic fertilizers (30 t/ha stable garbage well decomposed).

The crop esthablishment can be accomplished by seedling and direct sowing. The seedlings were produced in heated protected areas, in nutritional cubes, thereby at plantation the seedling has to be approximately 15 days and a number of 4 - 5 leafs. The seed used to produce seedlings and in direct sowing in the field was heated. Were tested a fertilization of the crop through seeds, a new concept that is based on the „starter" effect which these new fertilizers (Teprosyn) can be execute over the seeds and plants in the first developing phases.

This paper work it's proposes the presentation of the results obtained in three years of study (2012 - 2014) regarding the optimum time setting of esthablishment through seedling in protected areas (tunnel solarium type ICLF Vidra) and the optimum space of nutrition (density) at mellon with horns species. The experience was two-factor structured, in randomized blocks with four rehearsals. The data capitalization was made after analysis method version applied to placed experiments in randomized blocks for many years and in the same town. Excepting proposed variants were applied the recomended crop technology for cucumber crop in protected areas. During vegetation period were effectuate determinations regarding morphofiziological and production indices over each version and rehearsal partly.

Table 1 The influence of planting moment and density at *Cucumis metuliferus* in protected areas (2012 - 2014)

A-Planting moment / B-Density (Planting scheme)	(a-1) 05.04				(a-2) 15.04				(a-3) 25.04				(B)Planting scheme			
	t/ha	D(t/ha)	%	S	t/ha	D(t/ha	%	S	t/ha	D(t/ha)	%	S	t/ha	D(t/ha)	%	S
b-1(12.346 pl/ha) 4x1,4mx0,60m	27,3	2,2 -3.3	108,7 89,2	00	25,1	1,9 -5,12	108,2 82,8	000	22,2	1,9 -3,4	109,3 86,7	00	24,9	2,0 -3,9	108,7 86,5	0
b-2(9.260 pl/ha) 4x1,4mx0,80m	35,8	10,7 5,2	142,6 116,9	xxx xxx	36,4	13,2 6,1	156,8 120,1	xxx xxx	30,5	10,2 4,9	150,2 119,1	xxx xxx	34,2	11,3 5,4	149,3 118,8	xxx xxx
b-3(7.408 pl/ha) 3x1,4mx1m	32,3	7,2 1,7	128,7 105,6	xxx	33,5	10,3 3,2	144,4 110,5	xxx xx	26,8	6,5 1,21	132,0 104,7	xxx	30,9	8,0 2,1	134,9 107,3	xxx
b-4(5.556 pl/ha) 3x1,6mx1m	25,1	Mt_1 -5,5	100 88,0	000	23,2	Mt_1 -7,1	100 76,6	000	20,3	Mt_1 -5,3	100 79,3	000	22,9	Mt_1 -5,9	100 79,5	000
b-5(6.945 pl/ha) 3x1,6mx0,80m	28,6	3,5 -2,0	113,9 93,5		29,7	6,5 -0,6	120,0 98,0	xxx	24,6	4,3 -1,0	121,2 96,1	xx	27,6	4,7 -1,2	120,5 95,8	xx
b-6(9.260 pl/ha) 3x1,4mx0,60m	34,3	9,2 3,7	136,6 119,1	xxx xx	33,8	10,6 3,5	145,7 111,6	xxx xx	28,9	8,6 3,3	142,4 112,9	xxx xx	32,3	9,4 3,5	141,0 112,2	xxx x
Average values	30,6	-	-		30,3	-	-		25,6	-	-		28,8	-	-	

		Mt_2	100			Mt_2	100			Mt_2	100			Mt_2	100	
(A) Planting moment	30,6				30,3				25,6			DL (t/ha)	A	B	BxA	AxB
Dif (t/ha)	5,0				4,7				Mt			5%	2,54	3,27	2,81	3,80
%	119,5				118,4				100			1%	3,11	4,12	3,76	5,23
Signification	xxx				xxx							0,1%	4,72	5,16	5,05	7,26

Results and discussions

Analyzing the results obtained in three years of studies and testing (average years 2012 - 2014), from fruits production viewpoint, were finds that the best age of esthablishment crop of *Cucumis metuliferus* E. H. Ney ex Schard in protected areas (tunnels ICLF Vidra – 5,40 m), for agroecological Arad area is in the first decade of april month. Very significant results were obtained in relation to the two witnesses at the esthablishment of crop in both april 5th as in 15 of april, production differences being contained between 3,7 and 13,2 t/ha (table 1.1).

Factor action concerning the optimum space of nutrition settings, the results are different, from significant productions to very significant productions. Compared to the two witnesses, very significant results were obtained using densities between 7408 and 9260 pl/ha, both on four rows as well as on three rows from tunnel solarium.

In the bilateral combination – esthablishment age and plantation sketch – the best association for the agroecological Arad area is obtained trough establishing by plantation in protected areas (tunnels covered with polyethylene foil with 5,40 m width) during 5 -15 of april with a 7408 – 9260 pl/ha density. During vegetation period were made phenologic observations over the main morphoproductive indices, on versions and rehearsals.

Conclusions

1. Food and therapeutic importance of this species and the optimum conditions for a ecolgical agriculture in Arad area, justify the undertaken research regarding the yellow mellon with horns (*Cucumis metuliferus*).
2. The studied species has rapidly demonstrated by the genetic potential, adaptability at environmental conditions specifically to the agroecological area from the west side of the country, especially in protected areas.
3. The optimum space of nutrition for this species include the distance between the rows that is 1,4 – 1,6 m and between plants in a row is 0,60 – 0,80 m, making densities between 7408 and 9260 pl/ha.
4. The optimum establishing age for the crops from tunnel solarium is the first decade of april month.

Refernces

Păun, E. and co., 1998 – Medicinal and aromatic plants treaty, volume II, Publishing Academica, Bucharest.

Stoian, L and co, 2008 – Ecological culture of melons vegetables, Publishing EstFalia, Bucharest.

Benzioni, A., Mendlinger, S. and Ventura, M., 1996 – Improvement of the appearance and taste of kiwano fruits for export to the ornamental and consumer markets, Acta Hort. (ISHS) 434 : 293 – 300.

http://www.actahort.org/books/434/434_36.htm.

Volatile Organic Compounds Emitted by Plants Determination using New Gas Chromatography Mass-Spectrometry Methods

Lucian Copolovici[a,b], Astrid Kännaste[c], Andreea Pag[a], Daniel Tomescu[a], Adina Bodescu[a,b], Ülo Niinemets[c]

[a]*Institute of Research, Development, Innovation in Technical and Natural Sciences of "Aurel Vlaicu" University, 2 Elena Dragoi St., 310330, Arad, Romania*
[b]*Faculty of Food Engineering, Tourism and Environmental Protection, "Aurel Vlaicu" University, 2 Elena Dragoi St., 310330, Arad, Romania*
[c]*Institute of Agricultural and Environmental Sciences, Estonian University of Life Sciences, 1 Kreutzwaldi, 51014, Tartu, Estonia*

Corresponding author email: lucian.copolovici@emu.ee

Abstract

In the nature, plants emit numerous volatile organic compounds. Common plant volatiles include various green leaves volatiles, terpenes, phenylpropanoids and/or benzenoids. In the present paper it will be characterized thermal desorption (TD) and solid phase microextraction methods (SPME) for simultaneous determination of green leaves volatiles (GLVs), various mono- and sesquiterpenes in headspace of plants. The first method is based on preconcentration of VOCs on solid absorbents coupled with the gas chromatograpy mass-spectrometry coupled with thermal desorption system (GCMS-TD). For trapping the volatile organic compounds (VOC) we used a multibead tube filled with solid sorbents (Carbotrap© and Carbopack©). Different types of solid sorbents have been tested and characterised. The second method is based on adsorption of different volatile compounds on the fibres followed by GC-MS analyses. The fibres trapped and released volatile organic compounds with different numbers of carbons atoms. Both methods have been used for volatile organic compounds emitted by plants from *Betulaceae* family.

Introduction

Plants emit more than 100,000 chemical products and at least 1700 of these are known to be volatile (see for review (Loreto and Schnitzler, 2010)). A very large number of BVOC from plants are synthesizing using a few common biosynthetic pathways. Generally, several classes of secondary metabolites are produced by the plants via: shikimate-phenylpropanoid pathway: salicylic acid, and hydroxycinnamates and their esters, lipoxygenase pathway: C6 aldehydes, alcohols, and their esters and terpenoid pathway: carotenoids and chlorophylls, plant hormones including gibberellins, abscisic acid, cytokinins and terpene and isoprene (Dudareva et al., 2006). A vast array of volatile compounds - terpenes (mono- and sesquiterpenes), lipoxygenate pathway compounds, ethylene, nitric oxide, methanol, ethanol are involved in stress-dependent signalling within a single plant as well as communication between plants and between plants and insects (Dicke and Loreto, 2010; Niinemets, 2010).

There are several methods for collecting those volatiles prior to analysis including washing of plant leaves with solvent (Griffiths et al., 1999), sorption of VOCs into liquid coatings (Pillonel et al., 2002), collecting the VOCs into coated capillary columns (Pillonel et al., 2002). In the last years solid phase microextraction (Bojko and Pawliszyn, 2014; Savelieva et al., 2014) and pre-concentration of the VOCs on solid adsorbents followed by thermal desorption has become a well-accepted methods (Krol et al., 2010; Zhang and Li, 2010; Jansen et al., 2011; Pandey and Kim, 2011; Miekisch et al., 2014). In the recent paper, Curtis et al (2014)have been determined the biogenic volatile organic compound (BVOC) emissions of nine urban tree species using preconcentration on adsorbent followed by GC-MS analysis. Samples have been collected in glass tubes filled with a multi-adsorbent bed composed of Tenax GR and Carboxen 1016. The same method has been used to characterized the emissions from polymeric materials from heritage collections and to understand how the different compounds might affect the stability of other heritage objects (Mitchell et al., 2014). Solid phase micro-extraction (SPME) technique has been used for measurement of halogenated, aromatic and oxygenated VOC in the snow pack (Kos et al., 2014). The same procedure has been proposed by collection and identification of the volatiles from Norway spruce (*Picea abies* (L.) Karst) seedlings (Kannaste et al., 2013).

In the present paper we used thermal desorption (TD) and solid phase microextraction methods (SPME) for simultaneous determination of volatile organic compounds emitted in stress conditions.

Material and methods

Whole plants were placed in a dynamic headspace sampling cuvette system consisting of two 3 L glass chambers similar to the system described in detail in Toome et al. (2010) and Copolovici et al. (Copolovici et al., 2011).

First method (TD) for VOC sampling determination used adsorbent cartridges which have been mounted at the outlets of each cuvette. The sampling have been performed with a flow rate of 200 ml min^{-1} for 15 min by using a constant flow air sample pump (1003-SKC, SKC Inc., Houston, TX, USA). In addition, a sample was taken from the air inlet prior to the cuvettes to estimate the background VOC concentrations. Multibed adsorbent cartridges were filled with different types of carbopacks and were optimized for trapping of all plant volatiles between C5-C15 (Copolovici et al., 2009). Adsorbent cartridges were analyzed for lipoxygenase (LOX) pathway products, mono-, homo- and sesquiterpene concentrations with a combined Shimadzu TD20 automated cartridge desorber and Shimadzu 2010Plus GC-MS instrument (Shimadzu Corporation, Kyoto, Japan) using a method detailed in (Toome et al., 2010). The identifications and quantifications of different compounds were done using authentic standards (Sigma-Aldrich, Taufkirchen, Germany). The background (blank) VOC concentrations were subtracted from the emission samples with the seedlings.

The second method for sampling has been used a solid-phase micro extraction (SPME) syringe. The fiber used for the absorption of the volatile components was polydimethylsiloxane/divinylbenzene (PDMS/DVB), thickness 65 µm Supelco Company (Bellefonte, PA, USA). The fiber was conditioned before use for 30 minutes, as recommended by the manufacturer.

Volatile organic compounds were captured by placing the coated fiber extraction phase in the measurement chamber, with the plant, for 10 minutes followed by desorption in gas chromatograph injector. All measurements of plant volatiles have been done at room temperature of 25 °C. Background air samples were collected from the empty chamber before the measurements and were subtracted from the emission samples of the plants. BVOC samples were analyzed using a gas-chromatograph Agilent Technology 7820A (Agilent Scientific, USA) coupled with mass spectrometer MSD 5975, using a method described previously (Copolovici et al., 2009). The compounds were identified based on NIST library and on the retention time of standard compounds and the concentration of alpha-pinene, sabinene, 3-(Z)-1-hexen-1-ol and 3-(Z)-1-hexen-1-ol acetate were calculated based on with external authentic standards consisting of known amount of those compounds.

Results and discussions

Using the first method we manage to quantify different lipoxygenase (LOX) pathway products, mono-, homo- and sesquiterpenes. An example with a chromatogram obtained for emission of an evergreen tree *Quercus ilex* has been shown in the figure 1.

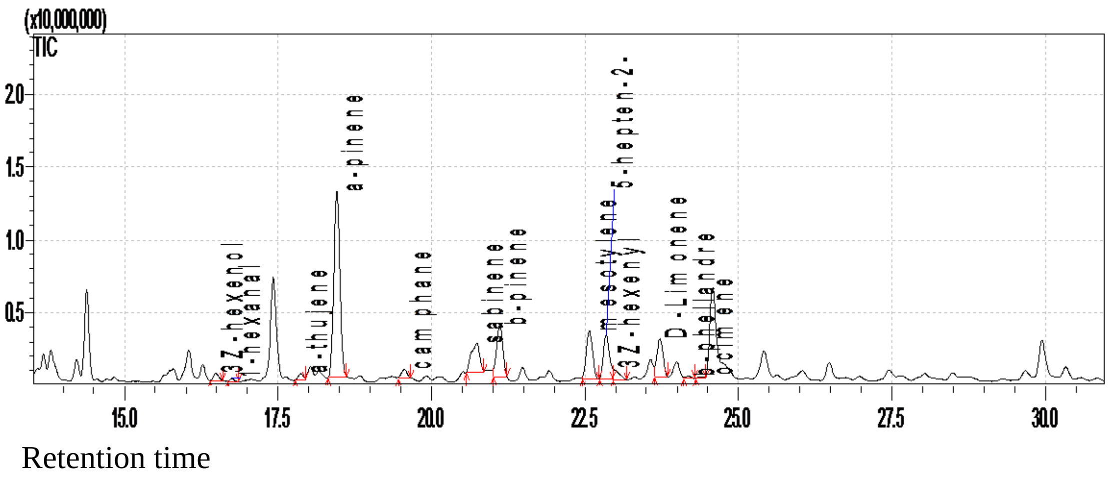

Figure 1 Typical chromatogram for emission of different volatile organic compounds from *Q. ilex* leaf

It can be seen that in the normal condition, monoterpenes emission have been relatively high while green leaves volatiles (C6 aldehydes and alcohols) emission is very low.

Using the same technique we measured the emission rates from *Fuchsia magellanica* which emit sesquiterpenes in the physiological conditions.

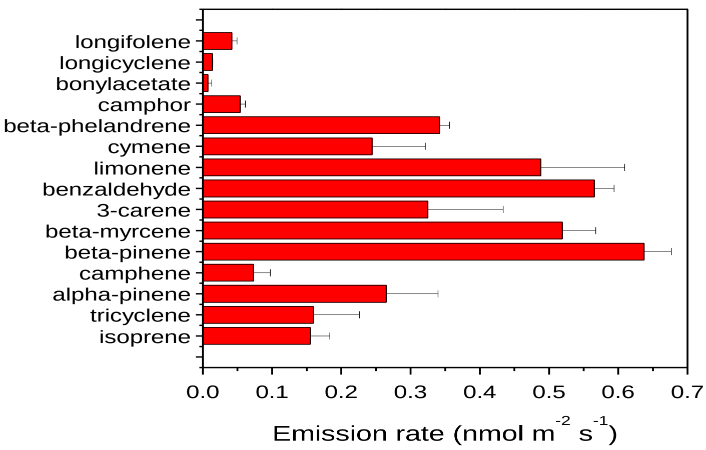

Figure 2 The emission rates of different terpenes from *Fuchsia magellanica* leaves

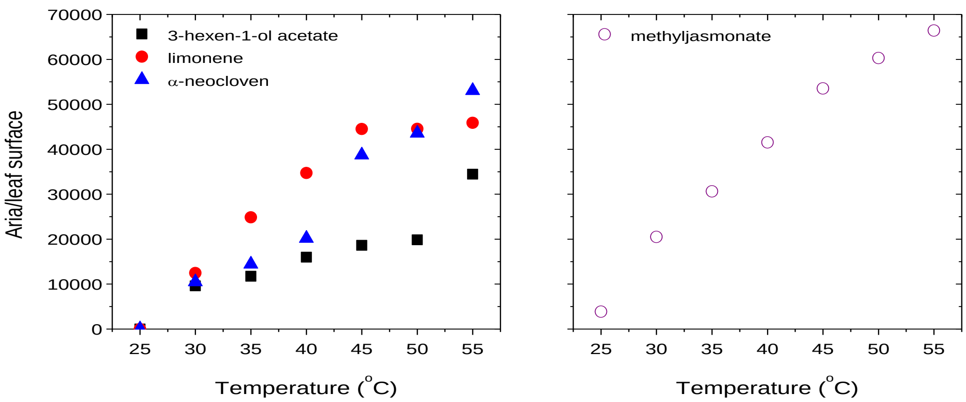

Figura 3 Relative emission rates for *F. excelsior* leaves function of temperatures

Using the SPME technique we have been shown that the emission of terpene from the leaves of *Fraxinus excelsior* increased with the temperature of the leaves.

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References

Bojko, B., Pawliszyn, J., 2014. *In vivo* and *ex vivo* SPME: a low invasive sampling and sample preparation tool in clinical bioanalysis. Bioanalysis 6, 1227-1239.

Copolovici, L., Kaennaste, A., Remmel, T., Vislap, V., Niinemets, U., 2011. Volatile emissions from *Alnus glutionosa* induced by herbivory are quantitatively related to the extent of damage. Journal of Chemical Ecology 37, 18-28.

Copolovici, L., Kännaste, A., Niinemets, U., 2009. Gas chromatography-mass spectrometry method fordetermination of monoterpene and sesquiterpene emissions from stressed plants. Studia Universitatis Babes-Bolyai Chemia 54, 329-339.

Curtis, A.J., Helmig, D., Baroch, C., Daly, R., Davis, S., 2014. Biogenic volatile organic compound emissions from nine tree species used in an urban tree-planting program. Atmospheric Environment 95, 634-643.

Dicke, M., Loreto, F., 2010. Induced plant volatiles: from genes to climate change. Trends in Plant Science 15, 115-117.

Dudareva, N., Negre, F., Nagegowda, D.A., Orlova, I., 2006. Plant volatiles: Recent advances and future perspectives. Critical Reviews in Plant Sciences 25, 417-440.

Griffiths, D.W., Robertson, G.W., Birch, A.N.E., Brennan, R.M., 1999. Evaluation of thermal desorption and solvent elution combined with polymer entrainment for the analysis of volatiles released by leaves from midge (*Dasineura tetensi*) resistant and susceptible blackcurrant (*Ribes nigrum L.*) cultivars. Phytochemical Analysis 10, 328-334.

Jansen, R.M.C., Wildt, J., Kappers, I.F., Bouwmeester, H.J., Hofstee, J.W., van Henten, E.J., 2011. Detection of Diseased Plants by Analysis of Volatile Organic Compound Emission. Annual Review of Phytopathology, Vol 49, pp. 157-174.

Kannaste, A., Zhao, T., Lindstrom, A., Stattin, E., Langstrom, B., Borg-Karlson, A.K., 2013. Odors of Norway spruce (*Picea abies L.*) seedlings: differences due to age and chemotype. Trees-Structure and Function 27, 149-159.

Kos, G., Kanthasami, V., Adechina, N., Ariya, P.A., 2014. Volatile organic compounds in Arctic snow: concentrations and implications for atmospheric processes. Environmental Science-Processes & Impacts 16, 2592-2603.

Krol, S., Zabiegala, B., Namiesnik, J., 2010. Monitoring VOCs in atmospheric air II. Sample collection and preparation. Trac-Trends in Analytical Chemistry 29, 1101-1112.

Loreto, F., Schnitzler, J.-P., 2010. Abiotic stresses and induced BVOCs. Trends in Plant Science 15, 154-166.

Miekisch, W., Trefz, P., Bergmann, A., Schubert, J.K., 2014. Microextraction techniques in breath biomarker analysis. Bioanalysis 6, 1275-1291.

Mitchell, G., Higgitt, C., Gibson, L.T., 2014. Emissions from polymeric materials: Characterised by thermal desorption-gas chromatography. Polymer Degradation and Stability 107, 328-340.

Niinemets, Ü., 2010. Mild versus severe stress and BVOCs: thresholds, priming and consequences. Trends in Plant Science 15, 145-153.

Pandey, S.K., Kim, K.-H., 2011. Human body-odor components and their determination. Trac-Trends in Analytical Chemistry 30, 784-796.

Pillonel, L., Bossett, J.O., Tabacchi, R., 2002. Rapid preconcentration and enrichment techniques for the analysis of food volatile. A review. Lebensmittel-Wissenschaft Und-Technologie-Food Science and Technology 35, 1-14.

Savelieva, E.I., Gavrilova, O.P., Gagkaeva, T.Y., 2014. Using solid-phase microextraction combined with gas chromatography-mass spectrometry for the study of the volatile products of biosynthesis released by plants and microorganisms. Journal of Analytical Chemistry 69, 609-615.

Toome, M., Randjärv, P., Copolovici, L., Niinemets, Ü., Heinsoo, K., Luik, A., Noe, S.M., 2010. Leaf rust induced volatile organic compounds signalling in willow during the infection. Planta 232, 235-243.

Zhang, Z., Li, G., 2010. A review of advances and new developments in the analysis of biological volatile organic compounds. Microchemical Journal 95, 127-139.

Analysis of the local use of ecolabelled detergents

Eugenia Tigan,[*] Monica Elena Lungu

Faculty of Food Engineering, Tourism and Environmental Protection, "Aurel Vlaicu" University, Elena Dragoi Street, No. 2, 310330 Arad, Romania

** To whom correspondence should be addressed: E. Tigan, E-mail: etigan@yahoo.com*

Abstract

Ecolabelling is an activity whose main goal is to establish a voluntary system of granting an Ecolabel for products with minimum environmental and health impact, for the product´s whole life-cycle[1]. The purpose of using Ecolabels is to promote the products that have minimal environmental impact; ecolabelling is a voluntary activity.

Keywords:

Ecolabel, ecolabelling as a voluntary activity, promotion of products with reduced environmental impact

Introduction

The aim of the EU politics, regarding business and environmental protection, is to take a step further towards a sustainable development. The EU ecolabelling scheme[2] is now part of a wider approach to Integrated Product Policy (IPP), through the EU Action Programme.

The EU Ecolabel is based on promoting the image of some non-food ecological products throughout Europe.

The goal of the community system, the one that grants the label, is to promote the products that can reduce the negative environmental impact, compared to other products from the same category, contributing this way to the efficient use of resources and a high level of environmental protection. This goal is reached through guiding and educating consumers by giving the right, precise and scientific-based information written on those products.

At national level, the ecological label is regulated through the Governmental Decision no. 661/2011 regarding the establishment of measures that ensure the application of the

[1] Ministry of the Environment - http://www.etichetaecologica.ro
[2] Regulation EC No. 1980/2000 in www.europa.ro

regulation's provisions (CE) no. 66/2010 of the European Parliament and Council from the 25th November 2009 regarding the EU Ecolabel[3].

The EU Ecolabel is a unique way of certification whose purpose is to help consumers distinguish the eco friendly products and services; foods and medicines not included[4].

The Ecolabel has an european dimension- a producer, retailer or a service povider who fulfills all the criteria for a group of products and who applies for ecolabelling, can sell on the European Union´s market.

Another feature is that the Ecolabel is selective- it is granted only to products with minimum environmetal impact.

It is also transparent- the transparency and widespreading are influenced by the significant input of the representatives of the industry, commerce, environmental and consumer oganizations.

The final consumer will recognize the flower logo as representing the criteria established according to technical and scientifical guides, with a great participation of the independent and neutral organizations[5].

The Ecolabel works as a multi-criteria approach- the criteria is not based on a single parameter, but rather on a series of studies that analyze the product´s or service´s environmental impact through its lifecycle, starting with the processing of raw materials in the pre-production stage, then production, distribution and final storing[6].

The Ecolabel is voluntary, the scheme is not established upon ecological standards that producers must follow. The merchant, the producer or the service provider may also decide on applying the Ecolabel or not. The voluntary nature of the scheme is based on the fact that it doesn´t create commercial barriers[7].

Material and methods

The field research has been done in 2013, in Arad, through 30 questionnaires whose purpose was to determin the level of knowledge regarding ecolabelled products, as well as the level of knowledge and the level of use of ecolabelled detergents. After applying the questionnaires on the field, the data was processed using the SPSS program; the findings and the results will be presented further on.

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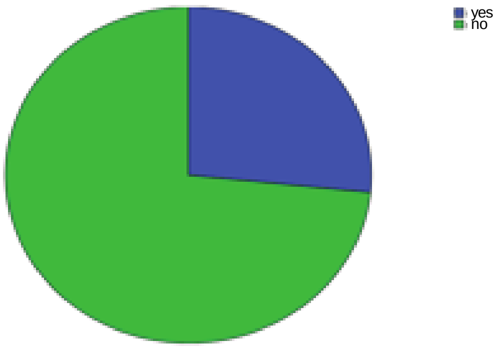
3 HG 661/2011 from www.legis.ro
4 EMAS - http://www.eco-label.com
5 Ministry of the Environment - http://www.mmediu.ro
6 EMAS - http://www.eco-label.com
7 Ministry of the Environment - http://www.etichetaecologica.ro

Results and discussions

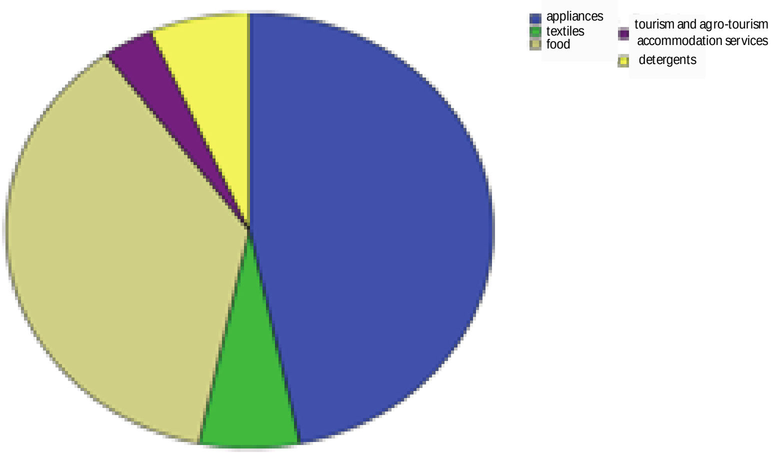
The first sought after aspect was that of evidentiating the level of awareness of the ecolabelled products; as shown in the figure below, 26.7% are aware of the Ecolabel , the other 73.3% are not.



Source: Data collected from the questionnaires, 2013

Figure 1 Have you ever heard of the Ecolabel?

Analyzing the first experience with ecolabelled products, or rather on which products was the Ecolabel noticed for the first time, it can be seen that the majority of the subjects asked, 46.7%, claim to have come across it on appliances, household machines, and only 6.7% came across it on detergents, Fig. 2.

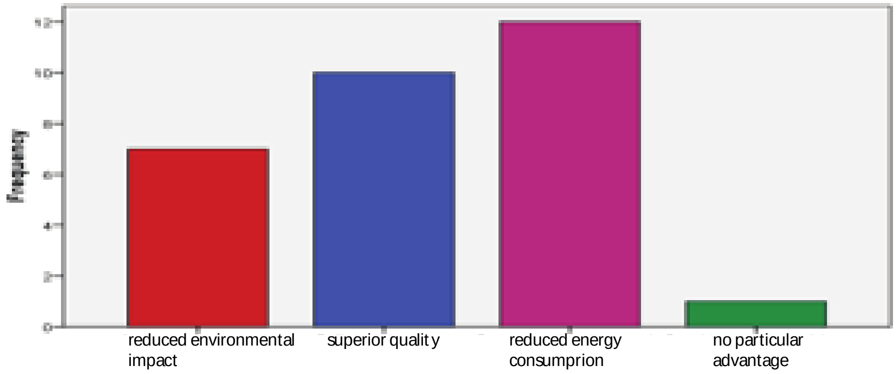


Source: Data collected from the questionnaires, 2013

Figure 2 On which of the following products/services did you come across the Ecolabel for the first time?

For this question it must be highlighted that, erroneously, a significant number of respondents claimed that they came across the Ecolabel on food products, confounding the Ecolabel with the bioproducts, which have a totally different legislation.

Further on, we wanted to show the characteristics of ecolabelled products and to see which is the level of knowledge of the subjects concerning these products, and, it has been noticed that even if the majority have not come across ecolabelled products, 40% still consider that these products have reduced energy, 33.3% that they are of superior quality, 23,3% that they have reduced environmental impact and 3.3% consider that ecolabelled products have no particular advantage. The data is shown in Fig.3.

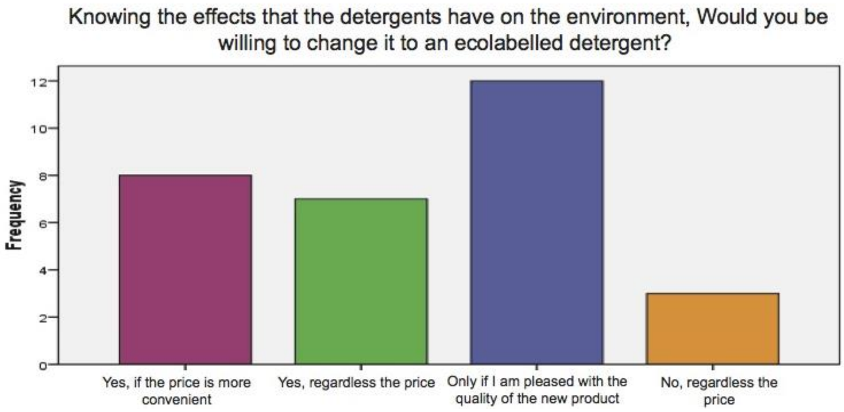


Source: Data collected from the questionnaires, 2013

Figure 3 What main advantage do you think ecolabelled products have?

When asked about the ecolabelled detergents, the percentage regarding the awareness about them shares the same levels as the awareness of other ecolabelled products. Hence, 26,7% are aware of the ecolabelled detergents and 63.3% are not aware of them.

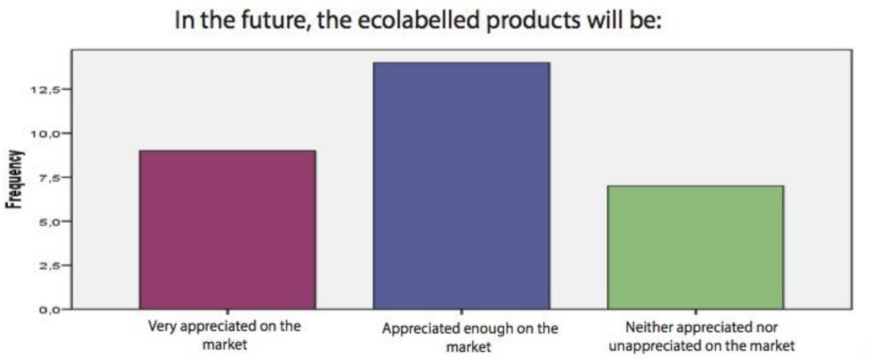
It is pleasantly surprising how the consumers embrace the new, because when asked if they would replace their usual detergent with an ecolabelled one, the vast majority replied with a yes. Hence 40% would make the change to the ecolabelled detergent if they were pleased by its quality, 26.7% would make the change if the price would be affordable, 23.3 % would make the change regardless of the price and 10% would not accept changing their usual detergent. Fig. 4.



Source: Data collected from the questionnaires, 2013

Figure 4

The respondents maintain this optimistic trend even when they are asked how they see the future of ecolabelled products. For this question, 30% consider that in the future, the ecolabelled products will be very appreciated on the market, 46.7% think that these products would be just appreciated, and 23.3% claim that they will be neither appreciated nor unappreciated; the data is shown in Fig.5.



Source: Data collected from the questionnaires, 2013

Figure 5

Consequently, it can be said that even though at the moment the ecolabelled detergents are relatively unknown to the wide public, in the future they will become appreciated and sought after by most consumers, some will acquire them regardless of their costs, some will do it depending on the cost while others will buy them if they are going to be pleased with the quality of the product, compared to the one that they usually use.

An optimistic trend towards the use of ecolabelled products and towards eco-products in general can be observed.

Recommendations

We recommend a better advertising of all kinds of ecolabelled products, especially the one studied today, the detergents Ecolabel.

References

1 Regulation EC N 1980/2000 in www.eco-label.com

2. European Union Eco-label - http://ec.europa.eu

3. Ministry of the Environment - http://www.mmediu.ro

4. EMAS - http://www.eco-label.com

5. Ministry of the Environment - http://www.etichetaecologica.ro

6. HG 661/2011 from www.legis.ro

7. Data collected from the questionnaires, 2013

The Main Objectives Related to Environment in Romania

Assoc. Prof. Dr. Petru Tărchilă

Universitatea "Aurel Vlaicu" din Arad, Faculty of Humanistic and Social Sciences, România

Abstract

Environmental protection is one of the horizontal policies of the European Union these days. Its main aim is to design and apply all policies of the Community and its member states. The integrated approach shouid be linked to the general integration strategies of the last decade of the previous century which were lowly adjusted to the pattern of sustainable development.

The Maastricht Treaty raises environmental policy to the "rank" of Community policy and the Amsterdam Treaty includes the principie of sustainable development to the main Community objectives. It also regulates the application of the Environmental Integration Principie to sectoral policies. The European Union has elaborated a complex system of horizontal Community Laws by designing six environment action programs. They occur in the following fields: air quality, waste management, water quality, landscape protection, industrial pol Iul jn and risk management, dangerous chemical substances and geneticaily modified organisms, noise, civil protection, nuclear safety and radioprotection. EU has changed the sectorial approach into an integrated one, has developed principles and action and has taken important steps in internaţional cooperation on environment safety.

Currently, the European Union runs the stages of the Sixth Action Programme "Environment 2010-2015: Our future, Our choice" which focuses on four main areas of action: climate changes, environment and health, nature and bio-diversity and management of natural resources.

When adhering to the European Union, aceording to Negotiation Chapter 22, România assumed to fulfill the European regulations and to allocate financial amounts in order to apply coherent measures in the field of Environmental protection. As full member of the European Union, România defined its own consistent policies in order to follow the strategic direction and priorities of the European Commission. While the Community Acquis was already adopted, further actions and environmental activities aim to reach the targets for each negotiated transition period.

Keywords: Negotiating chapters between România and the European Commission, main environmental objectives and targets, Community Acquis, Transition.

Introduction to Romania's environmental policy

Romania's environmental policy began in the 90s after the foundation of the Ministry of Environment. In 1992 Romania has adapted The National Strategy for Environmental Protection, updated in 1996 and 2002.

According to the strategy, the main objectives related to environment in Romania were:

1. preservation and improvement of people's health conditions;
2. sustainable development
3. pollution prevention
4. preservation of bio-diversity
5. preservation of cultural and historical heritage
6. application of the principle "the polluter should pay"
7. stimulation of environmental recovery (by allotting subventions, credits with low interest, etc)

The strategy has been supplemented in 1999 by the *"Environmental Status Report of Romania"* and *"The National Waste Management Strategy'"* (2002). The most important steps in the legislation, favored by the national strategy and by the EU membership program, were registered in the legislation related to the impact assessment, dangerous waste, waste landfills, packaging waste and waste transportation, legislation on wastewater, drinking water, pollution caused by hazardous waste, identification of spaces that require special protection, industrial pollution control, measures for the safety of nuclear fields [4].

Romania, as a member of the European Union, has to implement the community acquis on environment. The application of variable geometry strategy in the European model of integration facilitates the gradual enactment and application of community legislation by using the transition period and the transitional arrangements. These extension tools have been a support for our country, if we consider the high exigency of environmental protection in EU as compared to Romania's possibilities of legislation enforcement and the financial resources required by the insertion of the ecological responsibility principle among the citizens.

Romania's commitment at European Union integration

The Negotiation Chapter "Environment" (chapter 22) was opened in May 2002 and closed in 2004. After the negotiation Romania obtained the following transitional periods [2]:

- 3 transitional periods of 1. 2 and 3 years for compliance with the Directive on emission of volatile organic compounds from the storage of petrol and its distribution from the petrol distribution stations;
- 3 transitional periods of 3, 4 and 5 years to achieve the goals on recovery and recycling of plastic, glass and wood in compliance with the Packaging and Packaging Waste Directive;
- transitions periods of 1 and 2 years for compliance with the Waste Incineration Directive;
- transition periods of 3, 7 and 9 years for the compliance of 130 storages w ith the Waste Storage Directive;
- 2 transition periods of 2 years to reach the collecting and recycling targets as regulated by the Waste Electrical and Electronic Equipment Directive;
- 2 transition periods of 5 and 9 years for the full application of Regulations on Waste Shipment and *waiver from the application of article 7(4) on the period of*
- *temporary waiver for the destination installation;*
- *2* transition periods of 9 and 12 years for the application of regulations on treatment of urban waste water;
- 2 transition periods of 4 and 9 years for the compliance with all 9 quality parameters regulated by the Drinking Water Directive;
- 1 transition period of 3 years for 51 industrial plants for 8 hazardous waste;
- 1 transition period of 8 and 2 years for 195 installations that have to comply with the integrated pollution and prevention control Directive;
- 3 transition periods of 6 years for reduction of emissions in 34 large combustion plants, for the compliance with NOx requirements within 69 installations and powder limit values for 26 installations. Romania has also 1 year additional time to comply with the NOx requirement within 6 installations.

The Commission estimates costs of approximately 22 billion Euros [2] required for the compliance with European legislation on environment issues. But the implementation of the European acquis on environmental issues will prevent us from making the same errors as "older" Member States have made in the process of their economic development and thus bring about a faster improvement of environment and life conditions. Not at least, nature protection favors economic growth, creates jobs, develops labor markets with essential role in social welfare [3].

Romania has managed to corroborate domestic legislation with the community acquis on environment, but the Commission's reports have drawn attention constantly on the administrative limitations of PEM application as well as on the reduced possibilities of financing it, due to lack of proper financial tools. The European Community supported Romania through a series of financial pre-accession instruments like Phare and 1SPA, participation in LIFE programs and Community Initiatives as well as financial support provided by European Bank of Investment [1].

Romania s strategic action plan on the compliance of domestic legislation and environment actions with the environmental policy of the European Union

The priority of Environmental Policy application is the enactment of sectorial strategies that would integrate environmental components (according to the objectives of sustainable development) and improve the administrative structures of implementation. The Government considers that the community acquis has been fully enacted up to the moment of accession (January, I$^{s'}$. 2007), and the implementation plans have been put into practice. As far as strategic actions are concerned, the stress in Romania's Environmental Policy is laid on a series of priority axes that would strengthen the preventive component [5]:

a. The development of integrated monitoring of the environment;
b. Eco-production and sustainable consumption;
c. Decentralization of institutional system and the application of responsibility principle on all levels and in all fields;
d. The development of market targeted tools;
e. International cooperation on continuous environmental protection.

We can notice that priority axes in Romania's Environmental Policy are linked to European strategic directions on environment.

Conclusions

Environmental protection is one of the horizontal policies of the European Union these days. Its main aim is to design and apply all policies of the Community and its member states. The integrated approach should be linked to the general integration strategies of the last decade of the previous century which were lowly adjusted to the pattern of sustainable development.

The Maastricht Treaty raises environmental policy to the "rank" of Community policy and the Amsterdam Treaty includes the principle of sustainable development to the main Community objectives. It also regulates the application of the Environmental Integration Principle to sectorial policies. The European Union has elaborated a complex system of horizontal Community Laws by designing six environment action programs. They occur in the following fields: air quality, waste management, water quality, landscape protection, industrial pollution and risk management, dangerous chemical substances and genetically modified organisms, noise, civil protection, nuclear safety and radioprotection. EU has changed the sectorial approach into an integrated one, has developed principles and action and has taken important steps in international cooperation on environment safety.

Currently, the European Union runs the stages of the Sixth Action Program "Environment 2010-2015: Our future, Our choice" which focuses on four main areas of action: climate changes, environment and health, nature and bio-diversity and management of natural resources.

In the over 30 years of community actions on environmental protection the Commission states that the most important results obtained are: reduction of industrial waste, limitation or banning of certain hazardous substances with high environmental and health risks, reduction of acid in waters, improvement of waste management, and improvement of water, air and soil quality. The next few years will be dedicated to those strategies and instruments that would promote a better correlation between the environment objectives and those of a free market (especially by changing production and consumption behaviors).

A more effective and coherent integration of environment in sectoral policies will be also a goal in the next years. Moreover, one of the great challenges will be the compliance of the new Member States with the Environmental Policy of the European Union. As full member of the European Union, Romania designed and implements a set of integrated action in order to comply with EU regulations according to the agreed schedule.

References

[1] Dogaru L., (2012), Common Policies of the European Union, Academic Publishing House, Bucharest, 2012, (in Romanian);

[2] Pohoata 1. A history of economic doctrines, European Institute's Publishing House, Iasi, 2000 (in Romanian);

[3] Relicovschi A. European Policies in Environmental Management - Micro-monographic Series, European Institute of Romania, Bucharest, 2008, (in Romanian);
[4] Strategic de TAEE 2004-2008, published by the European Environmental Agency, 2004;
[5] The National Strategy of Romania for 2013 - 2020 - 2030, approved by the Romanian Government in 21.12.2013.

EUROPEAN UNION ROMANIAN GOVERNMENT Structural Instruments 2007-2013

Project co-funded by EUROPEAN UNION trough the European Regional Development Fund

Sectorial Operational Programme "Increase of Economic Competitiveness"

"Investing for your future"

PRIORITY AXIS 2 - Research, Technological Development and Innovation for Competitiveness

Operation 2.2.1: - Development of the existing R&D infrastructure and the creation of new infrastructures (laboratories, research centres)

Contract No.: 621/11.03.2014

Completion date: 11.09.2015

Project value: 15.941.661 RON

Contribution of European Union: 11.083.800 RON

Romanian Government contribution value: 1.916.200 RON

Project beneficiary: "AUREL VLAICU" UNIVERSITY - ARAD, ROMANIA; TECHNICAL AND NATURAL SCIENCES RESEARCH-DEVELOPMENT-INNOVATION INSTITUTE of UAV

Research Center in Technical and Natural Sciences
CESTN
http://cestn.uav.ro/

The main Objective of the project is **development of the existing R&D infrastructure of a new Research Center in Technical and Natural Sciences at "Aurel Vlaicu" University Arad for approaching more priority domains (Innovative Materials, Products and Processes, Health, Environment, Agriculture, Food Safety and Security).**

The specific objectives are focused on development of R&D infrastructure, modernization of the existing laboratories, by the creation of new infrastructures, acquisition of new instruments and equipments, and refurbishment of research premises.

The main equipments envisaged are:

- Scanning Electron Microscope with FIB and EDX
- Transmission Electron Microscope with STEM
- Ultra-cryo-microtome
- Upgrading Atomic Force Microscope with new controller
- Upgrading confocal RAMAN with 2 more lasers
- Upgrading QTOF with ionic mobility system (new in Europe)
- DSC
- UHPLC with DAD, RID, florescence and QQQ detectors
- GCGCMS with TD