CAMELINA SATIVA AS A CROP FOR DIVERSIFICATION OF AGRICULTURE AND AS A PRODUCER OF HIGH QUALITY OIL

IDRA (CAMELINA SATIVA) – AUGS LAUKSAIMNIECISKĀS VIDES DAŽĀDOŠANAI UN AUGSTAS KVALITĀTES EĻĻAS IEGUVEI

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Abstract. *'Camelina sativa' is one of the oldest oil crops in Europe. Growing areas were reduced dramatically in 20-40-ties of the last century. Low price of rape oil and unclear composition of camelina oil were primary reasons of this process. Nevertheless, last years 'Camelina sativa' attracted a great interest of scientists and oil processors as a crop for diversification of agriculture and, in the same time, for producing of the high quantity and quality oil for biofuel, feeding, food, and pharmacy (source of α-linolenic acid, linoleic acid and vitamins, especially E). In Latvia 'Camelina sativa' is spread as a wild form but for the agriculture it is a new crop.*

The potential of use of 'Camelina sativa' in the Latgale region as an alternative oil crop and a new plant in the crop rotation was investigated. We compared the oil content and it composition in 'Camelina sativa' seeds from plants of variety 'Ligena' grown in different conditions (Latvia and Germany). We also are looking for a possibility to use biotechnology methods for obtaining additional camelina breeding source material. For this purpose we applied calli culture method for producing plants-regenerants.

Keywords: *calli culture, camelina sativa, iodine value, oil content, vitamins*

Introduction

Camelina (*Camelina sativa*), wide known as False Flax or Gold of Pleasure, is a very old oilseed crop that was cultivated in Europe during the Iron and Bronze Ages. In early 1940's commercial production of camelina was ceased with the introduction of oilseed rape; the lack of knowledge on the value of oil content was the main cause of decrease of interest in camelina [1]. Furthermore, it is generally believed that camelina growing needs lower input than oilseed rape because high disease und pest resistance and good competitive ability against weeds. Camelina seeds produce golden-colored oil with a delicate, almond-like flavour, containing up to 45% omega-3 alpha-linolenic acid and approximately 15% of omega-6 linolenic acid. Camelina oil may contain up to 110 mg/100 g vitamin E, while linseed oil contains only trace (0.5 – 2 mg/100 g) amounts of this vitamin [2, 3], what makes camelina oil very stable and resistant to heat, rancidity and long storage. These fatty acids (α-linolenic, linoleic) are known to reduce the LDL (low density lipoprotein) cholesterol level in the blood and are good for heart and cardiovascular health [4]. Omega-3 fatty acids are essential for normal human growth and may play a role in the prevention and treatment of diabetes and some inflammatory and autoimmune disorders [2, 5].

Some derivatives for non-food application, such as industrial chemicals, pharmaceuticals, and cosmetics, could be produced in addition to food products (salad and cooking oil) from camelina oilseed. It has been suggested that camelina oil may be a cheaper source of biodiesel than oilseed rape. Camelina could produce acceptable yield when grown in relatively poor conditions and can be grow with lower input of nutrients and pesticides than required for oil-seed rape [6, 7].

Camelina sativa is spread in Latvia as a wild plant, but it is a new crop for agriculture. Therefore the goal of this study was to determine the usefulness of *Camelina sativa* as an alternative oil crop and a new plant in the crop rotation in the Latgale region of Latvia.

At present there is not cameline breeding program in Latvia. For potential breeding it is important to obtain good quality breeding source material in short time. It is known that after cultivation in calli culture regenerated plants could perform higher genetic variation, so-called somaclonal variation. Somaclonal variation has been described for many plant species as a method for obtaining new breeding source material [8, 9, 10, 11] but we did not find reports about establishment of camelina calli culture. Therefore an additional task of our work was to check a possibility of inducing viable camelina calli culture.

Materials and methods

Material

We used camelina seeds yielded from plants of variety 'Ligena' grown in Germany during the summer 2002 and in Latvia (Agricultural Science Centre of Latgale) during the summer 2004.

Oil content and biochemical analyses

The oil content in seeds was measured by the Soxhlet extraction: 10 g seeds were milled and the oil was extracted by hexane during two hours, extraction was repeated two times. Cold-pressed camelina oil (produced by mechanical pressing of clean seed material) was used to determine balance of unsaturated fatty acids. Iodine value was determinate by the Kaufman's method [12].

Biochemical analyses of seeds were done in the Laboratory of Animal Biochemistry and Physiology of the Institute of Biology, University of Latvia. Content of B_1, B_2, C and E vitamins, β-carotines, xanthophylls, selenium, zinc, copper and iron was determined.

Calli culture establishing

Seeds of variety 'Ligena' produced in Latvia were used to establish calli culture. A method elaborated earlier for oil flax [13] was applied. Plantlets were grown from seeds placed on the MS or B_5 basal medium with addition 10mg/l or without $AgNO_3$. Different parts of plantlets on two leaves stage were used as explants (leaves, 3-5 mm stem fragments and apex). As calli induction medium were used the MS or B_5 basal mediums with 1.5 or 2.0 mg/l 2,4-dichlorphenoxyacetic acid (2,4-D) (added after autoclaving) adjusted to pH 5.8 (Table 1). After every four weeks of cultivation calli were transferred on the fresh MS medium supplemented with 1.5 mg/l 2,4-D. Cultures were grown in the light conditions.

Table 1.

Number of explants placed on different calli induction mediums

Media	Plantlets growing	B_5+$AgNO_3$	B_5	MS+$AgNO_3$	MS	B_5
	Calli induction	B_5+2,4D 1.5 mg/l	B_5+2,4D 1.5 mg/l	MS+2,4D 1.5 mg/l	MS+2,4D 2 mg/l	B_5+2,4D 2 mg/l
Explants type	Leaves	71	-	15	38	18
	Stem	195	44	24	56	70
	Apex	35	-	10	-	-

Results and discussion

The yield of *Camelina sativa* in the Latvian climatic conditions (2004) was 2.0 t/ha. The yield of spring-sown camelina in different EU countries ranged from 2.0 to 2.5 t/ha [1].

Oil content in seeds grown both in Latvia and Germany was approximately 30% and it is in accordance with data reported in literature (29 – 39%) [14]. The iodine value was 153 for oil from seeds grown in Latvia and 127 for oil from German seeds. Oil from Latvian seeds was more unsaturated than oil from German seeds. It could be related with different growing conditions and with the fact that seeds from Germany were two years older than produced in

Latvia. Compared these results with iodine values in literature (144-155 [14]) we could noticed that oil produced from seeds yielded in Latvia was rather rich with unsaturated fatty acids.

Results of biochemical analysis of camelina seeds are presented in the Table 2. Camelina seeds produced in Latvia were richer with vitaminsB_1, E and copper and iron than seeds produced in Germany. Seeds from Germany had more xanthophylls and zinc.

Table 2.

Biochemical composition (mg/kg) of camelina seeds

Component	Country of seeds origin	
	Germany	Latvia
Vitamin B_1	3.68	7.04
Vitamin B_2	1.05	1.23
Vitamin C	34.60	33.50
Vitamin E	250.00	325.00
β-carotene	0	0
Xanthophylls	21.99	13.90
Selenium	0.08	0.09
Zinc	60.00	40.00
Copper	8.60	10.50
Iron	145.00	151.30

Camelina seeds placed on both basal mediums (MS and B_5) with and as well without $AgNO_3$ formed plantlets suitable as source of different type of explants for calli culture establishment. Nevertheless calli were obtained only from stem explants. Calli formation started two weeks after culture establishment. Optimal concentration of 2,4D was 1.5 mg/l. Explants from plantlets grown on medium supplemented by $AgNO_3$ formed not viable (necrotic) calli. Formation of regeneration zones started only after four months of calli cultivation. Producing of plants-regenerants is in the progress at the moment.

Conclusions

Latgale climate conditions are acceptable for camelina growing. Camelina have good disease und pest resistance and good competitive ability against weeds. The seed yield and biochemical analysis of seeds produced in Latgale region shown that *Camelina sativa* is a perspective alternative oil crop for Latvia and could be used here in the crop rotation for agriculture diversification. *Camelina sativa* has excellent quality of oil for different use, especially for food and pharmacy as a source of unsaturated fatty acids and vitamin E. Establishing of camelina calli culture open a possibility to obtain additional genetic variation for breeding purpose.

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