

INFLUENCE OF BIOSTIMULATORS ON STRUCTURE OF FAT ACIDS OF LINEN OIL

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Abstract. The structure and concentration of fat acids in linen oil is studied. Linen oil has been made of flax seeds, and flax plants at vegetation have been processed by regulators of growth of plants of Epin-Ekstra and Karvitol. It is established that the maintenance of polynonsaturated fat acids in oil increases at flax processing in a phase of a fur-tree biostimulators.

Key words: flax, linen oil, linen seeds, plant growth regulator, biostimulators, Epin-Ekstra, Karvitol, fat acids.

Flax-dolgunets is a traditional agricultural crop which grow up in the Nonchemozem zone of Russia. Complex processing of a flax fiber, fibres is necessary for increase of profitability of manufacture of flax and seeds [2]. Along with a flax fiber high value flax seeds possess. Linen seeds apply in medicine, they favorably influence health of the person because of presence in their structure of natural lignins among which are available phytoestrogens, polynonsaturated fat acids, macro- and microelements [1, 6, 7].

In Russia flax seeds use for oil reception. Linen oil concerns quick-drying oils as it is easy polymerase in the presence of air oxygen ("dries up"). This ability is caused by the high maintenance of nonsaturated fat acids (%): 15-30 linoleic, 40-60 linolenic (Omega-3 of acid) and 13-29 oleic acid. The maintenance of the sated fat acids much less also makes 9-10%. Fat acids of vegetable oils are not only irreplaceable factors of a food, but also energy carriers, the plastic material which is a part of cellular membranes. Lipids in a human body are involved in difficult exchange processes and bear responsibility for their normal course [4].

The basic world manufacturers of flax are China, France, Belarus, Russia, Belgium on which share it is necessary more than 90% of volumes of output of a linen fibre and seeds [5]. In table 1 the data on cultivation of fibrous flax in the various countries is presented. One of ways of increase of productivity of a linen fibre and seeds is application of plants growth regulators at preseeding processing of seeds and processing of plants in different phases of vegetation.

Studying of influence of processing of plants of flax-dolguntsa by new regulators of growth of plants on a chemical compound of linen oil was the purpose of our researches. As bioregulators have been applied: Epin-Ekstra (operating substance 24-epibrassinolid), Karvitola (operating substance acetylene spirit).

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Table 1

Fibrous flax cultivated area in the world [ha] by year

Country	2001	2002	2003	2004	2005	2006	2007	2008	2009
Austria	132	171	142	109	134	129	0,02	–	–
Belarus	70 000	67 900	70 900	79 000	78 500	75 200	78 500	80 080	–
Belgium	16 990	15 315	19 306	19 823	18 670	16 354	14 630	12 230	11 698
Bulgaria	210	470	150	70	–	–	–	–	–
China	100 000	80 000	133 000	130 000	130 000	118 500	110 000	–	–
Czech republic	7 095	5 885	6 003	5 500	4 318	2 736	824	–	–
Denmark	19	0	0	–	–	–	–	–	–
Egypt	7 649	8 936	13 010	17 138	5 847	–	20 000	–	–
Estonia	89	35	17	0	91	–	–	–	–
Finland	365	202	97	67	57	17	–	–	–
France	67 970	68 416	76 439	80 081	81 508	76 497	75 523	67 688	56 416
Germany	200	200	224	180	38	30	51	–	–
Italy	1	0	20	80	18	–	–	–	–
Latvia	–	–	–	1 654	2 072	1 420	220	–	–
Lithuania	9 600	9 346	9 444	5 494	3 599	1 057	950	–	–
Netherlands	4 415	4 000	4 615	4 517	4 691	4 366	3 458	2 572	2 086
Poland	4 520	5 100	6 000	6 345	6 843	4 225	2 056	1722,38	1001
Rumania	300	300	–	–	–	–	107	–	–
Russia	127 340	110 820	118 060	112 300	95 450	86 000	75 000	81 000	–
Slovak rep.	–	–	–	–	–	–	67	–	–
Spain	342	60	2	–	–	–	–	–	–
Sweden	32	25	0	30	–	–	34	–	–
Ukraine	28 280	28 200	32 480	38 220	25 530	16 164	12 000	–	–
United kingdom	4 430	156	175	1 820	196	21	–	–	–

Conditions, materials and methods of researches: Experiences are spent with seeds of flax of a grade of Antej. The grade of Antej is deduced by scientists of the Pskov scientific research institute of agriculture with use of a method of hybridization with the subsequent individual selection. The grade is high-yielding on seeds and a fibre. The fibre maintenance in a stalk makes 35,4%. The fibre possesses high spinning properties. The grade is steady against drowning, a rust and fuzarioz.

Flax has been grown up on fields in Privolzhsky area of the Ivanovo area in 2004-2005 rr. Flax spraying has been spent by bioregulators to a fur-tree phase. Concentration of Epin-Ekstra has made 0,00025 g/dm³, the expense of a working liquid of 250 l/ha. Concentration of Karvitol was 0,01 g/dm³, the expense of a working liquid of 300 l/hectares. As control applied processing of plants by water. In the end of the vegetative period seeds from plants of flax-dolguntsa with processing by biostimulators and water have been received. Linen oil has been received from linen seeds by a method cold pressing (GOST 5791). Structure and the maintenance of fat and nonlimiting organic acids it has been defined in «Service laboratory of the complex analysis of chemical compounds» of Russian State Agrarian University - MTAA named after K.A. Timiryazev. Triglyceride oils change over to methyl ethers of acids (by reaction of interetherification of methanol solution of a

methylate of sodium (GOST 30418, GOST P 51486)). Oil (2-3 drops) dissolved in 1,9 sm³ of geksan. In a solution added 0,1 sm³ of a methylate of sodium in a methanol with concentration 2 mol/dm³. A reactionary mix intensively mixed within 2 minutes. After hashing the mix settled within 5 minutes then has been filtered through the paper filter.

The received solution we analyze by chromatographe with the mass spectral detector «Clarus 600 C/D/S/T/MS». Analysis conditions: a capillary column in length of 30 m, diameter 0,25 mm, motionless phase BPX-70 with thickness of a film 0,25 pm. Speed of gas of the carrier (He) — 0,75 ml/minutes test Volume — 0,5 pi, stream division — 1+40. Injector temperature — 230°C. The temperature program of the thermostat of columns: reference temperature — 100°C — 2 minutes, lifting of temperature to 185°C with a speed of 5 °C/minutes, an isotherm 185°C — 10 minutes carried out Quantitative definition according to the ardently-ionized detector (temperature — 230°C). The structure of methyl ethers of acids has been defined according to the mass spectrometer detector (the temperature of the interface of input has made 180°C, source temperature — 200°C, an ionic current — 1,5 And, energy of electrons — 70 eV). The received mass spectra were processed with Ms-library application «NIST 2005». The analysis has been executed in 3 multiple frequencies, confidential intervals with a significance value of 95 % are calculated by means of program Excel.

Results and discussion. It is established that in the oil received from seeds of flax-dolguntsa, irrespective of a way of cultivation of plants with processing by biostimulators or without it, the sum of the sated fat acids makes 6,8-10,2%, the sum of monononsaturated fat acids of 14-15,5%, the sum of polynonsaturated fat acids of 74-78%. Thus, mainly in linen oil polynonsaturated fat acids contain, as corresponds to the literary data [3, 8].

At studying of the sated fat acids of linen oil (table 2) contains palmitic (C16:0) 3,5-5,2% and stearin acid (C18:0) 2,7-4,3% more.

Table 2

Structure of the sated fat acids of linen oil

Fat acid	Biostimulators		
	Control	Epin-Ekstra	Karvitol
Myristic (C14:0)	0,038±0,002	0,032±0,002	0,027±0,003
Pentadecanoic (C15:0)	0,017±0,001	0,018±0,002	0,023±0,002
Palmitic (C16:0)	5,268±0,321	3,473±0,190	3,625±0,203
Heptadecanoic (C17:0)	0,084±0,007	0,075±0,006	0,073±0,006
Stefric (C18:0)	4,383±0,036	2,849±0,180	2,764±0,176
Arachidic (C20:0)	0,144±0,011	0,134±0,009	0,100±0,008
Begenic (C22:0)	0,167±0,012	0,093±0,007	0,085±0,006
Lignoceric (C24:0)	0,113±0,081	0,165±0,086	0,148±0,084
The sum	10,214±0,880	6,839±0,708	6,845±0,709

Some reduction the maintenance of these acids in the oil received from seeds of plants of long flax with processing by biostimulators on 1,6-1,8% in comparison with control is marked. The maintenance of myristic acid (C14:0), pentadecanoic acid (C15:0), heptadecanoic acid (C17:0), arachidic acid (C20:0), begenic acid (C22:0), lignoceric acid (C24:0) in oil makes percent shares — 0,01-0,1%.

As a part of monononsaturated fat acids of linen oil (table 3) is marked more the maintenance of oleic acid (C18:1) 13,8-14,6 %, irrespective of a way of processing of plants. The maintenance oleic (C16:1[7Z]), palmitoleic (C16:1), vakcenoic (C18:1),

eicosenoic (C20:1[9Z]) makes 0,1 — 0,02 %. However, the maintenance of oleic acid in oil of seeds of the long flax received from plants with processing of preparations of Epin-Ekstra, Karvitol is less in comparison with control on 0,7-0,8 %.

Table 3

Structure of monounsaturated fat acids of linen oil

Fat acid	Biostimulators		
	Control	Epin-Ekstra	Karvitol
Cis-7-Palmitoleic (C16:1)	0,023±0,002	0,023±0,002	0,021±0,001
Palmitoleic (C16:1)	0,058±0,004	0,061±0,041	0,065±0,043
Oleic (C18:1)	14,618±0,812	13,919±0,803	13,817±0,788
Oleic (C18:1[11Z])	0,618±0,044	0,480±0,036	0,451±0,032
Eicosenoic (C20:1[9Z])	0,176±0,014	0,120±0,009	0,115±0,011
The sum	15,493±1,032	14,603±1,006	14,469±1,004

From polyunsaturated fat acids in linen oil (table 4) at research it has more appeared α -linolenic acids (C18:3) 57-63,8% which concerns Omega-3 to acids — irreplaceable fat acid in a food allowance of the person. In oil of seeds of the long flax, received from plants with processing by biostimulators, α -linolenic acids the maintenance increases by 5,5-6,4% in comparison with control. It is noticed that Karvitol has appeared more effective biostimulator from two studied, promoting concentration increase α -linolenic acids. The structure of polyunsaturated fat acids according to the analysis includes the big mass fraction of linoleic acid (C18:2) 14,8-16,7% and very few linolelaidic acid (C18:2).

Table 4

Structure of polyunsaturated fat acids of linen oil

Fat acid /class	Biostimulators		
	Control	Epin-Ekstra	Karvitol
Linolelaidic (C18:2)	0,049±0,003	0,033±0,003	0,030±0,002
Linoleic (C18:2)	16,762±1,043	15,504±1,032	14,800±1,011
Linolenic (C18:3)	57,482±2,611	63,021±2,785	63,856±2,932
The sum	74,293±3,162	78,558±3,238	78,686±3,249

Conclusions

1. It has been established that, processing of plants of fiber flax in a phase of a fur-tree by preparations of Karvitol with concentration 0,01 g/dm³, the expense of a working liquid of 300 l/hectares; Epin-Ekstra with concentration 0,00025 g/dm³, the expense of a working liquid of 250 l/hectares promotes increase in the maintenance of polyunsaturated fat acids in seeds.

2. Application of regulators of growth of plants leads to concentration increase α -linolenic acids which is irreplaceable fat acid in a food allowance of the person (ω -3). Nutritional value of linen oil improves in this case.

3. The regulator of growth of Karvitol has proved to be more effective on influence on structure of fat acids of oil of seeds of flax in comparison with a preparation of Epin-Ekstra.

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Аннотация. Изучен состав жирных кислот в льняном масле. Льняное масло было изготовлено из семян льна, а растения льна при вегетации были обработаны регуляторами роста растений Эпин-Экстра и Карвитол. Установлено, что содержание полиненасыщенных жирных кислот в масле увеличивается при обработке льна в фазу елочки биостимуляторами.