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Influence of biostimulants and humic extracts treatment on the fatty acid profile of the spring oilseed rape variety

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Abstract. *For two consecutive economic years, a field experiment was conducted with spring rapeseed hybrid Rasna. The aim is to trace the effect of phytostimulant treatment on the total fat content of rapeseed and the proportion of essential fatty acids. The application of biostimulants (organic acid and humic complexes) in the cultivation of rapeseed variety Rasna leads to changes in the fatty acid composition of the seeds. The use of biostimulants HL100, HLN 55 and TH1-20% in the first year leads to a decrease in the content of saturated by 3.5%, 1.74% and 4.7% and polyunsaturated fatty acids by 2.74%, 0.59% and 3.15% due to the higher content of monounsaturated fatty acids by 0.99%, 0.58 and 1.47%. Biostimulator TH1-10% leads to an increase in saturated by 0.06%, monounsaturated by 0.26% and a decrease in polyunsaturated fatty acids by 1.35% compared to the control group of seeds. In the second year of treatment of rapeseed variety Rasna saturated fatty acids decreased compared to the control group to a lesser extent: with the application of biostimulant TH1-10% and HLN 55 by 0.33% and 0.11%, while with biostimulants HL 100, TH1-20% and H40 their content increases by 0.97, 0.06% and 0.04% respectively. Monounsaturated fatty acids decreased in humic complexes by 0.34%, biostimulator TH1-10% by 0.72% and biostimulator TH1-20% by 0.23%. Polyunsaturated fatty acids have the highest degree of reduction when applying biostimulant HL 100-2.77%. Saturated and polyunsaturated fatty acids had a higher content in the first year of treatment in rapeseed hybrid Rasna, while the concentration of monounsaturated fatty acids increased with a high degree of confidence (P≤0.001) in the second marketing year. This, on the one hand, is due to environmental factors, and on the other - to the type of preparation for treatment. The improved fatty acid composition of the seeds makes them a suitable raw material for the production of fats and their use in feed for monogastric and ruminant animals.*

Keywords: rapeseed, saturated (SFA), polyunsaturated (PUFA), monounsaturated (MUFA) fatty acids

Introduction

The modern population consumes a large amount of refined foods, so there is a shortage of nutrients. A promising direction in food production is the creation of new functional foods from non-traditional raw materials containing biologically active components (proteins, lipids, vitamins, etc.) necessary for humans. Vegetable oils and fats should be part of a normally balanced and healthy diet. They are rich in unsaturated fatty acids and are a source of essential fatty acids (omega-3 and omega-6 fatty acids that the body cannot produce), vitamin E and do not contain cholesterol. Rapeseed is a plant that is grown annually in the temperate climates of Europe,

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Canada and China. In Europe, rapeseed oil is used mainly for food in Germany, Poland and the United Kingdom, followed by France, Belgium and Sweden. Nowadays, the use of rapeseed as an oilseed is relevant due to its high profitability. Rapeseed oil is used in the chemical, food and textile industries. The application of rapeseed oil in the food industry is recent and the reason for this is the use of modern methods for clarification, improving the quality of rapeseed, growing hybrid varieties with high linolenic acid content and low erucic acid content. Rapeseed oil contains an optimal amount of fatty acids compared to other types of oils, but has a drawback - the presence of erucic acid and thioglycosides, which adversely affect human and animal nutrition (Kleymenova et al., 2021). Rapeseed (*Brassica napus* L.*)* is rich in fat and protein. Rapeseed can give up to 45% rapeseed oil and is an excellent source of protein for the feed industry. The fat content of mature winter oilseed rape varies between 45% and 50% (Liersch et al., 2013). Stepien et al. (2017), in a study of 'Californium' winter oilseed rape found a fat content of 46 to 59%. The amount of fat in the seeds is determined genetically (Tanska et al., 2009; Wittkop et al., 2009; Ambrosewicz-Walacik et al., 2015), but the conditions of the growing environment also have an impact (Ozturk, 2010; Narits, 2010; Spychaj-Fabisiak et al., 2011; Faraji, 2012; Varényiová and Ducsay, 2016).

Rapeseed oil is an important source of energy in the human diet and contains a relatively high percentage of unsaturated fatty acids: linoleic acid (C18:2) and α-linolenic acid (C18:3), which are classified as essential unsaturated fatty acids. They in turn affect the lipid profile of the blood and reduce the risk of coronary heart disease (Omidi et al., 2010; Narits, 2010; Ntawubizi et al., 2010). Rapeseed oil has a low content of saturated fatty acids compared to other oil-bearing plants and a relatively high content of essential fatty acids (C18:2) and (C18:3) at optimal ratios of 2:1 (Zatonski et al., 2008). The protein and oil content of rapeseed can be modified in the diet through changes in the fatty acid composition of the oil and a reduction in anti-nutritional compounds, mainly fiber and glucosinolates (Liersch et al., 2013). Stepien et al. (2017) found an average content of saturated fatty acids (SFA) in rapeseed oil of 7.41%, polyunsaturated (PUFA) - 28.2% and monounsaturated (MUFA) -64.3% and a MUFA: PUFA ratio of 2.1:1 to 2.5:1. According to Liersch et al. (2013), an oil with a MUFA:PUFA ratio of 2:1 is suitable for food purposes. Degreased rapeseed is used as feed (Baltrukoniene et al., 2015).

The application of plant biostimulants is an important part of intensive agriculture. More and more farmers are effectively using biostimulants during certain phases of crop development to stimulate growth, the effectiveness of mineral nutrition, tolerance to stressors, and to improve the quality of crop production. The group of biostimulants includes protein hydrolysates, humic and fulvic acids, algae extracts, microbial biostimulants and others. The majority of research is focused on their effectiveness on productivity. Scientific data on the changes in the biochemical characteristics of plant raw materials and foods in the use of biostimulants are scarce.

The aim of the study was to trace the effect of phytostimulants treatment on the total fat content of rapeseed and the proportion of essential fatty acids in the lipid fraction.

Material and methods

Material for the study are the harvested seeds of spring oilseed rape hybrid Rasna, grown by treating the leaf mass with plant biostimulants in the conditions of a precise field experiment conducted at the Institute of Agriculture and Seed Science "Obraztsov Chiflik".

Rapeseed is grown using standard technology. The field trials were conducted for 2 economic years by the block method with a plot size of 20 m^2, in four replications for each treatment and random placement of the variants.

Five phytostimulant samples were tested:

1. HL 100 - developed on the basis of universal humate fertilizer with the trade name "Humusil", dose - 250 $ml.da^{-1}$

2. H 40 - the active ingredient is a derivative of organic acid with growth-stimulating effect, dose - 100 $ml.da^{-1}$

3. TH1-10% vermicompost extract with alkaline extractant, dose 300 $ml.da^{-1}$

4. HLN 55 - contains humic components and derivatives of organic acid with auxin-like action, dose - 40 $ml.da^{-1}$

5. TH1-20% vermicompost extract with alkaline extractant, dose 300 $ml.da^{-1}$

6. Control

The application of the preparations is in the rosette and initial flowering phases, by means of foliar treatment at a consumption rate of the working solution 25 $ml.da^{-1}$.

Fats are determined according to BDS EN ISO 1211: 2002, ISO 9622.

Fatty acid analysis of rapeseed performed – the total lipid extraction was performed by Bligh and Dyer (AOAC, 1959) with chloroform and methanol at a ratio of 1:2. The methyl esters of fatty acids (FAME) were analyzed using a Shimadzu-2010 gas chromatograph (Kyoto, Japan) by FID. The assay was performed with a CP7420 capillary column (100 m x 0.25 mm i.d., 0.2 m, Varian Inc., Palo Alto, CA), with carrier gas hydrogen and make-up gas nitrogen. A five-step gas chromatographic oven program was used. Column starting temperature - 80ºC min^{-1}, which was held for 15 min, then increased by 12ºC min^{-1} to 170ºC and held for 20 min, followed by a further increase of 4ºC min^{-1} to 186ºC for 19 min and up to 220ºC at 4ºC min^{-1} until the process was completed.

The results were processed by the methods of variation statistics by Student's t-test and presented in tables.

Results and discussion

Oilseeds are plants that are grown mainly for seeds or fruits that have a high fat content. The fat content as a percentage of the dry mass of rapeseed varies from 45 to 50% (Honermeier, 2012).

The fat content of rapeseed hybrid Rasna seeds in the control group in the first year was 37.3% (Table 1). The application of phytostimulant HL 100 (humate fertilizer) led to a reduction of the fat content to 37.12%, while with the application of other phytostimulants the fat content increases compared to the control rapeseed. The application of H40 (auxin-type regulator) gave the best results in terms of fat production in rapeseed and the concentration reached 38.19%, followed by treatment with HLN 55-37.81% and better results obtained at 20% TH1 (vermicompost extract) -37.75% compared to 10% TH1 - 37.45%. The total fat content of the treated and control group rapeseed for the second year were higher. The application of humate fertilizer HL 100 led to a lower fat content in rapeseed compared to the control untreated group, 38.45 and 40.57%, respectively, which confirms the effect of the first year. The best result was achieved when treating rapeseed with biostimulant TH1-20% extract and H 40 as follows: 45.3 and 45.23%, followed by HLN 55-44.71% and TH1-10% - 44.54% fat (Szczepanek et al., 2016; Kováčik et al., 2016; Matysiak et al., 2012).

Table 1. Fat content in rapeseed, %

	First year	Second year
HL 100	37.12	38.45
H 40	38.19	45.23
TH1-10%	37.45	44.54
HLN 55	37.81	44.71
TH1- 20%	37.75	45.3
Control	37.30	40.57

The research results revealed that biostimulants did not influence crude oil content but a slight tendency was observed for the values of this trait to increase by as much as 3.9%, compared with control or a small effect of plant stimulants on oil content in oilseed rape seeds (Matysiak et al., 2012; Szczepanek et al., 2016; Kováčik et al., 2016). Ijaz and Honermeier (2012), where crude oil content in oilseed rape seeds averaged from 440 to 490 g. kg^{-1} d.m. and the results obtained by Jankowski et al. (2015, 2016) were 406.0 and 495.6 g. kg^{-1} d.m. The crude oil content in oilseed rape seeds was significantly affected by the weather conditions prevailing in individual study years. Oil content was higher in colder years with higher precipitation rather than in warm years. The highest was seed content of oil in years with high precipitation and moderate temperatures (Kotecki et al., 2007; Mączyńska et al., 2015).

Treatment with the analysed biostimulants also affects the fatty acid spectrum (Tables 2, 3 and 4). The saturated fraction is represented mainly by palmitic and stearic acids.

The use of biostimulator TH1-10% in the first year leads to an increase in the content of palmitic acid (C16:0) compared to the control group of rapeseed. In other biostimulants, the effect of reducing palmitic acid was observed. Identical results were obtained for stearic acid (C18:0). Of the monounsaturated acids, oleic acid (C-18:1c9) had the highest concentration after treatment with biostimulant HL 100-63.91 g/100 g fat and the lowest with biostimulant H 40-52.82 g/100 g fat. Polyunsaturated linoleic acid (C-18:2c9,12) is synthesized in the highest amount in the treatment of rapeseed with biostimulant TH1-10%, followed by biostimulant HLN 55, TH1-20%, HL 100 and the lowest in biostimulant H 40 (Table 2). Gamma linolenic acid (gC-18:3n6) was insignificant in all types of stimulants and in the control group. Alpha linolenic fatty acid (αC-18:3n3) had higher values compared to the control group of rapeseed when applying the biostimulant TH1-10%, HLN 55 and TH1-20%.

Table 2. Fatty acid content of rapeseed, g/100g fat

	First year											
	HL 100		H 40		TH1-10%		HLN 55		TH1-20%		Control	
	X	SD	X	SD	X	SD	X	SD	X	SD	X	SD
C-16:0	4.62	0.00	4.34	0.02	5.36	0.00	5.12	0.00	5.10	0.00	5.30	0.00
C-18.0	1.80	0.00	3.22	0.01	4.27	0.00	1.60	0.00	3.48	0.00	4.26	0.00
C-18:1c9	63.86	0.05	22.94	0.10	59.14	0.02	61.72	0.04	60.36	0.04	59.36	0.03
C-18:2c9,12	20.64	0.02	8.53	0.04	22.50	0.01	22.38	0.01	22.28	0.01	22.43	0.01
gC-18:3n6	0.04	0.00	1.00	0.00	0.01	0.00	0.03	0.00	0.02	0.00	0.01	0.00
aC-18:3n3	5.07	0.00	2.49	0.01	5.36	0.00	5.42	0.00	5.41	0.00	5.26	0.00
C-20:1n9	0.01	0.00	1.56	0.01	0.51	0.00	0.53	0.00	0.43	0.00	0.00	0.00
SFA	6.75	0.01	14.61	0.06	9.93	0.00	7.13	0.00	8.88	0.01	9.87	0.01
MUFA	64.99	0.05	43.89	0.19	60.48	0.02	63.37	0.04	61.69	0.04	60.22	0.03
PUFA	27.70	0.02	29.98	0.13	29.09	0.01	28.85	0.02	28.86	0.02	29.44	0.02
Σn-3	5.25	0.00	4.62	0.02	5.54	0.00	5.54	0.00	5.53	0.00	5.44	0.00
Σ n-6	20.99	0.02	24.87	0.11	22.65	0.01	22.52	0.01	22.38	0.01	22.52	0.01
Σ n-6/Σn-3	4.00	0.00	5.39	0.00	4.09	0.00	4.07	0.00	4.05	0.00	4.14	0.00
Σ C-18:1cis-FA	63.86	0.05	22.94	0.10	59.14	0.02	61.72	0.04	60.36	0.04	59.36	0.03
	Second year											
	1		**2**		**3**		**4**		**5**		**6**	
	X	SD	X	SD	X	SD	X	SD	X	SD	X	SD
C-16:0	4.39	0.00	4.61	0.00	4.62	0.00	4.71	0.01	4.79	0.01	4.73	0.01
C-18.0	0.80	0.00	1.78	0.00	1.77	0.00	1.85	0.00	1.89	0.01	1.84	0.00
C-18:1c9	58.74	0.05	62.80	0.05	64.71	0.02	65.48	0.16	65.27	0.20	64.84	0.09
C-18:2c9,12	18.13	0.01	20.20	0.02	20.68	0.00	20.25	0.05	19.98	0.06	20.27	0.03
gC-18:3n6	0.03	0.00	0.01	0.00	0.02	0.00	0.01	0.00	0.02	0.00	0.01	0.00
aC-18:3n3	4.02	0.00	4.50	0.00	4.66	0.00	4.49	0.01	4.28	0.01	4.36	0.01
C-20:1n9	1.08	0.00	0.56	0.00	0.62	0.00	0.60	0.00	0.00	0.00	0.73	0.00
SFA	8.01	0.01	7.09	0.02	6.72	0.02	6.94	0.02	7.10	0.02	7.05	0.00
MUFA	66.12	0.05	65.84	0.06	65.80	0.02	66.70	0.16	66.04	0.20	66.36	0.10
PUFA	23.00	0.02	26.11	0.02	26.49	0.01	25.66	0.06	26.00	0.08	25.77	0.04
Σn-3	4.18	0.00	4.55	0.00	4.72	0.00	4.60	0.01	4.34	0.01	4.58	0.01
Σ n-6	20.02	0.02	22.18	0.02	20.79	0.00	20.34	0.05	20.10	0.06	20.38	0.03
Σ n-6/Σn-3	4.79	0.00	4.87	0.00	4.40	0.00	4.43	0.00	4.63	0.00	4.45	0.00
Σ C-18:1CFA	60.46	0.05	64.69	0.06	64.71	0.02	65.48	0.16	65.27	0.20	64.84	0.09

In the second year of treatment on rapeseed with biostimulants it was found that palmitic acid was lower by biostimulant HL 100, H 40, TH1-10% and HLN 55, while to biostimulant TH1-20% it was higher than the control group. In the case of stearic acid, a two-fold decrease in its concentration was observed when using the biostimulant HL 100 compared to the control group. In the second year, the stearic acid content was significantly lower than in the first, evidence with a high degree of reliability (P≤0.001). Oleic acid had the highest content of biostimulant HLN 55 in the second year compared to control rape. The changes in the second year had a tendency of increase of oleic acid compared to the first one with a high degree of reliability (P≤0.001). With regard to gamma linolenic acid, no changes were found compared to the control group and the previous year. Alpha linolenic acid had a higher concentration in biostimulant H 40, TH1-10% and HLN 55 compared to control rape, while the others had a lower content. The fatty acid that determines the quality of rapeseed oil is euric acid (C-20: 1n9), which has a serious toxic effect. In the first year its content in the tested rapeseed did not exceed 1.56 g / 100 g fat, but in the control group and in biostimulant HL 100 its presence was established. In the second year its amount varied in the range from 0.1 to 1, 08 g / 100 g fat.

Erucic acid is a natural plant toxin found in rapeseed and mustard oil (Hulan et al., 1976; Kramer et al., 1982; Wildt and Speijers, 1984; Ruso et al., 2021). Epidemiological studies show that in regions where mustard oil is still used in the traditional way (raw, unrefined), there is a higher number of cardiovascular diseases (Rastogi et al., 2004). It adversely affects cardiac tissue (FSANZ, 2003), is absorbed by myocardial tissue and is not metabolized (Kramer et al., 1979). According to EC Regulation № 1881/2006, the permissible concentrations of erucic acid in vegetable oils and fats and foods with vegetable oils are 50 g/kg and in baby foods up to 10 g/kg.

Table 3. Total fatty acid content for the period in rapeseed, g/100g fat

	HL 100				H 40				TH1-10%			
	X	Sd	min	max	X	Sd	min	max	X	Sd	min	max
C-16:0	4.50	0.13	4.38	4.62	4.48	0.15	4.32	4.62	5.05	0.39	5.36	4.63
C-18.0	1.30	0.55	0.8	1.8	2.50	0.79	1.77	3.23	3.20	1.34	1.77	4.27
C-18:1c9	61.30	2.80	58.69	63.91	52.87	11.84	52.82	62.84	61.52	2.98	59.12	64.72
C-18:2c9,12	19.38	1.37	20.18	20.65	14.36	6.39	8.49	20.68	21.72	0.98	20.67	22.51
gC-18:3n6	0.04	0.01	0.03	0.04	0.51	0.54	0.02	1.00	0.02	0.01	0.01	0.02
aC-18:3n3	4.55	0.58	4.02	5.08	3.49	1.10	2.48	4.51	5.06	0.38	4.65	5.36
C-20:1n9	0.55	0.58	0.01	1.08	1.06	0.55	0.56	1.56	0.56	0.06	0.51	0.56
	HLN 55				TH1-20%				Control			
	X	Sd	min	max	X	Sd	min	max	X	Sd	min	max
C-16:0	4.95	0.22	4.69	5.13	4.94	0.17	4.77	5.10	5.02	0.31	4.72	5.30
C-18.0	1.71	0.13	1.60	1.84	2.68	0.87	1.88	3.48	3.05	1.32	1.84	4.25
C-18:1c9	63.33	2.01	61.67	65.59	62.81	2.69	60.32	65.44	62.10	3.00	59.32	64.92
C-18:2c9,12	21.47	1.14	20.19	22.39	21.13	1.26	19.91	22.26	21.35	1.18	20.24	22.44
gC-18:3n6	0.02	0.01	0.01	0.03	0.02	0.00	0.01	0.02	0.01	0.00	0.01	0.02
aC-18:3n3	5.02	0.50	4.49	5.42	4.85	0.62	4.26	5.42	4.81	0.49	4.35	5.26
C-20:1n9	0.56	0.04	0.53	0.60	0.22	0.24	0.10	0.43	0.36	0.40	0.01	0.73

Table 4. Group of fatty acid for the period in rapeseed, g/100g fat

	HL 100				H 40				TH1-10%			
	X	Sd	min	max	X	Sd	min	max	X	Sd	min	max
SFA	7.38	0.69	6.74	8.03	10.85	4.12	7.07	14.54	8.55	1.72	6.70	9.93
MUFA	65.56	0.62	64.93	66.18	54.86	12.02	43.67	65.89	62.76	2.84	60.46	65.81
PUFA	25.35	2.58	22.98	27.72	28.04	2.12	26.08	30.09	27.98	1.39	26.48	29.10
Σ n-3	4.71	0.59	4.18	5.25	4.58	0.04	4.55	4.63	5.19	0.44	4.72	5.55
Σ n-6	20.50	0.53	20.01	21	23.52	1.47	22.16	24.96	21.85	0.99	20.79	22.65
Σn-6/Σn-3	4.39	0.43	4	4.79	5.13	0.28	4.87	5.39	4.22	0.17	4.09	4.40
ΣC-18:1CFA	62.16	1.86	60.41	63.91	43.81	22.87	23.02	64.73	61.52	2.98	59.12	64.72
	HLN 55				TH1-20%				Control			
	X	Sd	min	max	X	Sd	min	max	X	Sd	min	max
SFA	7.05	0.11	6.92	7.14	7.99	0.97	7.08	8.89	8.46	1.55	7.04	9.87
MUFA	64.80	1.78	63.32	66.82	63.86	2.39	61.65	66.22	63.29	3.37	60.18	66.45
PUFA	27.48	1.70	25.59	28.86	27.43	1.57	25.91	28.88	27.60	2.01	25.73	29.45
Σ n-3	5.13	0.50	4.58	5.54	4.94	0.65	4.32	5.54	5.01	0.47	4.57	5.44
Σ n-6	21.59	1.17	20.29	22.54	21.24	1.25	20.04	22.40	21.45	1.17	20.35	20.53
Σn-6/Σn-3	4.22	0.19	4.07	4.43	4.34	0.32	4.05	4.63	4.30	0.17	4.14	4.45
ΣC-18:1CFA	63.33	2.01	61.76	65.59	62.81	2.69	60.40	65.44	62.10	3.00	59.39	64.92

Table 5. Statistical reliability of the fatty acid results by treatment of rapeseed

	HL 100/ H 40	HL 100/ TH1- 10%	HL 100/ HLN 55	HL 100/ TH1- 20%	HL 100/ Control	H 40/ TH1- 10%	H 40/ HLN 55	H 40/ TH1- 20%	H 40/ Control	TH1- 10%/ HLN 55	TH1-10%/ TH1- 20%	TH1-10%/ Control.	HLN 55/ TH1- 20%	HLN 55/ Control	TH1-20%/ Control
C-16:0	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***
C-18.0	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***
C-18:1c9	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***
C-18:2c9,12	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***
gC-18:3n6	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***
aC-18:3n3	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***
C-20:1n9	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***
SFA	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***
MUFA	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***
PUFA	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***
Σ n-3	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***
Σ n-6	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***
Σn-6/Σn-3	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***
ΣC-18:1CFA	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***

* - P ≤ 0.05, ** - P ≤ 0.01, ***- P ≤ 0.001

The use of biostimulator HL 100, HLN 55 and TH1-20% in the first year leads to a decrease in the content of saturated and polyunsaturated fatty acids by 3.5%, 1.74% and 4.7%, respectively, with 2.74%, 0.59%, 3.15% at the expense of the higher content of monounsaturated acids by 0.99%, 0.58 and 1.47%. Biostimulator TH1-10% leads to an increase in saturated by 0.06%, monounsaturated - 0.26% and a decrease in polyunsaturated fatty acids by 1.35% compared to the control group of seeds. The use of biostimulator H 40 leads to an increase in saturated fatty acids by 4.74% and polyunsaturated fatty acids by 0.54% at the expense of monounsaturated, which decreased by 16.33% in the first year compared to the control group. In the second year of treatment of rapeseed hybrid Rasna saturated fatty acids decreased compared to the control group with the application of biostimulant TH1-10% and HLN 55 by 0.33% and 0.11%, while with biostimulant HL 100, TH1-20% and TH1-10% they increased by 0.97, 0.06% and 0.04%, respectively. Monounsaturated fatty acids decreased in humic acids by 0.34%, biostimulator TH1-10% by 0.72% and biostimulator TH1-20% by 0.23%. Polyunsaturated fatty acids had the highest degree of change when applying the biostimulant HL 100-2.77%. Saturated and polyunsaturated fatty acids had a higher content in the first year of treatment in rapeseed variety Rasna compared to the second one, while the concentration of monounsaturated fatty acids increased with a high degree of confidence (P≤0.001), which is, on the one hand, due to environmental factors, and, on the other hand, to the type of treatment preparation which allows to improve the fatty acid composition of the seeds, which are a suitable raw material for fat production and their use in feed for monogastric animals and ruminants.

Kleymenova et al. (2021) in a study of the fatty acid composition of rapeseed oil, found a higher content of linoleic acid of 20% (ω6) and linolenic acid of 12% (ω3) compared to the results of the study. In the database winter rapeseed oil has a concentration of ω6, respectively 5-5.5%, and ω3 is 4.5-6%. Schmidt et al. (2004) found a low content of erucic acid, oleic acid 48%, linoleic acid 37.8%, linolenic acid 13.5% and small amounts of the usual saturated acids in triacylglycerols from rapeseed oil.

Conclusion

The fat content in the studied rapeseed was higher in the second year of cultivation. The application of phytostimulants resulted in a slight increase in fat content compared to the control group of seeds, with the exception of treatment with HL 100 (Humusil), which showed a slightly lower fat content in both years compared to the control rapeseed. Saturated and polyunsaturated fatty acids had a higher content in the first year of treatment of rapeseed hybrid Rasna compared to the second one, while the concentration of monounsaturated fatty acids increased with a high degree of confidence (P≤0.001) in the second marketing year. This, on the one hand, is due to environmental factors, and on the other – to the type of preparation. The treatment of the vegetative mass with the tested phytostimulants allows improving the fatty acid composition of the seeds, which are a suitable raw material for fat production and their use in feed for monogastric animals and ruminants.

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