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STUDIES ON THE USE OF RAPESEED OIL MEAL (OBTAINED FROM DOUBLY IMPROVED RAPE VARIETY) IN RAINBOW TROUT (*Salmo gairdneri f. kamloops*) FEEDING

I I. UTILITY AND OPTIMAL CONTENT OF RAPESEED OIL MEAL IN THE FEED MIXTURES FOR RAINBOW TROUT FATTENING

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A b s t r a c t. Studies were carried out on five feed mixtures containing different levels of rapeseed oil meal. The meal was obtained from doubly improved winter rapeseed variety "Jantar". It substituted soybean oil meal and partly fish meal in the feed mixtures. It was found that rapeseed oil meal can be an isoactive substitute for soybean oil meal. Optimal content of this component in the feed mixture was 10.5%. Trout fed the feeds in which rapeseed oil meal substituted part of the fish meal was characterized by lower growth and worse utilization of the feeds.

Key words: RAINBOW TROUT, FEED MIXTURES, OIL MEAL

INTRODUCTION

This paper presents a continuation of the studies on the suitability of rapeseed oil meal (obtained from doubly improved rape variety) as a component in the feed mixtures fed to rainbow trout fry (Wojno 1987). It was found that rapeseed oil meal could be used as an isosubstitute for soybean oil meal, and that its optimal content in the feed was 10%. Taking into account rapid growth and high survival of the fry, as well as good utilization of the feed by trout fed the feeds containing rapeseed oil meal, it seems that the content of this component might be as high as 18%.

There are no data in the available literature on the utility of rapeseed oil meal (obtained from doubly improved rape varieties) in feeding older trout (fish fattening). Only Hardy and Sullivan (1983) found that rapeseed oil meal from "Canola" rape could be a good substitute for some of the soybean oil meal and some of the blood meal in the mixtures used in rainbow trout fattening. According to these authors, rapeseed oil meal content of 10-20% had no adverse effect on the fish growth and food utilization as well as on the changes of T_3 and T_4 content in older rainbow trout. However, all levels of rapeseed oil meal resulted in an overactivity of the thyroid gland, though no hypertrophy or haperplasia were observed.

The aim of the studies was to determine the suitability of rapeseed oil meal (obtained from doubly improved winter rape variety "Jantar") in feeding older rainbow trout. The meal substituted soybean oil meal in the feed mixtures, and partly also fish meal. In addition to this, an attempt was made to define optimal percentage of this component in the fish feeds.

MATERIAL AND METHODS

The experiments were carried out in a 1680 dm^3 aquarium divided into 10 equal parts. The aquarium was filled with lake water which was constantly aerated. Water temperature was controlled throughout the experiment, being 13°C ± 0.4°C. Oxygen content in the water inflow varied from 6.88 to 10.56 mg O_2/dm^3, and in the outflow from 6.56 to 9.40 mg O_2/dm^3, pH was 7.6-7.8. All water volume in the aquarium exchanged 6 times daily.

Rainbow trout (*Salmo gairdneri f. kamploops*) aged 0+ was used. All fish were of the same origin. Each compartment of the aquarium was stocked with 15 fish of average individual weight 50.5 g (Tab. 1).

TABLE 1

Stocking rates, catches, growth rate and survival, food conversion rates, and use of total protein per 1 kg of trout weight[1]

Feed number	Fish stocking rate ind.	Fish stocking rate weight g	Fish catch ind.	Fish catch gross weight g	Fish catch net weight g	Fish catch average ind. weight g	Weight increments gross g	Weight increments net g	Weight increments average increment g	Fish survival	Food conversion rate	Use of total protein per 1 kg of weight increment
1	30	1511	29	4824	4673	161.1	3313	3212	110.6 a[2]	96.7	1.04 a	425.7
2	30	1514	30	4875	4875	162.5	3361	3361	112.1 a	100.0	1.01 a	422.1
3	30	1515	30	4672	4672	155.7	3157	3157	105.2 ab	100.0	1.08 a	443.4
4	30	1513	30	4460	4460	148.7	2947	2947	98,2 b	100.0	1.13 a	467.0
5	30	1512	30	4455	4455	148.5	2943	2943	98.1 b	100.0	1.11 a	449.1

[1] *the results represent a sum or an average for two repetitions.*
[2] *Results with the same letter mean that there were no statistically significant differences at* $\alpha=0.05$

Five feed mixtures were tested (Tab. 2), each in two repetitions. Daily feed doses amounted to 1.5-1.2% of the fish weight. Fish were fed 3 times daily, and on weekends and holidays 2 times daily. Weight increments were controlled at 2-week intervals.

Content of total nitrogen, raw fat, ash, raw fibre and dry weight were determined in the fish feeds and in the fish body and excrements, according to the methods described by Skulmowski (1974).

TABLE 2

Composition of the feeds (in %)

Components	Feed no. 1	2	3	4	5
Fish meal	36	36	34	31	28
Meat-bone meal	15	15	15	15	15
Soybean oil meal	10	-	-	-	-
Rapeseed oil meal		10.5	15	20	25
Wheat meal	21	20.5	18	16	14
Yeasts	10	10	10	10	10
Fish oil	7	7	7	7	7
Premix WP-2	1	1	1	1	1

Exogenous amino acid content in the feeds was analysed after sample hydrolysis in 6 n HCl, in 105°C for 21 h in argon atmosphere. Amino acid separation was performed using an automatic amino acid analyser Joel ILC-6 AH (Japan). Tryptophane was determined according to the method of Mathesen (1974), after sample hydrolysis in 6 n NaOH, for 20 h in nitrogen atmosphere. Cystine content in the feed mixtures was determined after hydrolysis in HCl with an addition of 0.3 n dimethylsulfoxide, according to the method of Spencer and Wold (1969).

Coefficients of apparent digestibility of total protein and raw fat were determined with an index method using Cr_2O_3. The amount of chromium in the feed mixtures and the fish excrements was determined with the method given by Furukawa and Tsukahara (1969). Value of PER index, which is the measure of nutritive value of the protein, was calculated using the formula:

fish weight increment in g

$$PER = \frac{\textit{fish weight increment in g}}{\textit{amount of protein consumed in g}}$$

Protein utilization was determined using an index proposed by Zeitoun et al. (1974):

$$\textit{apparent NPU} = \frac{\textit{increase of protein in the body (g)}}{\textit{amount of protein consumed (g)}}$$

Basic haemotological indices were determined in blood collected from caudal veins of 10 fish in each group. Haematocrite was determined after 3 min sample centrifugation at 115 000 rotations/min. Haemoglobin content was determined colorimetrically (550 nm) using cyanohaemoglobin.

Content of thyoglucoside derivatives (ITC, OZT) in rapeseed oil meal was determined according to the method of Youngs and Wetter (1967). Increments of fish weight, values of the food conversion coefficients and haematological indices were analysed statistically, using the variance analysis. Significance of the differences was determined using a multiple range test (Ruszczyc 1978).

RESULTS

CHARACTERISTICS OF THE FEED MIXTURES

The mixtures contained components of animal origin - fish meal and meat-bone meal, and of plant origin - soybean oil meal, rapeseed oil meal, wheat meal, and yeasts. All mixtures contained fish oil and an addition of vitamin-mineral premix WP-2.

Percentage of fish meal in particular mixtures ranged from 36 to 28%. In the feeds no. 3, 4 and 5, rapeseed oil meal represented an isonitrogen substitute for part of the fish meal.

Soybean oil meal was used only in the feed mixture no. 1 which was treated as the control.

TABLE 3

Chemical composition of the feed components (%)

Components	Dry weight	Total protein	Digestible protein	Raw fat	Ash	Non-nitrogen extractable	Raw fibre	Water	Glucosinolates μg/g in dry weight
Fish meal	94.52	67.12	-	9.96	13.57	3.87	-	5.48	-
Meat-bone meal	96.11	40.58	-	17.56	34.12	3.85	-	3.89	-
Soybean oil meal	87.42	39.40	-	1.93	6.06	34.92	5.11	12.58	-
Rapeseed oil meal	86.66	37.58	36.25	2.08	7.03	31.86	8.11	13.34	0.88
Yeasts	95.94	41.61	-	0.48	13.38	40.47	-	4.06	-
				in dry weight					
Fish meal		71.01	-	10.55	14.36	4.09	-		
Meat-bone meal		42.22	-	18.28	35.50	4.01	-		
Soybean oil meal		45.07	-	2.21	6.93	39.94	5.84		
Rapeseed oil meal		43.36	41.83	2.40	8.11	36.77	9.36		106
Yeasts		43.37	-	0.50	13.94	42.18			

Commercial oil meal produced by the High Poland Enterprice for Fat Production was used in the study. It was produced from a doubly improved winter rape variety, and contained 43.36% of crude protein, 41.83% of digestible protein, and 2.40% of raw fat (on a dry weight basis). Raw fibre content was 9.36% and ash amounted to 8.4% (Tab. 3). Data presented in Tab. 4 show that protein in soybean oil meal contained all exogenous amino acids. Kozłowski et al. (1984) stated that the content of particular exogenous amino acids in the protein of rapeseed oil meal and soybean oil meal was similar. Also the sum of exogenous amino acids was similar in the two oil meals (Tab. 5).

TABLE 4

Content of exogenous amino acids and of cystine and tyrosine in the feeds and in the rapeseed oil meal (% d.wt.)

	Feed no.					Rapeseed oil meal	Trout requirements for exogenous amino acids, after Ogino 1980
	1	2	3	4	5		
Arginine	2.58	2.37	2.41	1.59	1.54	1.72	1.4
Histidine	1.06	0.95	0.74	0.79	0.83	0.72	0.6
Isoleucine	1.60	1.56	1.44	1.54	1.54	1.38	1.0
Leucine	2.86	2.79	2.81	2.76	2.61	2.61	1.8
Lysine	2.82	2.73	2.41	2.33	2.59	1.74	2.1
Methionine	0.94	0.88	0.84	0.83	0.84	0.66	0.7[1]
Cystine	0.50	0.54	0.53	0.57	0.61	0.93	-
Phenylalanine	2.13	2.00	1.95	1.89	1.90	1.70	1.2[2]
Tyrosine	1.26	1.13	1.11	1.14	0.99	0.93	-
Treonine	1.69	1.76	1.66	1.68	1.71	1.49	1.4
Tryptophane	0.63	0.56	0.48	0.51	0.54	0.69	0.2
Valine	2.11	1.96	2.01	2.05	2.03	1.89	1.2
Sum of exogenous amino acids	18.02	17.56	16.75	16.92	16.13	-	-

[1] *requirements at the presence of 0.4% of cystine in the feed*
[2] *the same at the presence 0.8% tyrosine*

Taking into account total amount of amino acids in % per dry weight of the two oil meals, it can be noted that it is lower in rapeseed oil meal. Levels of total protein in particular mixtures were more or less similar and ranged from 42.84 to 43.88% (Tab. 6). It was found by Steffens (1970, 1979), Luguet (1971), Gamygin and Kanidiev (1977) that rainbow trout attained best growth at total protein content in the feed from 40 to 50%.

TABLE 5

Amino acid content of proteins in rapeseed oil meal and soybean oil meal (Kozłowski et al. 1984)

	Rapeseed oil meal		Soybean oil meal	
	% in the meal	% in total protein	% in the meal	% in total protein
Histidine	1.04	2.99	1.11	2.43
Lysine	2.18	6.26	2.96	6.51
Phenylalanine	1.66	4.77	2.66	5.86
Tyrosine	0.96	2.76	1.44	3.18
Tryptophane	1.09	3.13	1.10	2.43
Methionine	0.96	2.75	1.19	2.62
Cystine	0.85	2.44	0.72	1.58
Treonine	1.72	4.93	1.92	4.22
Leucine	2.66	7.62	3.74	8.24
Isoleucine	1.41	4.04	2.14	4.72
Valine	2.03	5.82	2.34	5.15
Arginine	2.22	6.35	3.17	6.99
Total	16.97	48.67	22.33	49.17

TABLE 6

Chemical composition of the feeds (%)

Components		Feed number 1	2	3	4	5
Total protein	a	41.89	41.59	41.05	41.42	40.43
	b	43.71	43.76	43.46	43.88	42.84
Raw fat	a	12.89	12.71	12.50	12.28	12.11
	b	13.45	13.37	13.23	13.01	12.84
Ash	a	13.54	13.41	13.56	13.17	12.97
	b	14.13	14.11	14.35	13.95	13.74
Raw fibre	a	0.66	0.94	1.22	1.75	1.98
	b	0.69	0.99	1.29	1.85	2.10
Non-nitrogen extractable	a	26.84	26.39	26.13	25.77	26.87
	b	28.00	27.77	27.66	27.30	28.38
Dry weight		95.82	95.04	94.46	94.39	94.36
Water		4.18	4.96	5.54	5.61	5.64
Glucosinolates (μg/g in dry weight)		-	111.0	159.0	212.0	265.0

a - % in wet weight
b - % in dry weight

Crude fat content in the mixtures varied from 12.84 to 13.45% and was close to the lower limit of its optimal level which was 15-20% according to Steffens (1985).

Ash content in the mixtures ranged from 13.74 to 14.35%. Feeds no. 4 and 5 were characterized by slightly lower levels of this component as they contained less fish meal. Crude fibre content varied from 0.69 to 2.10% and depended on the percentage of rapeseed oil meal. Non-nitrogen extracted substances accounted for 25.77-26.87% (Tab. 6). Feed no. 1 was characterized by the highest content of exogenous amino acids (Tab. 4). This feed contained soybean oil meal. Content of amino acids in the feeds 2, 3 and 4 was similar. The lowest content of amino acids (total) was found in feed no. 5 which contained the highest percentage of rapeseed oil meal and the lowest of fish meal. Taking into account the levels of exogenous amino acids in the feeds, it may be stated that they were sufficiently high to meet the requirements of rainbow trout as defined by Ogino (1980).

FISH GROWTH AND SURVIVAL, DIGESTIBILITY OF THE FOOD COMPONENTS, AND UTILIZATION OF THE FEEDS

INCREMENTS IN BODY WEIGHT AND FISH SURVIVAL

Body weight increments of trout fed particular feeds were different (Tab. 1). The highest growth rate was observed for the fish receiving feed no. 2. Trouts given feed no. 1 (control) grew slightly less rapidly. Also the fish receiving feed no. 3 attained similar weight on the average. The differences of the average body weight of the fish receiving feeds no. 1, 2 and 3 were statistically insignificant.

TABLE 7

Chemical composition of the fish excrements (%)

Fish receiving feed no	Dry weight	Total protein		Raw fat		Ash		Carbohydrates		Water
		mm	sm	mm	sm	mm	sm	mm	sm	
1	18.62	3.06	16.45	0.80	4.31	6.36	34.14	8.40	45.10	81.38
2	17.11	2.82	16.49	0.74	4.32	5.67	33.17	7.88	46.02	82.89
3	17.71	2.81	15.85	1.23	6.95	6.19	34.95	7.48	42.25	82.29
4	15.41	2.48	16.13	1.05	6.80	5.03	32.68	6.85	44.39	84.59
5	17.87	2.77	15.48	1.09	6.09	5.61	31.40	8.40	47.03	82.13

mm - wet weight
sm - dry weight

TABLE 8

Chromium oxide content in the feeds and in the fish excrements (% d.wt.)

Specification		Fish receiving feed no. 1	2	3	4	5
Amount of chromium	Feeds	0.68	0.71	0.75	0.61	0.73
	Fish excrements	1.79	1.85	1.85	1.53	1.56

Trout receiving feeds no. 4 and 5 attained lower body weight. Percentage of rapeseed oil meal in these feeds amounted to 20 and 25% respectively, and of the fish meal to 31 and 28% (Tab. 2). The differences between average body weight of trout receiving feeds no. 4 and 5 and those receiving feeds no. 1 and 2 were statistically significant, at the level of $\alpha = 0.05$.

Fish survival in particular groups was very similar. Only in the group given feed no. 1 there were losses of 6.7% (Tab. 1).

DIGESTIBILITY OF FOOD COMPONENTS

Digestibility coefficients for total protein and raw fat were calculated basing on the content of these components in fish excrements, according to the data presented in Table 7. Cr_2O_3 content in the feeds and in the fish excrements is given in Table 8.

Data presented in Table 9 suggest that the apparent digestibility of total proteins in the feeds no. 1, 2, 3 and 4 was very similar, varying from 85.21 to 85.70%. The lowest digestibility of total protein was found for the feed no. 5 (82.38%).

TABLE 9

Values of apparent digestibility of total protein and raw fat of the feeds (%)

Feed no.	1	2	3	4	5
Total protein	85.70	85.28	85.21	85.34	82.38
Raw fat	88.11	87.46	78.70	79.16	78.25

Coefficients of apparent digestibility of raw fat were differentiated. Fat in the feeds no. 1 and 2 was characterized by the highest digestibility (88.11 and 87.46% respectively). Apparent digestibility of raw fat in the other feeds was lower, amounting to 78.25 and 79.16 respectively (Tab. 9). These values should be regarded as high, both for total protein and raw fat.

UTILIZATION OF THE FEEDS

Food conversion rates of the feeds were very similar (Tab. 1). It appeared that the feed no. 2 was best utilized by the fish. Food conversion rate of this feed amounted to 1.01, being slightly lower than of the control feed no. 1, as well as of the feed no. 3. Feeds no. 4 and 5 were characterized by lower utilization.

TABLE 10

Indices of total protein utilization

Feed no.	PER	Apparent NPU %
1	2.35	38.10
2	2.37	39.09
3	2.26	37.77
4	2.14	34.24
5	2.23	36.07

Data given in Table 1 reveal that the use of total protein for 1 kg of weight increment ranged in particular fish groups from 422.1 g to 467.0 g. The lowest use of the proteins was observed for the fish fed the feed no. 2, the highest for those fed the feed no. 4.

Phillips (1970, cit. after Steffens 1985) stated that the normal use of total protein for 1 kg of weight increment amounted in trout to 550-660 g. Low use of the feeds in the experiment, in this also of total protein, suggests that the feeds were characterized by high nutritive value.

PER and apparent NPU are widely used to assess nutritive value of the proteins. PER values of the feeds used in the experiment ranged from 2.14 (feed no. 4) to 2.37 (feed no. 2). PER of the feed no. 2 was very similar to that of the feed no. 1 (control). PER values of the feeds no. 3, 4 and 5 were lower (Tab. 10).

Values of apparent NPU followed the same pattern. The highest utilization of total protein was noted for the feeds no. 1 and 2, the lowest for the other feed mixtures (Tab. 10).

Nose (1971) found a parabolic relationship between PER and protein content in the feeds. According to this author, PER at optimal protein content ranged for rainbow trout from 2.2 to 2.8 in the case when the fish meal and casein represented the protein source. Hence, his values were very similar to those obtained in this experiment. Ogino et al. (1976) found that NPU values were affected also by the source of energy in the food. NPU value increased as protein content in the feeds decreased, on condition that fat was the source of energy.

HAEMATOLOGICAL INDICES

Haemoglobin content in the blood of trout receiving particular feeds varied from 7.36 to 7.91 g%, the differences being statistically insignificant (Tab. 11).

TABLE 11

Average haemoglobin and haematocrite content in blood of the experimental fish

Fish receiving feed no.	Average body length cm	Average individual weight	Haemoglobin content g%	Haematocrite %
1	23.8	184.9	7.36 ±0.89a	44.0 ±6.65a
2	23.2	161.2	7.91 ±1.29a	39.0 ±2.49b
3	23.6	171.5	7.87 ±1.10a	44.0 ±6.92ab
4	22.3	139.2	7.81 ±0.70a	49.0 ±3.90a
5	23.1	160.5	7.65 ±0.97a	48.0 ±5.00a

The same letter denotes lack of significant differences at α=0.01 and α=0.05

Haematocrite levels in the fish given feeds no. 1, 3, 4 and 5 were similar (no statistically significant differences). Only the fish receiving the feed no. 2 had lower levels, this difference being difficult to explain. The results revealed that the haematological indices were within the limits given by McCarthy et al. (1973, 1975) as normal. Similar haematocrite values were observed by Zeitoun et al. (1974), and haemoglobin content was the same as in the studies by Timoszina et al. (1985).

CHEMICAL COMPOSITION OF TROUT MEAT

Chemical composition of the meat of trout given different feeds was differentiated. This composition was determined at the end of the experiment. Total protein content ranged from 57.69 to 60.11% (dry weight) and of fat from 31.51 to 34.15% (Tab. 12). The highest protein content was found in the case of the fish receiving the feed no. 2. On the other hand, this group was characterized by the lowest fat content. Similar relation between protein and fat content in the meat was noted in other fish groups.

TABLE 12

Chemical composition of trout meat at the begining and at the end of the experiment (%)

Fish receiving feed no	Number of fish in the sample	Average ind. weight g	Dry weight %	Protein mm %	Protein sm %	Raw fat mm %	Raw fat sm %	Ash mm %	Ash sm %	Water %
at the begining of the experiment	10	47.5	25.37	17.61	69.41	4.35	17.15	2.35	9.26	74.63
1	8	184.9	27.67	16.42	59.34	8.95	32.35	2.25	8.13	72.33
2	10	161.2	27.45	16.50	60.11	8.65	31.51	2.14	7.80	72.55
3	10	171.5	28.01	16.75	59.84	9.12	32.56	2.14	7.64	71.99
4	10	139.2	27.38	15.99	58.40	9.16	33.46	2.02	7.38	72.62
5	10	160.5	28.08	16.20	57.69	9.59	34.15	2.28	8.12	71.92

mm - wet weight

sm - dry weight

Higher fat content in the meat was found in the case of the fish given the feeds no. 4 and 5, which contained the highest percentage of rapeseed oil meal. Glucosinolate content in these feeds amounted to 212.0 and 265.0 μg/g d.wt. respectively (Tab. 6). Also Yurkowski et al. (1978) stated that fish fry receiving feeds containing 223 μg/g d.wt. of glucosinolates were characterized by higher fat content in the body. Fry given 730 μg of glucosinolates per 1 g (d.wt.) of the feed was characterized by lower fat content in the body. Similar pattern was observed by Higgs et al. (1982) for Pacific salmon and by Dąbrowski and Kozłowska (1980) for carp fry.

DISCUSSION

The results of the studies showed that only the fish receiving the feed no. 2 (which contained 10.5% of rapeseed oil meal) and the feed no. 3 (containing 13% of this component) attained body weights similar to those in the control group (feed no. 1). Weight of the fish receiving feeds no. 4 and 5 was significantly lower.

Data on fish growth, utilization of particular feeds, raw fat and total protein digestibility, and haemoglobin content in the fish blood suggest that 10.5% content of rapeseed oil meal was the optimal one.

The results suggest that trout receiving feed no. 3 attained body weight and feed utilization index similar to those receiving the feed no. 2 (no statistically significant differences). These data suggest that the content of rapeseed oil meal in the feeds used for trout fattening may be as high as 15%.

These results do not agree with the results by other authors. Yurkowski et al. (1978) found that the content of rapeseed oil meal in the feeds for juvenile trout might be as high as 22%. Hardy and Sullivan (1983) showed that 10 to 20% of oil meal obtained from Canola rapeseed had no adverse effect on the growth, feed utilization, and T_3 and T_4 content in older rainbow trout. However, each substitution of soybean or blood meal with rapeseed oil meal resulted in an overactivity of the thyroid gland, although hypertrophy or hyperplasia were not observed. Studies made by Higgs et al. (1979, 1982) showed that also in the case of other species of salmonids (*Oncorhynchus tshawytcha* and *Oncorhynchus kisutch*) the content of rapeseed oil meal in the feeds should not exceed 20%.

Limited use of rapeseed oil meal in animal feeding is caused by the fact that this meal contains thyoglucosides which are decomposed by the enzyme myrosinase into toxic compounds, such as isothyocyanides (ITC) or vinylthyooxazolidones, and especially 5-vinyl-2-thyooxazolidone.

My studies showed that total amount of these substances in particular feeds was from 111.0 to 265 μg/g of dry weight (Tab. 6). Data presented in Tab. 1 show that growth inhibition took place in trout receiving the feed no. 4, in which ITC and OZT concentration was 212.0 μg/g of the feed. Yurkowski et al. (1978) stated that there was no growth inhibition in trout fry fed the feeds containing 223 μg/g of these substances (d.wt.). In view of this, it may be assumed that, apart from ITC and OZT content, there must have been some other factors inhibiting trout growth. One of them was probably lower nutritive value of the feeds no. 4 and 5, in which most of the fish meal protein were substituted with rapeseed oil meal protein.

Possibility of using rapeseed oil meal in trout feeding is of considerable economic significance. Cost of this meal is considerably lower than of the imported and very expensive soybean meal (1 kg of rapeseed oil meal costs less than 1 kg of soybean oil meal). Moreover, rapeseed oil meal is readily available (contrarily to soybean meal) and, thus, its use is one of the conditions for further development of trout culture in Poland.

CONCLUSIONS

1. It was found that rapeseed oil meal obtained from doubly improved rape variety was quite satisfactory in trout feeding and might constitute an isonitrogen substitute for soybean oil meal.

2. Optimal percentage of rapeseed oil meal in feeds used for trout fattening was 10.5%. In view of rapid growth rate and good utilization of the feed, it is acceptable to increase rapeseed oil meal content to even 15%.

3. Trout fed the feeds in which part of the fish meal (from 14.0 to 22.0%) was substituted with rapeseed oil meal were characterized by worse growth and worse utilization of the feeds.

Trans. by Maria Bnińska

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STRESZCZENIE

BADANIA NAD ZASTOSOWANIEM POEKSTRAKCYJNEJ ŚRUTY RZEPAKOWEJ (Z ODMIANY PODWÓJNIE USZLACHETNIONEJ) W ŻYWIENIU PSTRĄGA TĘCZOWEGO (*Salmo gairdneri f. kamloops*)

II. OKREŚLENIE PRZYDATNOŚCI I OPTYMALNEGO UDZIAŁU POEKSTRAKCYJNEJ ŚRUTY RZEPAKOWEJ W MIESZANCE PASZOWEJ PRZEZNACZONEJ DLA TUCZU PSTRĄGA TĘCZOWEGO

Celem badań było określenie przydatności poekstrakcyjnej śruty rzepakowej, otrzymanej z podwójnie uszlachetnionej odmiany rzepaku ozimego, dla żywienia pstrąga tęczowego jako substytutu poekstrakcyjnej śruty sojowej i części mączki rybnej. Poza tym podjęto próbę określenia optymalnego udziału tego komponenta w tuczowej mieszance paszowej. Eksperyment żywieniowy wykonano w akwariach. Temperatura wody w okresie trwania doświadczenia wynosiła 13°C ± 0.4°C. Do badań użyto narybku pstrąga tęczowego f. kamloops w wieku O+, o średniej początkowej masie ciała wynoszącej około 50.5 g.

Badaniami objęto 5 mieszanek paszowych, w których udział poekstrakcyjnej śruty rzepakowej wynosił od 10.5 do 25.0%. Każda mieszanka badana była w dwóch powtórzeniach. Dzienne dawki paszy wynosiły 1.5 do 1.2% masy obsady. Okres żywienia ryb wynosił 98 dni. Wyniki badań wykazały pełną przydatność poekstrakcyjnej śruty rzepakowej do żywienia starszych osobników pstrąga tęczowego jako izoazotowego substytutu poekstrakcyjnej śruty sojowej. Na podstawie kształtowania się średnich przyrostów masy ciała pstrągów, wartości współczynników pokarmowych badanych mieszanek, strawności pozornej białka ogólnego i tłuszczu surowego oraz wartości wskaźników hematologicznych należy stwierdzić, że optymalny udział poekstrakcyjnej śruty rzepakowej w badanych mieszankach paszowych wynosił 10.5%. W mieszankach, w których stosowano substytucję mączki rybnej poekstrakcyjną śrutę rzepakową przyrosty masy ciała ryb i wykorzystanie paszy było niższe. Zastosowanie w żywieniu pstrąga tęczowego poekstrakcyjnej śruty rzepakowej, oprócz określonych efektów ekonomicznych, przyczyni się do rozszerzenia dostępnej krajowej bazy paszowej.

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