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EFFECTIVENESS OF USING DIETS CONTAINING YELLOW LUPINE CULTIVAR MISTER IN GROWING PIGS

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ABSTRACT

The paper aimed at evaluating the effect of yellow lupine used in feed rations for growing pigs on the animals' growth parameters and slaughter value. The experiment involved 40 pigs [(PLW×PL)×Duroc] which were divided into 2 groups: control (C) and experimental (E). The sole source of protein in rations fed to the control pigs was soybean meal, whereas rations for the experimental pigs contained respectively 10, 15 and 20% of lupine in the corresponding periods: grower, fattener I and II. The inclusion of lupine in feed rations for weaner pigs and fatteners during period I did not affect the production performance, whereas for fatteners during period II it did increase ($P \leq 0.05$) daily weight gain values. Slaughter value was similar for the compared groups of pigs ($P > 0.05$). To sum up, an inclusion of 10, 15 and 20% lupine in feed rations for pigs can be recommended due to a significant increase in the final body weight and simultaneously increased feed conversion effectiveness. In addition, the feeding pattern did not affect the muscularity and fattening grade of pigs.

Key words: *Lupinus luteus*, nutrition, fatteners, performance results, slaughter value

INTRODUCTION

Rational feeding of swine is a significant environmental factor that not only has an influence on the fattening results but also, in addition to genetic factors, is a main determinant of the quantity and quality of meat [Zralý et al. 2006, Turyk et al. 2011, Sońta et al. 2015, Milczarek and Osek 2016, Debrecéni et al. 2018]. The base protein feed used in pigs' nutrition is soybean meal, but due to its high price and limitations on the use of animal meals new sources of protein are sought after [Sobotka et al. 2012, Milczarek and Osek 2014, Sońta et al. 2016]. One of them is the production of legumes covering 25% of the feed protein requirement of monogastric animals [Kasprowicz-Potocka et al. 2013]. The use of species and cultivars of such plants is fostered by breeding progress and implementation of new improvement technologies that contribute to advantageous changes in the nutritional value and suitability due to a considerable reduction in the level of anti-nutrients. The suitability of legumes for pigs' nutrition was confirmed by numerous studies [Pisařiková et al. 2008, Kim et al. 2012, Hanczakowska and Księżak 2012, Milczarek and Osek 2016]. Purwin and Stanek [2011], in evaluating the digestibility of legume seeds in the diets of growing pigs, found that the most digestible rations contained yellow lupine. Breeding progress with reference to the plant and animal material and varied opinions [Kim et al. 2008, Hanczakowska and Świątkiewicz 2014, Sońta et al. 2016] about the suitability of yellow lupine for pigs' nutrition provided the grounds for studies.

The paper aimed at evaluating the effect of yellow lupine cultivar Mister used in feed rations for growing pigs on the animals' growth parameters and slaughter value.

MATERIAL AND METHODS

The experimental material was 40 weaners, 3-breed cross-breeds: ♀(PWL×PL)×♂Duroc, with the initial body weight of approx. 20 kg. The animals were weighed one by one, marked for identification and divided into 2 equipotent groups: control (C) and experimental (E) one. The pigs (sex ratio 1 : 1) from both groups were stocked

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Table 1. Composition and nutritive value of weaner pig rations

Tabela 1. Skład surowcowy i wartość pokarmowa mieszanek dla warchlaków

Item – Wyszczególnienie	Rations – Diety	
	control (C) – kontrolna (K)	experimental (E) – doświadczalna (D)
Wheat – Pszenica	30.00	30.00
Barley – Jęczmień	23.70	22.70
Maize – Kukurydza	20.00	20.00
Soybean meal – Śruta poekstrakcyjna sojowa	21.00	12.00
Yellow lupine cv. "Mister" – Łubin żółty odmiany „Mister"	–	10.00
Rapeseed oil – Olej rzepakowy	1.00	1.00
Premix grower[1] – Premiks grower[1]	4.00	4.00
Acidifier – Zakwaszacz	0.30	0.30
Total – Razem	100.00	100.00
Calculated nutritive value per 1 kg of diets – Wyliczona wartość pokarmowa 1 kg mieszanki		
Metalizable energy, MJ – Energia metaboliczna, MJ	13.14	13.27
Crude protein, g/MJ – Białko ogólne, g/MJ	12.98	13.03
Lys, g/MJ	0.99	1.06
Crude fibre, g – Włókno surowe, g	32.7	43.2
Ca, g	8.0	8.0
P, g	6.0	6.0
Na, g	1.7	1.7
Analyzed nutrients per 1 kg of diets – Oznaczona zawartość składników w 1 kg mieszanki		
Dry matter, % – Sucha masa, %	89.18	91.11
Crude ash, % – Popiół surowy, %	4.67	4.70
Crude protein, % – Białko ogólne, %	17.03	16.98
Crude fat, % – Tłuszcz surowy, %	2.21	2.49
Crude fibre, % – Włókno surowe, %	3.72	4.38

[1] 1 kg premix grower contained: vitamins A – 505000 IU, D_3 – 50000 IU, E – 2500 mg, K_3 – 100 mg, B_1 – 80 mg, B_2 – 200 mg, PP – 1000 mg, B_5 – 625 mg, B_6 – 130 mg, B_{12} – 1000 µg, H – 6200 µg, B_4 – 16000 mg, C – 3750 mg, B_9 – 38 mg; microelements: Fe – 2500 mg, Mn – 1500 mg, Zn – 3750 mg, Cu – 4125 mg, I – 26 mg, Se – 10 mg, macroelements: Ca – 172 g, P – 30 g, Mg – 12 g, Na – 50 g, amino acids: lysine – 120 g, methionine – 45 g, threonine – 50 g, enzymes: phytase, beta-xylanase, beta-glucanase, antioxidant.

[1] 1 kg premiksu grower zawierał: witaminy A – 505000 IU, D_3 – 50000 IU, E – 2500 mg, K_3 – 100 mg, B_1 – 80 mg, B_2 – 200 mg, PP – 1000 mg, B_5 – 625 mg, B_6 – 130 mg, B_{12} – 1000 µg, H – 6200 µg, B_4 – 16000 mg, C – 3750 mg, B_9 – 38 mg; mikroelementy: Fe – 2500 mg, Mn – 1500 mg, Zn – 3750 mg, Cu – 4125 mg, I – 26 mg, Se – 10 mg, makroelementy: Ca – 172 g, P – 30 g, Mg – 12 g, Na – 50 g, aminokwasy: lizyna – 120g, metionina – 45 g, treonina – 50 g, enzymy: fitaza, beta-ksylanaza, beta-glukanaza, przeciwutleniacz.

in pens with slatted floors, keeping conditions according to Ordinance of the Polish Minister of Agriculture and Rural Development [Journal of Laws 2010]. All animals were fed *ad libitum* with bulk rations prepared according to Feeding recommendations and the nutritional value of feeds for pigs [2015]. During the 23-day weaner pigs period both groups (C and E) received rations containing identical cereal feed materials, soybean meal, oil and mineral and vitamin additives; however, in the ration for experimental pigs the protein was partly substituted by protein from the Mister cultivar of yellow lupine (Table 1).

Next, during the 2-stage fattening period consisting of: the first stage, 53 days, and the second stage, 30 days, the only protein component in the rations for control pigs was soybean meal, whereas in experimental pigs the soybean meal was partly substituted by 15% and 20% of yellow lupine cultivar Mister respectively at the first and the second stage of fattening (Table 2).

The seeds of yellow lupine Mister and the feed rations underwent chemical analyses measuring the content of: dry mass (DM), crude protein (CP), ether extract (EE), crude fibre (CF) and crude ash (CA) according to AOAC [2011]. The analyses were carried out in 3 replications. The amount of nitrogen-free extractives (NFE) was calculated from the formula:

$$NFE = DM - (CP + CA + CF + EE)$$

During the experiment the individual body weight of pigs was checked (on the experiment start day, after the rearing of weaners, after the grower and fattener stage) along with the intake of feed rations in respective periods and the animals' health status. Based on the results the body weight gain was calculated together with the conversion of feed and nutrients per body weight gain unit.

After fattening the animals were transported to a specialist slaughterhouse. Following a pre-slaughter rest and

Table 2. Composition and nutritive value of fattener rations

Tabela 2. Skład surowcowy i wartość pokarmowa mieszanek paszowych dla tuczników

Item – Wyszczególnienie	Rations – Diety			
	I period – I okres		II period – II okres	
	C	E	C	E
Triticale – Pszenżyto	27.50	27.50	32.00	32.00
Barley – Jęczmień	25.80	23.80	25.80	20.80
Oats – Owies	15.00	14.00	15.00	14.00
Maize – Kukurydza	10.00	10.00	10.00	10.00
Soybean meal – Śruta poekstrakcyjna sojowa	18.00	6.00	14.00	–
Yellow lupine cv. "Mister" – Łubin żółty odmiany „Mister"	–	15.00	–	20.00
Rapeseed oil – Olej rzepakowy	0.50	0.50	0.50	0.50
Premix "phase one"[1] – Premiks „I okres"[1]	3.00	3.00	–	–
Premix "phase two"[1] – Premiks „II okres"[1]	–	–	2.50	2.50
Acidifier – Zakwaszacz	0.20	0.20	0.20	0.20
Total – Razem	100	100	100	100
Calculated nutritive value per 1 kg of diets Wyliczona wartość pokarmowa 1 kg mieszanki				
Metalizable energy, MJ Energia metaboliczna, MJ	12.70	12.89	12.49	12.50
Crude protein, g ·MJ^{-1} – Białko ogólne, g ·MJ^{-1}	12.85	12.87	11.98	11.85
Lys, g ·MJ^{-1}	0.95	0.98	0.64	0.63
Crude fibre, g – Włókno surowe, g	41.5	38.6	42.1	42.1
Ca, g	6.8	6.7	5.6	5.6
P, g	5.3	5.4	5.0	5.0
Na, g	1.6	1.6	1.7	1.7
Analyzed nutrients per 1 kg of diets Oznaczona zawartość składników w 1 kg mieszanki				
Dry matter, % – Sucha masa, %	89.28	89.05	88.66	88.94
Crude ash, % – Popiół surowy, %	4.23	3.66	4.15	4.07
Crude protein, % – Białko ogólne, %	16.28	16.66	15.09	15.51
Crude fat, % – Tłuszcz surowy, %	2.59	2.41	2.06	2.37
Crude fibre, % – Włókno surowe, %	4.47	5.11	4.11	4.87

[1] 1 kg premix "phase one"/"phase two" contained: vitamins A – 300000/300000 IU, D_3 – 66667/6500 IU, E – 2500/2500 mg, K_3 – 90/90 mg, B_1 – 40/40 mg, B_2 – 170/170 mg, PP – 1000/1000 mg, B_5 – 700/700 mg, B_6 – 50/50 mg, B_{12} – 900/900 µg, H – 2700/2700 µg, B_4 – 7500/7500 mg, microelements: Fe – 2800/2600 mg, Mn – 1000/1000 mg, Zn – 4000/4000 mg, Cu – 800/840 mg, I – 20/20 mg, Se – 1010 mg, macroelements: Ca – 182/177g, P – 35/30 g, Mg – 20/20 g, Na – 56/58 g, amino acids: lysine – 100/120g, methionine – 16/14 g, threonine – 40/34 g, enzymes: phytase, beta-xylanase, beta-glucanase, antioxidant.

[1] 1 kg premiks „I okres"/„II okres" zawierał: witaminy A – 300000/300000 IU, D_3 – 66667/6500 IU, E – 2500/2500 mg, K_3 – 90/90 mg, B_1 – 40/40 mg, B_2 – 170/170 mg, PP – 1000/1000 mg, B_5 – 700/700 mg, B_6 – 50/50 mg, B_{12} – 900/900 µg, H – 2700/2700 µg, B_4 – 7500/7500 mg, mikroelementy: Fe – 2800/2600 mg, Mn – 1000/1000 mg, Zn – 4000/4000 mg, Cu – 800/840 mg, I – 20/20 mg, Se – 1010 mg, makroelementy: Ca – 182/177 g, P – 35/30 g, Mg – 20/20 g, Na – 56/58 g, aminokwasy: lizyna – 100/120 g, metionina – 16/14 g, treonina – 40/34 g, enzymy: fitaza, beta-ksylanaza, beta-glukanaza, przeciwutleniacz.

stunning, they were slaughtered in compliance with procedures applicable in the slaughterhouse. On the process line the half-carcasses were weighed using electronic scales and their muscularity and fattening grade were measured using an ultrasonic apparatus (Ultra–FOM 300, SFK-Technology, Herlev, Denmark). Backfat thickness and the height of *longissimus dorsi* muscle (MLD) as well as meatiness were measured between rib 3 and 4 at a distance of 7 cm from the half-carcass cutting line [Borzuta 2002].

The results were elaborated by statistical methods using one-way analysis of variance, according to the following mathematical model:

$$Y_{ik} = \mu + a_i + e_{ik}$$

where:

Y_{ik} – trait level,
μ – total mean,
a_i – effect of treatment,
e_{ik} – error.

The significance of differences between mean values was verified using *t*-Student test at the significance level $\alpha = 0.05$. The results were elaborated using STATISTICA PL 13.1 software [StatSoft Inc. 2019].

RESULTS

The evaluated seeds of yellow lupine cultivar Mister contained 88.91% dry matter, 3.83% crude ash, 41.3% crude protein, 15.03% crude fibre and 3.1% crude fat. The calculated percentage of nitrogen-free extractives was 25.65%.

After 23 days of weaner rearing, no significant effect of inclusion of yellow lupine in feed rations on body weight gain was identified (Table 3).

Pigs from group E showed a higher body weight (by 1.35 kg) and higher feed intake (by approx. 9%) in comparison to animals fed with feed rations containing soybean meal as the sole protein feed. Throughout the rearing period, weaners receiving control rations converted less feed (2.08 kg), crude protein (353 g) and metabolic energy (27.33 MJ) compared to experimental pigs fed with rations containing a 10% share of yellow lupine (2.25 kg, 389 g, 29.85 MJ).

The effectiveness of 2-stage fattening was determined based on the weight gain of animals and the conversion of feed and nutrients per 1 kg of body weight (Table 4).

After 53 days of the I stage of fattening, pigs fed with rations containing a 15% share of yellow lupine showed a body weight about 3.7% higher than control pigs receiving rations with soybean meal as the only protein-rich feed. However, the differences were not confirmed statistically. On the other hand, after the second fattening period, pigs fed rations containing a 20% share of yellow lupine had a significantly higher ($P \leq 0.05$) final body weight (116 vs 111 kg) in comparison to control pigs. The higher final body weight of pigs from group E was significantly ($P \leq 0.05$) related to higher (by approx. 7%) daily weight gain values in that period. Higher feed intake both at respective growing stages and throughout the whole period was characteristic of pigs from the experimental group, but they more effectively converted the feed and nutrients (crude protein and metabolic energy) per body weight gain unit.

No effect of the nutrition pattern used on the slaughter performance of pigs was observed (Table 5).

The dressing percentage of control growing pigs was 79.69% compared to 78.78% in the experimental group (a difference of about 0.91 percentage point to the disadvantage of the group fed rations containing yellow lupine) The level of meatiness of evaluated pigs in both groups was identical (59.2%) despite the carcasses being classified differently according to EUROP. A higher (by 3.25%) eye of the longissimus dorsi muscle but also thicker (by 1.36%) backfat were characteristic of the carcasses of pigs fed with mixtures containing yellow lupine seeds.

DISCUSSION

The content of nutrients in lupine determined by this author did not differ from values given in the Feeding recommendations and the nutritional value of feeds for pigs [KIAPN 2015]. A higher (437 g/kg d.m.) level of crude protein and crude fat (42 g/kg d.m.) was found by Chilomer et al. [2013]. A lower (36.17%) content of crude protein in the seeds of the same cultivar was shown by Sońta et al. [2016]. A significantly lower level of protein (277–342 g/kg d.m.) but more crude fat (32.8–55.3 g/kg d.m.) was determined in yellow lupine seeds by Musco et al. [2017]. In turn, Pisařiková and Zralý [2010] report varied contents of crude protein (37.5–45.9% d.m.) and crude fat (4.1–6.2% d.m.) in yellow lupine.

A 10% inclusion of yellow lupine in feed rations for weaners had no influence on the rearing performance. Similarly, Prandini et al. [2005] did not find any significant differences in feed conversion and daily weight gain of weaners after a 17% inclusion of lupine.

The lack of effect of a 15% inclusion of yellow lupine in feed rations for growing pigs at the first stage of fattening on the production performance confirms results obtained by Sońta et al. [2016]. Similarly, Pisařiková et al. [2008] substituting 50% or 100% of soybean meal with lupine seeds in pigs' diets did not note any effect of the nutrition pattern used on the body weight and feed conversion. In turn, Roth-Maier et al. [2004] using 20% of lupine in feed rations for growers showed improved body weight gain and increased feed conversion per body weight gain unit. In turn, Sońta et al. [2015] including 5% of lupine in pigs' diet noted smaller body weight gain (866 vs 959) while the conversion of feed increased simultaneously (2.37 vs 2.31).

An inclusion of a 20% share of lupine in feed rations for pigs at the second period fattening had a positive effect on body weight gain ($P \leq 0.05$) and feed conversion ratio. On the other hand, Roth-Maier et al. [2004] noted a reduction in body weight gain with increased feed conversion per weight gain unit after including the same amount of lupine in rations for fattening pigs. In turn, the lack of effect of 7.5% or 15% inclusion of lupine in feed rations for pigs on growing performance was demonstrated by Sońta et al. [2016].

Analysing fattening performance observed by those authors, it was found that pigs fed with rations containing yellow lupine had 4.5% higher body weight ($P \leq 0.05$) while their feed and nutrients conversion ratio improved by about 2% In turn, Sońta et al. [2015] using a 5% share of lupine in feed rations for pigs grown from body weight 27 to 113 kg showed a 2.5% weight loss with 2.6% improvement in feed conversion. The results of many sci-

Table 3. Rearing results of weaner pigs

Tabela 3. Wyniki odchowu warchlaków

Item – Wyszczególnienie	Group – Grupa		SEM[1]	*P* value Wartość *P*
	C	E		
Initial body weight, kg – Początkowa masa ciała, kg	19.63	20.80	0.691	0.402
Final body weight, kg – Końcowa masa ciała, kg	35.95	37.30	0.908	0.464
Total gain, kg – Przyrost ogółem, kg	16.32	16.50	0.390	0.826
Daily gain, g – Przyrost dobowy, g	709	717	17.001	0.825
Total feed intake, kg – Spożycie paszy ogółem, kg	679.5	742.0	–	–
Feed intake per head, kg – Spożycie paszy na sztukę, kg	33.97	37.10	–	–
Feed conversion ratio, kg – Zużycie paszy, kg	2.08	2.25	–	–
Crude protein conversion ratio, g Zużycie białka ogólnego, g	353	389	–	–
Metaboilzable energy conversion ratio, MJ Zużycie energii metabolicznej, MJ	27.33	29.85	–	–

[1] SEM – standard error of the mean.
[1] SEM – błąd standardowy średniej.

Table 4. Fattening results

Tabela 4. Wyniki tuczu

Item – Wyszczególnienie	Group – Grupa		SEM[1]	*P* value Wartość *P*
	C	E		
Body weight – Masa ciała, kg				
Initial – Początkowa	35.95	37.30	0.908	0.402
After I period – Po I okresie	82.62	85.72	0.885	0.079
After II period – Po II okresie	111*	116*	0.933	0.035
Daily gain, g – Przyrost dobowy, g				
I period – I okres	881	911	13.416	0.225
II period – II okres	947*	1013*	14.556	0.012
Whole fattening – Cały tucz	904*	948*	11.156	0.017
Feed intake per head, kg – Spożycie paszy, kg				
I period – I okres	127.25	128.25	–	–
II period – II okres	93.60	98.80	–	–
Whole fattening – Cały tucz	220.85	227.05	–	–
Feed conversion ratio, kg – Zużycie paszy, kg				
I period – I okres	2.72	2.65	–	–
II period – II okres	3.29	3.25	–	–
Whole fattening – Cały tucz	2.94	2.88	–	–
Crude protein conversion ratio, g – Zużycie białka ogólnego, g				
I period – I okres	444	426	–	–
II period – II okres	493	481	–	–
Whole fattening – Cały tucz	463	448	–	–
Metabolizable energy conversion ratio, MJ – Zużycie energii metabolicznej, MJ				
I period – I okres	34.54	34.16	–	–
II period – II okres	41.09	40.62	–	–
whole fattening – cały tucz	37.11	36.70	–	–

[1] SEM – standard error of the mean; *$P \leq 0.05$.
[1] SEM – błąd standardowy średniej; *$P \leq 0{,}05$.

entific works [Zralý et al. 2006, 2007, Hanczakowska and Księżak, 2012, Sońta et al. 2016] demonstrate that an inclusion of lupine not exceeding 20% generates advantageous production performance of growing pigs Van Nevel et al. [2000] and King et al. [2000] observed

Table 5. Slaughter value of pigs

Tabela 5. Wartość rzeźna świń

Item – Wyszczególnienie	Group – Grupa		SEM[1]	*P* value Wartość *P*
	C	E		
Body weight before slaughter, kg – Masa ciała przed ubojem, kg	111*	116*	0.993	0.035
Hot carcass weight, kg – Masa tuszy ciepłej, kg	88.40	91.10	1.178	0.267
Dressing percentage, % – Wydajność rzeźna, %	79.69	78.78	0.391	0.409
Meatiness, % – Mięsność, %	59.2	59.2	0.322	0.994
EUROP classification, heads – Klasyfikacja EUROP, sztuki				
S	9	3	–	–
E	10	17	–	–
U	1	0	–	–
Length of *longissimus dorsi* muscle, mm Wysokość mięśnia *longissimus dorsi,* mm	67.7	69.9	1.064	0.307
Backfat thickness, mm – Grubość słoniny, mm	14.7	14.9	0.472	0.795

[1] SEM – standard error of the mean.
[1] SEM – błąd standardowy średniej.
* $P \leq 0.05$.

growth depression, lower feed intake and FCR reduction after 30% inclusion of lupine in a diet.

In the studies carried out by Roth-Maier et al. [2004], the body weight of slaughtered animals was about 10 kg higher than that found by those authors and their carcasses showed a higher fattening grade (15.3–16.4 mm) and less meatiness (56.6–56.8%). Similar to the results of this study, Froidmont et al. [2005] observed lower dressing percentage when lupine seeds were included in a diet of two-breed fattening pigs (82.1 vs 82.6). Also, Zralý et al. [2006] reported that animals from the experimental group fed with rations containing lupine, compared to the control group, showed lower dressing percentage and lower fattening grade and slightly higher meatiness. In another experiment [Zralý et al. 2007], fatteners (Large White×Landrace) fed with rations containing lupine seeds were characterised by a higher dressing percentage and lower fattening grade. Similarly, Sońta et al. [2016] noted that the fattening grade was 6.3% lower for pigs fed with rations containing lupine seeds than for control pigs.

Thanks to good and comparable meatiness of growing pigs from both groups, most carcasses were classified as class E in the EUROP system, which coincides with the results of Roth-Maier et al. [2004] and Zralý et al. [2006, 2007]. On the other hand, Sońta et al. [2015] found a significant share of carcasses in class S (70% in the control group and 60% in the experimental group).

CONCLUSION

To sum up, an inclusion of 10%, 15% and 20% yellow lupine seeds in feed rations for growing pigs can be recommended due to a significant increase in the final body weight and simultaneously increased feed conversion effectiveness. In addition, the feeding pattern did not affect the slaughter value, including their muscularity and fattening grade.

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EFEKTYWNOŚĆ ŻYWIENIA ŚWIŃ ROSNĄCYCH MIESZANKAMI ZAWIERAJĄCYMI ŁUBIN ŻÓŁTY ODMIANY „MISTER”

STRESZCZENIE

Celem pracy było określenie wpływu łubinu żółtego w mieszankach dla świń rosnących na parametry wzrostu oraz wartość rzeźną. Doświadczeniem objęto 40 świń [(wbp×pbz)×duroc], które podzielono na 2 jednakowe pod względem liczebności grupy: kontrolną (K) i doświadczalną (D). Jedynym źródłem białka w mieszankach dla świń kontrolnych była poekstrakcyjna śruta sojowa, natomiast do mieszanek dla świń doświadczalnych wprowadzono kolejno 10, 15 i 20% śruty z nasion łubinu żółtego odpowiednio w okresach: warchlak, tucznik I i tucznik II. Zastosowanie łubinu w mieszance dla warchlaków i tuczników w I okresie nie wpłynęło na parametry produkcyjne, natomiast w II okresie tuczu istotnie ($P \leq 0,05$) zwiększyło dobowe przyrosty masy ciała. Wyniki rzeźne w porównywanych grupach świń były zbliżone ($P > 0,05$). Podsumowując, można rekomendować stosowanie 10, 15 i 20% nasion łubinu w mieszankach dla świń rosnących z uwagi na istotne zwiększenie końcowej masy ciała przy jednocześnie efektywniejszym wykorzystaniu paszy. Ponadto zastosowane żywienie nie wpłynęło na umięśnienie i otłuszczenie świń.

Słowa kluczowe: *Lupinus luteus*, żywienie, tuczniki, wyniki produkcyjne, wartość rzeźna

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