ANNALES UMCS
VOL. XXXV (1) SECTIO EE ZOOTECHNICA 2017

DOI: 10.24326/jasbb.2017.1.1

Department of Animal Nutrition and Feed Management, Siedlce University of Natural Sciences and Humanities, B. Prusa 14, 08-110 Siedlce, e-mail: amilczarek@uph.edu.pl

ANNA MILCZAREK, MARIA OSEK

# The impact of faba bean with high or low content of tannins on the results of rearing and carcass quality of broiler chickens Part I. Performance and slaughter results of chickens

Wpływ bobiku o wysokiej lub niskiej zawartości tanin na wyniki odchowu i wartość rzeźną kurcząt brojlerów. Część I. Wyniki odchowu i analizy rzeźnej kurcząt

**Summary.** The aim of the study was to compare the effectiveness of the use of mixtures with different content of high- or low-tannin faba bean in chickens for fattening. The study was performed on 160 sexed broiler chickens, assigned to 5 groups of 32 birds each. For the first 21 days chickens were fed starter mixtures and grower mixtures for the following 14 days. The seeds of faba bean were the experimental factor introduced into the starter/grower mixtures, according to the system: group I – without faba bean, group II – 8/15% of high-tannin faba bean seeds, group III – 16/22% high-tannin faba been seeds, group IV – 8/15% low-tannin faba been seeds, group V – 16/22% low-tannin faba been seeds. It was shown that regardless of the variety and the percentage of faba bean seeds in starter/grower mixtures, chickens reached similar (1864–1925 g) final body weight gain with a similar (1.60–1.62 kg) feed conversion ratio. There was no effect of the applied feeding on carcass quality and muscle percentage in chickens' carcasses. However, introduction of faba bean to the mixtures significantly ($P < 0.05$) reduced chickens' fatness. The obtained results allow to recommend an even higher percentage of faba bean in mixtures, because it has not affected breeding results and significantly decreased fatness of broiler chickens.

**Key words:** broiler chickens, performance results, slaughter value, faba bean

## INTRODUCTION

Seeds of faba bean (*Vicia faba* L. var. minor), similarly as soybean (*Glycine max* L.), belong to high-protein feeds, while the post-extraction soybean meal is a major source of protein for broiler chickens. Considering the fact that Poland lies outside the soy cultivation zone, as well as that this is a genetically modified material, possibilities are sought for even partial replacement of this raw material in the industrial mixtures for broiler

chickens. *Fabaceae* plant seeds, including faba bean seeds, create this possibility. In recent years, numerous studies were carried out [Moschini *et al*. 2005, Perella *et al*. 2009, Laudadio *et al*. 2011, Dal Bosco *et al*. 2013, Osek *et al*. 2013, Usayran *et al*. 2014] concerning the possibility of introducing faba bean in place of part of the soybean extraction meal to mixtures for broiler chickens, but the results of these experiments are sometimes divergent. They are typically associated with the presence of anti-nutritional substances contained in those seeds. Reports [Vilariño *et al*. 2009, Osek *et al*. 2013] have indicated that in the faba bean these are mainly tannins. They constitute a group of water soluble polyphenols quite commonly found in plant foods. In the body, they cause a range of diverse effects, mainly of antinutritional and even carcinogenic nature [Serrano *et al*. 2009, Zawadzki *et al*. 2010]. Cultivation research has been carried out for many years in order to reduce the level of these substances in faba bean seeds, resulting in low-tannin varieties of this plant [Masey O'Neill *et al*. 2012, Woyengo and Nyachotti 2012, Hanczakowska and Świątkiewicz 2014, Milczarek and Osek 2016]. Currently, in culture and cultivation there are both low- and high-tannin content varieties, and their nutritional value is modified by many factors [Vilariño i in. 2009, Osek *et al*. 2013, Fordoński *et al*. 2015, Adak and Kibritci 2016, Koivunen *et al*. 2016].

On the basis of these considerations, the present study verified the partial substitution of soybean meal protein with high- or low-tannin faba bean in both starter and grower mixtures on productive performance and carcass characteristic of broiler chickens.

## MATERIAL AND METHODS

The experiment consisted of 160 one-day-old Ross 308 chickens with an initial body weight of 49.6 g ±0.26, which were divided into 5 equinumerous groups (I, II, III, IV, V). Chickens were weighed and randomly placed in 20 metal cages, 8 chickens (4♀+ and 4♂) per each, which resulted in 4 replicates in each feeding group. All cages were in the same room in the same environmental conditions, and chickens had continuous access to feed and water. During the whole (35 days) bird rearing period, 24-hour electric lighting was used. The room temperature in the first week was 32ºC, and then every week (7 days) it was lowered by 2–3ºC to reach 21–23ºC in the last week of breeding.

For the first 21 days, chickens were fed starter mixtures and then grower mixtures for the following 14 days. Formulas of complete ration mixtures were developed in accordance with the Poultry Nutrition Standards recommendations [Normy… 2005], so that they were isoenergetic and isoproteinic. Nutritive value of mixtures was calculated on the basis of the chemical composition of the feed raw materials, while the content of metabolic energy from European Tables equations [Janssen 1989]. Dry matter, crude ash, crude protein, crude fibre and ether extract contents in the raw materials were determined according to AOAC International [2011] procedures No. 934.01, 942.05, 984.13, 978.10 and 920.39, respectively. Moreover, in faba bean seeds the fibre fractions (acid detergent fibre, neutral detergent fibre, lignin) were assayed according to Goering and Van Soest's methodology [1970]. The contents of the most important antinutritional factors in faba beans were analysed: tannins – by BN-90/91160-42 and trypsin inhibitors – by the Korol and Przegalińska's method [1994].

Mixtures were prepared in-house based on corn meal, post-extraction soybean meal, rapeseed oil and mineral-vitamin supplements. The experimental factor were faba bean seeds introduced into the starter/grower mixtures in amounts replacing 10/20% or 20/30% protein of post-extraction soybean meal according to the following scheme:

– group I (control) – no faba bean,
– group II – 8/15% of high-tannin faba bean,
– group III – 16/22% of high-tannin faba bean,
– group IV – 8/15% of low-tannin faba bean,
– group V – 16/22% of low-tannin faba bean.

Table 1. Feed ingredients and nutritive value of the mixtures
Tabela 1. Skład i wartość pokarmowa mieszanek

| Specification<br>Wyszczególnienie | Starter | | | Grower | | |
|---|---|---|---|---|---|---|
| | I | II, IV | III, V | I | II, IV | III, V |
| Ingredients/ Składniki ($g \cdot kg^{-1}$) | | | | | | |
| Maize/ Kukurydza | 499.20 | 445.90 | 393.7 | 552.85 | 452.45 | 412.20 |
| Faba bean*/ Bobik* | – | 80.00 | 160.0 | – | 150.00 | 220.00 |
| Soybean meal<br>Poekstrakcyjna śruta sojowa | 415.00 | 380.00 | 345.0 | 360.00 | 295.00 | 260.00 |
| Oil/ olej | 47.00 | 55.00 | 62.00 | 50.00 | 65.0 | 70.00 |
| L-lysine/ L-lizyna | – | – | – | 0.20 | 0.20 | 0.20 |
| DL-methionine<br>DL-metionina | 2.20 | 2.40 | 2.60 | 1.95 | 2.25 | 2.40 |
| Limestone/ Kreda pastewna | 13.00 | 13.30 | 13.60 | 13.10 | 13.50 | 13.70 |
| Monocalcium phosphate<br>Fosforan 1-Ca | 15.00 | 14.80 | 14.50 | 13.20 | 12.85 | 12.70 |
| Salt/ sól | 3.60 | 3.60 | 3.60 | 3.70 | 3.75 | 3.80 |
| Premix starter/grower**<br>Premiks starter/grower** | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 |
| Nutritive value per 1 kg of mixtures/ Wartość pokarmowa 1 kg mieszanek | | | | | | |
| ME/ (MJ) | 12.77 | 12.77 | 12.75 | 13.08 | 13.08 | 13.05 |
| Crude protein/ Białko og. (g) | 223 | 223 | 223 | 203 | 203 | 203 |
| Crude fibre/ Włókno sur. (g) | 26.01 | 29.40 | 32.81 | 25.32 | 31.68 | 34.64 |
| Lys (g) | 12.91 | 13.11 | 13.32 | 11.70 | 12.09 | 12.16 |
| Met (g) | 5.78 | 5.82 | 5.87 | 5.28 | 5.29 | 5.29 |
| Met + cys (g) | 9.73 | 9.67 | 9.61 | 8.95 | 8.77 | 8.66 |
| Ca (g) | 9.79 | 9.82 | 9.82 | 9.26 | 9.25 | 9.24 |
| P (g) | 6.99 | 7.04 | 7.07 | 6.42 | 6.52 | 6.56 |
| P available/ P przysw. (g) | 4.56 | 4.56 | 4.54 | 4.05 | 4.06 | 4.05 |
| Na (g) | 1.67 | 1.65 | 1.64 | 1.70 | 1.69 | 1.69 |

* group II and IV high-tannin faba bean/ grupa II i IV bobik wysokotaninowy, group III and V low-tannin faba bean/ grupa III i V bobik niskotaninowy;

** 1 kg of mixtures contained from premix starter/grower/ 1 kg mieszanki z prem iksu zawierał: vitamins/ witaminy A – 13500/10000 j.m., $D_3$ – 10000/3000j.m., E – 80/50 mg, K – 4/3 mg, $B_1$ – 3/2 mg, $B_2$ – 8.75/7 mg, $B_6$ – 5/4 mg, $B_{12}$ –24/27.5 µg, PP – 70/70 mg, $B_5$ – 25/14 mg, $B_9$ – 2.00/1.50 mg, H – 0.20/0.15 mg, $B_t$ – 500/500 mg; microelements/ mikroelementy Fe – 80/80 mg, Mn – 100/100 mg, Zn – 80/60 mg, Cu – 9/8 mg, I – 1.25/1.00 mg, Se – 0.275/0.25 mg, Co – 0.30/0.25 mg, Ca – 1.311/1.28g, coccidiostatic/ kokcydiostatyk; antioxidant/ przeciwutleniacz

During the experiment, body weight of chicken, feed consumed and possible deaths were monitored on day 1, 21 and 35 of rearing. These data were used to calculate body weight gain (BWG), feed intake (FI) and feed conversion ratio (FCR).

On the last day of the experiment, 8 birds (4 roosters and 4 hens) were selected from each group with a weight representative for a given group and gender, and then slaughtered. After 24 hours chilling, the carcasses were weighted, and dressing percentage was determined relative to body weight before slaughter. In the course of a simplified carcass analysis [Ziołecki and Doruchowski 1989], the individual elements were weighed, including muscles (breast, thigh, drumstick), abdominal fat and skin with the subcutaneous fat. The results of the carcass analysis were used to calculate the percentage of muscle, skin with subcutaneous fat and abdominal fat in carcasses.

The obtained results were analyzed statistically using one-way analysis of variance (ANOVA). Duncan's test was used to determine the significance of differences between mean values of the groups [StatSoft ver. 12.5, 2015].

## RESULTS AND DISCUSSION

High- and low-tannin faba bean seeds evaluated in the study contained similar 24.71% *vs*. 25.41% crude protein content (tab. 2). More fat and less crude fibre was found in high-tannin faba bean seeds, while the fibre of low-tannin faba bean contained 30% less of ADL fraction and by 23% more CEL. Low-tannin faba bean contained nearly 60% less tannin, but there were no differences found between varieties in the amount of trypsin inhibitors.

Table 2. Chemical composition of faba bean seeds
Tabela 2. Skład chemiczny nasion bobiku

| Specification<br>Wyszczególnienie | 'Granit'<br>high-tannin variety odmiana wysokotaninowa | 'Albus'<br>low-tannin variety<br>odmiana niskotaninowa |
|---|---|---|
| Basal nutrients/ Składniki podstawowe (%) | | |
| Dry matter/ Sucha masa | 88.35 | 87.00 |
| Crude ash/ Popiół surowy | 2.61 | 2.95 |
| Crude protein/ Białko surowe | 24.71 | 25.41 |
| Crude fat/ Tłuszcz surowy | 1.21 | 0.93 |
| Crude fibre/ Włókno surowe | 6.82 | 8.23 |
| Nitrogen-free extract<br>Związki bezazotowe wyciągowe | 53.00 | 49.48 |
| Fibre fractions/ Frakcje włókna (%) | | |
| ADF | 12.53 | 12.67 |
| NDF | 18.88 | 19.40 |
| ADL | 5.22 | 3.68 |
| CEL = ADF-ADL | 7.31 | 8.99 |
| HCEL = NDF-ADF | 6.35 | 6.73 |
| Tannins/ Taniny ($g \cdot kg^{-1}$) | 9.01 | 3.65 |
| Trypsin inhibitors/ Inhibitory trypsyny ($g \cdot kg^{-1}$) | 1.50 | 1.50 |

ADL – acid detergent fibre/ włókno detergentowe kwaśne, NDF – neutral detergent fibre/ włókno detergentowe neutralne, ADL – lignin/ lignina, CEL – cellulose/ celuloza, HCEL – hemicellulose/ hemiceluloza

The differences obtained in the study relating to the content of basic nutrients in the analyzed faba bean seeds probably resulted from the varietal characteristics as well as agronomic conditions, as believed by Duc *et al.* [1999], Vilariño *et al.* [2009] and Adak and Kibritci [2016]. The high variation in the crude protein (21.8–34.7%) in seeds of both faba bean varieties was recorded in many experiments [Zijlstra *et al.*, 2008, Hanczakowska and Świątkiewicz 2014, Milczarek and Osek 2016]. In the present study, a higher amount of crude fibre was recorded in the seeds of low-tannin faba bean, which can be attributed to the fact that the seeds of this variety were visibly smaller than the high-tannin variety. The content of NDF and ADF fractions was in the ranges provided by Zijlstra *et al.* [2008] and Woyengo and Nyachoti [2012], but it was higher than showed by Kiarie *et al.* [2013] and Hanczakowska and Świątkiewicz [2014]. The amount of tannins determined in the seeds was nearly 60% higher in the low-tannin variation compared to the high-tannin plant (1.02% dry matter). This value was in the range (from undetectable to 1%) provided by Masey O'Neill *et al.* [2012], Kiarie *et al.* [2013], Hanczakowska and Świątkiewicz [2014] and Milczarek and Osek [2016].

In the current study, there was shown that chickens fed mixtures with faba bean (except for group V) ate less feed in the first period of rearing ($P < 0.05$) than the control birds (tab. 3). Despite this, it was found that neither the variety of faba bean nor its level in the mixtures had statistically significant effect on body weight gain of birds in successive periods of rearing, similarly as on the feed conversion ratio.

Table 3. Rearing results of broiler chickens
Tabela 3. Wyniki odchowu kurcząt brojlerów

| Specification Wyszczególnienie | Groups/ Grupy | | | | | SEM | P value Wartość P |
|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | | |
| Body weight/ Masa ciała (g) | | | | | | | |
| 1 day/ dzień | 49.69 | 49.62 | 49.56 | 49.50 | 49.60 | 0.26 | 0.435 |
| 21 day/ dzień | 783 | 780 | 748 | 749 | 759 | 56.38 | 0.222 |
| 35 day/ dzień | 1925 | 1876 | 1864 | 1883 | 1879 | 75.27 | 0.812 |
| Body weight gain/ Przyrost masy ciała (g) | | | | | | | |
| 1–21 days /dni | 733 | 730 | 698 | 699 | 709 | 56.33 | 0.226 |
| 22–35 days/ dni | 1142 | 1096 | 1116 | 1134 | 1120 | 70.12 | 0.898 |
| 1–35 days/ dni | 1875 | 1826 | 1814 | 1833 | 1829 | 110.37 | 0.946 |
| Feed intake/ Spożycie paszy (g) | | | | | | | |
| 1–21 days/ dni | 49.09 [a] | 47.62 [b] | 47.62 [b] | 47.14 [b] | 48.57 [ab] | 0.17 | <0.05 |
| 22–35 days/dni | 138.57 | 135.44 | 135.00 | 138.57 | 138.57 | 0.20 | 0.644 |
| 1–35 days/ dni | 85.71 | 82.74 | 82.86 | 84.00 | 84.57 | 0.61 | 0.707 |
| Feed conversion ratio/ Zużycie paszy (kg) | | | | | | | |
| 1–21 days/ dni | 1.41 | 1.40 | 1.43 | 1.42 | 1.44 | 0.04 | 0.118 |
| 22–35 days/dni | 1.70 | 1.73 | 1.69 | 1.71 | 1.73 | 0.05 | 0.136 |
| 1–35 days/ dni | 1.59 | 1.60 | 1.60 | 1.60 | 1.62 | 0.05 | 0.915 |
| EIP* (point/ pkt) | 344 | 333 | 333 | 336 | 331 | 39.50 | 0.455 |

* European Index of Productivity/ europejski indeks produkcyjności

a, b – values in rows with different letters differ significantly/ wartości oznaczone w wierszach różnymi literami różnią się istotnie

Shargh and Azari [2010] and Laudadio *et al.* [2011] also found no effect of the level (from 6% to 31%) of faba bean in the mixtures on the rearing results (BWG, FCR) of broiler chickens. In turn, Perella *et al.* [2009] and Dal Bosco *et al.* [2013] introduced 16% of faba bean into the diet of birds and observed lower weight gain and poorer feed conversion, but in younger chickens, which was compensated in subsequent rearing periods. Sterling *et al.* [2002] and Wijtten *et al.* [2004] emphasized that young chickens, in addition to a high demand for protein of high biological value, are very sensitive to the anti-nutritional substances contained in the feed, which should be associated with not fully developed digestive system. A confirmation can be the study of Moschini *et al.* [2005], who introduced 25% and 50% crude faba bean into the diet of chickens and showed a significant reduction in body weight gain only during the starter growth period (till day 10 of chickens' life) at a higher level of faba bean in the mixture. Osek *et al.* [2013] demonstrated a significant weight gain of chickens fed a mixture containing 19.5% high-tannin faba bean in the second period of rearing. The study by Usayran *et al.* [2014] also reported a significant improvement in weight gain and feed conversion in chickens fed a mixture with 30% low-tannin faba bean. In turn, Brévault *et al.* [2003] demonstrated a significant reduction in the weight of chickens after the introduction of 20% high-tannin faba bean into the mixture, but the application of low-tannin faba bean allowed to achieve results similar to those of the control group.

Table 4. Slaughter value of broiler chickens
Tabela 4. Wartość rzeźna kurcząt brojlerów

| Specification<br>Wyszczególnienie | Group/ Grupa | | | | | SEM | P value<br>Wartość P |
|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | | |
| Dressing percentage<br>Wydajność rzeźna (%) | 75.78 | 76.14 | 75.71 | 76.53 | 76.80 | 1.23 | 0.351 |
| Share in cold carcass/ Udział w tuszce schłodzonej (%) | | | | | | | |
| Muscles total<br>Mięśnie ogółem | 51.40 | 52.54 | 52.82 | 52.28 | 51.97 | 1.25 | 0.112 |
| including/ w tym: | | | | | | | |
| – breast/ piersiowe | 31.59 | 31.24 | 31.39 | 31.70 | 30.27 | 2.13 | 0.973 |
| – thigh/ udowe | 11.96 | 12.84 | 12.90 | 12.39 | 12.83 | 0.73 | 0.063 |
| – drumstic/ podudzi | 7.85 | 8.47 | 8.53 | 8.19 | 8.87 | 0.60 | 0.062 |
| Skin with subcutenous fat/ Skóra z tłuszczem podskórnym | 10.48 $^{A}$ | 9.74 $^{B}$ | 9.11 $^{B}$ | 9.83 $^{B}$ | 9.26 $^{B}$ | 0.60 | <0.01 |
| Abdominal fat<br>Tłuszcz sadełkowy | 0.99 $^{a}$ | 0.66 $^{b}$ | 0.68 $^{b}$ | 0.76 $^{ab}$ | 0.72 $^{ab}$ | 0.27 | <0.05 |

A, B and a, b – values with different superscripts differ significantly at A, B – P < 0.01 or a, b – P < 0.05 in row
A, B i a, b – wartości oznaczone w wierszach różnymi literami różnią się istotnie A, B – P < 0,01 i a, b – P < 0,05

The results obtained in this study concerning carcass quality indicated the usefulness of faba bean (low- or high-tannin) in the feeding of broiler chickens (tab. 4). For no effect of faba bean (variety percentage) was shown on carcass quality and slightly better musculature was observed, as well as significantly lower fatness of chickens. Many other authors [Moschini *et al.* 2005, Nale *et al.* 2010, Shargh and Azari 2010, Laudadio *et al.* 2011, Osek *et al.* 2013, Dal Bosco *et al.* 2013], by introducing 16, 25, 31 or 50% faba

bean into the diet of chickens, did not observed a significant impact of this feed on carcass quality and the percentage of breast and thigh muscles. Diaz *et al.* [2006] showed a significant increase in the percentage of breast muscles in carcasses of chickens fed mixtures with faba bean compared to controls. A significantly lower percentage of skin with subcutaneous fat ($P < 0.01$) and abdominal fat ($P < 0.05$) found in this study in the carcasses of chickens provided with mixtures containing high-tannin faba bean was a reversal of the results obtained by Usayran *et al.* [2014]. Laudadio *et al.* [2011], Osek *et al.* [2013] and Dal Bosco *et al.* [2013] reported no significant effect of diets with faba bean on the percentage of abdominal fat in carcasses of chickens, while Shargh and Azari [2010] found its lowest percentage in chickens fed a mixture with the highest (18%) content of faba bean.

## CONCLUSIONS

In summary, the current study confirmed that faba bean seeds had allegedly a significant impact on the feed intake, but only 1–21 days of rearing Ross 308 chickens. The higher level of this raw material in mixtures did not deteriorate the assessed production indices. Given the fact that chickens receiving mixtures with faba bean were slightly more musculature and significantly less fatty, so even higher (16% – starter/22% – grower) levels of faba bean (regardless of the variety) can be recommended as a partial replacement of soybean post-extraction meal in mixtures for broiler chickens.

## REFERENCES

Adak M.S., Kibritci M., 2016. Effect of nitrogen and phosphorus levels on nodulation and yield components in faba bean (*Vicia faba* L.). Legume Res. 39 (6), 991–994.

AOAC International, 2011. Official Methods of Analysis of AOAC International. Current through revision 4. 18th Edition. Gaithersburg, Maryland, USA.

BN-90/91160-42. Oznaczanie tannin.

Brévault N., Mansuy E., Crépon K., Bouvarel I., Lessire M., Rouillére H., 2003. Utilisation de différentes variétés de féveroles pour l'alimentation du poulet biologique. In: 5éme Journées Techniques Avicoles, ITAVI, Paris, 221–224.

Dal Bosco A., Ruggeri S., Mattioli S., Mugnai C., Sirri F., Castellini C., 2013. Effect of faba bean (*Vicia faba* var. minor) inclusion in starter and growing diet on performance, carcass and meat characteristics of organic slow-growing chickens. Ital. J. Anim. Sci. 12 (4), 76, 472–478.

Diaz D., Morlacchini M., Masoero F., Moschini M., Fusconi G., Piva G., 2006. Pea seeds (*Pisum sativum*), faba beans (*Vicia faba* var. minor) and lupin seeds (*Lupinus albus* var. multitalia) as protein sources in broiler diets: effect of extrusion on growth performance. Ital. J. Anim. Sci. 5, 43–53.

Duc G., Marget R.P., Esnault, Le Guen J., Bastianelli D., 1999. Genetic variability for feeding value of faba bean seeds (*Vicia faba*): Comparative chemical composition of isogenics involving zerotannin and zero-vicine genes. J. Agric. Sci. (Camb.) 133, 185–196.

Fordoński G., Pszczółkowska A., Krzebietke S., Olszewski J., Okorski A., 2015. Yield and mineral composition of seeds of leguminous plants and grain of spring wheat as well as their resid-

ual effect on the yield and chemical composition of winter oilseed rape seeds. J. Elementol. 20 (4), 82 –838.

Goering H.K., Van Soest P.J., 1970. Forage fiber analysis. USDA Agriculture Handbook, 379– 381.

Hanczakowska E., Świątkiewicz M., 2014. Legume seeds and rapeseed press cake as replacers of soybean meal in feed for fattening pigs. Ann. Anim. Sci. 14 (4), 921–394.

Janssen W.M.M.A., 1989. European Table of Energy Values for Poultry Feedstuffs. 3rd edn. Working Group No. 2 of the European Branch, World's Poult. Sci. Assoc., Beekbergen.

Kiarie E., Lopez P., Furedi C., Nyachoti C.M., 2013. Amino acids and energy utilization in zero-tannin faba bean and co-fermented wheat and corn dried distillers grains with solubles fed to growing pigs. J. Anim. Sci. 91, 1728–1735.

Koivunen E., Partanen K., Perttilä S., Palanderd S., Tuunainena P., Valajae J., 2016. Digestibility and energy value of pea (*Pisum sativum* L.), faba bean (*Vicia faba* L.) and blue lupin (narrow-leaf) (*Lupinus angustifolius*) seeds in broilers. Anim. Feed Sci. Tech. 218, 120–127.

Korol W., Przegalińska B., 1994. Ocena metod szacowania aktywności antytrypsynowej nasion strączkowych. Biul. Nauk. Przem. Pasz. 3 (4), 5–13.

Laudadio V., Ceci E., Tufarelli V., 2011. Productive traits and meat fatty acid profile of broiler chickens fed diets containing micronized fava beans (*Vicia faba* L. var. minor) as the main protein source. J. Appl. Poul. Res. 20 (1), 12–20.

Masey O'Neill H.V, Rademacher M., Mueller-Harvey I., Stringano E., Kightley S., Wiseman J., 2012. Standardised ileal digestibility of crude protein and amino acids of UK-grown peas and faba beans by broilers. Anim. Feed Sci. Tech. 175, 158– 167.

Milczarek A., Osek M., 2016. Partial replacement of soya bean with low-tannin faba bean varieties (Albus or Amulet): effects on growth traits, slaughtering parameters and meat quality of Pulawska pigs. Ann. Anim. Sci. 16 (2), 477–487.

Moschini M., Masoero F., Prandini A., Fusconi G., Morlacchini M., Piva G., 2005. Raw pea (*Pisum sativum*), raw faba bean (*Vicia faba* var. minor) and raw lupin (*Lupinus albus* var. multitalia) as alternative protein sources in broiler diets. Ital. J. Anim. Sci. 4, 59–69.

Nalle C.L., Ravindran V., Ravindran G., 2010. Evaluation of faba beans, white lupines and peas as protein source in broiler diets. International J. Poult. Sci. 9 (6), 567–573.

Osek M., Milczarek A., Klocek B., Turyk Z., Jakubowska K., 2013. Effectiveness of mixtures with the *Fabaceae* seeds in broiler chicken feeding. Annales UMCS, sec. EE, Zootechnica 31 (4), 77–86.

Perella F., Mugnai C., Dal Bosco A., Sirri F., Cestola E., Castellini C., 2009. Faba bean (*Vicia faba* var. minor) as a protein source for organic chickens: performance and carcass characteristics. Ital. J. Anim. Sci. 8, 575–584.

Normy żywienia drobiu. Zalecenia żywieniowe i wartość pokarmowa pasz, 2005. Red. S. Smulikowska, A. Rutkowski. Wyd. 3, IFŻZ PAN, Jabłonna.

Shargh M.S., Azari M.A., 2010. Determination of the optimum inclusion level of faba beans in diet of broiler chicks. Indian J. Anim. Sci. 80 (9), 940–942.

Serrano J., Puupponen-Pimia R., Dauer A., Aura A.M., Saura-Calixto F., 2009. Tannins: Current knowledge of food sources, intake, bioavailability and biological effects. Mol. Nutr. Food Res. 53, 310–329.

Statistica ver. 12.5 (data analysis software system), 2015. StatSoft, Inc., Tulsa, www.statsoft.com.

Sterling, K.G., Costa E.F., Henry M.H., Pesti G.M., Bakalli R.I., 2002. Responses of broiler chickens to cottonseed and soybean meal-based diets at several protein levels. Poult. Sci. 81, 217–226.

Usayran N.N., Sha'ar H., Barbour G.W., Yau S.K., Maalouf F., Farran M.T., 2014. Nutritional value, performance, carcass quality, visceral organ size, and blood clinical chemistry of broiler chicks fed 30% tannin-free fava bean diets. Poult. Sci. 93, 2018–2027.

Wijtten P.J.A., Lemme A., Langhout D.J., 2004. Effects of different dietary ideal protein levels on male and female broiler performance during different phases of life: single phase effects, carryover effects, and interactions between phases. Poult. Sci. 83, 2005–2015.

Woyengo T.A., Nyachoti C.M., 2012. Ileal digestibility of amino acids for zero tannin faba bean (*Vicia faba* L.) fed to broiler chicks. Poult. Sci. 91, 439–443.

Vilariño, M., Métayer, J.P., Crépon, K., Duc, G., 2009. Effects of varying vicine, convicine and tannin contents of faba bean seeds (*Vicia faba* L.) on nutritional values for broiler chicken. Anim. Feed Sci. Tech. 30, 114–121.

Zawadzki W., Wincewicz E., Biowska M., Graczyk S., Malicki A., Kozak M., 2010. Investigation on the effect of high- and low- tannin horse bean seeds on selected hematological and biochemical parameters of rats. Med. Wet. 66 (10), 711–715.

Zijlstra R.T., Lopetinsky K., Beltranena E., 2008. The nutritional value of zero-tannin faba bean for grower-finisher pigs. Can. J. Anim. Sci. 88 (2), 293–302.

Ziołecki J., Doruchowski W., 1989. Metody oceny wartości rzeźnej. COBRD, Poznań, 1–22.

**Streszczenie.** Celem przeprowadzonych badań było porównanie efektywności stosowania mieszanek z różnym udziałem bobiku wysoko- lub niskotaninowego w żywieniu kurcząt rzeźnych. Badania przeprowadzono na 160 kurczętach brojlerach Ross 308, przydzielonych losowo do 5 grup po 32 ptaki w każdej. Przez pierwsze 21 dni kurczęta żywiono mieszankami typu starter, a przez kolejne 14 dni – grower. Czynnikiem doświadczalnym były nasiona bobiku wprowadzone do mieszanek starter/grower według układu: grupa I (kontrolna) – bez bobiku, grupa II – 8%/15% nasion bobiku wysokotaninowego, grupa III – 16%/22% nasion bobiku wysokotaninowego, grupa IV – 8%/15% nasion bobiku niskotaninowego, grupa V – 16%/22% nasion bobiku niskotaninowego. Wykazano, że niezależnie od odmiany i udziału nasion bobiku w mieszankach starter/grower kurczęta brojlery uzyskały zbliżone (1864–1925 g) końcowe masy ciała przy podobnym (1,60–1,62 kg) zużyciu paszy. Nie odnotowano wpływu zastosowanego żywienia na wydajność rzeźną i udział mięśni w tuszkach kurcząt, aczkolwiek wprowadzenie bobiku do mieszanek istonie ($P < 0,05$) zmniejszyło otłuszczenie kurcząt. Wyniki badań pozwalają na zalecanie nawet większego udziału nasion bobiku (niezależnie od odmiany) w mieszankach, bowiem pozostał on bez wpływu na wyniki odchowu i istotnie zmniejszył otłuszczenie kurcząt brojlerów.

**Słowa kluczowe:** kurczęta brojlery, wyniki odchowu, wartość rzeźna, bobik