

THE EFFECT OF DIFFERENT LYSINE AND THREONINE RATIOS IN THE DIETS IN FATTENING PIGS

Branislav Živković^{1*}, Wladyslaw Migdal², Goce Cilev³, Čedomir Radović¹, Marija Gogić⁴

¹Institute for Animal Husbandry, 111080 Zemun, Autoput 16, Republic of Serbia

²Akademia Rolnicza, 31-149 Kraków, Balicka 122, Poland

³Veterinary Faculty, St. Kliment Ohridski University, 7000 Bitola, Prilepska bb,
Republic of Macedonia

⁴Fellow granted by the Ministry of Education and Science of Republic of Serbia,
11000 Belgrade, Nemanjina 22, Republic of Serbia

*email: zivkovicbranslav@yahoo.com

Abstract

The effects of feeding the mixtures containing different lysine and threonine ratios (1:0.72 and 1:0.68 in control and experimental mixture) on performance, level of nutrient utilization and economical indicators of trial animals - fattening pigs through whole fattening period, were studied.

For total fattening period (30-94 kg), trial mixture of pigs caused increased of daily gain by 2.35%, slightly higher food intake by 0.83% and better feed conversion ratio by 1.75% compared to control group of animals.

Level of utilization of nutrients was better in general, by 0.56 percentage units in dry, by 2.57 units in organic matter, by 1.74 units in crude proteins, by 1.60 units in ether extracts, by 2.60 units in crude fibre and by 0.89 units in nitrogen free extractives (NFE) in trial group.

Because of better feed conversion ratio, the cost of gain in trail pigs was lower by 1.08% compared to the control group of animals.

In general, the obtained results showed that by correcting the lysine:threonine ratio in the mixture for fattening pigs favourable effects on the performance, level of nutrient utilization and the cost of kilogram of gain in this category of pigs can be expected.

Key words: *Lysine and threonine ratios, performance, fattening pigs.*

1. Introduction

Threonine, together with lysine, methionine and tryptophan, is a nonessential limiting amino acid in pig diets, which means that pigs can only obtain these amino acids through dietary sources. Threonine is the second limiting amino acid in piglets feeds especially in the diets base on wheat (Cervantes *et al.* [5]). It is one of the important protein components and an indispensable part of many of them (Zeman

et al. [18]). Threonine intake should not only cover the requirement for protein deposition, but should also account for the threonine expense occurring in the digestive tracts through endogenous gut losses, brush border cell turnover and digestive secretions (Haude [10], Hess and Sève [11], Stein *et al.* [16]). In addition to its role in protein synthesis, threonine is involved in some physiological functions of the digestive, immune and reproductive system in pigs (Leonard and Speer [13]). For this reason, total threonine requirement may vary according to the importance of each of these functions. Estimating threonine requirement for a specific physiological state is the key to formulating balanced diets in terms of the amino acid content. Either an excess or a deficiency of dietary threonine decreases protein synthesis in growing tissues of young pigs (Wang *et al.* [20]). Piglets are able to detect metabolic changes caused by a marginal threonine supply and that they change their feeding behavior in order to overcome deficiency.

Because of the involvement of threonine in gut function, threonine requirement is likely to vary according to the weight of the digestive tract, which is related to the weight of the animal (Ettle *et al.* [7]).

Our experience concerning lysine and threonine ratio 1:0.70 (Živković *et al.* [19]) in the mixtures showed on the positive effects on the performance and economic items of fattening pigs.

This paper represents the continuation of the study of the quality of mixtures with lysine:threonine ratio of 1:0.68 and its effect on production performance, nutrient utilization rate and cost of 1 kg gain in fatteners.

2. Materials and Methods

Research included total of 20 fatteners of Swedish

landrace breed, of initial body mass of approx. 30 kg, and it was carried out on Experimental pig farm of the Institute for Animal Husbandry, Belgrade-Zemun.

Based on standard criteria, origin, sex and initial mass, piglets were divided into groups taking into the account that the age of animals and their body masses be as uniform/equal as possible and avoiding to have siblings within groups. Each group had 10 animals, with equal sex ratio in groups.

Animals were fed mash mixtures and watered ad libidum. The first, control, group of pigs was fed the standard mixture without addition of amino acids, and lysine:threonine ratio of 1:0.72, and the second trial group with diet where due to adding of synthetic lysine the ratio of two amino acids was 1:0.68 (Table 1).

In addition to production parameters, also in this trial the utilization of nutrients in pig nutrition was studied. Digestibility of nutrients was tested at the end of trial, i.e. when pigs reached body mass of approx. 55 kg.

The following parameters were used in evaluation of obtained results: average daily gain of pigs, daily feed intake and utilization of food per 1 kg of gain, utilization of dry matter, organic matter, crude proteins, ether extract, ash, fiber and nitrogen free extracts (NFE), as well as economical justification for use of mixtures with different lysine:threonine ratio expressed as the cost of kilogram of gain.

Obtained results for gain of pigs and digestibility coefficients of nutrients were statistically processed by using variance analysis and average values by using t-test.

3. Results and Discussion

The effect of use of control mixture (lysine:threonine ratio 1:0.72) and trial mixture (lysine:threonine ratio 1:0.68) was studied in the nutrition of fattening pigs.

a) Production indicators

Obtained results (Table 1) showed that the first, control, group of pigs, in the initial fattening period (30-55 kg) realized average daily gain of 555 g, with daily feed intake of 1.76 kg and feed conversion ratio of 3.16 kg. Introduction of the trial lysine:threonine ratio in trial mixtures lead to improvement of the rate of growth by 36 g or 4.69%, with insignificant difference in food intake and improvement in feed conversion ratio by 0.15 kg or 4.74% compared to the control group of pigs.

In final fattening period, the use of „the narrower“ lysine:threonine ratio improved the growth rate in average by 17 g or 2.71%, increased the feed intake in average by 0.08 kg or 3.53%, but without significant

effects in regard to 1 kg of gain compared to animals in the control group fed diet with „the wider“ lysine:threonine ratio.

For entire fattening period, nutrition with diet containing „the narrower“ lysine:threonine ratio of 1:0.68 lead to improvement in the gain in average by 14 g or 2.35% and feed conversion by 0.06 kg or 1.75% in studied fatteners.

b) Nutrient digestibility

Results of the nutrient digestibility (Table 2) showed that fatteners in the trial group, fed diet containing „the narrower“ lysine:threonine ratio expressed the tendency of better utilization of all observed indicators compared to animals in the control group.

c) Economical indicators

Calculation of cost of mixture (Table 2) showed that the cost of mixture increased by 0.05 EUR/kg. If the cost of mixture is considered in relation to the feed conversion, it can be concluded that, regardless of the higher cost of mixture, the cheaper 1 kg of gain is realized by 0.008 EUR or 1,0% compared to the control group with „the wider“ lysine:threonine ratio.

Table 1. Performance of growing-finishing pigs

Group	1 control	2 experimental
Lysine:threonine	1:0.72	1:0.68
Average daily gain, g		
- 30–55 kg of body weight of pigs	555	591
Compared to the control group, %	-	+ 4.69
- 55–95 kg of body weight of pigs	627	644
Compared to the control group, %	-	+ 2.71
- 30–95 kg of body weight of pigs	594	608
Compared to the control group, %	-	+ 2.35
Average daily feed intake, kg		
- 30–55 kg of body weight of pigs	1.76	1.78
Compared to the control group, %	-	+ 1.14
- 55–95 kg of body weight of pigs	2.26	2.34
Compared to the control group, %	-	+ 3.53
- 30–95 kg of body weight of pigs	2.03	2.05
Compared to the control group, %	-	+ 0.98
Feed conversion ratio, kg		
- 30–55 kg of body weight of pigs	3.16	3.01
Compared to the control group, %	-	+ 4.74
- 55–95 kg of body weight of pigs	3.61	3.64
Compared to the control group, %	-	+ 0.83
- 30–95 kg of body weight of pigs	3.43	3.37
Compared to the control group, %	-	+ 1.75

Table 2. Digestibility of nutrients and the price of pig gain in the experiment

Group	1 control	2 experimental
Lysine:threonine	1:0.72	1:0.68
Digestibility of nutrients, %		
- Dry matter	74,69	75,25
- Organic matter	78,25	80,82
- Ash	14,82	27,00
- Crude proteins	70,51	72,25
- Ether extracts	62,86	64,46
- Fiber	40,48	43,08
- Nitrogen Free Extracts	84,98	85,87
Economic justifiableness of use of mixtures, %		
Price of 1 kg of mixtures, E	0.23	0.235
Feed conversion ratio, kg	3.43	3.37
Price of 1 kg of gain, E	0.800	0.792
Price of 1 kg of gain, %	100.0	99.00
Compared to the control group, %	-	+ 1.00

In general, the obtained results showed that by using „the narrower“ lysine:threonine ratio 1:0.68 compared to „the wider» ratio 1:0.72 in the mixtures for fattening pigs, with similar feed intake, improvement of gain by 2.35% is realized, as well as of feed conversion ratio by 1.75%, better utilization of nutrients, and 1,0% more favourable cost of gain in trial animals.

Increasing the threonine to lysine ratio by the addition of L-threonine makes it possible to optimize the efficiency of production in pigs (Bellego [2]), and piglet performance (weight gain and feed intake) are optimized when digestible threonine supply represents at least 65% of digestible lysine (Bellego *et al.* [3]). Piglets are able to detect metabolic changes caused by a marginal threonine supply and that they change their feeding behavior in order to overcome deficiency (Ettle and Roth [6]).

The highest gains during fattening were observed in pigs from group 100:68, and the lowest in groups 100:62 and 100:64 (Barowicz *et al.* [1]). The best results being achieved for threonine to lysine ratio of 65:100. Increasing the threonine to lysine ratio from 60 to 65% improves body weight gain by about 3% and feed conversion by 2.5% (Bellego *et al.* [3]). Finishing swine diets containing up to .30% synthetic L-Lys, supplemented with L-Thr, does not affect growth performance or carcass characteristics (Kendall *et al.* [12]). Suggested relative requirement ratio for effective lysine and threonine is 1:0.57, compared lysine with 1:0.70 for crude protein (Liebert and Gebhardt [14]). An optimum total dietary Thr:Lys ratio in the finisher stage of pigs ranges from 0.66:1 to 0.68:1 (Pitzner *et al.* [15]). Only by reducing the energy need for 1 kg live weight

gain a closer relation would be necessary, for which adequate experiments have to be realized (Haude [10], Hess and Sève [11], Stein *et al.* [16]). The better results are achieved by correction of lysine content than ME versus threonine ones in the mixtures for fattening pigs (Živković *et al.* [19]).

Supplemental amino acids minimize the excretion of both fecal dry matter and N of pigs (Grandhi [9]). The requirements of true ileal digestible threonine for optimize both, daily gain and feed to gain ratio, were 10.3 g/animal and day for growing and 10.7 g/animal and day for finishing pigs respectively (Ettle *et al.* [7]). The addition of glutamic acid to a threonine-deficient diet had no significant effect on threonine oxidation but did reduce the rate of threonine release from protein breakdown (Floch *et al.* [8]).

The lysine and threonine level in the diet affects the amount of these amino acids in milk, especially at the beginning of lactation of sows (Bojčuková and Krátky [4]).

Protein sources can be replaced if diet formulation is based on the ileal digestible amino acid contents of feedstuffs (Szabo *et al.* [17]).

4. Conclusions

The effects of use of different lysine:threonine ratios in diets, 1:0.72 in control and 1:0.68 in trial group, in the nutrition of fattening pigs were studied.

Obtained results showed that:

- by using the trial mixture the gain improved by 2.35% compared to the control group
- there was no significant difference in feed intake between investigated groups
- pigs fed diets containing „the narrower“ lysine:threonine ratio consumed less food by 1,75% for 1 kg of realized body gain
- level of utilization of nutrients from the diet was under positive effect of nutrition with trial mixture
- in regard to economical justification – „the narrower“ amino acids ratio showed positive effect on the cost of gain of fattening pigs.

In general, nutrition with mixtures containing the lysine:threonine ratio of 1:0.68 compared to those with ratio 1:0.72 showed positive effects on all studied indicators in pig fattening.

Acknowledgements

Research was financed by the Ministry of Science and Technological Development Republic of Serbia, project TR 31081.

5. References

- [1] Barowicz T., Pietras M., Piecyka M., Migdal W., Živković B. (2009). *The effect of dietary Synthetic Threonine Supplementation on Fattening Traits, Slaughter Traits and Meat Quality of Fatteners*. Biotechnology in Animal Husbandry, 25 (5-6), p. 871-877.
- [2] Bellego le L. (2002). *Zapotrzebowanie na treoninę u świń. Korzyści z uzupełniania diety L-treoniną*. Pasze przemysłowe, 11-12, 23-29.
- [3] Bellego le L., Relendau C., Cauvenberghe van S. (2002). *Low protein diets for piglets*. Ajinomoto to Eurolysine Information, N° 25, 1-20.
- [4] Bojčuková J., Krátký F. (2006). *Influence of various lysine and threonine levels in feed mixtures for lactating sows on milk quality and piglet growth*. Czech J. Anim. Sci., 51, (1), 24-30.
- [5] Cervantes M., Pichardo A., Cuca M., Cervantes M., Araizal A.B., Torrenteral N. (2000). *Limiting amino acids in wheat for growing pigs*. J. Anim. Sci., Vol. 79, Suppl. 1, page 474.
- [6] Ettle T., Roth F.X. (2005). *Dietary preferences for feeds varying in threonine concentration by the piglet*. Physiol. Behav., 85, 289-295.
- [7] Ettle T., Roth-Maier D.A., Bartlet J., Roth F.X. (2004). *Requirement of true ileal digestible threonine of growing and finishing pigs*. Journal of Animal Physiology and Animal Nutrition, 88, 211-222.
- [8] Floch le N., Obléd C., Sève B. (1995). *In Vivo Threonine Oxidation Rate is Dependent of Threonine Dietary Supply in Growing Pigs Fed Low to Adequate Levels*. Journal of Nutrition, 125, 2550-2562.
- [9] Grandhi R. R. (2001). *Effect of dietary ideal amino acid ratios and supplemental carbohydrase in hullless-barley-based diets on pig performance and nitrogen excretion in manure*. Canadian Journal of Animal Science, 81, 125-132.
- [10] Haude I. (2003). *Examinations on effects of varying threonine supply of fattening pigs on N-balance, body composition and performance (live weight gain, energy need)*. <URL: http://elib.tiho-hannover.de/dissertations/haudei_2003.pdf. Accessed 1 March 2011.
- [11] Hess V., Sève B. (1999). *Effects of body weight and feed intake level on basal ileal endogenous losses in growing pigs*. Journal of Animal Science, 77, 3281-3288.
- [12] Kendall D.C., Alleel G.L., Usry J.L. (2002). *Evaluation of synthetic L-Lysine use in finishing pigs*. J. Anim. Sci., Vol. 79, Suppl. 1, 65.
- [13] Leonard R.P., Speer V.C. (1983). *Threonine requirement for reproduction in swine*. Journal of Animal Science, 56, 1345-1353.
- [14] Liebert F., Gebhardt G. (1990). *Ergebnisse zum Bedarf an Lysin, Methionin, Zystin und Threonin für Mastschweine*. Tierernährung und Fütterung, Vol. 16, pp. 125-129.
- [15] Plitzner C., Ettle T., Handl S., Schmidt P., Windisch W. (2007). *Effects of different dietary threonine levels on growth and slaughter performance in finishing pigs*. Czech J. Anim. Sci., 52, (12), 447-455.
- [16] Stein H.H., Trotier N.L., Bellaver C.R.A., Easter R.A. (1999). *The effect of feeding level and physiological status on total flow and amino acid composition of endogenous protein at the distal ileum in swine*. Journal of Animal Science, 77, 1180-1187.
- [17] Szabo Cs., Jansman A.J.M., Babinszky L., Kanis E., Verstegen M.W.A. (2000). *Ileal Digestibility of Amino Acids in Pig Feeds and its use in Diet Formulations*. <URL: www.pfos.hr/~poljo/sites/default/data. Accessed 5 June 2011.
- [18] Zeman L., Prudil M., Lichovnicková M., Klecker D. (2000). *Aminokyseliny a jejich význam ve výživě Monogastričských zvířat*. Krmivářství, 3, 12-18.
- [19] Živković B., Rusmirović D., Migdal W., Rusmirović B., Radović Č., Skakić V. (2011). *The effects of relationship of lysine and threonine in the diets of fattening pigs*. XVIII International Conference «Krmiva 2011», Opatija, Croatia, June 8-10, Book of Abstracts, p. 58.
- [20] Wang X., Oiao S., Yin Y., Yue L., Wang Z., Wu G. (2007). *A deficiency or excess of dietary threonine reduces protein synthesis in jejunum and skeletal muscle of young pigs*. Journal of Nutrition, 137, 1442-1446.