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Effects of zeolite supplementation on selected fecal and blood characteristics in young pigs

Lukáš Bujňák[1] Alena Hreško Šamudovská[1] and Alica Tvrdá[1]
[1]University of Veterinary Medicine and Pharmacy in Košice, Department of Animal Nutrition and Husbandry, Komenského 73, 04181 Košice, Slovak republic

***For Correspondence**

Correspondence Author
University of Veterinary Medicine and Pharmacy in Košice, Department of Animal Nutrition and Husbandry, Košice, Slovak Republic

lukas.bujnak@uvlf.sk

Abstract: *The aim of this study was to investigate the effect of a six-week supplementation with zeolite on selected faecal parameters. Twelve fattening pigs were divided into two groups, a control group (n = 6) and a test group (n = 6), with an average initial body weight of 30.2 ± 2.4 kg and 31.4 ± 2.3 kg, respectively. In the test diet, natural zeolite was added at a rate of 20 g per 1 kg of feed mixture. Statistical analysis of the results confirmed a significantly higher average dry matter content in the faecal samples of the test group ($P < 0.01$), as well as higher crude protein and ammonia values in fresh faeces samples ($P < 0.01$; $P < 0.001$) from the group receiving zeolite. The analysed blood parameters were not significantly affected by the dietary treatment.*

Keywords: *ammonia, protein, pigs, zeolite*

I. INTRODUCTION

The primary zeolite structure is characterized by a framework of linked tetrahedrals composed of oxygen atoms surrounding a central cation [4]. Zeolites are minerals that have intriguing properties such as water absorption, ion adsorption and cation exchange capacity [11].

There are many species of zeolites with differ in chemical formula, void volume, pore size, thermal stability, and ion exchange [2]. Due to their chemical characteristics, zeolites have a relatively great potential for use in animal production, especially in pig farms, as feed additives with direct and indirect effects on performance, yield and reduction of environmental pollution.

The use of zeolites in swine farming is mainly related to animal nutrition. Earlier studies were focused to assess the effect of zeolites on growth performance and other production parameters [7, 12].

The properties of zeolites allow the retention of nitrogen and confer the ability to improve the efficiency in the digestion of proteins [6, 9, 12]. Newer studies also related zeolites to the preservation of the environment due to their capacity to retain pollutants of animal production, especially ammonia [3, 5].

This study was conducted to evaluate the parameters of excretion depending on zeolite addition in feeds for growing pigs.

II. Materials and Methods

Twelve fattening pigs (meat hybrid) were divided in two groups (six in control group and six animals in test group). The experiment was conducted during 42 days, with initial mean body weight (BW) 30.2 ± 2.4 kg in control group and 31.4 ± 2.3 kg in test group. The test group diet was supplemented with natural zeolite in an amount of 20 g / 1 kg of feed mixture (fraction 0−0.3 mm). Composition of test and control diet and the analysis of crude protein and energy from the diets are shown in Table 1. After 6 weeks, the faeces were collected in plastic buckets. In the laboratory, they were analysed nitrogen substances (CP) and ammonia (NH_3) from fresh sample and the level of dry matter (DM). For these determinations, the procedures of AOAC [1] were used. Blood was drawn from the anterior vena cava of each pig at day 42 for the determination of selected serum biochemical parameters. Blood serum was analysed to determine urea using biochemical analyzer (Chemistry Analyzer Ellipse, Italy). The differences between means were determined, according to the unpaired t-test using GraphPad Prism 6 software.

III. Results and Discussion

In the assessment of parameters of the diets used in the experiment, the test and control diets were almost identical in crude protein content 171.7 vs. 172.3 g/kg and metabolizable energy 12.81 vs. 12.83 MJ/kg.

Zeolites has three essential properties: ion adsorption, water absorption and ion exchange capacity [11]. In preservation of the environment zeolites have been tested continuously. In the test group was analysed a higher dry matter content of faeces than in the control group ($P < 0.01$), with individual values within the range 28.5−33.9% vs. 24.5−28.5%. The humidity reduction in the faeces can be explained by the capacity of the zeolites of absorbing more than 60% of their weight in water [13].

The level of nitrogen excretion parameters in the fresh faeces and serum urea levels in both groups are shown in Table 2. By analyzing the CP content in fresh faeces samples in the test group, we recorded higher mean values of CP compared to the control group ($P < 0.01$). Similarly, when assessing NH_3 excretion in a fresh sample of faeces, we found higher NH_3 levels in the test group, with individual values within the range 981−1376 vs. 615−896 mg/kg. In pigs, most of the nitrogen is excreted in the urine, to a lower extent in faeces. The total amount of nitrogen excreted by these two pathways changes only slightly, but the shift of urine excretion to the fecal nitrogen excretion has an impact on ammonia emissions. Ammonia is the final product of organic nitrogen compounds from excreta (urine, faeces) of pigs. Its source is mainly urea present in urine. The ability of zeolite to bind NH_4+ was recorded in pigs repeatedly in many authors [6, 10].
There was no significant difference between the test group of animals supplemented with natural zeolite and the control group in certain blood variables, including serum urea level. Blood serum biochemical parameters from both groups were generally within the normal range.

Data obtained by Ly et al. [8] showed in growing pigs, higher faecal concentration of ammonia, as well as the amount of its daily output in the treatments with zeolite. Zeolite and clinoptilolite were effective in reducing ammonia produced by the deamination of proteins in the gastrointestinal tract during digestion, preventing their absorption and resulting in increased fecal nitrogen, while the total nitrogen content in urine decreased [12]. Islam et al. [5] reported that the use of 0.5% artificial zeolite in the diet of pigs led to a significant reduction in the emission of ammonia.
Results regarding production performance is variable and can be related to the different doses and kinds of zeolites. The zeolites have potential for the mitigation of pollution and waste control processes produced by the pig industries.

Table 1: Composition and analysis of the diets.

Feeds:	Test (+ 20 g Zeolite per 1 kg of feed mixture	Control
Corn (%)	27.5	
Wheat (%)	24	
Barley (%)	24.1	
Soybean meal (%)	21	
Premix VM (%)	3	
AA supplements (%)	0.4	
Dietary indicators:		
Dry matter (g/kg)	887.6	890.2
Crude protein (g/kg)	171.7	172.3
Metabolisable energy (MJ/kg)	12.81	12.83

Abbreviations: VM – vitamins and minerals, AA – amino acids, DM – dry matter, CP – crude protein, ME – metabolizable energy

Table 2: Parameters of excretion in the faeces and the blood serum variables (Mean ± SD).

Parameter	Test	Control
Faeces		
DM (%)	30.63 ± 1.79**	26.90 ± 1,54
CP (%)	6.25 ± 0.45**	5.53 ± 0.28
NH_3 (mg/kg)	1182.26 ± 155.14***	750.96 ± 114.28
Blood serum		
Total protein (g/L)	60.42 ± 0.55	60.05± 0,55
Albumin (g/L)	32.80 ± 0.87	29.98 ± 1.75
Glucose (mmol/L)	5.19 ± 0.11	5.05 ± 0.06
Urea (mmol/L)	4.44 ± 0.97	4.85 ± 0.93

Abbreviations: SD – standard deviation; CP – crude protein; NH_3 – ammonia; DM – dry matter; significant differences: **P < 0.01, ***P < 0.001

IV. Conclusion

The addition of zeolites showed a higher content of crude protein and ammonia in the faeces from the group given zeolite, decreasing their volatilization to the environment. No significant difference in selected serum variables of protein metabolism was found between the test group of animals with natural zeolite supplementation and the control group. The dietary addition of natural zeolite has no adverse effects on analysed serum biochemical parameters and does not affect the normal physiological homeostasis of animals.

Acknowledgements

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References

[1] AOAC, Official methods of analysis, 2000, Washington: Association of official analytical chemists.
[2] Bernardi A.C.C., Werneck C.G., Haim P.G., Rezende N.G.A.M., Paiva P.R.P. & Monte M.B.M., Crescimento enutrição mineral do porta-enxerto limoeiro 'Cravo' cultivado em substrato com zeólita enriquecida com NPK (in Portuguese). Revista Brasileira de Fruticultura, 2008, 30, 794-800.

[3] Bujňák L., Bindas Ľ., Maskaľová I. & Vajda V., Effects of zeolite supplementation on some fermentation process characteristics of growing pigs. Acta Fytotechnica et Zootechnica, 2015, 18(3), 63-65.
[4] Coombs, D. S., Alberti, A., Armbruster, T., Artioli, G., Colella, C., Galli, E., ... & Vezzalini, G., Recommended nomenclature for zeolite minerals; report of the Subcommittee on Zeolites of the International Mineralogical Association, Commission on New Minerals and Mineral Names. The Canadian Mineralogist, 1997, 35(6), 1571-1606.
[5] Islam M. M., Ahmed S. T., Kim S. G., Mun H. S. & Yang C. J., Dietary effect of artificial zeolite on performance, immunity, faecal microflora concentration and noxious gas emissions in pigs. Italian Journal of Animal Science, 2014, 13(4), 3404.
[6] Leung S., Barrington S., Wan Y., Zhao X. & El-Husseini B., Zeolite (clinoptilolite) as feed additive to reduce manure mineral content. Bioresource Technology, 2007, 98(17), 3309–3316.
[7] Lichvar, I., Effect of zeolites-clinoptilolites on growth, feed conversion and pig production efficiency. Krmivarstvi Sluzby 1984, 20(4): 86-88.
[8] Ly J., Lon-Wo E. & Castro M., Nitrogen and energy balance in pigs fed sugar cane molasses diets and natural Cuban zeolites from different deposits. Cuban Journal Agricultural Science, 1996, 30, 287–293.
[9] Mumpton F. A., La roca magica: uses of natural zeolites in agriculture and industry. Proceedings of the National Academy of Sciences, 1999, 96(7), 3463-3470.
[10] Papaioannou D., Katsoulos P. D., Panousis N. & Karatzias H., The role of natural and synthetic zeolites as feed additives on the prevention and/or the treatment of certain farm animal diseases: a review. Microporous and mesoporous materials, 2005, 84(1-3), 161-170.
[11] Schneider A. F., Zimmermann O. F. & Gewehr C. E., Zeolites in poultry and swine production. Ciência Rural, 2017, 47(8).
[12] Shurson G. C., Ku P. K., Miller E. R. & Yokoyama M. T., Effects of Zeolite a or Clinoptilolite in Diets of Growing Swine. Journal of Animal Science, 1984, 59(6), 1536-1545.
[13] Wilson G.P. & Mumpton F.A., Zeo agriculture, use of natural zeolites in agriculture and aquaculture. Ed Westview Press / Baulder, 1984, Colorado. USA. p. 296