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EFFECTS OF APPLICATION OF ENZYME PREPARATIONS IN POULTRY NUTRITION

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ABSTRACT. In this paper a review of recent studies relating to the effect of application of enzymes in poultry nutrition is presented. Application of enzymes in poultry nutrition started in the fifties of the last century. At the beginning, single enzymes were applied in order to improve the utilization of certain nutritive substances in the diet. Later on, the application of preparations containing two or more enzymes, so called «enzyme cocktails», began. With improvement of technologies for production enzyme preparations their price was reduced which contributed to their greater application in poultry nutrition. Enzymes today are regular/usual supplements in pre mixtures for poultry. In some countries (Great Britain), 95% of produced mixtures for poultry nutrition in 1993 contained enzymes. Use of enzymes in nutrition of fattening chickens contributes to improvement of production results (higher daily gain, better feed consumption and conversion, better quality of product, lower mortality). Effects of application of enzymes in nutrition of fattening chickens are more expressed in young chickens (1-28 days) compared to older chickens (29-42 days). Use of enzyme preparations in nutrition of layers contributes to better laying ability, lower consumption of food per one egg, increased egg mass, etc. Application of enzymes contributes to better utilization of nutritious substances from the diet and lower excretion of these substances into the environment and in this way the human environment is protected.

Key words: poultry nutrition, fattening chickens, enzyme preparations, cellulose, phytase

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Application of enzymes in poultry nutrition started in the fifties of the last century. At the beginning single enzymes were applied (amylase, protease, cellulase) in order to improve the digestibility of certain nutritive substances in grains and feeds containing higher percentage of non-starch carbohydrates such as: barley, wheat, rye, oats, etc. (Fry et al., 1958). Later on, enzyme preparations containing two or more enzymes, so called «enzyme cocktails» were used. Researches carried out during the last years (Mohagana et al., 1993, Mitchell and Edwards 1996, Cmiljanić et al., 1997, Senköylü and Konyoh 1997, Cmiljanić et al., 1998, Cmiljanić et al., 2001, Cmiljanić et al., 2003, Shivaram and Dewegoda, 2004) showed that by adding of enzyme preparations positive effects on body mass gain, feed consumption and conversion in chickens are realized, also better laying ability of layers, higher egg mass and better egg quality are achieved. Better utilization of nutritive substances achieved by supplementing diets with enzymes reduces the secretion of undigested remnants and in this way the environment is protected. Improvement of the production technology of certain enzymes caused to reduction of the price of such preparations and increase of their use and application in poultry nutrition. Today enzymes are regular/usual component of diets for nutrition of poultry. In some countries (Great Britain), 95% of produced mixtures for poultry nutrition in 1993 contained enzymes. Enzymes are usually added through pre mixtures.

Effects of enzyme application in nutrition of fattening chickens. In young chickens, the enzyme system is insufficiently developed, therefore, by supplementing diets with enzymes the utilization of nutritive substances from the diet is improved. This is especially the case when diet is composed of grains (barley, wheat, rye) or contains protein feeds with higher content of coarse fibres (sunflower meal, oil seed meal, arašidova sačma). Investigations carried out by Cmiljanić et al. (1997) showed that addition of enzyme preparation «Yeasture» to diet had positive effect on gain of body mass and feed conversion in the first fattening period (1-28 days). In the second fattening period (29-42 days) these effects were not expressed in the same extent. Similar results were obtained by Mellor (2002). This author established that the effects of enzyme application in older chickens were not expressed in the same extent as in younger chickens. Investigation by Korelski (1993) demonstrated that by adding enzymes β -glucanase and "ovozy-m-343" to diets for chickens based on barley the gain of body mass was considerably improved. Similar results were obtained by Vukić-Vranješ and Venka (1995). These authors have established that adding of enzyme preparation "Trihoderma Virde" had positive effect on utilization of nutritive substances from barley, but that the effect was even greater if extruded barley was used in the diet. Investigations also showed that enzymes had positive effect on utilization of nutritive substances from diet used in nutrition of fattening chickens which are based on wheat. Also, Velduren and Vahl (1994) have established that adding of enzyme xylanase to diets for fattening chickens based on wheat had positive effect on gain of body mass and feed conversion. Frigard et al. (1994) have established that chickens fed diets based on rye and supplemented with enzymes have higher gain compared to chickens fed the same diet but without supplemented enzymes.

Investigations by Cmiljanić et al. (2001) showed that addition of two enzyme preparations "Hostazym-C" and "Enzymix-Z" to diets based on corn, soy bean and sunflower meal for fattening chickens had positive effect on gain of body mass, feed conversion and health condition of chickens. Addition of enzyme preparation «Novo Nordisk AS» to diets for fattening chickens composed of soy bean and sunflower meal significantly increased the nutritive value of sunflower meal. This increase was expressed in higher body mass of chickens at the end of fattening and more efficient feed conversion. Obtained production results were similar to those obtained in case of diets containing soy bean meal. Similar results were obtained by Bedford et al. (1996). These authors established that addition of «enzyme cocktail» consisting of xylanase, protease and amilase to diets for fattening of chickens based on corn and soy bean meal had positive effect on gain and feed utilization.

Investigations of Roth-Maiera and Kirchgessner (1994) showed that addition of enzyme preparation «Roxsazyme» to diets for fattening of chickens based on lupina caused increase of gain and improvement of feed conversion.

Special significance in nutrition of fattening chickens has enzyme phytase. It is known that total phosphorus in plant feeds approx. by 70% is in the form of phytic acid. Utilization of this form of phosphorus in nutrition of poultry is very low (approx. 30%). It is also known that phytic acid forms complex with proteins, minerals and enzymes of the digestive tract (Kies et al., 2001). These studies suggest that phytic acid has certain anti nutritive traits. First investigations showed that by adding enzyme phytase to diets for layers the utilization of phytine phosphorus was improved (by 30%). Addition of phytase to diets for layers also the utilization of calcium, zinc and copper is improved. Based on investigation of Lukića et al. (2002) it can be concluded that up to max. 30% of total phosphorus can be replaced if 1000 FU of phytase/kg of diet is added. Investigations also showed that addition of phytase to diets for layers has positive effect on utilization of phytine phosphorus and content of ashes in tibia (Williams 2001). Addition of 300FU of phytase/kg of diet for nutrition of layers can replace 1,15 g of phosphorus from dicalcium phosphate (Gunther and Schienoni, 1997). Phytase added in combination with 1,25 dihydroxycalcifier in diet for layers has positive effect on utilization of phytine phosphorus (Carlos and Edwards, 1998). Addition of phytase to diets for fattening chickens based on

soy bean meal the utilization of phosphorus is achieved as well as better gain and feed conversion (Kiskinen et al., 1994). Denbow et al. (1998) have established that the degree of utilization of phytine phosphorus increases with the increase of level of added phytase. Similar results were obtained by Jensen et al. (1996). Addition of enzyme phytase to diets for fattening chickens with low level of phosphorus improves the utilization of total phosphorus, improves bone mineralization and achieves higher gain of body mass, Sebastijan et al. (1996). Investigations by Qiana et al. (1996) showed that addition of phytase had positive effect on firmness of bones, body mass gain and feed conversion in fattening chickens.

Effects of application of enzyme preparations in nutrition of layers. In the last ten years the application of enzymes became widely spread. Investigations showed that application of enzymes in nutrition of layers had positive effect on egg laying ability; the utilization of feed per produced egg is reduced and egg mass increased. By adding enzymes (β -glucanase, xylanase and pectinase) to diets for nutrition of layers the egg mass is increased and share of eggs of over 60 g is higher (Fraqucesch et al., 1995). Addition of enzyme preparation "Vegpro" to diets for nutrition of layers based on sunflower meal caused significant improvement in utilization of diet, viscosity of intestinal content was reduced which indicated better utilization of diet. Based on obtained results it was concluded that sunflower meal supplemented with enzyme preparation "Vegpro" can be introduced into diets for layers up to 30% (Lević Jovanka et al., 1997). Investigations by Olaffs et al. (1998) showed that enzyme preparation (β -glucanase and xylanase) added to diet for layers based on barley and oats and combination of wheat and oats had positive effect on egg shell thickness and also the share of tainted eggs was reduced.

Enzyme cellulase added to diets for layers with high content of coarse fibres considerably improved the production of eggs (Prakash and Mortad 1996). Investigations by Miskiniene and Sedereviciute (1996) showed that by supplementation of diet for layers containing 37% of wheat, 25% of rye and 15% of soy bean meal by enzyme preparation "MEC-CGAP" the egg mass and egg yolk mass were increased.

Effects of application of enzymes in nutrition of other poultry species. Enzymes are also applied in nutrition of other poultry species. For instance, enzyme added to diets for turkeys based on triticale and barley had positive effect on economical efficiency of this production (Mikulski et al., 1998). Diet for young geese with 0,22% utilizable phosphorus with added enzyme phytase (600 FU/kg of diet) satisfied the need of young geese in phosphorus. Young geese fed this diet had higher gain and higher content of ashes in tibia compared to young geese fed diets containing 0,17% of utilizable phosphorus (Lin Lushi, 1997). Application of enzymes in nutrition of young ducks causes significant increase of gain and reduces consumption of food per unit of gain. Addition of enzyme increases digestibility of starch and proteins in diets «corn-sorghum-soy bean meal» (Hruby, 2002). Addition of enzyme to diets for nutrition of quails based on barley had positive effect on gain of body mass and body weight (Yildiz and Osturk, 1998). Finally, it can be concluded that if enzyme preparations are adjusted to the diet composition, their application in poultry nutrition shall be greater.

LITERATURE

1. Bedford R.M., Morgan J.A. The use of enzymes in poultry diets. *World's Poultry Science Journal*, 1996, 52(1): 61-62.
2. Cmiljanić R., Pavlovski Zlatica, Hopić S., Lukić M. Neki efekti primene preparata »Yeasture« u ishrani tovnih pilića. *Inovacije u živinarstvu-97* 5 april Arandjelovac, 1997: 25-28.
3. Cmiljanić R., Pavlovski Zlatica, Hopić S., Vlahović Milica The effect of Enzymix-Ž supplementation to diets on body weight gain and feed conversion in fattening chicken. 10-th European Poultry Conference. Jerusalem, Israel, 21-26 June 1998, 1998: 395-398.

4. Cmiljanić R., Lukić M., Škrbić Zdenka, Trenkovski Snežana. The effect of Hostazym-C and Enzymix-Ž supplementation to diets for fattening chickens on gain and feed conversion. *Biotechnology in Animal Husbandry*, 2001, 17 (1-2): 39-44.
5. Cmiljanić R., Pavlovski Zlatica, Trenkovski Snežana, Lukić M. New additives in poultry nutrition. *Biotechnology in Animal Husbandry*, 2003, 19 (5-6): 357-365.
6. Cmiljanić R., Pavlovski Zlatica, Hopić S. Primena enzima u ishrani živine. *Biotehnologija u stočarstvu*, 1997, 13 (3-4): 163-170.
7. Carlos A.B., Edvards H.M.Jr. The effects of 1,25-dihydroxycholecalciferol and phytase on the natural phytate phosphorus utilization by laying hens. *Poultry Science*, 1998, 77(6): 850-858.
8. Denbow D.M., Grabau J.A., Lacz G.H., Kornegaz E.T., Russell D.R., Umbeck P.F. Soybeans transformed with a fungal phytase gene improve phosphorus availability for broilers. *Poultry Science*, 1998, 77 (6): 878-881.
9. Fry R.E., Allred J.B., Jensen L.S., McGinnis J. Influence of cereal grain components of the diet on the response of chicks and poults to dietary enzyme supplements. *Poultry Science*, 1957, 36: 1120-1130.
10. Frigard T., Pettersson D., Aman P. Fiber degrading enzyme increases body weight and total serum cholesterol in broiler chickens fed a rye-based diet. *Journal of Nutrition*, 1994, 24 (12): 2422-2430.
11. Fraquecech M., Perez-Vedrell A.M., Esteve-Garcia E., Brufau J. Enzyme supplementation of a barley and sunflower based diet on laying hen performance. *Journal of Applied Poultry Research*, 1995, 4 (1): 32-40.
12. Gunther C., Schienoni A. Microbial phytase is suitable for laying hens. *Rivista di Avicoltura*, 1997, 66 (12): 7-11.
13. Hruby M. Enzymes help unlock energy in corn-based dack feeds. *World Poultry*, 2002, 18(12): 16-18.
14. Jensen F., Nielsen M., Christensen L. and Thrine Hastrup, Effect of phytase addition to feed on growth performance of broiler chickens. XX World's Poultry Congress, New Delhi India, 2-5 September, 1996: 237-241.
15. Koreleski J. Feed value of covered (common) and naked barley in feeding broiler chickens and the effectiveness of enzyme preparations. *Roczniki Naukowe zootechniki*, 1993, 20 (1): 207-224.
16. Kuskinen T., Pürönen J., Hakonen T. Effects of supplemental microbial phytase on performance of broiler chickens. *Agricultural Science in Finland*, 1994, 3 (5): 457-466.
17. Kies K.A., Vanhemert K.H.F., Sauer W.C. Effect of phytase on protein and amino acid digestibility and energy utilisation. *World's Poultry Science Journal*, 2001, 57(2): 109-126.
18. Lević Jovanka, Stojanović S., Ševković N., Isakov V., Sredanović Slavica, Džinić Nataša. Oplemenjivanje suncokretove sačme upotrebom enzima. VII Simpozijum tehnologije stočne hrane, «Unapredjenje tehnologije proizvodnje stočne hrane» Tara, 30 Sep.- 4 Okt. 1997, 1997: 266-277.
19. Lukić M., Sinovec Z., Pavlovski Zlatica, Cmiljanić R., Spasojević J. Effects of microbial phytase in nutrition of broilers on production performance, carcass and meat quality. *Archiv für Geflügelkunde*, 2002, Band 66: 1619-2354.
20. Lin Lu Shi, Lu Lin Jenn, Lin Bing Hung, Chen Kaolon, Chen Ching Chang. Effect of supplemental phytase on growth performance, blood components, tibial bone characteristic, and the bioavailability of phosphorus in goslings. *Journal of the Chinese Society of Animal Science*, 1997, 26(2): 135-151.
21. Mohagna M., Nir I., Nitsan Z., Larbier M. Effect of exogenous amylase and protease on development, digestibility and digestive enzyme activity in young meat – type chicks. 9-th European Symposium on Poultry Nutrition, September 5-9, Poland, 1993: 468-470.
22. Mitchel R., Edvards H. Effects of phytase and 1,25 dihydroxycholecalciferol on phytate utilisation and the quantitative requirement for calcium and phosphorus in young broiler chickens. *Poultry Science*, 1966, 75(1): 95-110.
23. Mellor Sarah. Enzymes make the grade. *World Poultry*, 2002, 18(4): 26-27.
24. Miskiniene M. and Sedereviciute Z. The effect of enzyme preparations on the yolk characteristics of laying hens. XX World's Poultry Congress, New Delhi, India, 2-5 September, 1996: 244-246.

25. Mikulski D., Jankowski J., Faruga A., Mikulska M. The effect of enzyme supplementation on triticale - barley feeds on fattening performance of turkeys. *Journal of Animal and Feed Sciences*, 1997, 6(3): 392-399.
26. Oloffs K., Jeroch H., Schoner F. J. The efficiency of enzyme hydrolysing non-starch polysaccharides (NSP) as feed additives to layer rations on barley-rye basis. *Journal of Animal Physiology and Animal Nutrition*, 1998, 78(4-5):178-195.
27. Prakash L. and Morton M.G. Efficiency of enzyme supplementation to high fibre diets on performance of layers. XX World 's Poultry Congress, New Delhi, India, 2-5 September, 1996, 253-256.
28. Qian H., Veit H., Kornegay E., Ravindran V., Denbow D. Effects of supplemental phytase and phosphorus on histological and other tibial bone characteristics and performances of broilers fed semi-purified diets. *Poultry Science*, 1996, 75, 5: 618-626.
29. Roth-Maier D.A., Kirchgessner M. High proportions of white lupins (*Lupinus albus*) and enzyme supplements for fattening chickens. *Archiv für Geflügelkunde*, 1994, 58 (6): 245-248.
30. Senkoylu N. and Konyali A. Effects of whole wheat feeding and enzyme addition on brown layers performance at 2-nd year production. XI The European Symposium on Poultry Nutrition . Faaborg, Denmark, 1997: 258-260.
31. Shivaram D.A., Devegowda A. Effect of enzyme (Vegpro) supplementation to sunflower meal based diets on performance of laying hens. XXII World 's Poultry Congress Istanbul, 8-13 Septembere 2004, 2004: 504-505.
32. Sebastian S., Touchburn S., Chavez E., Lague P. The effects of supplemental microbial phytase on the performance and utilisation of dietary calcium, phosphorus, copper and zinc in broiler chickens fed corn-soybean diets. *Poultry Science*, 1996, 75(8): 729-736.
33. Veldman A., Vahl H.A. Xylanase in broiler diets with differences in characteristics and content of wheat. *British Poultry Science*, 1994, 35(4): 537-550.
34. Vukić-Vranješ Venk C. The influence of extruded vs untreated barley in the feed, with and without dietary enzyme supplement on broiler performance. *Animal Feed Science and Technology*, 1995, 54 (1/4): 21-32.
35. Williams P.W. Economic implications of phytase use in layer nutrition. *Science and Technology in the Feed Industry, Proceedings of Alltech's 17th Annual Symposium*. Nottingham University Press, 2001: 235-239.
36. Yildiz I., Ozturk E. Effects of enzyme supplementation on the performance and carcass traits of quail fed barley and wheat based diets. *Ondokuzmayis Universitesi Ziraat Fakultesi Dergisi*, 1997, 12 (3): 109-122.