Biological Forum – An International Journal **14(4a): 564-567(2022)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Role of Amylase Enzyme in Poultry Feed

Ritu Khasa[1] and Sushil Kumar[2*]
[1]Department of Molecular Biology and Biotechnology, CCS HAU, Hisar (Haryana), India.
[2]Department of Food Science and Technology, CCS HAU, Hisar (Haryana), India.

(Corresponding author: Sushil Kumar)*
(Received 28 September 2022, Accepted 18 November, 2022)
(Published by Research Trend)

ABSTRACT: Poultry product's consumption has risen over the years and demand will be more in developing countries. So the demand of feed and raw materials is the main concern of poultry industry. However maize and soyabean are the traditional feed ingredients but we can't met the demand over the coming decades because feed remains the largest cost item in poultry production contributing to 60-70% of total expenses. Most of the ingredients used in poultry feed are also used for human nutrition, driving the costs up further. This leads to producers switching to local feed ingredients like sunflower meal, palm meal, wheat bran, rice bran, groundnut cake etc, which can adversely affect birds' health and growth. Feed additives are seeing an increasing role in poultry nutrition as ways to improve feed utilization and simultaneously prevent diseases. About 15-25% of the total feed is not digested by the animals use since the feed contain some indigestible components and or the animal bodies lack the specific enzyme - to counter this problem feed enzyme additives play an important role. Amylases are the important food additives which increase the digestibility and nutritional value to improve the growth of poultry. Numerous studies have shown that supplementation of exogenous enzymes in wheat, barley, sorghum or triticale-based rations can improve performance of poultry to a level compared to that obtained by corn-soya-based rations. Naturally, the gastrointestinal tract of poultry produces enzymes to aid the digestion of nutrients. However, the birds do not have enough enzymes to digest fiber completely and need some commercial exogenous enzymes in the diets to improve the digestion.

Keywords: Enzymes, Poultry feed, broilers, corn-soyabean meal and amylase.

INTRODUCTION

Global consumption of poultry products, especially poultry meat, has consistently increased over the years, and this trend is expected to continue. Much of the increase in global demand for poultry products will be in developing countries. Such growth in the poultry industry is having a profound effect on the demand for feed and raw materials. However, it is also becoming clear that the requirements for the four traditional feed ingredients – maize, soybean meal, fish meal and meat meal – cannot be met, even according to optimistic forecasts. The gap between local supply and demand for these traditional ingredients is expected to widen over the coming decades. Hence, researcher can help the poultry by identifying suitable enzyme produced from many microbes for poultry to degrade the undigested compound in poultry feed. Enzymes are the biological catalysts that catalyzing the rate of reaction without being altered (Tiwari *et al*., 2004). Addition of enzymes in poultry feed results in improving nutrient utilization and meat production efficiency (Cozannet *et al.,* 2017). These enzymes help in increasing more feed intake, weight gain, digestion and absorption of nutrients and improve Apparent Metabolizable Energy (AME) value of the diet (Ulo *et al*., 2022). The addition of exogenous amylase to the diet increased the apparent ileal digestibility of DM, CP, and starch in FB seeds. The AME_N value increased as a result of enzyme addition (P <0.05). The group 3 showed higher apparent ileal digestibility of essential amino acids (Lys, Leu, Phe, His) as well as nonessential amino acids (Tyr, Ala, Pro) in FB seeds. It could be concluded that FB seeds supplemented with exogenous amylase have a greater nutrition value for broiler chickens (Perz *et al*., 2022). It is possible to produce large amounts of cheap enzyme by continually selecting favourable microbes, growing them in advanced fermentation systems by optimizing process parameters with cheaply available agroresidues and the extraction and purification of the amylase enzyme and their effect in poultry described below by reviewing the various literature findings.

Amylase

Amylases are the group of hydrolyzing enzymes that catalyzing the glycosidic bonds present in starch and convert it in simple sugars (Cowieson *et al*., 2019b). There are three types of amylases alpha-amylase, beta-amylase and gamma-amylase (Saranraj *et al*., 2013). The sources of these enzymes are microbes (bacteria, fungi), plants and animals. In amylase class, 19 enzymes have been listed (Mohanan and Satyanarayana 2019). In this list, Alpha-amylase (E.C 3.2.1.1) causes the hydrolysis of α-1, 4-glycosidic bond of starch. Alpha-amylase play important role in industries by contributing by one fourth of total enzyme market. Amylases have potential applications in divergent areas including food industries, textile and paper industries (Saranraj and Amp; D. stella 2013) and pharmaceutical industries (Afolabi *et al*., 2022).

The Aspergillus sp. are the common source for the production of Alpha-amylase. It causes the hydrolysis of α-1, 4- glycosidic bond of starch to convert it into glucose, α-limit dextrin and maltose. These oligosaccharides further converted into glucose by maltase, isomaltase and dextrases, resulting glucose enter into citric acid cycle to generate ATP (Cowieson *et al*., 2018). The specific activity of α-amylase depends on different parameters like temperature, ph, substrate and metal ion requirement. The optimum PH for specific activity may differ from species to species but in a range of 4-10 (Heidi *et al*., 2022). Temperature is also important factor in deciding enzyme activity; it depends on origination of microorganism.

Table 1: Effect of amylase on poultry.

Source	Substrate	Effect on poultry	References
Trichoderma virens	Watermelon rinds	Production of α-amylase by fungi under SSF	Heidi *et al*. (2022)
Trichoderma harzianum	Corn-Soyabean	Use in diet of broiler chicks	Marques *et al.* (2016)
Sheep rumen	Corn-Wheat	Degradation of poultry feed at different temperatures-50, 70, 85	Motahar *et al.* (2020)
Bacillus amyloliquefaciens	Corn-Soyabean	Increased in weight, growth, improved digestibility of nutrients & performance of broilers	Gracia *et al*. (2003)
Saccharomyces cerevisiae	Corn, Rice, Canola	Increase in egg production, egg weight	Khan *et al.* (2011)
Lactobacillus plantarum	Maize, Soyabean	Robust and faster growth of chicks	Nwachukwu *et al*. (2022)
Rhizopus oligosporus	Cassava stem	Broiler chicks showed marked increase in weight gain	Ojo *et al*. (2022)
Rhizopus oligosporus	Maize cob	Weight gain in broilers	Nandi *et al*. (2022)
Aspergillus oryzae	Corn starch	Increased sucrase activity in the jejunum and improve digestibility of starch	Yuan *et al.* (2017)
Aspergillus niger	Apple pomace	Higher reducing sugar concentration in ileal phase	Suresh *et al.* (2019)

Role of Amylases in Poultry Feed

The most common poultry feed includes barley, corn, wheat, canola meal and soybean meal. Starch is one of the most important components of poultry diet and its digestibility depends on the presence of amylose which varies from corn to others cereals, which significantly affects the AMEn value of the diet (Tester *et al*., 2004). Therefore supplementation of hydrolases exogenously improves the better digestibility of starch results in increase in energy utilization and performance (Gracia *et al*., 2003). Oguntoye *et al*. (2018) reported the use yam peel can replace the maize upto 30% with or without enzymes results in improving the performance of broilers. Yam peel is a byproduct of agro-industries, have nutritional value and easily available so fall in cost of production. When corn-soybean meal diet replaced with faba bean seed + amylase showed increased the apparent ileal digestibility of dry matter and starch in FB seeds. Increased ileal digestibility of essential and non-essential amino acids with amylase supplementation improved nutrition value for broiler chickens (Perz *et al*., 2022). Exogenous amylase supplementation significantly increases the digestibility of resistant starch in corn-SBM–based diets (Schramm *et al*., 2021). Starch and energy digestibility varied with the intestinal sites; the anterior jejunum (AJ), posterior jejunum (PJ), anterior ileum (AI), and posterior ileum. The efficiency of amylase supplementation was higher within jejunum compared to others sites and viscosity of the jejunal digesta decreased (Aderibigbe *et al.*, 2020). When amylase supplementation given with combination of different enzymes like amylopectase, glucoamylase, protease, xylanase, cellulose and pectinase results in increasing starch digestibility, decrease in ileum lesion and intestinal microbiota; increased growth of broilers fed with newly harvested corn (Matthiesen *et al*., 2021). The use of amylase in chicken feed increase the energy value of corn and that energy used for production of biodiesel which reduce 6% of green house gas emission. The broiler live performance was affected by drying temperature and particle size of corn which influence gastrointestinal organ development, energy utilization and nutrient digestibility (Morgan *et al*., 2022). Use of amylase in diet improved these parameters. Broilers fed coarse corn–based diets had heavier gizzard and liver than

chickens that consumed fine corn-based diets. Stefanello *et al*. (2017) reported that use of amylase and xylanase separately and in combination with maize-soy diet leds to increase in AMEn and body weight gain. A marked difference occurred in favor of amylase when compared to xylanase supplementation where as adding both enzymes in the same feed generated similar AMEn to the single addition of amylase. The effect of fed corn diets supplemented with exogenous xylanase , amylase, and protease (XAP) as single or combined activities showed a synergistic effect between these enzymes on broiler nutrient digestibility and performance (Flores *et al*., 2016). The 25-day-old broilers fed a complete corn-SBM-based diet supplemented with amylase results in increasing digestibility (Schramm *et al*., 2021) of starch. When α-amylase was tested in a corn-soyabean based diet, 105 and 100 KNU/kg maximized its ileal digestible energy and AMEn release effect (Stefanello *et al*., 2017). Amylases supplemented with maize-soyabean diet increased ileal digestible energy (IDE) from 12.21 to 12.50 MJ/kg dry matter across maize batches (Liu *et al*., 2020).

CONCLUSION

The use of enzymes as a feed additive has rapidly expanded. In the last decade, extensive studies have been conducted to study the effects of feeding exogenous enzymes on the performance of poultry. By compiling these studies into a single focused work, this review provides evidence that enzyme is a significant instrument for the use in poultry feed. Although the economic and social benefits of enzymes have been well established and the future of feed enzymes is a bright one. However, further research is required if enzymes are to reach their full potential in the industry and to answer some of the questions that this article raises, particularly those regarding the mode of action of enzymes, how best to match the levels of enzyme and substrate and how enzymes counter the variable environments in the animal's gut. Any advances in this field must ultimately improve the welfare of chickens, reduce the production of wastes and conserve resources. Poultry industry is becoming increasingly receptive to the use of exogenous enzymes supplementation. Enzyme supplementation to the poultry rations has a positive effect on feeds digestibility and leads to better productivity and performance. Moreover, supplementation of commercial enzymes can increase the nutritive value of feed ingredients and diets as well as allow greater flexibility in diet formulation. It has also a potential effect on mitigation of the environmental pollution by reducing the excretion of some elements such as nitrogen and phosphorus in poultry manure.

FUTURE SCOPE

The development of enzyme technology needs to go hand in hand with better characterisation of substrate structures, the gut microflora, and the immune system. There is a great scope to impart enzymes in the poultry feed which helps in cost cutting of poultry industry.

Conflict of Interest. None.

REFERENCES

Aderibigbe, A., Cowieson, A. J., Sorbara, J. O., Pappenberger, G. and Adeola, O. (2020). Growth performance and amino acid digestibility responses of broiler chickens fed diets containing purified soybean trypsin inhibitor and supplemented with a monocomponent protease. *Poultry Science*, *99*(10), 5007–5017.

Afolabi, F. T., & Adetayo, O. O. (2022). Isolation and characterisation of alpha-amylase producing yeast from different fermented foods and dairy products.

Cowieson, A. J., Abdollahi, M. R., Zaefarian, F., Pappenberger, G., & Ravindran, V. (2018). The effect of a mono-component exogenous protease and graded concentrations of ascorbic acid on the performance, nutrient digestibility and intestinal architecture of broiler chickens. *Animal Feed Science and Technology*, *235*, 128-137.

Cowieson, A. J., Vieira, S. L. and Stefanello, C. (2019b). Exogenous Microbial Amylase in the Diets of Poultry: What do We Know? *Journal of Applied Poultry Research*, *28*(3), 556–565.

Cozannet, P., Kidd, M. T., Neto, R. M., & Geraert, P. A. (2017). Next-generation non-starch polysaccharide-degrading, multi-carbohydrase complex rich in xylanase and arabinofuranosidase to enhance broiler feed digestibility. *Poultry Science*, *96*(8), 2743-2750.

Flores, C., Williams, M., Pieniazek, J., Dersjant-Li, Y., Awati, A. and Lee, J. T. (2016). Direct-fed microbial and its combination with xylanase, amylase, and protease enzymes in comparison with AGPs on broiler growth performance and foot-pad lesion development. *Journal of Applied Poultry Research*, *25*(3), 328–337.

Gracia, M. I., Araníbar, M. J., Lázaro, R., Medel, P. and Mateos, G. G. (2003). α-amylase supplementation of broiler diets based on corn. *Poultry Science*, *82*(3), 436–442.

Heidi M. A.M., Amal Z. B., Roqaya I. B., Alshaimaa M. E., Hala A. S., Azza M. A. and Saleh A. M. (2022). Biotechnology approach using watermelon rind for optimization of α-amylase enzyme production from *Trichoderma virens* using response surface methodology under solid-state fermentation. *Folia Microbiol.*, *67*, 253–264.

Khan, S. H., Atif, M., Mukhtar, N., Rehman, A. and Fareed, G. (2011). Effects of supplementation of multi-enzyme and multi-species probiotic on production performance, egg quality, cholesterol level and immune system in laying hens. *Journal of Applied Animal Research*, *39*(4), 386–398.

Liu, H., Sorbara, J. O. B., Cowieson, A. J., Romero, L. F., Wang, S. K., Wu, J. L. and Kluenter, A. M. (2020). Exogenous α-amylase supplementation reduces the variability of ileal digestible energy in broiler chickens fed complete diets with maize batches of variable protein solubility. *Animal Feed Science and Technology*, *268*.

Marques, S. F. F., Minafra, C. S., Cafe, M. B., Stringhini, J. H. and Ulhoa, C. J. (2016). Production and Characterization of a *Trichoderma harzianum* Multienzyme Complex and its Application in Broiler Chicks' Diets. *Current Biotechnology*, *7*(1), 26–33.

Mohanan N. and Satyanarayana T. (2019). Amylases. In: Schmidt TM (ed) Encyclopedia of microbiology. Fourth, p. 107-126.

Martins, P. A., Pacheco, T. F., de Camargo, B. R., De Marco, J. L. and Salum, T. F. C. (2022). Solid-state fermentation production and characterization of an alkaline lipase from a newly isolated *Burkholderia gladioli* strain. *Preparative Biochemistry & Biotechnology*, *52*(1), 70-79.

Matthiesen, C. F., Pettersson, D., Smith, A., Pedersen, N. R. and Storm, A. C. (2021). Exogenous xylanase improves broiler production efficiency by increasing proximal small intestine digestion of crude protein and starch in wheat-based diets of various viscosities. *Animal Feed Science and Technology*, *272*.

Morgan, N., Bhuiyan, M. M. and Hopcroft, R. (2022). Non-starch polysaccharide degradation in the gastrointestinal tract of broiler chickens fed commercial-type diets supplemented with either a single dose of xylanase, a double dose of xylanase, or a cocktail of non-starch polysaccharide-degrading enzymes. *Poultry Science*, *101*(6).

Motahar, S. F. S., Khatibi, A., Salami, M., Ariaeenejad, S., Emam-Djomeh, Z., Nedaei, H., Kavousi, K., Sheykhabdolahzadeh Mamaghani, A. and Salekdeh, G. H. (2020). A novel metagenome-derived thermostable and poultry feed compatible α-amylase with enhanced biodegradation properties. *International Journal of Biological Macromolecules*, *164*, 2124–2133.

Nandi, S., Bose, T., Mahato, S., Chatterjee, S. and Chatterjee, A. (2022). Isolation and partial characterization of amylase produced by fungal isolates from the agro-industrial waste source. *Journal of Applied Biology & Biotechnology*, 45–49.

Nwachukwu, U. F. and George-Okafor, U. O. (2022). Evaluation of probiotic Lactobacillus plantarum CS fermented culture and its crude enzymes as chicken growth enhancers. *World Journal of Advanced Research and Reviews*, *14*(3), 332-337.

Oguntoye, M. A., Hapson, U., Adamu, F., Daniel, D. K. and Daniel. (n.d.). Performance and Economic of Production of Broiler Chickens fed Maize and Yam Peels based Diets supplemented with Xylanase, Amylase and Protease Multi-enzymes at starter phase Target audience: Nutritionist, researchers, feed millers and poultry farmers. In *Nigerian J. Anim. Sci.* (Vol. 2018, Issue 3).

Ojo I., Apiamu A., Egbune O. E. and Tonukari J. N. (2022). Biochemical Characterization of Solid-State Fermented Cassava Stem (*Manihot esculenta* Crantz-MEC) and its Application in Poultry Feed Formulation. *Appl. Biochem. Biotechnol.*, *194*, 2620–2631.

Saranraj, P., & Stella, D. (2013). Fungal amylase—a review. *Int. J. Microbiol. Res.*, *4*(2), 203-211.

Perz, K., Nowaczewski, S., Kaczmarek, S. A., Cowieson, A. J. and Hejdysz, M. (2022). Research Note: Amylase supplementation improves starch and amino acids digestibility of faba bean for broilers. *Poultry Science*, *101*(11), 102117.

Schramm, V. G., Massuquetto, A., Bassi, L. S., Zavelinski, V. A. B., Sorbara, J. O. B., Cowieson, A. J., Félix, A. P. and Maiorka, A. (2021). Exogenous α-amylase improves the digestibility of corn and corn–soybean meal diets for broilers. *Poultry Science*, *100*(4).

Stefanello, C., Vieira, S. L., Rios, H. V., Simões, C. T., Ferzola, P. H., Sorbara, J. O. B. and Cowieson, A. J. (2017). Effects of energy, α-amylase, and β-xylanase on growth performance of broiler chickens. *Animal Feed Science and Technology*, *225*, 205–212.

Suresh, G., Santos, D. U., Rouissi, T., Brar, S. K., Mehdi, Y., Godbout, S., Chorfi, Y. and Ramirez, A. A. (2019). Production and in-vitro evaluation of an enzyme formulation as a potential alternative to feed antibiotics in poultry. *Process Biochemistry*, *80*, 9–16.

Tester, R. F., Karkalas, J., & Qi, X. (2004). Starch structure and digestibility enzyme-substrate relationship. *World's Poultry Science Journal*, *60*(2), 186-195.

Tiwari, S. P., Srivastava, R., Singh, C. S., Shukla, K., Singh, R. K., Singh, P. and Sharma, R. (2015). Amylases: an overview with special reference to alpha amylase. *J Global Biosci.*, *4*(1), 1886-1901.

Ulo, Y. B. (2022). Fundamental Role of Supplanting Enzymes in Poultry Diet. *World Scientific News*, *166*, 100-115.

Yuan, J., Wang, X., Yin, D., Wang, M., Yin, X., Lei, Z. and Guo, Y. (2017). Effect of different amylases on the utilization of cornstarch in broiler chickens. *Poultry Science*, *96*(5), 1139–1148.

How to cite this article: Ritu Khasa and Sushil Kumar (2022). Role of Amylase Enzyme in Poultry Feed. *Biological Forum – An International Journal*, *14*(4a): 564-567.