APPLICATIONS AND BENEFITS OF XYLANASE IN THE ANIMAL FEED INDUSTRY: A REVIEW

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ABSTRACT

Xylanase is an essential enzyme in the animal feed industry, improving digestibility, animal performance, nutrient utilization, as well as productivity. This review explores the origin, mechanism of action, and applications of xylanase, highlighting its economic and environmental benefits. The research was conducted using databases such as ScienceDirect, focusing on studies published in the last 10 years. Keywords included "xylanase", "animal feed", and "enzymes". Current limitations and future perspectives for research in this area are also discussed. In conclusion, despite the limitations, the studies suggest that the strategic application of xylanase in animal feed formulation may represent a promising opportunity to improve feed digestibility and potentially nutritional efficiency for animals.

Keywords: Xylanase; Digestibility; animal feed, xylan.

1 INTRODUCTION

The constant search for improvements in animal production has led to the exploration of various strategies to optimize feed efficiency and, consequently, animal performance. In this context, the application of enzymes in feed formulation has been the subject of study, aiming to improve nutrient digestibility.

Xylanase has played a crucial role in improving the efficiency of animal feeds. The hypothesis of this study is that the application of the xylanase enzyme in animal feed, under different experimental conditions, will result in significant variations in digestive efficiency. It is expected that adjustments in environmental parameters, such as temperature and humidity, can modulate enzymatic activity, optimizing the degradation of vegetable fibers present in the feed.

Enzymatic activity is highly sensitive to environmental factors, and xylanase, in particular, plays a crucial role in breaking xylan bonds present in plant feed components. Understanding how controlled variations in these parameters can influence the effectiveness of this enzyme is essential to develop precise strategies in feed formulation, aiming to improve digestibility and, therefore, animal performance.

This enzyme, due to its ability to degrade xylan, has aroused interest in several areas, from the biofuel industry to the production of food and chemical products. Its potential in industrial processes and the green economy continues to be explored to drive innovative and sustainable solutions in different sectors [1].

Considering the potential of applying enzymes in animal nutrition, with the objective of improving feed efficiency and considering the need to reduce production costs, this study was carried out with the objective of evaluating the use of xylanase in animal feed.

2 MATERIAL & METHODS

The research was conducted using databases such as ScienceDirect, focusing on studies published in the last 10 years. Keywords included "xylanase", "animal feed", and "enzymes".

3 RESULTS & DISCUSSION

Characteristics of Xylanase

Xylanase is an enzyme that degrades xylans, which is the main constituent of the plant cell wall and the second most common polysaccharide found in nature after cellulose ([2; 3; 4]). Xylanases are the main exogenous enzymes that act on the xylan chain. This polysaccharide is present in 2.2% of PNAs (non-starch polysaccharides) in corn and 1.33% in soybean bran, the main

ingredients in diets for non-ruminants [5]. It is estimated that xylanases have the capacity to degrade only 25% of the xylans present in the cell walls of ingredients of plant origin [6].

Exogenous xylanases are produced by a wide variety of fungi, bacteria, protozoa and algae and depending on the microorganism of origin, the mode of action and the products released in the catalytic reaction may differ [7].

Normative Instruction No. 13 of 11/30/2004 [15], which approves the regulation technical report on additives for products intended for animal feed, says that enzymes exogenous additives are classified as zootechnical additives belonging to the functional group digestive.

Xylanase is a glycosidase-type enzyme that acts in the hydrolysis of β 1-4 bonds of vegetable xylans, acting in the rupture of fibers, enabling greater capacity for action of amylases and proteases, an important characteristic of this enzyme being its broad range of action pH range, which can vary from 3.5 to 6.5, enabling its action throughout the small intestine [16].

In addition to contributing to reducing the viscosity of diets at the intestinal level, xylanases have secondary effects, such as: the release of protein in the process of breaking down arabinoxylans and xylans, they induce an increase in beneficial microorganisms for the gastrointestinal tract of non-ruminants, decrease the excretion of nitrogenous waste into the environment, minimizing levels of pollution in the environment and also reducing food costs, improving feed efficiency and animal weight gain [6].

Applications in the Animal Feed Industry

The use of additives has been gaining ground in diet formulations for non-ruminants. Exogenous enzymes are among the main additives used in diets due to their effectiveness in increasing the digestibility of foods rich in fiber, in addition to corn and soybean meal [8].

Enzymes are globular proteins, have a three-dimensional structure and accelerate chemical reactions (Angel and Sorbara, 2014), under specific conditions, such as pH, temperature and humidity, exert catalytic power and have substrate specificity. However, for these enzymatic reactions to occur in the gastrointestinal tract, the substrate must be accessible to the action of the enzymes [6].

By catalyzing the breakdown of xylan into smaller units, such as xylose, xylanase improves digestive efficiency, making nutrients more accessible to animals. This action not only optimizes animal nutrition, but also reduces dependence on expensive ingredients, making better use of agricultural by-products and reducing food waste [9], being especially beneficial for monogastric animals, such as poultry and pigs, which have limited digestive systems to handle complex fibers [10]. In addition to improving digestibility, the inclusion of enzymes in the animals' diet can promote a healthier gastrointestinal environment, balancing the intestinal microbiota and reducing digestive problems [11].

From these studies, it is possible to suggest that the controlled inclusion of xylanase in the feed formulation can promote an increase in the availability of essential nutrients for animals. This nutritional optimization can result in better use of feed, leading to a potential increase in weight gain, feed efficiency and animal health. Broiler chickens consuming diets with xylanase and probiotic additives showed better performance and weight gain results, as presented by [12].

In addition to the direct benefits for animals, improved digestibility can also have economic implications. With better use of nutrients, there is the possibility of reducing the amount of feed needed to meet the animals' nutritional needs. This can reduce production costs for breeders and minimize the environmental impact associated with feed production [13].

Several studies correlate xylanase supplementation in pig and poultry diets with improved performance, improved digestibility and positive effects on intestinal microecology ([14]; [6]) and can be used as a probiotic in the intestinal health of poultry and pigs [6]. However, there is still a great lack of information in the literature that has evaluated the efficiency of using xylanase to determine the benefit of this additive in nutrition [6].

Challenges and Future Perspectives

Although xylanase offers many benefits, its effectiveness can vary depending on diet composition and processing conditions. Future research should focus on engineering more robust and efficient xylanases adapted to a variety of conditions. A direction in future research indicates that there is a need to investigate the change of other ingredients in the diet, such as soybean oil, since the xylanase enzyme is a possible substitute for energy sources in order to reduce diet costs [6].

4 CONCLUSION

Xylanase plays a vital role in the animal feed industry, improving animal digestibility and performance while providing significant economic and environmental benefits. Continued research is essential to maximize these benefits and overcome current limitations.

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