



Hydrolysis Enzyme of Alternative Ingredients for Fish Feed: A Review

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Alternative raw materials have high potential as a source of feed protein that can support growth. Alternative raw materials have advantages such as low cost, abundant availability but the use of alternative raw materials in feed formulations is often limited by the presence of anti-nutritional substances and a relatively high crude fiber content of 11-28%, so further processing is needed to improve the quality of feed ingredients from alternative materials. The purpose of this literature review study is to determine the advantages of alternative feed ingredients for fish that have been hydrolyzed by enzymes. Evaluation studies of improving the quality of feed ingredients through enzymatic hydrolysis give varying results. The best enzyme hydrolysis can reduce the crude fiber content in coconut cake by 67.8%. Enzyme hydrolysis in alternative feed ingredients can also affect growth in fish due to increased digestibility in fish. The best growth was obtained in tilapia at 4.34% by hydrolysis of the protease enzyme. Enzyme hydrolysis is proven not to have a negative impact on several types of fish so that enzyme hydrolysis can be applied to improve the quality of alternative feed ingredients in fish feed formulations. However, enzyme hydrolysis has drawbacks, namely it only works specifically and depends on temperature and pH.

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1. INTRODUCTION

Growing activity cultivation fishery make Request feed *too* increase. However, the price of conventional feed ingredient ingredients for protein sources is still high [1]. The height price is caused because of supply limitations resources, sources of protein that are not stable [2,3]. To resolve the Thing, you need an alternative raw ingredient that has good quality nutrition _ at an affordable price [4]. An alternative ingredient for fish feed must be worth nutrition including high protein, sufficient amino acids , taste and digestibility, as well as fiber and heavy metal must be low carb _ no dissolve, because it will affect the growth process, feed costs , feed conversion ratio , and must be in accordance with the economy production feed [5]. Fish need about 50% of the necessary protein, fat <8% for carnivorous fish, and herbivores no more than 3%, minerals such as magnesium, potassium, iodine, and iron, fiber for carnivorous fish no more than 4% while herbivorous fish 5- 10%, as well as vitamins C, A, K, B12, B1, B2, B3, B5, B6, M, H, and inositol [6]. Study about the use of alternative raw ingredients in total or some who have researched and provided influence to fish growth. Among them is use soya bean flour cake [7,8], leaves lamtoro [8,9], waste vegetables [10,11], as well as dregs know [12,13]. However, the use of local raw ingredients is still often constrained by the high rough fiber content that can interfere with fish digestion [14,15], the low crude protein content, the presence of anti-nutritional substances, and the presence of a low balance in amino acids. This thing results in the need for the processing of raw ingredient feeds before they are used as ingredient feeds [16].

Hydrolysis is the process of solving polymers into monomers for compounds that could dissolve like glucose [13]. Factors affecting the hydrolysis process are reaction time, temperature reaction, concentration acid (catalyst), starch suspension level, and mixing reactor [17]. Enzyme hydrolysis can degrade substrates as an energy source so that enzymes can hydrolyze carbohydrates, especially fiber in feed ingredients derived from high-fiber vegetable ingredients so that they can trigger rapid growth in fish [18]. The disadvantage of enzymatic hydrolysis is that it depends on temperature and pH. Enzymes will work optimally at a certain temperature and pH. If the temperature is too high it will cause the enzyme to be denatured, while the pH which is not in accordance with the provisions will greatly

affect the course of the reaction [19]. In addition, enzymatic hydrolysis takes a long time, only works specifically and cannot penetrate the lignin that binds hemicellulose and cellulose and the price of the enzyme is relatively expensive [20]. Destination hydrolysis is to damage the structure of cellulose crystals and to increase the porosity of something ingredient [21]. This review focuses on the excellence of alternative ingredient feeds for fish that have been hydrolyzed by enzymes through search journals as reference main.

2. POTENCY ENZYME FOR FISH FEED

Enzyme is a protein that has activity catalyst for lower energy Activation of something reaction so that conversion Becomes substrates product could progress faster [22] Lots of enzymes used which are protease, lipase, and amylase enzymes which are enzyme breaking down hydraulics compound macromolecule carbohydrates, fats, and proteins. A research that has been conducted with the title "Activity Test Enzyme Amylase, Lipase, and Protease from *Hermetia* Larva Intestine Extract *illucens* " aimed at knowing *Hermetia* larvae potential *illucens* which produces protease, amylase and lipase enzymes. The result is that Protease is able to break down protein into amino acids, lipase breaks down fat into fatty acids and glycerol, as well as amylase breaks up starch to maltose [23].

Enzyme activity in the fish body depends on the eating habits of fish, for example, herbivorous fish. Herbivorous fish will tend to secrete enzymes that can accelerate the hydrolysis reactions of fats and carbohydrates such as lipase and maltase [24]. The intestines of herbivorous fish can also secrete proteases which function to accelerate protein hydrolysis reactions and break down peptide bonds [24]. In addition, the fish stage also affects the needs of fish enzymes. Adult fish tend to require exogenous enzymes to speed up the hydrolysis process because adult fish tend to produce endogenous enzymes compared to fish at fry size [25]. The addition of these exogenous enzymes to artificial feed can increase growth and reduce the feed conversion ratio in adult fish [26].

Enzymes can also increase the growth of fish through enhancing the fish feed efficiency score [27,28]. height the amount of feed efficiency

proves that the quality of the feed is better because the efficiency of the feed has changed. Becomes meaningful meat that costs required _ to produce meat that is more inexpensive [29]. Fish need good enzymes in the form of endogenous enzymes nor exogenous enzymes to speed up protein hydrolysis to amino acids and speed up the digestive process [30]. Power digest feed is influenced by enzymes present in the digestion channel and long time eaten food reacts with enzyme digestion [27] because good digestion power will add body weight to fish [31]. A number of studies mention that gift enzymes in tilapia feed add heavy of 1.26 g [32], giving papain and protease enzymes increase growth heavy absolute catfish jambal of 4.87 g-6.63 g [33], giving protease, lipase, and amylase enzymes in baung fish feed succeed increase growth heavy absolute of 11.06 g [34]. Increase growth heavy caused the existence of enzymes that speed up gut work _ protein hydrolysis in feed so that protein hydrolysis to more amino acids fast and more widely absorbed by the fish body [27].

3. INGREDIENT QUALITY ALTERNATIVE AFTER HYDROLYSIS ENZYME

Hydrolysis enzyme could repair function and structure nutrition protein ingredients in short time and method _ this no need sterile and anaerobic conditions as fermentation bacteria [35]. Hydrolysis use certain ingredients could degrade rough fiber content on raw material feed [36]. Hydrolysis works by degrading crude fiber in feed ingredients including cellulose which is converted into sugar with the help of enzyme catalysts [37]. The hydrolysis of a material by enzymes is strongly influenced by the dose (quantity) and the incubation time of the hydrolysis process [38]. Enzymes have the ability to activate other compounds specifically and are able to increase the speed of the reaction so that the hydrolysis process is faster than chemical hydrolysis [39]. Enzyme hydrolysis works specifically so it does not produce unwanted products and is more environmentally friendly [40]. The mechanism of action of enzymes on the hydrolysis of feed ingredients containing cellulose can use cellulase enzymes. Generally, cellulase enzymes consist of a mixture of several enzymes involved in hydrolysis of cellulose, namely endoglucanase which acts on the region of cellulose fibers which have low crystallinity in breaking down cellulose and forming free chains, exoglucanase which further degrades molecules by removing cellobiose units from the free end of

the chain. Sera glucosidase which hydrolyzes cellobiose to glucose [40].

Now, the application of hydrolysis enzymes in the ingredients feed has been done a lot. This thing is proven by a number of studies that hydrolysis by enzyme activity amylase, cellulase, protease, and lipase on coconut cake could lower Rough fiber by 67.8% [41], in water goiter Rough fiber decreased by 19.72% [42], on the dregs know capable of lowering fiber Rough by 22.03% [43], on flour leaf moringa capable of lowering fiber Rough up to 4.33% [36]. Besides lowering coarse fiber, hydrolysis can also increase Crude protein content in soya bean flour cake [44].

4. INFLUENCE HYDROLYSIS ENZYME INGREDIENT FEED ALTERNATIVE AS FISH FEED

Feed is the main factor that can influence fish growth. In addition to the nutrients contained in feed, feed consumption and feed conversion ratio also have an effect on fish growth [45]. The more high consumption of feed will increase the possibility of a lot amount consumed by fish. Ratio conversion feed show amount feed needed to produce fish weight [46].

The nutrients needed by fish include nutrients that can produce energy in the form of proteins, fats and carbohydrates which are needed in relatively large amounts and nutrients that do not produce energy in the form of vitamins and minerals which are needed in relatively small amounts [47]. Fish feed must have good nutritional content, namely protein ranging from 20-60%, fat ranging from 4-18%, carbohydrates ranging from 20-30%, crude fiber ranging from less than 8%, and vitamins and minerals ranging from 2-5% [47]. Materials for making fish feed can be sourced from animals such as fish oil, fish bones, chicken feathers, as well as from vegetable sources such as corn, coconut soybeans, peanuts, forages, and so on.

A number of researchers have tested the influence of hydrolysis enzyme ingredient alternative for fish feed on growth without giving negative impact to a number of fish [36,48,44,49,50] However, in research using water hyacinth goiter, it does not take effect on tilapia growth. That thing is suspected of having microbes present in the material that has been hydrolyzed not yet grown optimally, so that the enzymes produced to hydrolyze the ingredients do not go well [42].

Table 1. Influence of hydrolysis enzyme ingredient feed alternative as fish feed

Fish species	Enzyme type	Alternative ingredients	Daily growth rate (%)	References
<i>Clarias</i> sp.	Proteases, lipases and amylase	Moringa Leaves	2.81	[36]
<i>Oreochromis niloticus</i>	protease	Feather Meal	4.31	[48]
<i>Ictalurus punctatus</i>	Protease, phytase	Soybean	2.73	[44]
<i>Chanos chanos Forsskal</i>	Protease, amylase, lipase, and cellulase	Rice bran	Increase 11.34 (g) growth	[49]
<i>Sparus aurata</i>	protease	Feather Meal	2.34	[50]
<i>Osphronemus gouramy</i>	Cellulase	Indigofera zollingeriana	3.10	[51]
<i>Cheilinus undulatus</i>	Papain	Trash fish	3.29	[52]

5. CONCLUSION

The high crude fiber in alternative materials, which is around 11-28%, is an obstacle in its use for fish feed, so it is necessary to increase feed ingredients, one of which is through enzyme hydrolysis. Protease, lipase, amylase, cellulase and phytase enzymes can improve the quality of alternative ingredients for fish feed. The application of enzyme hydrolysis to moringa leaf meal, feather meal, soybean meal, and refined bran has been shown to increase the growth of tilapia, catfish, milkfish, and snapper.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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