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ALTERNATIVE FEED INGREDIENTS FOR AQUACULTURE

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ABSTRACT

Availability of feed with appropriate amount and nutrient content are importantfor determining size of population, growth, and reproduction of fish. The nutritional contents needed by fish are protein, carbohydrates, fats, vitamins and minerals. However, the rapid development of aquaculture causes increasing demand of quality feed. In addition, another challenge in aquaculture is the high cost of feed ingredients. Therefore, alternative feed ingredients that are cheap and have good nutritional content need to be developed. This review aims to explain the various alternative feeds for aquaculture such as banana peels, palm kernel meal, soybean, and spirulina.These alternative feed ingredients contain adequate nutrition such as protein, carbohydrates, fats, vitamins, and minerals.

Keyword : Feed, banana, palm meal, soybean, spirulina

Introduction

Aquaculture is the fastest growing food production sector in the world. It is estimated that production projections will double in the next 15-20 years. Analysis shows that before 2030, aquaculture will take over capture fisheries as the main source of fish providers (Phillips etal., 2015).

The success of aquaculture is influenced by the availability of quality and nutritious fish feed. Feed costs are also a major factor influencing the success of aquaculture businessbecause food costs constitute 60-70% of the costs of fishery production. The expensive and increasingly limited stock of feed are challenge in the aquaculture business.

Khairuman (2003) said that good feeds must have high nutritional value, be easily digested, relatively inexpensive and do not contain toxins. The type of feed is also adjusted to the fish mouth opening, the smaller the fish mouth opening, the smaller the feed size is given. In addition, feeding also needs to pay attention to the age of the fish. Nutritional requirements for each type of fish are different, protein around 30-55% (Subandiyono and Hastuti, 2016), fat around 7.5-12% (DinasPerikananKabupatenBuleleng, 2018), and carbohydrates ranging from 10-40 % (DirektoratPengembanganSekolahMenengahKejuruanKemendikbud, 2013). Therefore, good alternative fish feed ingredients need to be developed to reduce feed costs and overcome the problem of feed limitations. Alternative feed ingredients include banana peels (Agustono etal., 2011), palm kernel meal (Amri, 2007), soybean (Yanti,2019), andsprulina (Nazhiroh et al., 2019).

Banana Peels

Banana-based food industryproduces a lot of banana peels waste. Banana peels are usually just thrown away and not utilized optimally. Banana peels waste can be used as an alternative to fish feed ingredients because it still contains nutrients and cheap. Nutritional contents in banana peels are carbohydrates 11.27%, protein 1.71%, fat 3.28%, and vitamin C 0.30% (Susanto, 2016).

Several studies on the use of banana peel waste as alternative feed ingredients have been carried out. Jeharu et.al (2015) conducted a study aimed to determine the effect of feeding with banana peels to growth and feed efficiency for tilapia fish. The results of the study showed that feeding containing 20% of banana peels gave the highest absolute growth value of 2.93.Pratamaningrum (2013) conducted a research about fermented banana peel as alternative feed for tilapia juvenile (*Oreochromis niloticus*). The result showed that 20% banana peels as feed for tilapia gave the highest growth 8,06%, feeding eficiency ranged from 10,31% - 13,65%.

Other research on banana peels as alternative feed was also carried out by Utari (2019). Utari (2019) used banana peel waste and chicken feather flour silage as feed ingredients for sangkuriang catfish (*Clariasgariepinus*). The results showed that giving 75% banana peel flour and 25% chicken feather silage gave absolute daily growth rate 142.85%, absolute length increase11.86 ± 0.15, absolute weight growth 12.99 ± 0.15, utilization efficiency of 2.2% of feed, relative growth of 333.3% and feed conversion (FCR) 1.73.

Palm Kernel Meal

The palm oil industry produces palm kernel meal that has not been used optimally. Palm karnelmeal still has nutritional content including protein of 15.43% (Amri, 2007), fat ranging from 17.1% -21.55% (Hadadi et al., 2007), carbohydrate 14.32%, calcium 0.08%, phosphor 0.004%, and energy 102.02 cal/100 g (Utomo et al., 1999). With this nutrient content, Palm karnel meal can be used as an alternative to fish food.

Farida et.al (2016) conducted a study aimed to determine the use of palm karnel meal in artificial gouramy feed. The study was conducted for 60 days to determine the rate of weight growth and the rate of long daily growth. The results showed that the provision of artificial feed containing 18% palm kernel meal gave a better fish body weight than controls. The average specific growth rate of gouramy weight which given 18% palm kernel meal is 1.502% and the long daily growth rate is 4.06%.

The quality of feed is not only determined by the nutrient content but also determined by the palatability of the feed. Pamungkas (2013) has conducted a research about the effect of commercial feed mixed with palm kernel meal (PKM) that was hydrolyzed by sheep rumen liquor enzyme to palatability of feed. Pamungkas (2013) measured total feed

consumption and growth responses of seed catfish (*Pangasius hypopthalmusSauvage*). The result showed that 40% palm kernel meal that has been hydrolized by sheep rumen liquor enzyme can be used as feed for seed catfish (*Pangasius hypophthalmusSauvage*).

The Ministry of Maritime Affairs and Fisheries (KKP) through the Directorate General of Aquaculture and the Food and Agriculture Organization (FAO) collaborates to make feed containing palm kernel meal for catfish. The composition of the developed feed consisted of fish silage (7.5%), shrimp head (10%), salted fish (34%), polish (22.5%), oil palm cake (21.6%), starch/sago (4%), premix (0.25%), multi-enzyme (0.1%) and phytase (0.05%). The protein content of artificial feed is 28%. Catfish that are harvested at the age of 6 months can reach> 600 gr/head whereas with ordinary feed it only reaches 400-500 gr/head (KKP, 2019).

Soybean Meal

Soybean meal has a high protein content so that it can be used as alternative feed ingredients for fish. Soybean meal also has several other advantages such as the good composition of amino acids, widely available, good quality of oil content, and low prices. Novriadi (2018) reports that crude protein content in commercial soybean is 43.67%, in alcohol extracted soybean meal is 64.93%, in soybean meal with enzyme treatment is 62.55%, and in fermented soybean meal is 52.87%. Sunardiyanto (2014) also reported that a mixture of 80% soybean meal and 20% fermented soybean meal contained crude fiber 10.35%, crude protein 30.88%, and water content 10.93%.

Several studies on the use of soybean meal as an alternative to fish feed have been carried out. Yanti (2019) conducted a study aimed to determine the effect of soybean meal on the growth and survival of white snapper seeds (*Latescalcarifer*). The results showed that giving 40% soybean in fish feed gave better growth and survival results compared to control without adding soybean.

Pong-maneerat and Watanabe (1992) combined 25% of defatted soybean meal with 15% gluten meal for rainbow trout proved to be able to provide better growth compared to white fish meal control. Besides fish, soybean meal is also proven to be good for white shrimp growth. The provision of 42% sobean meal with 38% crude protein has also been proven to be more efficient for the growth and survival of white shrimp compared to commercial feed (Vaghei, 2016).

Sprulina

Spirulinais blue green algae, unicellular, spiral, and prokaryotic. It has chlorophyll so that it can make its own food. Besides containing chlorophyll, spirulina also contains phycocyanin so it is blue green. Spirulina can live in lakes, fresh water, sea water, soil and at optimal temperatures of 35-40°C (Christwardana and Hadiyanto, 2013; Campanella et al., 1999).

Spirulina is high in protein and has been used as a food supplement for humans and animals. Spirulina has been used as a complementary dietary ingredient of feed for fish, shrimp and poultry (Campanella et al., 1999). The Spirulina which widely used as human food suplement and animal feed is *Spirulina platensis*. The nutritional content of *Spirulina platensis* can be seen in Table 1.

Table 1. Nutrient Content of *Spirulina platensis* (Christwardana and Hadiyanto, 2013)

Parameter	**Content (%)**
Protein	50-62
Fat	4-6
Carbohydrate	17-25
Chlorophyll	0,8
Phycocyanin	0,7-11,7
Carotene	0,43

water	3-6

Widianingsih (2008) conducted a study to know the nutritional content of spirulina which culture in several media such as walne media and technical media. The results showed that in Walne media, protein content was 50.05 ± 0.53. Meanwhile, in technical media, the protein content was 16.23 ± 0.4. This research showed that medium culture influences the growth and nutrient content of spirulina.

Several studies have proven that Spirulina can be used as an alternative food for fish. Nazhiroh et al (2019) conducted a study to determine the effect of Spirulina platensis administration on artificial feed for growth and food efficiency in carp. The results showed that 60 g of sprirulina plus 1 kg of artificial feed showed the best growth and food efficiency for carp compared to controls. Provision that 60 g of sprirulina plus 1 kg of artificial feed gave an average total growth length of 2.19 cm, average weight growth of 1.51 g, and average feed efficiency of 30.26% (Nazhiroh et al., 2019).

Spirulina containing carotenoids can also influence the color of the goldfish (*Carassius auratus*). Carotenoids are color pigments forming in goldfish. Noviyanti et al (2015) reported that adding 1.2 grams of spirulina flour had a better effect on the intensity of the color of the goldfish chefs (*Carassius auratus*) compared to controls (Noviyanti et al., 2015).

Conclusion

Banana peels, palm kernel meal, soybean meal and spirulina have nutrient content which effective for growth of some kind of fish. Because of that, these ingredient can be used as alternative fish feed.

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