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Physical Characteristics Content Evaluation of Feed Containing Termite as a Potential Alternative for Fish Feed

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Termite flour is very promising as a raw material for snakehead feed to substitute fish meals. The good raw material and composition will produce quality artificial feed with a high level of water stability, preferred and safe for fish. The purpose of this study was to evaluate the quality of snakehead feed at various levels of substitution of fish meal with termites based on physical tests. The treatments given were the subtitution 0, 9, 6, 12% of fish meal with termite flour. The feed physical test results include water stability, homogeneity level, bouyancy, attractability, and storability. The results showed that the substitution of fish meal with termite flour was able to maintain water stability for more than 24 hours, the level of feed homogeneity was quite uniform in all treatments, the pungent aroma of feed preferred by snakehead was proven by the results of the

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feed allureness test which showed that the feed was eaten by snakehead in less than 5 seconds. The test results showed that the level of substitution of fish meal with termite flour with different levels resulted in feed with relatively the same quality in all treatments.

Keywords: Termite; fish feed; physical characteristics.

1. INTRODUCTION

More than 1200 fish species live in Indonesia's inland waters of about 54 million hectares. The surrounding community utilizes fish resources as a food table (food security) and a source of income for economically valuable fish species such as Snakehead (*Channa striata*). The need for fish tends to increase as the human population increases as a result the number of fish populations decreases. Snakehead is an important commodity in South Kalimantan which is closely related to the culture of the local community. Culturally, Snakehead is the main commodity for regional specialties, namely Ketupat Kandangan. Snakehead is a contributor to high inflation due to very high demand while natural and cultivated products are still limited. Snakehead is a freshwater fish that is easier to find in Asia-Africa and is considered a source of high-quality protein and traditional medicine for diseases. Snakehead is not only a healthy food to eat and enjoy, but is often used as a medicine for various diseases [1]. From a food source perspective, they play the role of functional foods, providing health benefits beyond basic nutritional requirements.

Aquaculture relies heavily on a consistent supply of fish meal (FM), which is a key component in commercial fish feeds. The further development of aquaculture is hampered by the increasing costs of aquaculture feeds, including meat meal, FM and soybean meal, which account for 60-70% of the total cost of aquaculture production. Therefore, in order to have sustainable aquaculture, it is very important for fish cultivators and researchers to utilize alternative protein sources which are cheaper and not commonly used by humans. A more suitable alternative is insect meal as a nutritional component, which is more similar to FM. Although, since 1969, insects have been evaluated and used as potential food components in feeds formulated for animals [2], their incorporation into aqua feeds did not receive much attention until the 2000s [3]. Over the last 20 years, research has been conducted to determine the effect of substitution of FM with insects on the growth and health of aquaculture species [4].

Recently an increasing number of feed trials have been performed using insects to partially replace FM in aquaculture species. Generally, most experiments show promising results for partially replacing FM with insects, although it depends on fish species and insect type [5,6]. Insects dominate the world's population, especially in the tropics [7]. Insects are rich in protein, easy to obtain and have a surplus during the rainy season. Maggot flour is a source of animal protein produced from waste, it has been reported to be highly nutritious with crude protein ranging between 43.9 and 62.4%, lipids 12.5 and 21%, and fiber 5.8 and 8.2% [8]. Apart from maggot, termite is very rich in protein, and much consumed by humans and other animals.

There is very interesting information in the Asam Village area of Sungai Raya District, Hulu Sungai Selatan Regency, South Kalimantan, cultivators have a habit of using termites as food for Haruan Snakehead Fish. The utilization of termites as a source of protein for the Haruan Snakehead fish is a local wisdom of the local community which has not been explained and is known for its usefulness and value as a raw material for feed scientifically. The addition of a combination of maggot and termites as feed ingredients in the feed formulation itself has not been carried out. This study aims to examine the physical test of fish feed using different compositions of termite flour.

2. MATERIALS AND METHODS

2.1 Tool and Materials

The tools and materials used in this study can be seen in Table 1 and Table 2.

2.2 Experimental design

This research is experimental by making termite flour which is then followed by making pellets (the process for making feed can be seen

in (Fig. 1). The treatments given are follows, namely:

A: Substitution of fish meal with a percentage of 0% termite flour.
B: Substitution of fish meal with a percentage of 6% termite flour.
C: Substitution of fish meal with a percentage of 9% termite flour.
D: Substitution of fish meal with a percentage of 12% termite flour.

2.3 Research Procedure

Fish feed is made from several constituent ingredients which contain proteins, fats, carbohydrates, vitamins, and minerals. Feed production starts with weighing the raw materials according to the composition of the raw materials making up the feed. Furthermore, these ingredients are mixed until homogeneous, starting with mixing the ingredients with the lowest percentage to the highest percentage.

a. The process of making termite flour

The process of drying the termites is carried out by drying them for 2 days under the sun and in the oven at 50 ^{o}C until the feed ingredients are completely dry.

b. Termination process

The process of refining the termites is done by grinding using a grinder then filtering and sifting until you get fine flour.

c. Preparation of feed raw materials

The preparation stage for making test feed begins with preparing feed raw materials. Feed raw materials consisting of fish meal, termite flour and maggot as a source of animal protein, soy flour as a source of vegetable protein, bran flour as a source of carbohydrates, fish oil as a source of fat, sago flour as an adhesive, mineral mix as a mineral source, and vitamin c as a source of vitamins. All raw materials are made in the form of fine flour using a grinder.

d. Feed processing

The ingredients used are maggot flour, termite flour, soybean flour, bran flour, tapioca flour, corn oil, fish oil, mineral mix, vitamin C, probiotics (composition of ingredients in Table 3). Then the pellets are dried using an oven at 50^{o}C until the feed ingredients are completely dry.

Table 1. Tools and function

No	Tool	Function
1.	Basin	Container for mixing ingredients
2.	Grinder	Grinding feed ingredients
3.	Blender	Smooth the feed ingredients
4.	Sieve	Sieve out the coarse ingredients
5.	Meat grinder	Scoring feed
6.	Oven	Drying termites
7.	Scales	Weigh the feed
8.	Tray	Place materials
9.	Plastic	Wrapping material
10.	Rubber	Binding wrapping material

Table 2. Materials and function

No	Material	Function
1.	Fish meal	Feed raw materials
2.	Termite flour	Feed raw materials
3.	Maggot flour	Feed raw materials
4.	Soybean four	Feed raw materials
5.	Bran flour	Feed raw materials
6.	Tapioca flour	Feed raw materials
7.	Corn oil	Feed raw materials
8.	Fish oil	Feed raw materials
9.	Mineral Mix	Feed raw materials
10.	Vitamin C	Feed raw materials

Table 3. Composition of the experimental diets

Ingredient	(% Per Kg)			
	Diet A	Diet B	Diet C	Diet D
Fish meal	52	44	30	25
Termite flour	0	6	9	12
Maggot flour	28	30	41	43
Soybean four	15	15	15	15
Bran flour	2	2	2	2
Tapioca flour	1	1	1	1
Corn oil	0.5	0.5	0.5	0.5
Fish oil	0.5	0.5	0.5	0.5
Mineral Mix	1	1	1	1
Vitamin C	1	1	1	1
Probiotic	0.5	0.5	0.5	0.5
Total	100.00	100.00	100.00	100.00

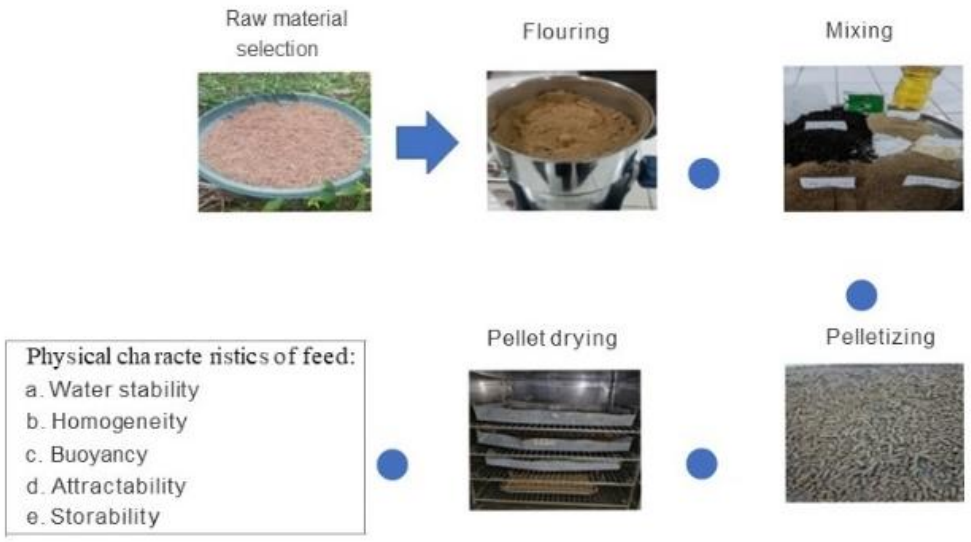

Fig. 1. Fish feed processing steps

2.4 Physical Test Parameters

Physical test parameters observed according to Saade et al. [9] include water stability, homogeneity, buoyancy, attractability, and storability.

a. Water stability

Water stability measures how long it takes for the feed to disintegrate in the water. The rupture test was observed visually. 10 sticks of feed are put into a beaker filled with 1L of water, observations are made every 5 minutes to find out whether the feed is soft or not. Observations continued until the feed was broken/destroyed.

b. Homogeneity

The feed homogeneity level test aims to determine the uniformity level of the particle size of the feed ingredients. As much as 5 g of feed was crushed until broken and then sieved using a 0.5 to 0.63 mm sieve. The degree of homogeneity is calculated in the proportion of feed that is under 0.5 mm.

c. Buoyancy

The buoyancy test is carried out by measuring the length of time it takes for the feed to move from the surface of the water to the bottom of the rearing medium. Feed as many as 5 sticks put into a beaker with a height of 20 cm from the

surface of the water. The stopwatch is executed exactly when the feed is dropped onto the water surface. Sinking speed is the distance divided by the feed time until it reaches the bottom of the measuring cup.

d. Attractability

Allure is measured by calculating the total time needed by the fish to approach or eat (start) the test feed. The stopwatch is run when the feed is in the rearing medium at a distance of 50 cm from the fish.

e. Storability

Storability is determined by calculating how long feed can be placed at room temperature. The formulated feed is then put into the container and the changes are observed descriptively. Good feed is feed that has a distinctive odor, is brown in color, has a soft texture, and is not moldy [10].

2.5 Data Analysis

The resulting data are water stability, homogeneity, buoyancy, attractability, and storability are presented in the form of tables with descriptive methods.

3. RESULTS AND DISCUSSION

The results of feed physical tests including water stability, homogeneity, bouyancy, attractability and storability can be seen in Table 4.

In the manufacture of feed (pellets) there are several physical properties that must be known to obtain the desired physical properties of fish pellets, they must have protein content and pellet size according to the type and age of the fish. Physical properties are basic properties possessed by a material that can be used as one of the criteria for determining the quality and efficiency of the production process [11].

It is important to know the physical properties of feed because it is related to the processing, handling, storage and design of tools that can assist the feed production process, assist the agricultural product processing industry and play a role in applying advanced processing technology so that it can be used optimally as fish feed. Physical properties that need to be considered in feed ingredients include specific gravity, pile density, pile compaction density and pile angle, because these properties are closely related to the handling and processing of feed ingredients [12].

Making termite flour is done manually, by drying it in the sun and then grinding it until smooth and then filtering it. In the manufacture of fish feed, it turns out that it does not only require the right formulation of raw materials, both in terms of the type of raw material and the composition of the nutrients, what is no less important is the quality of the fish feed after it is spread into the water. Many feeds have been successfully made with nutritional quality that meets the requirements, but sink quickly, break down easily and decompose in the water, even though not all of them are eaten by fish. As a result, the feed given becomes ineffective and inefficient. The physical form of fish feed is strongly influenced by the type of material used, the size of the printer, the amount of water, the pressure, the method after processing, and the use of adhesives to produce fish feed with a strong, compact and sturdy structure so it is not easily broken [13].

The results of water stability testing on various test feeds show that the test feeds have the ability to survive above 24 hours. Artificial feed with low water stability causes the feed to be easily crushed and dispersed so that it cannot be eaten by fish [14]. Feed breaking speed in water is a major consideration in fish feed formulations. Artificial feed with a low breaking speed causes the feed to be easily crushed and dispersed so that it cannot be eaten by fish. In general, the test feed already has a better level of stability compared to Edison et al. [15] using seaweed flour (*Gracilaria gigas*) as an adhesive, yielded stability for 55 minutes. Thus the feed has very high stability compared to the general requirements of fish feed. High water stability (not easily destroyed) allows pellets to last longer in water so that when eaten, no nutritional content is lost due to the destruction of the pellets [16]. The factors that affect the water stability of feed are feed raw materials, particle fineness, binder, processing of raw materials [17].

In general, the water stability of feed in water ranged from 3 to 5 hours [18]. Several factors affect the stability of feed in water, such as the fineness of the feed raw materials and the process of mixing the ingredients in the feed manufacturing process, the finer the feed ingredients the better the feed produced [19]. The feed ingredients are evenly mixed to

Table 4. The value of the physical test of feed treatment

Treatment	Diet A	Diet B	Diet C	Diet D
Water stability (hour)	>24 jam	>24 jam	>24 jam	>24 jam
Homogeneity (g)	4,20	4,36	4,28	4,21
Buoyancy (cm/s)	2,23	6,60	6,25	1,50
Attractability (s)	< 5	< 5	< 5	< 5
Storability (month)	±2.5 Bulan	±2.5 Bulan	±2.5 Bulan	±2.5 Bulan

Sourch: Primary data, 2023

produce a product that is more compact and stable in water. In order to obtain homogeneous raw materials in the feed, the mixing stage must be carried out as well as possible [20]. Good fish feed has a compact texture and a fine and uniform particle size of raw materials [21]. In simple terms mixing can be done by hand, while in large quantities it can use a mixing tool that uses electrical energy.

The attracftability of the feed by snakehead to the test feed was relatively fast in all treatments. The feed given is directly approached and eaten in less than 5 seconds. It is because the test feed contains ingredients that give a strong delicious power. Termite flour and maggot which are used as raw materials for the test feed are able to create a sharp aroma of feed that is liked by fish. Determination of the allure of the test feed is intended to determine the level of interest of fish.

The storability in each treatment has a different length of time, the storability life of artificial feed is around 2.5 months, so it can be concluded that the substitution of fish meal with termite and maggot flour for fish meal can increase the shelf life longer.

4. CONCLUSION

Based on physical tests on the test feed, it showed that the feed broke for more than 24 hours, it means the stability of the feed in water was long enough, the level of feed homogeneity in all treatments was quite homogeneous, the bouyancy of the feed in all treatments were classified as sinking feed, the allure of feed by fish and the feed's pretty good storability.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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