UNIVERSITI TEKNOLOGI MARA
Cawangan Perak
Kampus Tapah

FACULTY OF APPLIED SCIENCES

SCIENTIFIC PROJECT COLLOQUIUM

2024

Final Year Project Colloquium 2024
Faculty of Applied Sciences,
Universiti Teknologi MARA,
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35400 Tapah Road, Perak, Malaysia.

Colloquium date 12 July 2024
Publication date 30 October 2024

Proceedings of Extended Abstracts

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e-I.S.B.N: 978-629-97630-4-8

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Preface

The Scientific Project Colloquium offers a platform for publishing Diploma Science final year projects (FYP). The objective is to effectively distribute research findings throughout all scientific disciplines. The primary objective of including final year projects into the course curriculum is to encourage students to put their theoretical knowledge into practical applications.

We would like to express our gratitude to our primary establishment, the Faculty of Applied Sciences and Universiti Teknologi MARA, Perak Branch, for their invaluable assistance.

Lastly, we would like to express our gratitude to all of the authors for the tremendous help in preparing the articles, without which this undertaking would not have been completed.

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October 2024

PHYSICAL PROPERTIES OF FISH PELLET FROM BANANA PEEL WASTE SUPPLEMENTED WITH *TRICHANTHERA GIGANTEA* LEAVES

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Abstract: As a rapidly expanding industry, aquaculture faces challenges securing environmentally friendly and cost-effective feed sources. In pursuing sustainable alternatives for aquafeed production, this research delves into the physical properties of fish pellets formulated using banana peel waste supplemented with *Trichanthera gigantea* leaves. Four different formulations of fish pellets were prepared by adding different ratios of *Trichanthera gigantea* leaves and banana peel waste into a mixture of mealworms, tapioca, palm oil, and water. The physical properties of the formulated fish pellet were evaluated: size, swelling, floating, and leaching. Results show that the best fish feed formulation is F2 (Formulation 2) because it obtains ideal swelling and floating ability properties. This formulation has more starch and suitable oil content to float. It is ideal for covering the pellet in a hydrophobic barrier that decreases the ability to take water from the surroundings. The F2 (Formulation 2) also indicates that the formulation is highly stable and can resist quick degradation. Further study can be conducted on the chemical properties of this fish pellet to prepare this formulation for future commercialization.

Keywords: *fish pellet, Trichanthera gigantea, banana peel*

INTRODUCTION

Recently, attention was brought to using banana peels as a viable alternative in fish pellet formulations, showcasing its potential for fostering sustainable aquaculture practices. According to Khairuman (2003), effective fish feeds should possess high nutritional value, easy digestibility, cost-effectiveness, and toxins-free. The feed selection is also contingent upon the size of the fish's mouth; smaller fish mouth openings necessitate smaller feed sizes. Furthermore, the age of the fish is a crucial factor in feeding considerations. Each fish type has distinct nutritional requirements, with protein ranging from 30-55% (Subandiyono and Hastuti, 2016), fat from 7.5-12% (Dinas Perikanan Kabupaten Buleleng, 2018), and carbohydrates between 10-40% (Direktorat Pengembangan Sekolah Menengah Kejuruan Kemendikbud, 2013). Consequently, developing alternative fish feed ingredients becomes essential to mitigate feed costs and address feed limitations. Some examples of alternative feed ingredients include banana peels (Agustono et al., 2011), palm kernel meal (Amri, 2007), soybean (Yanti, 2019), and spirulina (Nazhiroh et al., 2019).

Banana peel, a by-product often discarded, has gained attention for its nutritional composition, including carbohydrates, dietary fiber, vitamins, and minerals. The peels of bananas and plantains contained 8–11% protein. Significant amounts of leucine, valine, phenylalanine, and threonine were necessary amino acids. The limiting amino acid was lysine. Lipids ranged in concentration from 2.2% to 10.9% and were mainly composed of polyunsaturated fatty acids, especially linoleic and α-linolenic acid. The most essential mineral element was potassium. Plantain peels had a higher starch content than banana peels. Fruits that had reached maturity had higher levels of soluble sugar and lower levels of starch. The increase in the soluble sugar may be explained by the body's enzymes breaking down the starch (Happi Emaga, T et al., 2007). Processing involves drying, grinding, and incorporating it into feed formulations, contributing to improved nutritional profiles and sustainability. Additional research exploring banana peels as an alternative feed was conducted by Utari (2019). This study employed banana peel waste and silage made from chicken feathers as feed ingredients for sangkuriang catfish (*Clarias gariepinus*). The outcomes indicated that providing a mixture of 75% banana peel flour and 25% chicken feather silage resulted in an impressive absolute daily growth rate of 142.85%, an absolute length increase of 11.86 ± 0.15, absolute weight growth of 12.99 ± 0.15, feed utilization efficiency of 2.2%, a remarkable relative growth of 333.3%, and a feed conversion ratio (FCR) of 1.73.

Trichanthera gigantea (*T. gigantea*), known as ketum ayam, is a fast-growing shrub native to tropical regions. It is valued for its high protein content and essential amino acid profile. Harvested leaves and stems can be processed into tilapia feed pellets, offering a sustainable source of essential nutrients (Abdel-Fattah M El-Sayed, 1999). T.gigantea, sometimes called Nacedero, is prized for its adaptability in Colombia's Andean foothills. It has proven adaptable in various tropical environments, and effective introductions have been noted in the Philippines, Vietnam, and Cambodia. In Malaysia, the *T. gigantea* can be found in northern areas such as Perak state. *T. gigantea* is a compact shrub that belongs to the Acanthaceae family. It usually reaches a height of 5 meters, but it can grow as high as 12 to 15 meters. With quadrangular branches, rounded nodes, and minutely hairy tips, it has a well-branched structure. The rectangular to oblong-shaped leaves are oppositely borne on petioles that are 1 to 5 centimeters long, which adds to the tree's unique look (Heuze V., 2017). The usefulness of *T. gigantea* goes beyond its environmental adaptation. Pigs, rabbits, and ruminants may obtain good food from its leaves. According to Rosales (1997), the tree is used in fodder bank systems, where live fences offer shade and nourishment. *T. gigantea* is found across central and northern South America, from humid regions and moist woods to the slopes of the Andes. It has been successfully introduced to Southeast Asian nations in addition to its original area in Colombia. The tree is cultivated from sea level to a height of 2000 meters, demonstrating its resilience to various soils, including infertile and acidic ones, with a pH as low as 4.5. *T. gigantea* is resistant to frost, yet it has a significant drawback. The tree does well in areas with shade; it performs best in settings with leucaena or banana shadow. Its ecological value in preserving water channels and adaptability has led to extensive planting near springs, riverbanks, and wells, earning it the moniker "madre de agua."

Thus, this study evaluates the physical properties of fish feed pellets formulated from banana peel waste supplemented with *T. gigantea* leaves, which vary based on formulation and processing methods. Adjusting pellet properties like size, shape, density, and texture during the pelletization process by controlling moisture, temperature, and pressure influences the acceptability and digestibility of fish feed.

METHODOLOGY

The fish pellets were prepared with the main ingredients of *T. gigantea* leaves and banana waste, using the four different ratios of main ingredients formulation, before being tested for their physical properties. The physical properties of the prepared fish pellet were evaluated, including size, swelling test, floating ability, and leaching.

Preparation of the fish pellets

The fish pellet was prepared by mixing all of the ingredients that had been prepared before. In this study, the main ingredients, *T. gigantea* and banana waste, were mixed in a ratio of 0:5, 5:0, 5:5, and 10:10 grams, respectively. Thirty-two grams of the mealworms, the main protein source in making fish pellets, were added. All ingredients were weighed according to the formulation and mixed until a doughy texture was obtained. The dough is then shaped into fish pellets before it is dried in the oven at 80°C for 24 hours. After the fish pellets dried, they were kept in an airtight container to ensure preservation for the subsequent test.

Table 1 Formulation of fish pellet from banana peel waste supplemented with *T. gigantea* leaves

Formulation	**Banana waste (g)**	***Trichanthera gigantea* leaves (g)**	**Mealworms (g)**	**Palm oil (mL)**	**Water (mL)**	**Tapioca starch (g)**
1	0	5	32	12	23	30
2	5	0	32	12	23	30
3	5	5	32	12	23	25
4	10	10	32	12	23	15

Evaluation of physical properties of the prepared fish pellet

(a) Pellet Size

The test involving the measurement of fish pellet size determines the average diameter of the fish pellets (Khater et al., 2014). This measurement is crucial for assessing the uniformity in pellet sizes, which can impact aquatic organisms' feeding efficiency and nutritional intake. In measuring the pellet's size, the fish pellet's diameter was assessed using a vernier caliper.

(b) Swelling

3.0 grams of fish pellets were weighed and immersed in 100 ml water for 30 minutes. After this immersion period, the fish pellet underwent filtration to separate excess water, and the resulting precipitate was then weighed. The percentage of swelling for each pellet was calculated based on the formula:

$$\text{swelling}\,(\%) = (FM - IM) / IM \times 100$$

Where, FM = Final mass, IM = Initial mass

(c) Floating Ability

Five fish pellets were put into 100 ml water in a 250 ml beaker. The time taken for all the fish pellets to sink was noted (Fauzana et al., 2022).

(d) Leaching

3.0 grams of fish pellet was immersed in 250 ml water for 30 minutes. After this duration, the fish pellet was filtered to obtain the filtrate. The filtrate sample was analyzed using a spectrophotometer at 200 to 700 nm wavelength range, and absorbance peaks were obtained.

FINDINGS

In tilapia farming, the best feeding and growth rates depend on the suitable meal sizes and application. Table 2 shows the physical properties of the formulated fish pellet. For the sizes, the pellet ranges from 4.00 mm to 5.00 mm. Pellets between 2.38 mm and 3.18 mm are the preferred feed for tilapia weighing over 40 grams. A feed size of roughly 20-30% of the fish's mouth size is recommended for efficient consumption. Inadequate feeding may cause the fish to exert more energy in search of food, while larger particles may lead to obstructions and even suffocation. Thus, this fish pellet is suitable for adults and larger-sized tilapia fishes.

Table 2 Physical properties of the formulated fish pellet

Formulation	Size (mm)	Swelling (%)	Floating ability (min)	Leaching (abs)
1	4.67± 0.06	47.69 ± 5.12	0.45± 0.11	0.34
2	4.00± 0.00	59.10± 5.49	1.82 ±0.46	0.14
3	5.00 ± 0.00	54.12± 13.46	0.23± 0.16	0.15
4	5.00± 0.10	74.91± 10.26	5.45± 0.51	0.15

For swelling properties, formulation 1 (highest tapioca starch content, 30%) shows the lowest percentage of swelling, which is the most recommended formulation pellet because when the fish pellet has a high swelling percentage, soluble vitamins and minerals will be easily leached out, resulting in environmental issues and nutrient deficiencies in fish tanks or ponds (Saalah et al., 2010). One of the factors that differs in the swelling of all formulations of fish pellets is the starch content. Adding tapioca starch can decrease the swelling of fish pellets (Saalah et al., 2010). In other words, the higher the starch content, the lower the swelling percentage.

For floating properties, formulation 4, which contains 10% of banana peels, 15% of starch, 12% of oil, and 10% of *T. gigantea* leaves, shows the highest floating ability with around 5.45± 0.51 minutes (Table 2). For a good fish pellet, the floating average time of the fish pellets needs to be maximized (Saalah et al., 2010). The first factor that helps the floating of the fish pellets is the temperature when the fish pellets are dried. The higher the drying temperature, the longer the floating time of the fish pellets (A.E. Adedeji et al., 2020). As the temperature increases, the moisture will decrease (A.E. Adedeji et al., 2020). This leads to the second factor that influences the fish pellets' floating time, which is the fish pellets' moisture content. The lower the moisture content of the fish pellets, the longer the average time it takes for the fish pellets to stay afloat (A.E. Adedeji et al., 2020).

Providing fish with the proper nutrition is crucial for their health and growth. However, when fish feed pellets disintegrate quickly in water, they can release vital nutrients into the environment, leading to nutrient leaching. A comprehensive leaching test determined which pellet formulation produces the least color suspension. This test involved subjecting four different formulations to water for a specific period and measuring the color suspension produced. Based on the test results analysis, it has been determined that formulation 2 is the most effective among all the formulations tested. The key reason for its superiority is the deficient level of leaching observed with an absorbance reading of just 0.14. The data indicates that the formulation is highly stable and can resist quick degradation. Leaching property is a critical factor as it helps to prevent the loss of precious nutrients into the environment, thereby ensuring that the formulation retains its efficacy over an extended period. Formulation 2 contains high starch, which significantly aids in the stability of this pellet formulation. As stated by Catargiu (2015), the gelatinization process causes the starch granules to expand, leaving a narrow space between pellet particles, thereby preventing the protein from leaching out of the pellets.

CONCLUSIONS

Overall, it can be concluded that the best formulation of fish feed is F2 because it has more starch and suitable oil content to float and is ideal for covering the pellet in a hydrophobic barrier that decreases the ability to take in water from the surroundings. Further study can be conducted on the chemical properties of this fish pellet to prepare this formulation for future commercialization.

COMPLIANCE OF ETHICAL STANDARDS

Not applicable.

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Saya yang menjalankan amanah,

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