

## RESPONSE OF EELS (*Monopterus* sp) TO VARIOUS TYPE OF FEED

### Respon Belut (*Monopterus* sp.) Terhadap Variasi Jenis Pakan

Zaenal Abidin\*, Salnida Yuniarti Lumbessy, Dewi Putri Lestari, Sahrul Alim, Thoy Batun  
Citra Rahmadani

Aquaculture Study Program, University of Mataram

Pendidikan Street, Mataram City, Indonesia

\*Corresponding Author: [zaenalabidin@unram.ac.id](mailto:zaenalabidin@unram.ac.id)

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#### ABSTRACT

Eel seeds for aquaculture are primarily sourced from the wild. These seeds respond poorly to feed during the initial rearing phase. Therefore, this study aimed to provide feed that eels can consume in the early stages of culture. This study used an experimental method by testing the level of eel acceptance for natural feed, namely worms (*Lumbricus* sp.), golden snails (*Pomacea* sp.), chicken intestines, and maggots (black soldier flies), which will then be used as attractants mixed with pellet flour. Based on the order of feed selection and the time duration of eel response to the feed, eels preferred earthworms and snails as feed compared to maggots and chicken intestines. However, the four tested feed types can be consumed by eels. Mixing earthworms with pellet meal in the form of paste feed was responded well by eels. Eels consumed more ( $p < 0.05$ ) pellet meal mixed with earthworms than feed that did not have earthworms added to it. The incorporation of earthworms as an attractant in paste feed, as much as 50%, produced the same eel growth ( $P > 0.05$ ) as eels given 100% worms. It indicated that a combination of artificial feed and earthworms could facilitate the consumption of artificial feed by eels in the initial phases of culture.

**Keywords :** earthworm, chicken intestine, golden snail, maggot, paste, eel

#### ABSTRAK

Benih belut kebanyakan diambil dari alam. Belut hasil tangkapan yang digunakan sebagai benih sangat lambat untuk merespon pemberian pakan pada saat awal penebaran. Oleh karena itu penelitian ini bertujuan untuk menyediakan pakan yang dapat dikonsumsi oleh belut dimasa awal pemeliharaan. Penelitian ini menggunakan metode experimental dengan menguji tingkat penerimaan belut terhadap pakan alami yaitu cacing (*Lumbricus* sp.), keong mas (*Pomacea* sp.), usus ayam, dan maggot (*black soldier fly*) yang selanjutnya akan digunakan sebagai atraktan yang dicampur pada tepung pellet. Berdasarkan urutan pemilihan pakan dan lama waktu belut merespon pakan, maka cacing dan keong lebih dipilih oleh belut sebagai pakan dibandingkan dengan maggot dan usus. Meskipun demikian keempat jenis pakan yang dicobakan dapat dikonsumsi oleh belut. Pencampuran cacing pada tepung pellet dalam bentuk pakan pasta direspon dengan baik oleh belut. Belut akan lebih banyak ( $p < 0,05$ ) mengkonsumsi tepung pellet yang dicampur dengan cacing dibandingkan dengan pakan tanpa penambahan cacing. Pencampuran cacing sebagai atraktan dalam pakan pasta sebanyak 50% menghasilkan

pertumbuhan belut yang sama ( $P>0,05$ ) dengan belut yang diberikan cacing 100%. Hal ini menunjukkan pakan buatan yang dicampur dengan cacing dapat digunakan untuk menginisiasi pengambilan pakan buatan oleh belut selama masa awal pemeliharaan.

**Kata Kunci :** Belut, Cacing, Keong, Maggot, Pasta, Usus

## INTRODUCTION

Eel (*Monopterus* sp) is a popular freshwater fish consumed by the people of West Nusa Tenggara (NTB). Even one of the traditional Lombok cuisine menus uses eel as its main side dish, nasi lindung. However, until now, the supply of eel in NTB, especially in Mataram, is still minimal compared to other types of freshwater fish, especially when compared to tilapia and catfish. That is why eel is not always available in the market in Mataram. Even eel production is not recorded in the NTB fisheries statistics. The eel in Mataram is mainly obtained from wild capture or imported from the islands of Java and Kalimantan.

A significant challenge in advancing intensive eel production is the lack of specialized feed for eels. In contrast to tilapia, catfish, and carp, the feed for eel is not commercially available; thus, farmers depend on the natural food in ponds or utilize supplementary feed such as worms, snails, and other waste, which are lacking if required for intensive eel farming practices. Prior research indicates that eels fed natural feed (earthworms) exhibited superior growth and feed intake than those fed commercial feed (Mashuri *et al.*, 2018). Consequently, technology for feeding initiation is essential for eels to ingest commercial feed.

According Oliva-Teles *et al.* (2015) the feed's low palatability contributes to its failure to provide optimal growth. Feed that contains a high proportion of plant-based ingredients has a lower palatability than feed that contains fish meal (Daniel, 2018). Nevertheless, incorporating attractants into plant-based feed can enhance fish growth and feed consumption (Fang *et al.*, 2022; Jiang *et al.*, 2019).

There are a variety of attractants, one of which can be derived from the natural fish diet. Eels can consume snails, larvae, worms, and intestines (Idris *et al.*, 2022; Kordi, 2024; Yuan *et al.*, 2024). Consequently, it is crucial to determine the level of eels' preference for the four categories of natural feed to identify a suitable candidate to use as an attractant in artificial feed by combining it with artificial feed. Fish will consume more food that is palatable to them and provide them with the energy necessary for growth.

The objective of this investigation is to ascertain the following: 1) the eel preference for a variety of natural feeds; 2) The response of eels to the addition of artificial feed to natural feed; and 3) The growth rate of eels that are provided with artificial feed.

## RESEARCH METHODS

The study was carried out utilizing an experimental method. The research was divided into three stages: monitoring several eels' responses to various types of natural feed, mixing selected natural feed with artificial feed, and measuring eel growth. The natural feeds studied included earthworms (*Lumbricus* sp), golden snails (*Pomacea* sp), chicken intestines, and maggots (black soldier fly).

### Materials

The eel pond consists of two tarpaulin units measuring 2 x 1 x 0.5 m; scales (0.1 g) for weighing eels and feed; infrared cameras for monitoring eel behavior; eel (*Monopterus* sp.) as animals tested weighing 10±2.0 g; and natural feed including earthworms (*Lumbricus* sp.), maggots (black soldier fly), chicken intestines, golden snails (*Pomacea* sp.), and pellet meal.

### **Media and Eel Preparation**

The cultivation media was made by mixing the rice field mud with banana stems and then fermenting for 1 month. The mud media was then put into two tarpaulin ponds. The height of the mud was 30 cm, and the water was 5 cm above the mud surface. In the middle of the pond, a mound was provided as a place to put feed.

The eels used were eels (10±2.0 g) caught from the wild and were then adapted in ponds with mud media for 2 weeks. The total number of eels in the pond was 25 per pond. During the adaptation process, the water was replaced every 3 days and fed using earthworms. Feeding was once a day at 18.00 (before sunset). Worms were placed on a mound of mud, and every day, the eel's activity in taking worms was observed. The adaptation process would have been successful if the eel had actively taken the worms.

### **Feeding Test of Natural Feed Acceptance**

The worms were cut or killed to avoid the worm's movement and could not be observed by the camera. The shells of snails were removed and cut into small pieces. The intestines and maggots were cut into a short size, approximately 1 cm. The four types of feed were then placed on a mound of still-watery mud. Feeding was carried out at 18.00.

The feed was given or replaced with a new feed every 60 minutes, and the position of the feed was randomized at every feeding time. Feeding was carried out until 22.00, so there were 2 repetitions of feeding every night. The order of feed eaten, namely first, second, third, and fourth, was recorded for later analysis. Feeding was carried out for 7 days, so the total repetition was 14 times.

The length of time needed by the eels to take feed was grouped into three groups, namely <15 minutes, 15-30 minutes, and >30 minutes. Each group was given a score, namely <15 minutes score 3, 15-30 minutes score 2, and >30 minutes score 1. The scores were used for further statistical analysis. The four types of feed were placed at the bottom of the pond randomly. Observations were carried out for 7 days so that 14 repetitions were obtained.

### **Feed Consumption Rate**

The type of natural feed, namely worms that have a high level of selection, was then used in the second stage of the study. Earthworms were pulverized, and artificial feed in the form of pellets was also ground into a fine powder. Earthworms and pellet meal were mixed and added with 10% binder (a mixture of CMC and water in a ratio of 1:1) until a paste-like feed was obtained. The percentage comparison between worms and pellet meal was :

Feed A = 100% pellet meal

Feed B = 75% pellet meal + 25% worms

Feed C = 50% pellet meal + 50% worms

Feed D = 25% pellet meal + 75% worms

The four types of feed were placed on the mound at 18:00 and 20:00. The feed was molded lengthwise (approximately 1 cm). The amount of feed eaten was then recorded as the amount consumed. Feed testing was carried out for 7 days, so 14 repetitions were obtained.

### **Growth Trial**

The eels were fasted for 24 hours before selection. Healthy eels with a size of 10±2 g were selected and placed in two tarpaulin ponds of 2 x 1 m, with a mud media height of 30 cm and a water height of 5 cm. Each pond was filled with 25 eels.

The eels were kept for 30 days and fed once a day. The amount of feed given was 13.7 g or 5% of the total body weight. Each pond was fed according to the treatment, namely fresh

worm and paste feed made from a mixture of 50% pellet meal and 50% earthworms. The parameters measured were the eels' weight gain.

### Data Analysis

Data on eel response to various types of feed and feed consumption levels were analyzed using the Kruskal Wallis nonparametric test at a 5% confidence level, while the growth test was carried out using the F test. Data were analyzed using SPSS 25 software.

## RESULT

Based on the order of feed selection by eels, our research findings underscore the importance of understanding their feeding preferences. Worms were more often chosen as the first feed, followed by snails, maggots, and intestines. Snails were also widely chosen in the first and second choices, although worms still seem to be preferred by eels. Maggots and chicken intestines can be eaten by eels even though they were chosen when snails and worms were no longer available (Figure 1).

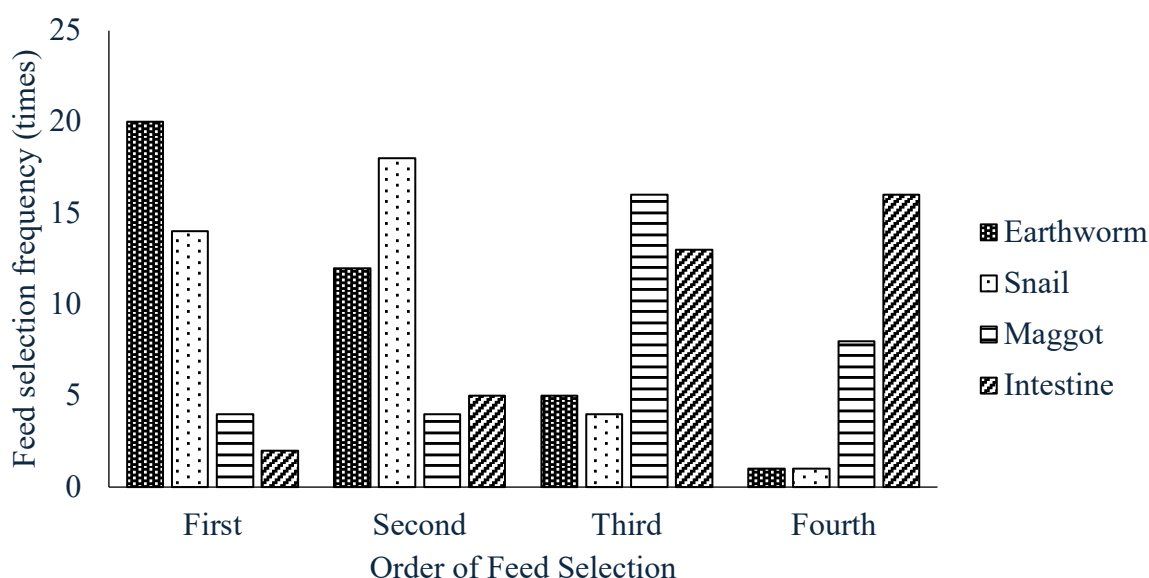


Figure 1. Order Feed Preference of Eels

Figure 2 illustrates the duration of the eel's response to the feed. The Kruskal-Wallis test indicates that the duration of the eel's response to feed was significantly influenced ( $P < 0.05$ ) by the type of feed. All four feed types were consumable by eels; however, the Mann-Whitney test indicates that eels exhibited a more rapid response to worms and snails ( $P < 0.05$ ) in comparison to maggots and chicken intestines.

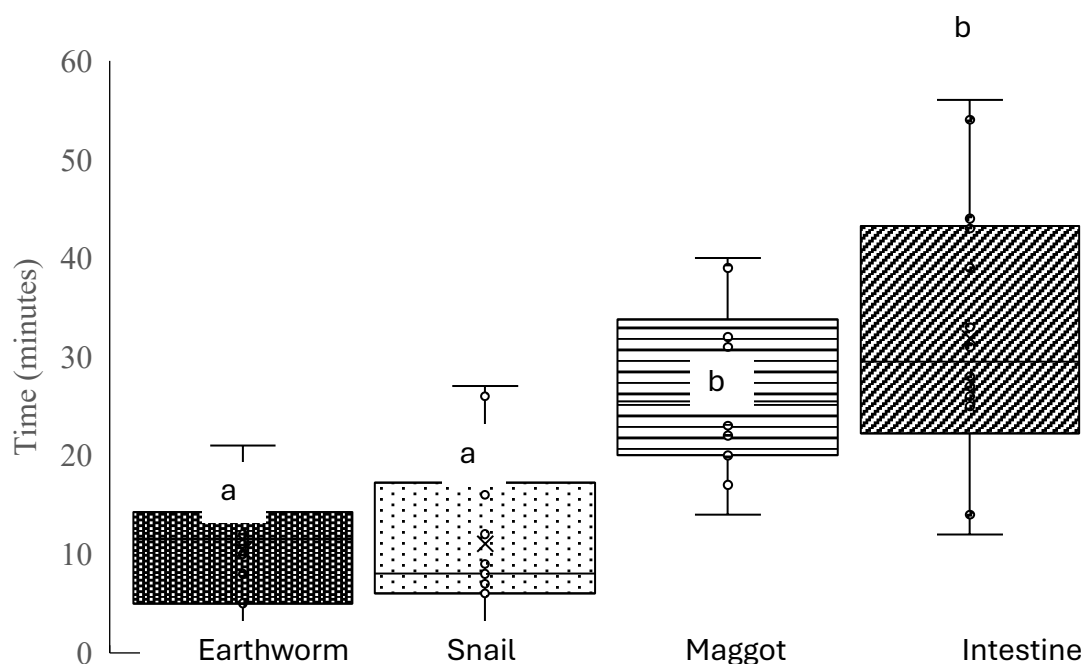


Figure 2. The Length of Time for Eels to Respond The Feed. Different Superscript Letters on Each Bar Indicate A Significant Difference ( $p < 0.05$ ).

Due to the eels' strong response to earthworms, then earthworms was selected as attractants and then combined them with feed meal. Figure 3 illustrates the frequency of feed consumption by eels on a paste feed with varying concentrations of earthworms.

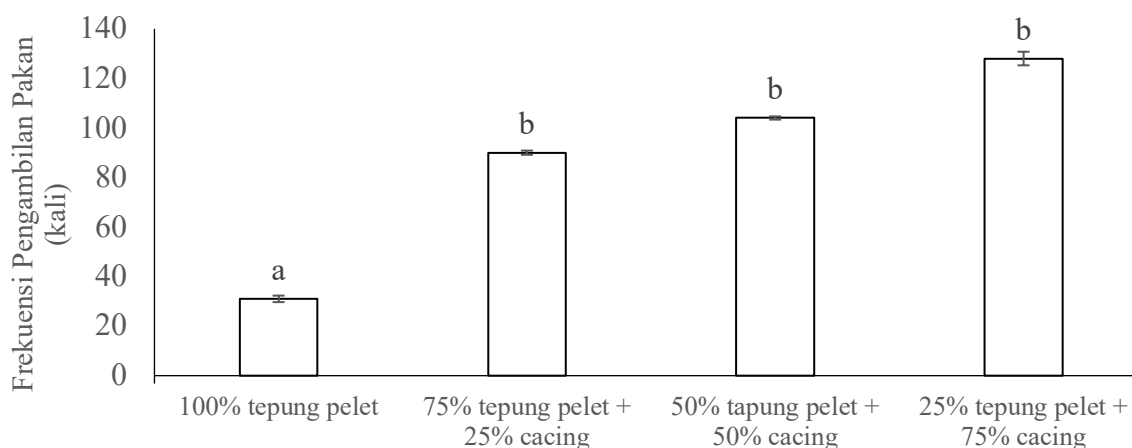


Figure 3. Frequency of Feed Taking by Eels. Different Superscript Letters on Each Bar Indicate A Significant Difference ( $p < 0.05$ ).

Kruskall Wallis test showed that the incorporation of earthworms with feed meal affected ( $p < 0.05$ ) the level of feed intake of eels. Based on the Mann-Whitney test, it was found that the level of feed intake or consumption of eels was lower in feed without earthworms ( $P < 0.05$ ) than in feed mixed with earthworms. However, incorporating earthworms in any concentration results in the same consumption level ( $P < 0.05$ ).

Figure 4 illustrates the outcomes of the eel weight gain experiment conducted over a 30-day period.

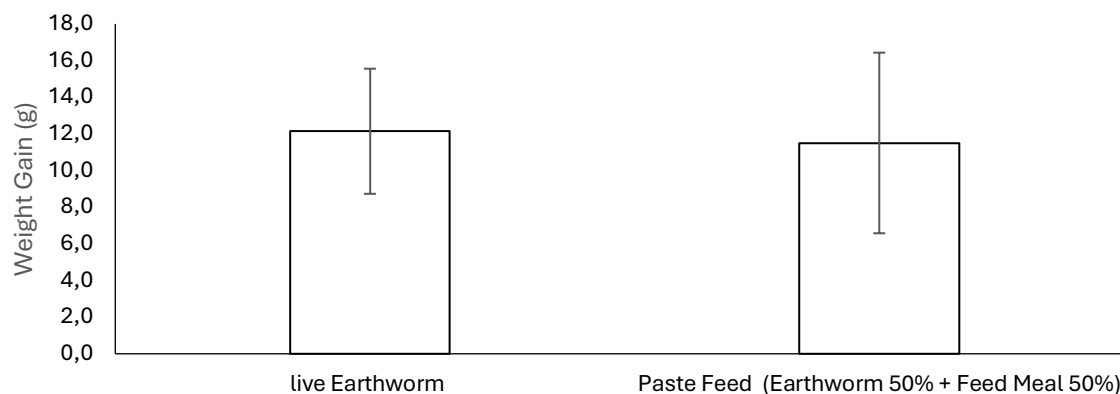


Figure 4. Weight Gain of Eel

The T-test of the weight gain of eels kept for 30 days showed no difference ( $P > 0.05$ ) between the weight gain of eels-fed live earthworms and those fed paste. The result showed that eels caught in the wild could be fed artificial feed by paste mixed with 50% earthworms.

## DISCUSSION

Seed availability is a challenge for grow-out eel farming. The majority of the seeds are caught in the wild. Unfortunately, seeds caught in the wild are tough to consume during the initial rearing period (Yuan et al., 2024). Therefore, to initiate eels' consumption of feed during the adaptation process, it is necessary to provide the feed that is most preferred by eels.

Measuring the frequency of the fish when choosing a particular diet can be used to determine the level of food preference. Earthworms and snails are foods more preferred by eels than maggots and chicken intestines. It can be seen from the high selection of earthworms and snails as eels' first and second choice of feed. The high level of selection of worms and snails as the first and second choice is because worms and snails are natural foods for eels (Herawati et al., 2017; Mashuri et al., 2018; Yuan et al., 2024), while intestines and maggots are foods that are not naturally available to eels. However, maggots are omnivorous fish, so eels can still eat maggots and chicken intestines.

In addition, eels not only select worms and snails to eat more frequently but also react to the feed faster. Worms and snails have a function as good attractants in fish feed that can increase feed consumption levels (Amalia et al., 2019; Astino et al., 2021; Ismi & Khalil, 2014). Fish may search for food more quickly when attractants are present because they can send the right signals to eels, allowing them to identify their food swiftly (Khasani, 2013), and finally accelerating fish growth (Di et al., 2022).

Among the four natural feeds, earthworms and snails have the same attraction to eels. However, earthworms were chosen as attractants because worms produce better growth performance than snails for eels (Herawati et al., 2017). Attractants can be used by mixing them directly into the feed (Hadi et al., 2024). Mixing feed with worms allows eel seeds to receive artificial feed immediately during the initiation period at the start of cultivation.

Mixing artificial feed with earthworms as an attractant has improved eel acceptance of the artificial feed. Giving pellet meals in the form of paste without a mixture of worms as an attractant results in a very low feed intake rate. In contrast, if the pellet flour is mixed with earthworms at a 25 - 75% concentration, it generates a feed that eels respond to quite well. Other research has found that using worms as an attractant can boost the feed consumption of pangasius (Amalia et al., 2019), *Mystus nemurus* (Astino et al., 2021), dan eels (Yuan et al., 2024).



In addition to eels, several other aquatic animals thoroughly enjoy eating worms. Earthworm flour has excellent potential to replace fish meal as a source of protein in feed (Mohammed *et al.*, 2022). Earthworms also have the potential to be cultured on a mass scale (Lowe *et al.*, 2023) and can be enriched with nutrients (Mashur *et al.*, 2021). and can be enriched with nutrients (Hill & Watson, 2007).

Although worms have many advantages as feed, the use of worms as eel feed is not economical in eel cultivation because the price of worms is high and their availability is limited, while if the artificial feed is used, the growth of the eels will be low (Khan *et al.*, 2021; Mashuri *et al.*, 2018). Therefore, using worms as feed must be reduced through substitution with artificial feed. The growth test in this study showed that the growth of the eels fed earthworms and those fed pellet meal mixed with earthworms was the same. It demonstrates that the utilization of earthworms can be lowered without compromising eel growth.

### CONCLUSION

Earthworms and snails are the most preferred natural feed types for eels. Mixing pellet flour and worms can increase eels' acceptance of artificial feed. Artificial feed mixed with earthworms produces the same eel growth as eels that only consume earthworms. Therefore, using 100% earthworms as feed during the initiation period of feeding for seeds caught from nature can be replaced with artificial feed mixed with 50% earthworms.

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