Effect of Alternative Food Combinations on the Development of Silkworms (*Tubifex* sp.)

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ABSTRACT

Silkworm (*Tubifex sp.*) is one of the natural feeds that has high nutritional value and is used for fish farming. This study aims to determine the effect of the use of different types of feed on the growth of silkworms. The method used in this study is experimental with a complete random design (CRM) consisting of three treatments and one for control, test materials: tofu pulp, chicken manure, sawnut vegetable waste, plantain peel, rice field mud, Em4 and combined according to the research plan. The observed parameters include absolute biomass of the population and individual increase of the population. The results of the study showed that the treatment of each A: 1733 ind/m^2 with 34.67 g/m^2, B: 2067 ind/m^2 with 41.33 g/m^2 ,C: 3400 ind/m^2 with 68.67 g/m^2 and Control (K): 1567 ind/m^2 with 31.33 g/m^2, counting from the statistical data of the ANOVA Table shows that the Fcout is larger than the Ftable 0.05 and 0.01, which means that the difference is very noticeable with the follow-up test of Smallest Real Difference Test, Treatment C is larger, treatment B, A, K (control) treatment B is larger, treatment A and K (control) while treatment A and K (control) are not significantly different. This means that the type of feed used in treatment C has a significant influence on the increase in population biomass and the increase in the number of silkworm populations compared to others. These results can be further tested with different materials or different containers.

Keywords: *Tubifex* sp, feed, development, absolute biomass

Received: January 7, 2025 **Revised:** March 11, 2025 **Accepted:** May 21, 2025

INTRODUCTION

The country of Timor-Leste as a developed country that has a National Aquaculture Development Strategy (2012-2030). This strategy targets to increase the production of farmed fish to reach 12,000 tons per year by 2030, which leads to an increase in annual fish consumption to 15 kg per person (Pant, J., at al 2024). In fish feed, protein is the largest nutrient and is considered the most expensive source for the quality of health and optimal growth of fish (Naeem *et al.*, 2024).

Fish feed is divided into 2 groups, namely staple feed with high nutrient content which is usually natural feed and additional feed that relies on manufactured feed added with vitamins to meet the needs of fish (Andriani *et al.*, 2020). *Tubifex* sp. alternative feed as fish feed is better than artificial feed because of its high protein content and fresh, cheap and young and available and not polluted by the environment (Khotimah *et al.*, 2023). Silkworm (*Tubifex* sp.) is a natural feed that is widely used as fish feed. The nutritional content of silkworms consisting of protein reached 57%, fat 13.3%, crude fiber 2.04%, ash content 3.6% and water 87.7% (Febrianti *et al.*, 2020).

According to (Yazid *et al.*, 2022) that silkworms can grow well in media that has a high organic content. Silkworms have been widely cultivated in various media, including the use of

chicken manure, tofu pulp (Wulandari *et al.*, 2020) quail droppings, afkir milk powder, tapioca flour (Rachmawati Rusydi *et al.*, 2021) pig manure, chicken manure, cow manure, and fine mud and the media contain organic matter that can be used as a food supply to support the growth of silkworms (Wenda *et al.*, 2018). The value of the nutritional content contained in cultivated silkworms is greatly influenced by the living medium during rearing (Santoso *et al.*, 2022). So it is necessary to cultivate with the addition of nutrients as food to maintain its constant availability. Research (Mi'raizki *et al.*, 2015) stated that the C-organic element in silkworm rearing media plays a role as an energy source. The population growth and absolute biomass of *Tubifex* sp. is influenced by the presence of C-organic elements. The same thing was also conveyed by (Hayati *et al.*, 2021).

Research results from (Zalukhu *et al.*, 2023) Using 20% mud, 30% chicken manure, 20% tofu pulp and 30% kepok banana peel, got absolute biomass with 108.03 g. Based on the results of previous research (Masrurotun *et al.*, 2014) A combination of 50% chicken manure, 35% rucah fish silage and 15% tapioca flour, got 79.42 g/0.065 m^2, with a population density of 29,808.67 ind/0.065 m^2 And the development of the tubifex population is also related to the low protein diet, the high protein produced by the Kuran is good. Related to EM4 biotechnology as fermentation of *Tubifex* sp. living media (Wenda *et al.*, 2018).

This study aims to evaluate the influence of different types of feed on the development of *Tubifex sp.* As well as determining the most optimal type of feed in increasing the biomass and reproductive rate of *Tubifex* sp. silkworms. With this research, it is hoped that effective and economical solutions can be found to increase production *Tubifex sp.* on a cultivation scale, so that it can support aquaculture cultivation in a sustainable manner.

METHODS

This research was carried out from June 10 to August 10 at the Tilapia Cultivation Laboratory, Oriental University of East Timor (UNITAL). This place is a special construction for *Tubifex* sp. permanen cultivation with a water recirculation pond.

The tools used in this study are paralon containers, water pumps, water supply paralon pipes, selans, digital scales, thermometers, pH meters, Panggaris DO meters, cameras. Meanwhile, the material of this study uses silkworms (*Tubifex* sp.) as the research object with the test materials being local chicken manure, tofu pulp (Wulandari *et al.*, 2020)., vegetable waste,(Hamka *et al.*, 2022) rice field mud, plantain peel, EM4 and fresh water (Zalukhu *et al.*, 2023).

The treatment design used in the study was the Complete Random Design (RAL) with 3 treatments and 1 control, each treatment and control were repeated 3 times. The treatment consisted of treatment A :(Tofu Pulp + Mustard Sapyur Waste + Rice Field Mud + Em4), Treatment B :(chicken manure + banana skin + Rice Field Mud +Em4), treatment C :(Tofu Dregs + plantain peel + chicken manure + Rice field mud + Em4), and control (rice field mud).

The preparation of test materials such as chicken manure is dried in the sun in the sun before it is cool, tofu pulp is squeezed, sawih sausage waste is boiled in small potons, plantain peel is boiled in small small potons, rice field mud is dried from grassroot beetles, Em4 is used to decompose the test material because it is a bioactivator that contains fermentative microorganisms (Sari *et al.*, 2024), used in treatment and

control: For Control use as much as gram of rice field mud: In treatment A: plantain peel 100 g of palm vegetable waste 150 g EM4 100 ml of rice field mud 250 g, for treatment B: Tofu pulp 100 g, chicken manure 150 g Em4 100 ml of rice field mud 250 g. Treatment C: Tofu pulp 50 g of plantain peel, 50 g of vegetable waste, 50 g of free-range chicken manure, 150 g of rice field mud, 250 rams, Em4, 100 ml. Control and treatment of the test material is 5 cm soaked in test material with about 5 cm of water in a container 12 cm wide 1 m long 1 m deep 6 cm container there is water intake and discharge, soaking time of the test material for 5 days (Wenda *et al.*, 2018),before being removed from *Tubifex* sp. The soaking was removed with 12 g of *Tubifex* sp. in Individo 600, spread on the *Tubifex* sp. test container. in each treatment and control. *Tubifex* sp. was taken from nature, size 0.02 gra/ind measured at 8.9-11 cm/indi before the test was cleaned and acclimatized for 2 days. The water discharge in the test wahah is 500 ml/min with recirculation. Harvested after 60 days, the main parameters in this study are the number of population, and the biomass of the population.

Data Collection Techniques

Growth parameters were measured at the beginning and end of the study by observing the increase in population weight and counting the total population. Samples of population weight and total population individuals were taken 2 times, at the beginning of the study and at the end of the study with 12 g of 600 individo of tutifex sp. silkworm. The population weight of the tutifexx sp. silkworm can be measured using the formula of Effendie (1997) in (Safrina *et al.*, 2015).

W= Wt-Wo
Information:
W = Biomass Increase (g)
Wt = End-of-maintenance biomass (g)
Wo = Initial biomass of maintenance (g)

Water Quality Treatment

Silkworm maintenance is carried out by means of a recirculation system, which is water running 24 hours a day in a test container. During maintenance, checks are carried out on the water flow holes to ensure that the water flow is really running smoothly. The addition of water is only done in case of water shortage or evaporation. Water quality measurements of temperature, DO, and pH were carried out daily (Ngatung *et al.,* 2017).

Data analysis

The data obtained was then analyzed variously (ANOVA) with a 95% confidence interval. If there is one treatment that has a real effect on the population and biomass of the silkworm population, then it is followed by the Smallest Real Difference Test (SRD) (Gaspersz, 1995 in (Nurali *et al.*, 2020).

RESULT AND DISCUSSION

Increase in absolute biomass of *Tubifex* sp.

To find out the absolute biomass increase of *Tubifex* sp. which is the effect of different organic matter combined, such as from tofu pulp, sawaw vegetable waste, plantain peel, chicken manure rice field mud, EM4, can be seen in Table 1. From the results of Table 1, it shows that under treatment C using a combination, Tofu Pulp + plantain peel + chicken manure + Palm vegetable lamb, rice field mud + Em4 gets the Ultimate Population biomass up to 80.67 g/m^2 with a total concentration of 68.67 g/m^2 with treatment B, Using Tofu Pulp + chicken manure + rice field mud +Em4, reaching 53.33 g/m^2 got an increase of 41.33 and from the results of treatment A, the skin of the rice paddies + Saiyan

sausage waste + Rice field mud + Em4 got 46.67 g/m^2 with an increase of 34.67 g/m^2 the lowest was Control (K) using rice field mud producing 43.33 g/m^2 the amount of biomass increase 31.33 g/m^2 (Figure 1).

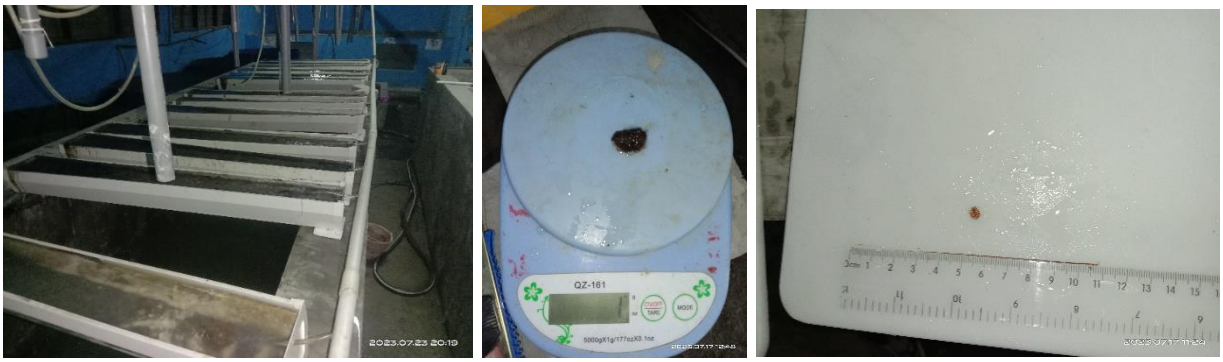

Figure 1. Test materials in research sites, weighing the growth of *Tubifex* sp., measuring the length of the tubules.

Table 1. Average absolute biomass increase of silkworms

Treatment	Average biomass of early silkworms (gr/m^2)	Average biomass of final silkworms (gr/m^2)	Amount of biomass increase of silkworms (gr/m^2)
A	12	46.67 ^{c}	34.67
B	12	53.33b	41.33
C	12	80.67a	68.67
K	12	43.33c	31.33

Description: The results of the increase in tubif biomass The BNT sequence test is very real.

Table 2. Average population increase of silkworms

Treatment	Average population of early silkworms (ind/m2)	Average population of late silkworms (ind/m^2)	Increase in the population of tubifex sp (ind/m^2
A	600	2333c	1733
B	600	2667b	2067
C	600	4000a	3400
K	600	2167c	1567

Description: The results of tubifex popupation increase, BNT test shows very real differences.

Table 3. Water quality parameters

Treatment	Water quality		
	Temperature (^{0}C)	Ph	DO
A	29.1	7.9	3.4 ppm
B	29.1	7.9	3.4 ppm
C	28.9	7.9	3.4 ppm
K (control)	29	7.9	3.4 ppm

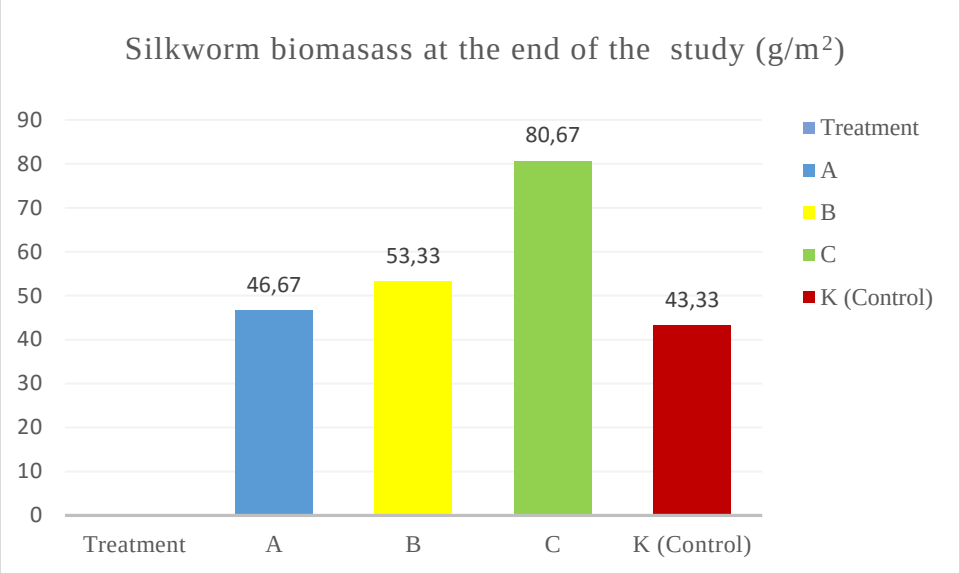

Figure 2. Absolute biomass increase.

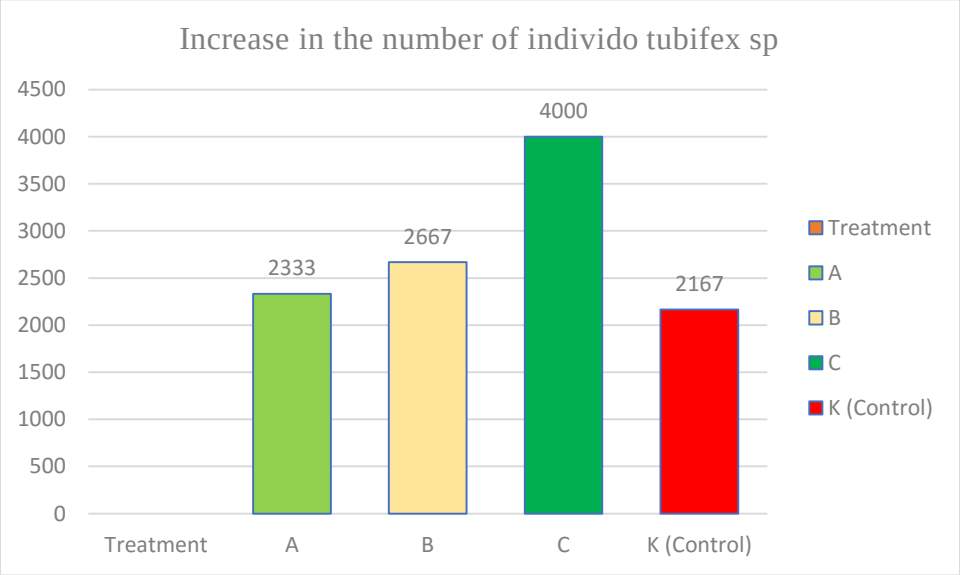

Figure 3. Increase in the number of individuals *Tubifex* sp.

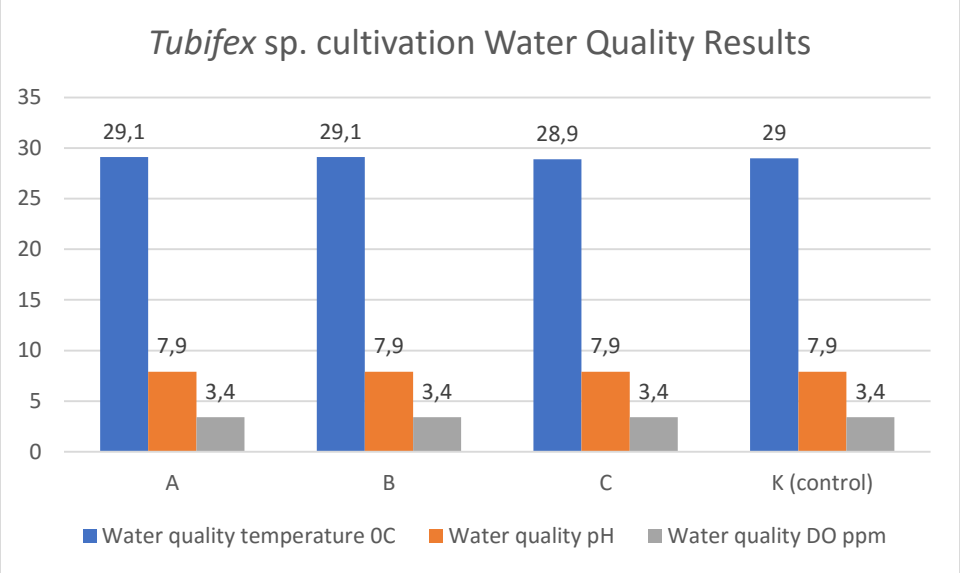

Figure 4. Water quality parameters.

From the results of Table 2, it shows that under treatment C using a combination, Tofu Pulp + plantain peel + chicken manure + sawnut vegetable waste, rice field sludge + Em4 gets the final population biomass up to 4000 ind/m^2 with an increase in the number of individuals of 3400 ind/m^2 followed by treatment B, Using tofu pulp + chicken manure + rice field mud +Em4, amounting to 2667 ind/m^2 with an increase in the number of individuals 2067 ind/m^2 From the results of treatment A plantain peel + Sayur sewage + Rice field mud + Em4 got 2333 ind/m^2 with the number of individual population additions of 1733 g/m^2. From Control (K) using rice field mud yielded 2167 ind/m^2 the number of individual population additions 1567 ind/m^2 (Figure 2).

Table 3 shows the water quality in *Tubifex* sp. from treatment temperature A :29 ^{0C}, pH 7.9 DO 3.4 ppm, B:29.10C pH 7.9, DO 3.4 ppm C: 28.9 ^{0C,} pH 7.9, DO 3.4 ppm, at K (control): temperature 29 ^{0}C, pH 7.9, DO 3.4 ppm. During the study, the temperature was in the range that was obtimum for *Tubifex* sp. cultivation even though the research was carried out homogeneously which was carried out in diindor with water recirculation (Figure 3).

Figure 1 shows the absolute biomass yield of the tubifex population which is the highest level of treatment C reaching 20 g/m^2 get a total of 17 g/m^2 by using (Tofu pulp, 50 g of plantain peel, 50 g of sawnut vegetable waste, 50 g of free-range chicken manure, 150 g of rice field mud, 250 g, Em4, 100ml) following treatment B reaches 53.33 g/m^2 got an additional amount of 43.33 g/m^2 using (100 g of tofu pulp, chicken manure 150 g of rice field mud 250 g, Em4 100 ml) from treatment A got 46.67 g/m^2 got an additional amount of 34.67 g/m^2 who used (plantain peel, 100 g, sawnut vegetable waste, 150 g, rice field mud, 250 g, Em4, 100 ml) compared to the control, there were 43.33 g/m^2 with a total population biomass increase of 31.33 g/m^2 using 500 g of rice field mud, from the results of Anova's statistics with BNT follow-up tests showed very real differences ** P>0.05, treatment C was higher than treatment B, A and K (Control) and treatment B was higher than treatment A and K (Control) while treatment A and K (Control) were not

significantly different, giving the bottom explanation as from the results (Batubara *et al.*, 2023) and (Nurfitriani *et al.*, 2014) Under the tofu pulp is fermented chicken manure, so that it is easier to be absorbed by silkworms so that it can increase the production of silkworm biomass. The fermentation process will simplify the particles of feed ingredients, so that it will increase its nutritional value and quality. This result is enriched with a lot of organic ingredients that can give silkworm growth better.

Figure 2 shows that the highest increase in the tubif population is the C treatment reaches 4000 ind/m^2 Got an additional amount of 3400 ind/m^2 by using (Tofu pulp, 50 g of king skin, 50 g of mustard vegetable waste, 50 g of free-range chicken manure, 100 g of rice field mud, 250 g, Em4, 100ml) follow treatment B to reach 2667 g/m^2 Got a total addition of 2067 g/m^2 by using (Tofu Pulp 100 g, chicken manure 150 g of rice field mud 200 g, Em4 100 ml) compared to treatment A got 2333 ind/m^2 Got a total addition of 1733 ind/m^2 who uses (plantain peel 100 g of mustard vegetable waste 150 g of rice field mud 250 g, Em4 100 ml) while Control reaches 2167 ind/m^2 with a population increase of 1567 ind/m^2 using 500 g of rice field mud, from the results of Anova's statistics with BNT follow-up tests showed a very real difference ** P>0.05, treatment C was greater than treatment B, A and K (Control) and treatment B was greater than treatment A and K (Control) while treatment A and K (Control) were not significantly different, as shown by the results of the study (Rachmawati Rusydi *et al.*, 2021) Showing the lower population of silkworms indicates that the peak population for each treatment occurs in the 3rd to 4th week during the maintenance period. Furthermore, the decline in the silkworm population occurred in the 5th week of the maintenance period. Suharyadi (2012) continued that the production of silkworms is easy from the hatching of silkworm eggs has begun to occur on days 10-12 of the maintenance period. This means that in the 3rd week, the population increase occurs due to the presence of young silkworms that hatch from eggs produced by silkworm mothers. The results of this study turned out to be a significant increase in population in 60 days., in a lot of organic materials.

The growth and development of *Tubifex* sp. populations is more dependent on cultivation media as it is crucial for the success of farmers. Water quality is very important for the medium consumed by *Tubifex* sp. as it affects its nutrition during maintenance. Figure 3 shows Water Quality The water quality of silkworm maintenance during the study shows the suitable environmental conditions for silkworm life, obtained in the temperature range of 28.9-29.1 ^{Oc}, pH 7.9, 3.4 ppm. According to (Sriwahyuni *et al.*, 2020) which states that the optimum temperature of the silkworm reaches 25 ^{Oc} and 30 ^{Oc} The optimal pH for silkworm cultivation is 6.0-10 (Wenda *et al.*, 2018) According to (Efendi 2013) in (Neko Ade Syahputra *et al.*, 2020) The dissolved oxygen content of 2.5-7 ppm can be the standard for the cultivation of *Tubifex* sp. It is assumed that during the research the water quality is very good for the cultivation of *Tubifex* sp.

CONCLUSION

Combination ingredients fermented in a test container for 5 days from tofu pulp 50 g plantain peel 50 g sawnut vegetable waste 50 g free-range chicken manure 150 g rice field mud 250 g Em4 100 ml is more effective for mining individual populations and biomass growth of tubifex populations

on C treatment and sufficient water quality is temperature 28-29, pH 7.9, DO 3.4.

Acknowledgment

The authors acknowledge UNITAL for supporting facilities during this study.

Author Contribution

All authors participated to all aspects of this work, including preparation, research, data collecting and analysis, manuscript drafting, and publication approval.

Competing Interest

None.

Ethical Approval

None.

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