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POTENTIAL USE OF DIFFERENT FERTILIZERS ON THE GROWTH OF *Brachionus* sp.

Potensi Penggunaan Pupuk yang Berbeda Terhadap Pertumbuhan *Brachionus* sp.

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ABSTRACT

Brachionus sp. is a zooplankton that is widely used by farmers as natural feed for fish larvae stages. In the process of cultivating Brachionus sp. it is necessary to fulfill the nutritional needs for its growth by providing fertilizer. The use of natural fertilizer as a culture medium for Brachionus sp. using fertilizers such as chicken manure, Urea, NPK, TSP, and POC. This study aims to determine the potential use of different fertilizers in the growth of Brachionus sp. The method used is a literature study. The results obtained from the potential use of different fertilizers in the culture of Brachionus sp. namely the concentration of 300 mg of chicken manure; 7.5 mg TSP; 6 mg Urea; 0.45 gr of Bread Yeast per 3 L of water enriched with 0.30 gr Extrajoss produced the highest population density of 5.01 ind/mL. In addition, the concentration of chicken manure fertilizer between broiler chickens and kampung chickens was 2 L of water; 4 mg urea; 3 mg TSP; 400 mg of broiler chicken manure produced the highest productivity of 89,639 ind/2 L.

Keywords: Brachionus sp., Fertilizer, Growth, Natural Feed, Water Quality

ABSTRAK

Brachionus sp. termasuk zooplankton yang banyak digunakan oleh pembudidaya sebagai pakan alami stadia larva ikan. Dalam proses kultur *Brachionus* sp. perlu dilakukan pemenuhan nutrisi untuk pertumbuhannya dengan cara memberikan pupuk. Penggunaan pupuk alami sebagai media kultur *Brachionus* sp. dengan menggunakan pupuk seperti pupuk kotoran ayam, Urea, NPK, TSP, dan POC. Penelitian ini bertujuan untuk mengetahui potensi penggunaan pupuk yang berbeda dalam pertumbuhan *Brachionus* sp. Metode yang digunakan yaitu dengan studi literatur. Hasil yang diperoleh dari potensi dari penggunaan pupuk yang berbeda dalam kultur *Brachionus* sp. yaitu konsentrasi pemberian 300 mg kotoran ayam; 7,5 mg TSP; 6 mg Urea; 0,45 gr Ragi Roti per 3 L air yang diperkaya dengan 0,30 gr Extrajoss menghasilkan kepadatan populasi tertinggi sebesar 5,01 ind/ml. Selain itu, konsentrasi pupuk kotoran ayam antara ayam broiler dan ayam kampung sebanyak 2 L air; 4 mg urea; 3 mg TSP; 400 mg kotoran ayam broiler menghasilkan produktivitas tertinggi sebesar 89.639 ind/2 L.

Kata Kunci: *Brachionus* sp., Pupuk, Pertumbuhan, Pakan Alami, Kualitas Air

INTRODUCTION

Success in fish farming activities is influenced by the availability of feed. This is related to the survival and growth of fish. The larval development phase is very susceptible to mortality because when the yolk sac runs out, the larvae begin to need food from outside. The type of fish feed used for the larval stage is natural feed.

Natural feed is feed that is available in nature, natural feed is divided into 2, namely phytoplankton and zooplankton (Sihombing et al., 2022). Natural feed has a content that is rich in carbohydrates, vitamins, proteins, minerals, amino acids, lipids, carotenoids, and fatty acids (Simhachalam et al., 2015). Natural feed has very good nutritional content and is used in cultivation efforts, namely *Brachionus* sp. (Redjeki, 1999).

Brachionus sp. is a zooplankton that is commonly used for natural feed in the larval stage. *Brachionus* sp. is small in size, swims slowly, is easy to digest, is nutritious, and can be mass cultivated with a relatively short culture time (12-19 days). *Brachionus* sp. has good nutritional content for larvae, including 77.7% protein, 15.7% fat, and 27.8% carbohydrates (Arak & Mokashe, 2015). In addition, the nutritional content of *Brachionus* sp. is 8-9% EPA and 12-13% DHA (Hamre, 2016).

Brachionus sp. can grow in media that has organic C content consisting of Nitrogen (N), Magnesium (Mg), Phosphorus (P), Sulfur (S) and Potassium (K) (Hamre, 2016). In the process of culturing *Brachionus* sp. it is necessary to fulfill the nutrition for its growth by providing fertilizer. In general, in the culture of *Brachionus* sp. using media such as chicken manure, Urea, NPK, TSP and POC.

Brachionus sp. has been widely used by cultivators as a natural feed that is sufficient to meet the growth and survival of fish larvae. So many studies related to the use of different fertilizers on the growth of *Brachionus* sp. This article aims to determine the potential use of different fertilizers in the growth of *Brachionus* sp.

METHODS

The method used is a systematic review related to the potential use of different fertilizers in the growth of *Brachionus* sp. which is relevant to the keywords fertilizer, *Brachionus* sp., and water quality parameters. Systematic review is a method of collecting data obtained based on research results related to the subject being studied, both published in the form of journals, proceedings, books, or other research reports (Setiawan & Kautsar, 2018). Data collection was carried out through internet searches from various online journal sites in the period 2014–2024 in indexed national and international journals such as: Research Gate, Google Scholar, Publish or Perish, and Elsevier.

RESULT AND DISCUSSION

Biology of *Brachionus* sp.

Brachionus sp. can be found in aquatic environments that have organic content in conditions that can change, so that *Brachionus* sp. has the ability to adapt to different environments (Rumengan et al., 2007). *Brachionus* sp. has a body size that varies between 50-300 µm (Djarijah, 1995). The body size of *Brachionus* sp. can be divided into 2 types, namely, the small S type ranging from 50-220 µm and the large L type ranging from 230-400 µm. In general, *Brachionus* sp. has a body size ranging from 80-120 µm, has the nature of a non-selective filter feeder or filters food non-selectively, moves slowly, is easy to digest, has complete nutritional content, and a relatively short culture time (Watanabe, 1988).

Brachionus sp. body parts are divided into 3, namely, head, trunk, and legs or tail. The head has 6 spines and the spines in the middle are a pair of long spines. On the head there are cilia that are shaped like a spiral called the corona. The function of the corona is to bring food into the mouth (Lavens & Sorgelos, 1996). The corona has a diameter ranging from 60-80 µm.

The digestive system in *Brachionus* sp. begins from the mouth which is close to the corona. *Brachionus* sp. has a thick cuticle layer that forms a special shape called lorika (Djarijah, 1995). Mastax is an organ shaped like a pharynx located in the mouth. *Brachionus* sp. has a short esophagus that functions as a connection between the mastax and the stomach. When swimming, *Brachionus* sp. takes food continuously (Isnansetyo & Kurniastuty, 1995). While the remaining food that cannot be processed will come out through the anus. On the tail and legs there are splits called fingers. Morphology of *Brachionus* sp. can be seen in Figure (1) as follows.

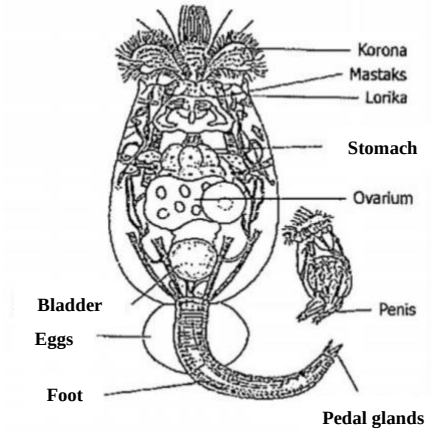

Figure 1. Morphology of *Brachionus* sp. (Koste, 1980)

Feeding Habits

Brachionus sp. is a non-selective filter feeder or filters food non-selectively, so *Brachionus* sp. can live in the media by eating microorganisms. *Brachionus* sp. has an omnivorous nature that consumes feed such as phytoplankton, detritus, periphyton, and absorbs organic particles in the water according to the size of the mouth opening.

In *Brachionus* sp. sufficient nutritional content is needed for growth. The nutritional content that can be obtained comes from plankton, bacteria, or suspended organic materials given in the culture media. The organic material obtained can be obtained from biological fertilizers, one example of biological fertilizer is chicken manure, because it contains nitrogen elements (Djarijah, 1995). In addition, the fertilizers used include urea, NPK, POC and TSP.

Growth Curve

Growth in *Brachionus* sp. has several phases, namely the adaptation phase, exponential phase, stationary phase, and death phase (Sari et al., 2019). The growth curve of *Brachionus* sp. can be seen in Figure (2). The adaptation phase or lag phase is the first phase before *Brachionus* sp. experiences growth (Widawati et al., 2022). In the adaptation phase, *Brachionus* sp. begins to adapt to the new environment and there has been no increase in population.

The exponential phase or logarithmic phase is the number of cells that increase with a rapid growth rate, this is because in this phase *Brachionus* sp. experiences cell division (Armanda, 2013). The growth rate of *Brachionus* sp. can increase under optimal culture conditions (Bold & Wayne, 1985). According to Selvika et al. (2016) the exponential phase has a high nutrient content in the culture medium, so that these nutrients are utilized by *Brachionus* sp. for its growth.

The stationary phase is the growth rate of *Brachionus* sp. begins to decrease gradually. In the stationary phase, reproduction of Brachionus sp. is balanced with death. According to Armanda (2013) this is due to a decrease in the growth rate of *Brachionus* sp. by diatoms that begin to die.

The death phase or called the declination phase is the last phase in the growth of *Brachionus* sp. The death phase is a decrease in the population of *Brachionus* sp., so that the growth rate is lower than the death rate. This is because the growth rate of *Brachionus* sp. experiences a decrease in the amount of nutrients and an increase in secondary metabolites that inhibit natural cell growth (Armanda, 2013).

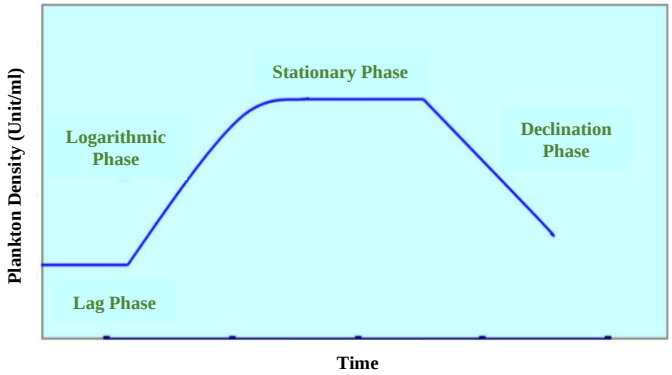

Figure 2. Plankton Growth Curve (Dziosa & Makowska, 2016)

Nutritional Content of *Brachionus* sp.

Brachionus sp. is a zooplankton that is commonly used as natural feed in the larval stage because it contains high nutrients. *Brachionus* sp. has a very good content such as protein, carbohydrates and amino acids. The nutritional content of *Brachionus* sp. is very suitable as natural feed for the larval stage, especially in the early stages of development. *Brachionus* sp. is included as meeting the requirements as the right food for fish larvae, including being easily digested, nutritious, suspended, and slow moving (Safrizal et al., 2013). In the cultivation of *Brachionus* sp. the use of fertilizers enriched with vitamins can function as an increase in data resistance and enrich the nutritional content of *Brachionus* sp. which is needed for the continuity of all processes in the body (Prayoga et al., 2017). The nutritional content of *Brachionus* sp. can be seen in Table (1) as follows.

Table 1. Nutritional Content of *Brachionus* sp.

Nutritional Content	**Percentage (%)**
Protein	77.7*
Fat	15.7*
Carbohydrate	27.8*
Eicosapentaenoic Acid (EPA)	8-9**
Docosahexaenoic Acid (DHA)	12-13**

Source: *(Arak, G. V, Mokashe, 2015)
**(Hamre, 2016)

Factors Affecting the Abundance of *Brachionus* sp.

a) Water Quality

Water quality plays an important role in the abundance of *Brachionus* sp. such as temperature, pH, salinity, and DO. *Brachionus* sp. can grow in optimal water media with optimal temperature, pH, salinity, and DO. If the water quality experiences poor conditions or fluctuations, it will inhibit the growth and survival of *Brachionus* sp.

b) Fertilizer

The availability of sufficient food in the culture medium greatly affects the abundance of *Brachionus* sp. According to Cahyaningsih (2006), the growth of *Brachionus* sp. is influenced by the availability of macronutrients and micronutrients in the culture medium. Good media and sufficient nutrients can support the growth of *Brachionus* sp. quickly, but growth can

decline rapidly if the conditions of the media and nutrients no longer support the survival of *Brachionus* sp. (Dahril, 1996).

c) Population Density

Population density that is too high can affect the abundance of *Brachionus* sp. This can occur competitive interactions between individuals that can affect the abundance of *Brachionus* sp. The high population in the culture medium can cause food competition between individuals, so that the abundance of *Brachionus* sp. has limitations due to lack of nutrients in the culture medium.

d) Light Intensity

Lighting is needed when culturing *Brachionus* sp. So far, culture has only been carried out using sunlight, so it is not uncommon for productivity to decrease due to lack of sunlight. To overcome this, TL lamps can be used as a substitute for sunlight. The appropriate light intensity for *Brachionus* sp. is 2000-5000 lux. The distance between the TL lamp and the maintenance medium is about 20 cm (Safrizal et al., 2013).

Types of Fertilizers

Fertilizers are organic materials that can meet nutritional needs for cultivation activities, so many cultivators use fertilizers as nutrients for the growth of natural feed. The types of fertilizers are divided into 2, namely organic and inorganic fertilizers. Organic fertilizer is the final result of the decomposition of animal or plant waste, one of which is manure such as chicken manure, cow manure, and goat manure. While inorganic fertilizer is the result of industrial fertilizer factories such as urea and TSP.

In *Brachionus* sp. sufficient nutritional content is needed for growth. The nutritional content that can be obtained comes from plankton, bacteria, or suspended organic materials given in the culture medium. *Brachionus* sp. can grow in media that have C-organic content such as N, P, K, S, and Mg (Hamre, 2016). The organic material obtained can be obtained from biological fertilizers. In general, in the culture of *Brachionus* sp. using media such as chicken manure, Urea, NPK, TSP and POC.

Abundance of *Brachionus* sp. in Different Fertilizers

The abundance of *Brachionus* sp. in different fertilizers in various studies conducted by several authors can be seen in Table (2) as follows.

Table 2. Abundance of *Brachionus* sp. in Different Fertilizers

No	Types of Fertilizers	Concentration	Result	Reference
1.	Urea	150 mg/L	The best concentration of urea fertilizer, namely 150 mg/L, produced the highest growth rate of 4.34 ind/mL.	Nurlinda *et al.* (2019)
2.	Chicken Manure, Urea, TSP	200 mg chicken manure; 4 mg Urea; 5 mg TSP	The highest population growth of *Brachionus plicatilis* was found at a concentration of 200 mg chicken manure; 4 mg Urea; 5 mg TSP, which was 8,667 ind/mL.	Safrizal *et al.* (2013)
3.	Chicken Manure, TSP, Bread Yeast, Extrajoss	300 mg chicken manure; 7.5 mg TSP; 6 mg Urea;	The highest population density was found at a concentration of 300 mg	Prayoga *et al.* (2017)

No	Types of Fertilizers	Concentration	Result	Reference
		0.45 gr; Bread Yeast; 0.40 gr Extrajoss per 3 L of water	of chicken manure; 7.5 mg TSP; 6 mg Urea; 0.45 gr; Bread Yeast; 0.40 gr Extrajoss per 3 L of water of 5.01 ind/mL.	
4.	Bread yeast, Scott emulsion, Vit C, Vit B12	1.2 grams of bread yeast	The concentration of 1.2 grams of bread yeast, Scott emulsion, Vit C, Vit B12 has a population density of 524 ind/mL.	Sukiandi *et al.* (2021)
5.	Urea, TSP, Chicken Manure	2 L water; 3 mg TSP; 4 mg urea; 400 mg broiler chicken manure	The use of concentrations of 2 L of water; 3 mg TSP; 4 mg urea; 400 mg broiler chicken manure produced the highest population of 89,639 ind/2 L with an average value of 9,960 ind/2 L.	Darmawansyah *et al*. (2011)

Various types of fertilizers that can be used as a substitute for commercial fertilizers with various nutritional contents that can meet the needs of *Brachionus* sp. for reproduction and growth. The use of chicken manure in the culture of *Brachionus* sp. can increase the growth of *Brachionus* sp. The use of organic fertilizers, especially chicken manure, can stimulate an increase in the population of microorganisms (Setyamidjaja, 1986).

Chicken manure is an organic fertilizer that is widely used in fisheries development efforts by farmers. According to Sutejo (1995), chicken manure generally contains complete nutrients such as N and P, which are essential nutrients for the growth of *Brachionus* sp. The concentration of chicken manure fertilizer between broiler chickens and kampung chickens is 2 L of water; 4 mg urea; 3 mg TSP; 400 mg broiler chicken manure produces the highest productivity, namely 89,639 ind / 2 L (Darmawansyah et al., 2011). According to Jayanti (2010), the use of balanced urea and TSP fertilizers greatly determines the growth of *Brachionus* sp. This is because the nitrogen content in urea fertilizer is 46% and the phosphorus content in TSP is around 14-20% (Darmawansyah et al., 2011).

The use of chicken manure + TSP + yeast enriched with 0.40 gr Extrajoss as a vitamin that increases endurance and enriches the nutritional content needed for the continuity of all processes in the rotifer's body. Extrajoss contains vitamin B complex and Taurine. Vitamin B complex is an organic compound needed for cell metabolism reactions containing thiamine, pantothenic acid, riboflavin and pyridoxine. Taurine is a type of amino acid that has physiological functions in the body such as playing a role in the synthesis of bile acids and osmoregulation in marine invertebrates (Huxtable, 1992). The addition of 0.40 gr Extrajoss resulted in the highest population density of 5.01 ind / ml, this was due to the availability of nutrients in the culture medium for the population density of *Brachionus* sp. Meanwhile, the addition of 0.50 grams of Extrajoss resulted in the lowest population density of 0.95 ind/ml. This occurred with the addition of 0.50 grams of Extrajoss which did not support the composition of the media as a source of nutrients. The high acid content in Extrajoss can be toxic to *Brachionus* sp. (Prayoga et al., 2017).

Water Quality Parameters

Water quality is an important factor in the growth of the *Brachionus* sp. population, including temperature, salinity, pH (degree of acidity), and dissolved oxygen (DO). The optimum water quality to support the growth and reproduction of *Brachionus* sp. can be seen in Table (3),

a) Temperature

Temperature can affect the mortality rate in natural feed in the early stages of life and affect the growth or reproduction of *Brachionus* sp. *Brachionus* sp. has the requirements needed for its growth, such as the temperature of the culture media is not too high or too low, which means that the culture media must be at the optimum temperature (Mudjiman, 2004).

b) Potential of Hydrogen

Potential of Hydrogen (pH) or acidity is the activity of hydrogen ions in a solution measured based on the concentration of hydrogen ions at a certain temperature (Indriani et al., 2022). pH is a factor that affects the growth of *Brachionus* sp. *Brachionus* sp. lives with a pH ranging from 5.0-10.0.

c) Dissolved Oxygen

Dissolved Oxygen (DO) or dissolved oxygen is an important factor that can limit the conditions of the culture media, if the DO levels in the water do not meet the needs for natural feed, this can inhibit the growth of natural feed (Indriani et al., 2022). DO is one of the important factors for the cultivation of natural feed. DO will decrease along with increasing salinity in the maintenance media. According to Sari et al. (2019) *Brachionus* sp. can live at DO ranging from <2 mg/l, DO should not be ≤ 1.5 mg/l.

d) Salinity

Salinity can affect the growth and survival of *Brachionus* sp. Salinity can change due to the influence of evaporation, if the salinity in the water medium fluctuates, it can cause the growth of *Brachionus* sp. to be inhibited, if the fluctuation occurs continuously it can cause death for *Brachionus* sp. In *Brachionus* sp. sea water can live with a salinity ranging from 20-35 ppt, *Brachionus* sp. brackish water lives with a salinity ranging from 5-20 ppt, and *Brachionus* sp. fresh water can live with a salinity ranging from 0-5 ppt.

Table 3. Water Quality Parameters

Parameter	Result
Temperature	25-27°C*
pH	7.5-8.0**
Salinity	10-35 ppt**
DO	5-7 mg/l*

Source: *(Sari *et al*., 2019)
**(Isnansetyo & Kurniastuty, 1995)

CONCLUSION

Based on the results obtained from various literature studies related to the potential use of different fertilizers in the growth of *Brachionus* sp., it can be a recommendation for cultivators to cultivate natural feed by utilizing several of these fertilizers.

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