



## Effect of Variant Manure on Generation Time in *Daphnia* sp.

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### ABSTRACT

The research about generation times of *Daphnia* sp. was carried out on Mei – June 2017 in Biology Laboratory, FPIK UNPAD. The objective of this research was to analyse the generation time of *Daphnia* sp. in different manure. The research used experimental method Randomized Completely Block Design (RCBD) with four treatment and three replication. The variant of manure as treatment were chicken manure (A), quail manure (B), cow manure (C), and goat manure (D). The weight for each manure media as many as 2,4 g/l in 1 litre of glass media. The best performance of life table distribution showed from the cow manure, but quail manure treatment give the best of all biological factor, it mean that *Daphnias* were cultured with quail manure have good performance in biological parameter.

**Keywords :** *Daphnia* culture, generation times,

### 1. Introduction

Rapid advancement of fisheries sector also give impact for the resources management, technology, and knowledge. The one of the most potent resources is *Daphnia* sp. as the part of zooplankton. *Daphnia* plays a central role as an energy transfer between producer and secondary consumer in the food webs of the aquatic ecosystem (Kim. *et al*, 2017) and also used to be natural feed for aquaculture.

Natural feed brings risks for bioaccumulation (Celia *et al*. 2000) such as pesticide, heavy metals, and their mixtures (Mansour, 2015). The best effort to get the great of natural feed is manipulating the environment like the native habitat and good nutrition supported (Prastya *et al*. 2016). *Artemia* sp. is an example for the best of natural feed in aquaculture. In reality, *Artemia* sp. has expensive price and difficult to culture particularly for fish farmer from Indonesia. *Daphnia* sp. is the best natural feed for tropical fry fish and also has potential to be an alternative to substitute *Artemia* sp. function as natural feed.

The high reproduction rate, the ease of culturing, the accessibility to experimental manipulation, and the potential to apply

sophisticated measuring techniques such as flow cytometry render some ciliate species ideal candidates for ecophysiological laboratory experiment (Weisse, 2006).

*Daphnia* sp. is the potential of natural feed source to develop for aquaculture (Mubarak *et al*. 2009). Another strengths of culturing *Daphnia* sp. are sterile assured, free from diseases, also guaranteed quality and continuity because stocking *Daphnia* sp. into culture media will not make water quality stress (Darmawan 2014).

Nutrient for *Daphnia* sp. culture obtained from manure in media. Decomposition from manure will growth bacteria, and the bacteria will be a feed source for *Daphnia* sp. (Shigang 1985). Ammonia is the first substance from organic matter decomposition. Ammonia divided into un-ionized ammonia (NH<sub>3</sub>), and ionized ammonia (NH<sub>4</sub><sup>+</sup>). Ammonia in water will more toxic with pH increase (Xiang. *et al*, 2010).

Generation time in particular, is a life-history or period from the laying of an egg to the time the individual which develops from that egg reaches sexual maturity. Generation time in the single most important determinant of the rate of population growth in species and thus (Gillooly, 2000). *Daphnia* sp species and another microcrustacean give short of

generation time with high population (Pietrzak, 2011).

Variation in the time spent in each life history of *Daphnia* has often been explained as species-specific adaptations to environment condition, but the information about variant manure for *Daphnia* culture is seldomly found. Herman *et al* (2018) showed that if quail manure is the best organic manure for *Daphnia* culture and give the best performance of life history between growth rate, natality rate, and mortality rate, but the generation time was not analyse yet.

The objective of this research was to analyse the generation time as biological factor of *Daphnia* with using different manure media.

## 2. Material and Method

The research consist of preparation, kohort culture, and main research. This research used experimental method by using Randomized Completely Block Design (RCBD) with four treatment and three replication. The treatments in this research are the variant manures from chicken, quail, goat, and cow with same growth (2,4 g/l). This research analysed the primary datas consist of :

1. The number of parent of *Daphnia* sp. on the time- $x_i$  (KU- $x_i$ )
2. The number of natality of neonets from female on the time- $x_i$  (KU- $x_i$ )
3. The number of death *Daphnia* sp. on the time- $x_i$  (KU- $x_i$ )
4. Water quality (temperature, pH, DO, ammonia)

Growth rate, net reproduction rate (Ro), generation times (Tc), natality rate, and mortality rate were calculated by formula from Lotta (1913) in Ocampo *et al.* (2012) :

$$Ro = \sum_{x=0}^{\infty} l_x \cdot m_x$$

$$Tc = 1 / Ro \sum_{x=0}^{\infty} x \cdot l_x \cdot m_x$$

$$e^{7-rx} l_x \cdot m_x = 1097$$

$$1/\beta = Lx \cdot e^{-r(x+1)}$$

$$b = \frac{r\beta}{e^{\beta} - 1}$$

$$d = b - r$$

Note:

Tc = generation times (days)

Ro = net reproduction rate

r = growth rate

lx = the number of individu after standarization (survival time specific)

Lx = average of individu in KU-x and KU-x+1

mx = the number of neonet in specific time

x = time of culture

b = natality rate

d = mortality rate

There were two preparation for this research. First, manure should be dried without water contained. After that, manure weighed amount 2,4 gram. Next, the manure should be wraped and tied.. Futhermore, one liter water put in a container and installed it on the aeration set. The wraped manure entered, and the media aerated for 3 days.

Mature *Daphnia* sp.(F0) cultured in a media culture for 1 day. The new neonets (F1) would be present, and took the neonets (F1) to the other media culture. The new neonets (F1) cultured until adult and made a new generation (F2). The new generation (F2) used for the main research.

Second generation (F2) of *Daphnia* sp. entered in every treatment amount 100 individu/l. *Daphnia* (F2) counted everyday and moved into new media. If neonets (F3) has presented, the neonets (F3) devided from the previous media and count in different place to avoid the neonets (F3) growth up and difficult to be distinguished. The main research will be done if all of *Daphnia* (F2) died.

Growth rate, net reproduction rate, natality rate, mortality rate, and generation times will analyse using ANOVA with signigicatr degree 95%. If the result has significant, the result will continued with Duncan test. Water quality will analyse with descriptive comparative. Water quality used for guideline point of research and take effect for life span *Daphnia* population.

## 3. Result and Discussion

The highest growth rate showed from quail manure (Table 1) with average amount 3,68. The lowest growth rate showed from chicken manure treatment with average amount 2,32.

Table 1. Growth rate of *daphnia* sp. from culture

No	Treatment	Growth Rate (unit)
1	Chicken manure	2,32 <sup>a</sup>
2	Quail manure	3,68 <sup>b</sup>
3	Cow manure	2,74 <sup>ab</sup>
4	Goat manure	2,55 <sup>a</sup>

Note : The value follows by code of different word is not giving significant value according to Duncan double distance test in significant degree 95%

The highest natality rate showed from quail manure amount 3,68 while the lowest natality rate showed from chicken manure with average 2,59.

Table 2. Natality rate of *daphnia* sp. from culture

No	Treatment	Natality Rate (unit)
1	Chicken manure	2,59 <sup>a</sup>
2	Quail manure	3,87 <sup>b</sup>
3	Cow manure	3,00 <sup>a</sup>
4	Goat manure	3,31 <sup>ab</sup>

Note : The value follows by code of different word is not giving significant value according to Duncan double distance test in significant degree 95%

Mortality rate showed variant value from the research. The highest mortality rate showed from goat manure with average amount 0,76. The lowest mortality rate showed from quail manure with average amount 0,28.

Table 3. Mortality rate of *daphnia* sp. from culture

No	Treatment	Mortality Rate Rate (unit)
1	Chicken manure	0,28 <sup>ab</sup>
2	Quail manure	0,19 <sup>b</sup>
3	Cow manure	0,26 <sup>b</sup>
4	Goat manure	0,76 <sup>a</sup>

Note : The value follows by code of different word is not giving significant value according to Duncan double distance test in significant degree 95%

While the quail manure treatment give the highest of growth rate, natality rate, and low of mortality rate, but using quail manure give the lowest of maintenance time (x). The maintenance time of using quail manure is lower than using another manure caused with high reproduction and decline the carrying capacity of *Daphnia* sp. While the environment in poor condition, *Daphnia* sp. will attend to growth, develop, and try to metabolism although the population will be decrease (Maier 2009).

Table 4. Generation times of *daphnia* sp. from culture

No	Treatment	Generation Times (days)
1	Chicken manure	2,87 <sup>a</sup>
2	Quail manure	2,98 <sup>ab</sup>
3	Cow manure	3,15 <sup>b</sup>
4	Goat manure	2,88 <sup>ab</sup>

Note : The value follows by code of different word is not giving significant value according to Duncan double distance test in significant degree 95%

Cow manure give the highest generation time with average amount 3,15 days. This result showed very significant value than the others treatment. Quail manure give second position after cow manure. The lowest generation time showed from chicken manure with average value 2,87 days.

A new case showed in this research because cow manure showed the best performance of generation times. Bacteria to compose nitrogen compound from birds feces are more than mammals feces because birds change the compound twice, there are uric acid into urea, and urea into ammonia, while the mammals just change urea into ammonia. Feces from cow also contain fibre or selulose from their food (cow). It will make *Daphnia* difficult to filter and lost their food easily. Despite cow obtusive in generation times, quail manure showed high value in generation times although not as high cow, but quail manure consist give the best perform in every biological factor such as growth rate, natality rate, and mortality rate. From analysing the potential of *Daphnia* biological parameter with variant manure media (growth rate, natality rate, mortality rate, and generation time), quail manure fill all of the biological factor in good condition (Table 5).

Table 5. Parameter test recapitulation

Treatment	Growth rate	Natality rate	Mortality rate	Generation times
Chicken manure			X	
Quail manure	X	X	X	X
Cow manure	X		X	X
Goat manure		x		X

Table 6. Water quality of media culture

Manure Treatment	Temperature (°C)	DO (mg/l)	pH	NH <sub>3</sub> (mg/l)
Chicken manure	24,1 – 25,6	3,7 – 4,2	7,7 – 8,1	0,08 – 0,15
Quail manure	24,3 – 25,6	3,6 – 4,1	7,6 – 8,3	0,10 – 0,38
Cow manure	24,1 – 25,7	3,7 – 4,2	7,5 – 8,0	0,01 – 0,13
Goat manure	24,2 – 25,7	3,7 – 4,2	7,6 – 8,2	0,01 – 0,13

Quail manure contain higher ammonia (0,1 – 0,38 mg/l) than another manure treatment. Ammonia is a key for this culture because the first product of animal waste is ammonia. Ammonia from chicken or poultry manure is from uric acid, and from mammals manure is from urea. Ammonia is very toxic for all organism, but in acid condition the toxicity will be decrease, so that pH monitoring is

Temperature on this research occur in tolerance range for *Daphnia* life span (24,1° – 25,7°C). Khan and Khan (2008) said that if *Daphnia* will on optimum life span at 25°C. Ocampo *et al* (2012) suggest the temperature for *Daphnia* culture amount 20 – 25°C. Oxygen demand from culture media support respiration of *Daphnia* sp. without competition between *Daphnia* and decomposite microbial. DO in the culture controlled by aeration. DO in the media culture occur in tolerance range for *Daphnia* life span. *Daphnia* sp. could be life in DO > 3 mg/l, but they growth up more optimum on 6 mg/l (Ocampo *et al.*, 2012). Power of Hydrogen (pH) affected for eggs life span zooplankton *microcrustacean* (Vijverberg *et al.*, 1996 in Darmawan 2014). According to Ocampo *et al.* (2012), optimum pH for *Daphnia* culture on range 7 – 8,6. Darmawan (2014) present that if neutral or on base relative (range pH 7,0 – 8,2) is good for *Daphnia magna* growth. Power of hydrogen (pH) determine the toxicity of medium from ammonia. According to Delzer and McKenzie (2003), nitrogen decomposition from ammonia, nitrit, and nitrat by microba start at 6th day with temperature amount 20°C. Normally, decomposition divided into two stages, carbonaceous (carbon decomposition start from 0 day), and nitrogenous (nitrogen decomposition).

required for *Daphnia* culture. The example of ammonia decomposer in culture media are possibly-like grouped within *Nitrosomonas* and *Nitrosococcus* genus (Reddy and Shah, 2016). *Daphnia* sp. will eat them as non-selective filter feeder in culture media because *Daphnia* has potentio to filter commensal and pathogenic bacteria associated with fecal pollution (Norgaard and Roslev 2016).

This research using manure soaked for three days. This time was not enough for ammonia decomposition, so that the concentration of ammonia in the treatments are 0,1 – 0,38 mg/l. This concentration is deficient for *Daphnia* life span. Ammonia also influence the feeding rate according to Norgaard and Roslev (2016) with acute inhibition by unionized ammonia with a 24 h EC50 of 0,18 mg/l and a LOEC of 0,09 mg/l.

#### 4. Conclusion

According to the result and discussion, cow manure give the best generation time followed with quail manure performed good of generation times. Quail manure manifested the best of biological factor includes generation times, growth rate, natality rate, and mortality rate in *Daphnia* culture than using chicken manure, goat manure, and cow manure.

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