The Effect of Treated Quail Dung on the Movement and Weight of Asian Clam (*Corbicula fluminea*)

By

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A report submitted in fulfillment on the requirements for the degree of Bachelor of Applied Science (Animal Husbandry Science) with Honours

Faculty of Agro Based Industry

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DECLARATION

I hereby declare that the work embodied in this report is the result of the original research and has not been submitted for a higher degree to any universities or institutions.

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I certify that the report of this final year project entitled "**The Effect of Treated Quail Dung on The Movement and Weight of Asian Clam (*Corbicula fluminea*)" by Azree Faiz Bin Anizam**, metric number **F14A0031** has been examined and all the correction recommended by examiners have been done for the degree of Bachelor of Applied Science (Animal Husbandry Science) with Honours, Faculty of Agro-Based Industry, Universiti Malaysia Kelantan.

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Kesan Tahi Puyuh Yang Dirawat Ke Atas Pergerakan Dan Berat Etak

(*Corbicula Fluminea*)

ABSTRA

Etak telah lama menjadi makanan tradisi dan pendapatan bagi penduduk di Pantai Timur, Malaysia terutama di Kelantan. Jumlah populasi etak dari habitat semula jadi semakin menurun disebabkan oleh penuaian. Keadaan ini memberi kesan negatif kepada ekonomi sosial tempatan. Bagaimanapun, penyelidikan saintifik mengenai pengeluaran etak jarang dilakukan. Kekurangan maklumat dan penerbitan yang terdapat pada spesies ini termasuk pengeluaran dan pergerakan etak. Kajian ini dijalankan untuk memerhatikan hubungkait pergerakan dan berat etak terhadap tahi puyuh yang dirawat dalam sistem tertutup. Tangki eksperimen akan disediakan dalam tiga replika. Tiga grid (A, B dan C) telah ditandakan dalam setiap tangki eksperimen untuk mengukur pergerakan etak. Setiap tangki eksperimen mengandungi 30 sampel yang ditanda dengan nombor pengenalan dan diberi makan tahi puyuh yang dirawat di Grid C. Berat (g), pergerakan (mm) dan kematian setiap sampel diambil setiap minggu selama empat minggu. Dari hasilnya, peratusan terbaik (%) untuk kenaikan berat badan dan pergerakan etak masing-masing ialah 1.27 ± 2.68 dan 1.48 ± 0.86. Kadar kematian etak dalam eksperimen ini adalah 4.44 ± 4.16. Penemuan hasil ini menunjukkan tahi puyuh yang dirawat boleh digunakan sebagai sumber makanan etak.

Kata Kunci: **Etak, Pergerakan, Berat Badan, Tahi Puyuh Yang Dirawat.**

The Effect of Treated Quail Dung on the Movement and Weight of Asian Clam (*Corbicula fluminea*)

ABSTRACT

Asian clam has long been a traditional food and income for people in the East Coast of Malaysia especially in Kelantan. The number of Asian clam population from natural habitat is declining due to over harvesting. This situation negatively affected local social economic. However, scientific research on production of Asian clam are scarce been carried out. The lacking of information and publication found on this species including its production and movement of Asian clam. This research was conducted to observe the correlation between Asian clam movement and weight towards treated quail dung in closed system. The experimental tanks will be set up in triplicates. Three grids (A, B and C) have been marked in each experimental tank to measure the movement of Asian clam. Each experimental tank containing 30 samples marked with identification number and fed with treated quail dung at Grid C. The weight (g), movement (mm) and mortality of each sample was taken weekly for four weeks. From the results, the best percentages (%) for mean weight increment and movement of Asian clam are 1.27 ± 2.68 and 1.48 ± 0.86 respectively. The mortality rate of Asian clam in this experiment is 4.44 ± 4.16. The findings of this result shown treated quail dung can be used as food source of Asian clam.

***Keywords*: Asian Clam, Movement, Weight, Treated Quail Dung.**

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LIST OF ABBREVIATION

mm	millimeter
cm	centimeter
g	gram
D.O	dissolved oxygen
ppt	parts per thousand
s.d	standard deviations
TP	total phosphorus
OM	total organic matter
TN	total nitrogen
Ca	Calcium
P	Phosphorus
N	Nitrogen
K	Potassium
Mg	Magnesium
NH_4^+	Ammonium ion
SPSS	Stastical Package for Social Science
mL	Milliliter
m	Metre

LIST OF SYMBOLS

&	And
%	Percentage
^{o}C	Degree Celsius
^{o}	Degree
<	Less than
>	More than

CHAPTER 1

INTRODUCTION

1.1 Asian clam

In the aquaculture industry, several species of clam were introduced for the purpose of human consumption such as protein source. Asian clam or scientific name is *Corbicula fluminea* from the Corbiculidae family is a small bivalve with two shells that are symmetrical at both side shells. The common size of Asian clam is less than 25mm and rarely exceed 50 mm and the color of the shell are light green or light brown with distinctive elevated concentric ridges on their shell (Robinson, 2004). Asian Clam is a small clam with an inflated shell, slightly round to triangular in shape. The shell consists of numerous heavy concentric ridges (Zaween *et al.,* 2014).

The natural habitat of Asian clam is at freshwater area such as river with low water level. It can also be seen live on an area close to the mouth of the river near the ocean. Asian clam need bed such as sand and silt area for attached place. The condition of water for Asian Clams prefers noiseless waters with low salinity and sandy substrates because origin of Asian clam is from fresh water (Robinson, 2004). This species prefer to colonize sunlight warmer areas near the shore, and typically avoid the low oxygen levels and cooler conditions associated with the deeper layer (hypolimnion) of the water body. It causes by their short siphons, one third of the shell protrudes above the substrate.

Sousa, Antunes & Guilhermino (2004) is highlighted that the Asian clam is hermaphrodites, so it can change its reproduction organ depend on the situations for self-fertilization. Sperm of this clam is released into the water, caught by another clam, and brooded in the gills for about 4-5 days. The larval shells are released through the ex-current siphon at about 1.0 to 1.5 mm in size, then crawl on the bottom and attach to the substrate with byssus (Moretzsohn & Barrera, 2006).

In Malaysia, Asian clam have their own economic value. For example, in Kelantan, Asian clam are treated as one of the protein sources for the population. They are widely marketed especially in rural areas. One of the Asian clam products that is well distributed is the “Etok Salai” where the Asian clam is smoked and consumed as a snack.

1.2 Treated Quail Dung

Treated quail dung has been used as food source of Asian clam for all replication in this research. The treated quail dung was mixed with sand substrate. Quail dung contains high number of Calcium that are importance in metabolism and growth of shell in bivalve. Not only that, treated quail dung also contain nutrient such as Nitrogen (N), Phosphoruis (P), Potassium (K) and Magnesium (Mg). All of these nutrient are needed for growth of Asian clam because from natural habitat those nutrient get from organic matter in the sediment. The large natural river supply of phosphorus and nitrogen, essential nutrient for marine plans and algae (Celik, Karayucel, & Karayuicel, 2009). Phosphorus (P) and nitrogen (N) was major nutrient elements for various aquatic organisms and it also the major factors for eutrophication (Schindler, 2006). Organic matter possibly a direct organic nutrient resource for shellfish pond organismn on fertilizer particle. Pond treatment by organic matter represent mixed between fertilization and feeding (Mischke, 2012).

1.3 Problem Statement

Asian clam is well recognized clam among the people particularly in East Coast of Malaysian. Nowadays, the decreasing numbers of Asian clam in the wild become the major problem for stakeholders in industry. This research has been carried out to get information for farming this species in order to have continuity of resource. Therefore, this research has emphasizes the movement and weight of Asian clam by using treated quail dung as food source for Asian clam farming.

1.4 Objective

To evaluate the movement and weight of Asian clam by using treated quail dung.

1.5 Hypothesis

H_0 : There is no correlation ($p>0.01$) between movement and weight of Asian clam by using treated quail dung

H_a : There is a correlation ($p<0.01$) between movement and weight of Asian clam by using treated quail dung.

1.6 Scope of Study

This study focused on the observation of the correlation between movement and weight of Asian Clam on treated quail dung for closed-cultured system. The correlation has been determined by measuring the movement and the weight of the clam along the research period.

1.7 Significant of Study

The result from this study shows whether treated quail dung is suitable or not as Asian clam feed. Information from this study will be used to improve density and area of Asian clam in closed system farming. Correlation between weight and movement was observed to get the information either the weight of Asian clam will increased or decreased when move toward the food source that is treated quail dung. Thus, the data gained from this study can be used for the future research and also can be used to establish a production of Asian clam in a closed system as to commercialise the bivalve species.

1.8 Limitation of Study

This study conducted on triplicate experimental tanks and each experimental tank consisted of limited number of samples since the source of Asian Clam from natural habitat is limited.

CHAPTER 2

LITERATURE REVIEW

2.1 Pedal or Deposit Feeding of Clam

Research conducted by Arapov *et al.* (2010), described the feeding of bivalve species for how and they eat. According to the study, based on collection food mechanism, bivalve can be suspension-feeder or deposit feeder or both feeding method. Some bivalve's species also have the ability to regulate filtration and select particles depend on their size, shape, nutritional values or chemical component on the surface of the particle. This study showed that different species used different mechanisms of particle selection; this finding suggested that some bivalve could use chemosensory detection as the selection mechanism. This researched stated phytoplankton was considered as the main food source for bivalve and previous studies demonstrated that in shallow areas phytoplankton abundance could be strongly controlled by bivalve grazing (Arapov *et al.,* 2010). The contribution of different groups of phytoplankton in bivalve diet depending on the position of bivalves in a water column and the structure of phytoplankton community in the surrounding (Compton *et al.,* 2008). As a conclusion, the growth bivalve was depending on diet quality and from aquaculture side, it is important to know the best condition of optimum energy available to maximize the growth of bivalve.

The study conducted by Soo & Todd (2014), described the behaviour of giant clams (Bivalvia: Cardiidae: Tridacninae) include the feeding of giant clam. He also mentioned in this experiment, Giant clams will undergoes several shifts in their mode of feeding, started with a lecithotrophic and planktotrophic diet. After metamorphosis, Giant clam will switch to pedal feeding and after that will followed by the transition to a dual mode of filter feeding and phototrophy (Soo & Todd, 2014). Their unique range of feeding modes allowing them to adapt with local environmental factors. This research also explained that pedal feeding of Giant clam will be in three putative forms of pedal feeding. First, locomotion on forward direction over a hard substrate form through the pedal gape and small clumps of detritus was allowed the substrate surface to enter the mantle cavity. Second, the foot will extends posteriorly on a sandy substrate by anteroposterior pedal feeding and it was swept forward with slight rotation before retracting. The foot will produce musus strings to traps sediments then ingested. Lastly, during an upright position, the foot was probing down into the substratum to gather particulate food by pedal cilia. This can be concluded that Giant clam can be filter feeding or deposite feeding at the same time and for early juveniles It is essential to provide it with substrates with physical properties matched with mode of feeding, especially in terms of rugosity and size of food particle.

Ward & Shumsay (2004) stated the particle selection in suspension-feeding and deposit-feeding of bivalves. The mechanisms of particle feeding of bivalves that is suspension and deposit-feeding often play significant roles in ecosystem processes. The research also mentioned that particle-feeding bivalve are often found in large populations that profoundly effect pelagic and benthic processes (Ward & Shumway, 2004). Through suspension and deposit feeding activities, large amounts of particulate matter was cycle within the environmental conditions and cycling complex molecules into inorganic forms. They also mentioned that differences in food collection methods, that can be separated into two major categories depending on particle uptake and processing mechanism. First, the mucous nets or strings was utilize on external or within the mantle cavity to collect particle. Second, the ciliated structures was reely on proboscides and ctenidia for collection of particle, transporting and processing. The deposit-feeding bivalves was captured and collection of particles was accomplished either by using siphon to ctenidia transfer via tentaculate and palp proboscides.. Conclusion of this research is most of particle-feeding by bivalves are mainly rely on phagocytosis of particles and intracellular digestion.

Research conducted by Vaughn & Hakenkamp (2001) stated that burrowing bivalves in freshwater ecosystem filter phytoplankton, bacteria and organic matter from the water column. They also stated Corbicula and sphaeriids also removed an organic matter by deposit feeding from the sediment (Vaughn & Hakenkamp, 2001). Pedal feeding is a form of deposit-feeding to collect buried organic matter in sediment by using ciliaon the foot. Pedal feeding also has been observed for juvenile unionids, the reslt shown juvenile unionids are grown faster when able to feed in sediment as compared with filter feeding itselt. Deposit feeding also may provide a significant proportion of total food energy (Vaughn & Hakenkamp, 2001). Previous research showed that unionids were consumed 80% deposited material and 20% suspended material (Raikow & Hamilton, 2001).

2.2 The dispersal of Asian clam

Research conducted by Rosa *et al.* (2012) stated the effects of upper-limit water temperatures on the dispersal of the Asian clam. This research mentioned that stressful conditions such as temperature increase have been suggested to induce flotation behavior in *Corbicula fluminea* which might be important in dispersal of this species (Rosa *et al.,* 2012). It was already proven that Asian clam drifting was supported by a mucilaginous drogue line produced by mucocytes present in the ctenidia (Rosa *et al.,* 2012). Refer to Rosa (2013) a particular life-cycle trait of this species that has been considered to contribute to its dispersal abilities is the production of a mucilaginous drogue line by modified cells (mucocytes) packed along the inner demibranchs of the ctenidia of juvenile and young adult clams. This drogue line was proven to assist clam flotation (in clams up to 14 mm shell length) in response to water currents, thus promoting drifting into new locations and favoring the species dispersal (Rosa, 2013). This research was tested the different independent temperature treatments that was 20ºC, 25ºC and 30ºC with 3 replicates to Asian clam exposed. The clam flotation behavior was observed by different temperatures following one, two and three weeks of exposure. Results of this research show that an acceleration of the mucocytes production and stimulated flotation behavior was triggered by changes in temperature.

2.3 Chemotaxis of clam

Research conducted by Dumas *et al.* (2013) stated the Sessile Giant clam of early chemotaxis contributing to active habitat selection. They investigated the chemosensory ability and subsequent locomotion of the widely-distributed by Giant clam (Dumas *et al.,* 2013). Although many species of invertebrates larvae are possess sensory abilities that allow posssible settlers to spot suitable areas. In previous study, Huang *et al.* (2007) was stated the chemosensory abilities in giant clam and the locomotory behavior may alowed juveniles to explore for ecological environments that will raise their survival (Huang *et al.,* 2007). More recently study, Soo & Todd (2012) provided experimental proof of active movement in byssate juveniles of *Tridacna squamosa* as a result of possible geotaxis, and support the evidence of Giant clam was moved between reef habitats (Soo & Todd, 2012). The objective of this research was to investigate chemosensory locomotory responses, chemosensory capability from larvae to settled juveniles and ability to choose actively contrasted reef territory using chemosensory cues in *T. Maxima*. Method that has been used in this research was using a bidirectional water inflow system to investigate the chemotactic responses of five-day-presettlement larvae with separated into three sections in the experimental tank. The result of locomotive activity stated the juveniles shown much stronger locomotive activity when swimming headed for the conspecifics. Coupled with locomotion, chemotaxis is a essential process that may allow marine organisms to improve their fitness by choosing most favourable settlement habitats on the basis of ecological cues.

2.4 Fertilizing Aquaculture Site

Research done by Godara *et al.* (2015) stated the effect of aquaculIture fertilization with vermicompost and some other dung on the growth performance of Indian major carps. The production of fish can be improved by feeding and pond fertilization. Optimal fertilization rate is the amount of organic matter that can be utilized in a fishpond ecosystem without giving any harmful effect on water quality as well as on growth performance of fish (Jha *et al.,* 2004). In this experiment, they were used different treatments and each treaatment with four replications. The treatment used is semi dried pig manure, poultry manure, cowdung, and vermicompost. Result of this experimement was the body weight of fish species increased tremendously under of all the treatments. Pond fertilization has become an important preparation in modern aquaculture and the inorganic fertilization has been replaced with the organic fertilization (Wurts, 2004).

2.5 Growth Performance of Clam

Research conducted by Serdar *et al.* (2007) about the growth and survival rates of carpet shell clam using three differed cultture method that is net, box and fence. The aim of this study, to measure the efficiency of these three different methods to maximize the production of clam. The environmental water parameters were measured by month over the experimental timeline. Each experimental method was carried out in triplicate and was tested on a 0.5 m^2 surface area. For all replication, the density of clam was chosen to 200 individual./$m^{2.}$. The parameter that was monitored such as shell length, and total wet weight were measured individually for all replication of treatment on a monthly basis. The mortality rate of the clam was estimated by counting opened bivalve shells and remved broken-up shell caused by predatation. The result from one year of experiment shown the growth of shell and total wet weight are gradually increased over the year. The highest growth was in net cultured method and the lowest growth was in the fenced ground cultured method. Clam growth is affected by surronding environmental factor such as temperature, salinity, and food availability (Sobral & Widdows, 2000). The findings of this experiment, clams growth reached 34.13 ± 0.38mm in shell length and 9.09 ± 0.27 g in total wet weight and survival rate (64%) were obtained in this research using the hard plastic net culured method (Serdar *et al.,* 2007).

Washitani *et al.* (2017) conducted a research comparing the mangrove clam survival rate in mangrove forests of Iriomote Island. This experiments was set up on four plots which were set acrossed a mangrove forest from seaward zone to landward zone for more than 10 months. They measured the survival rates of mangroove clam at experimental plot for four months. Not only that, salinity of of the plot also was measured during the study timeline. Ten *Polymesoda* spp. were placed into a metallic cage with sizing of 15 × 15 × 5cm and 1 cm mesh. The metallic cages are function to protected the clams from being preyed by predator at mangroove forest. These species have a capability to maintain the wetness, however it prefer to be kept in water. However, a lot of individuals of *G. coaxans* were burrowed in to sediment that containing water in the mangrove forest (Fukuoka *et al.*, 2010). These results shown that the survival rates of the clam have no corelations with the sediment temperature, but the salinity level of water have the direct relatioship with survival rate. The survival rate is 0%, 40% and 90% for landward side, seaward zone and mesozone respectively. These shown mesozoone are the best area for mangroove clam survived (Washitani *et al.*, 2017)

CHAPTER 3

METHODOLOGY

3.1 Sampling

The sample of Asian Clam has been taken from Sungai Pergau at coordinate (5°41'36.6"N, 101°43'38.1"E) (Figure 3.2)

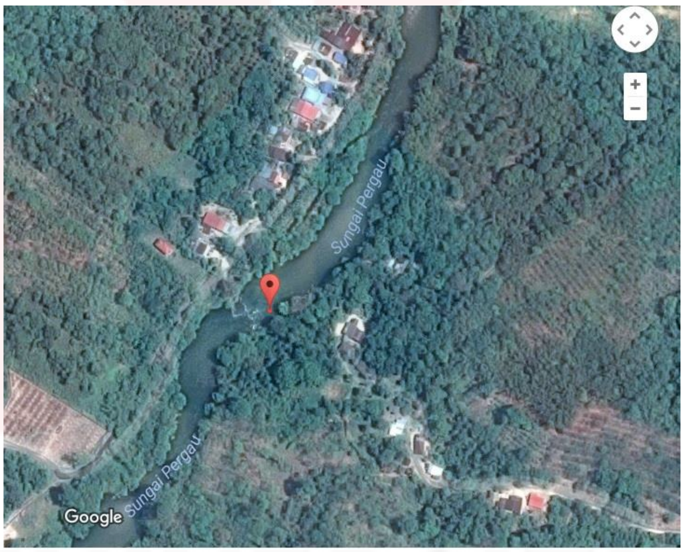

Figure 3.1: Location of sampling at Sungai Pergau

Sources: (Google Maps, 2017)

Sungai Pergau is located at Jeli, Kelantan. This location is upstream area with sandy substrate. The depths of the river that Asian clam habitat is swallow area with low current water. The sample was taken by using sieve tray. Asian clam obtain was put in holding tank with water pump for acclimatization in one week and was cultured in experimental tank at Aquaculture Laboratory.

3.2 Experimental Design

3.2.1 Experimental Tank

The experimental tank has been set up in triplicate. The size of each experimental tank for length, width and height is 122cm X 46cm X 46cm respectively. The volume of water in that tank is 168,360 cm^3 as the height of water is 30 cm. The tank has been installed with pump Aqua San AS-1000 with flow rate 14.97 per/hour that was supplies oxygen and filtering the water in the experimental tanks.

A plastic tray with size (50 cm x 36 cm) was used as culture tray and it has been placed in each experimental tank. A tray was divided into three grid area to observe and measure the movement of Asian clam in experimental tank. The movement of Asian clam was measured using measuring tape 1m/3ft (Richie's, China). Each grid was labeled as grid A, grid B, and grid C respectively for each plastic tray. Asian clam has been placed at grid A as a starting point for the movement while at grid C, the treated quail dung has been put for feed of Asian clam.

Figure 3.2.1: Culture tray marked with Grid A, B and C.

3.2.2 Substrate

In order to imitate natural habitat of Asian clam, sand was used as a substrate and taken from Sungai Pergau. The samples from Sungai Pergau was brought to laboratory for soil analysis. The sedimentation method using British Standard has been used. The purpose of the analysis is to get the percentage composition of sand, silt and clay. From the analysis, the result is 0.15%, 0.44%, and 99.4% for clay, silt and sand respectively. The tank has been prepared with sand substrate that thickness was two centimeter (cm) for each tray.

3.2.3 Treated quail dung.

Quail dung was used as food source of Asian clam. The quail dung was treated first before used. 100g of quail dung was weighed on weighing balance then; 4mL of Hydrogen Peroxide was poured on quail dung. The mixtures were mixed it well and leave it for 15 min. After that, 4mL of Phosphoric acid was added into the mixture of quail dung and hydrogen peroxide and mixed it well. Let the mixture of quail dung and hydrogen peroxide for 15 min and after that, the mixture has been dried under the sunlight. The amount of treated quail dung used is one percent (%) from weight of sand substrate that it's because from soil analysis the percentage of sand from natural habitat is about 99% and another 1% was silt and clay. From that, the composition of substrate was modified and added with one percent (%) of treated quail dung as organic matter in the sediment.

3.2.4 Samples of Asian Clam

Asian clam was sampling at Sungai Pergau. After a week of adaption in holding tank, Asian clam was reared at experimental tanks that already set up. 30 samples of Asian clam was put in each experimental tank. Each Asian clam in the experimental tank was marked with identification number from number 1 to 30 respectively for each experimental tank.

3.3 Environmental Factor

Water parameter was monitored weekly by using YSI Pro Plus Multi-Parameter (YSI, USA). All the variables including pH, dissolved oxygen (DO), salinity (ppt) and temperature (ºC) were taken from all experimental tanks.

3.4 Data Analysis

The following indices of growth were calculated at the end of the experiment:

1. Relative Growth Rate (RGR) = $[(W_f - W_i)/W_i]$ 100%
2. Survival rate (SR)= Final clam total number / Initial clam total number x 100

Data was analysed using one-way ANOVA method and Sperman's rho correlation by using Stastical Package for Social Science (SPSS) software version 22.0.

CHAPTER 4

RESULT AND DISCUSSION

4.1 Result

At the end of the experiment period, data were analysed by replication based on weight, movement and survival rate of Asian clam (*Corbicula fluminea*). The total periods of this research were four weeks. Data for all three replications were analysed and summarized in graph. The correlation between weight and movement by using treated quail dung were analysed in Table 4.4.

4.1.1 Weight of Asian Clam

Throughout the experimental activity, the initial weight of 30 sample of Asian clam for each replication was weighed. Data of increment weight after four weeks of experiment was analysed using Stastical Package for Social Science (SPSS) software version 22.0. (Table 4.1)

From the table 4.1 the percentage (%) mean of weight increment is highest in replication 2 which is 1.27 ± 2.68g while compared to replication 1 and replication 3 which are 1.26 ± 2.75g and 0.96 ± 2.39g. However, there is no significance difference for all the replications.

Table 4.1: Table shows the Percentage (%) mean of weight increment (±s.d.) for Asian clam (*Corbicula fluminea*). The data has no significance difference

Replication	Percentage (%) mean of weight increment (g)(±s.d.)
1	1.26 ± 2.75
2	1.27 ± 2.68
3	0.96 ± 2.39

From the graph below the mean of weight increase from 1.847g on week 0 (initial reading) to 1.921g on week 1 but decrease slightly from 1.921g on week 1 to 1.899g on week 2. After that, the weight increase from 1.899g on week 2 to 1.973g on week 4. The trend of graph shows that there is increase on first week but drop suddenly on week 2 and increase back for the rest of all the weeks. The data used a cumulative mean from all replicates for each week.

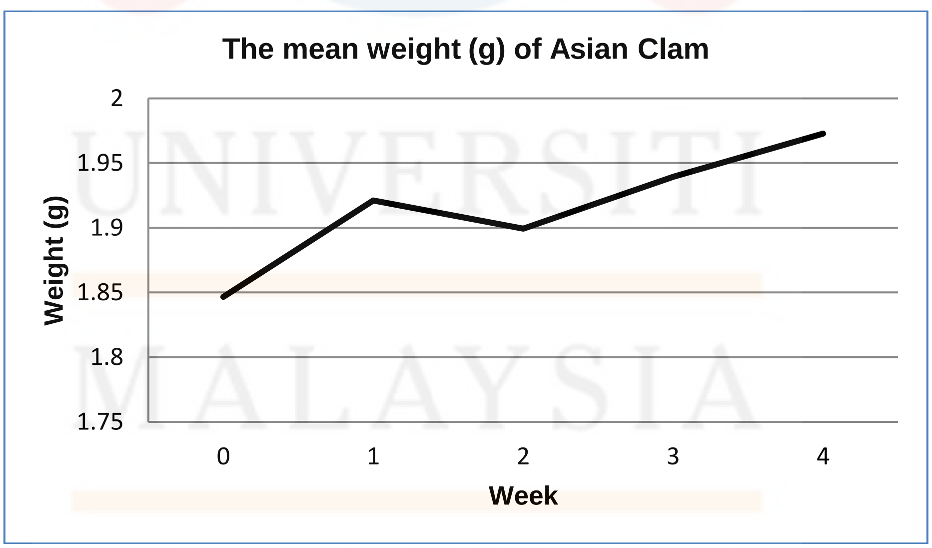

Figure 4.1: the graph shows the weight (g) of Asian Clam (*Corbicula fluminea*) for 4 weeks**.**

Based on the result, it demonstrated that by comparing all the replication, there is a no signifance different among all the replication (Table 4.1). The highest percentage (%) mean of weight increment (±s.d.) is 1.27 ± 2.68g while the lowest is 0.96 ± 2.39g. Figure 4.1 shown a weekly mean of weight of Asian clam for four weeks. The result of this experiment based on graph (Figure 4.1) shows positive result that treated quail dung can be source of food for Asian clam. In addition, Asian clam was able to take nutrient in treated quail dung directly by pedal-feeding from body sediment but is not clear whether this is sufficient to Asian clam nutritional requirement. Based on nutrient content of treated quail dung, it was rich in Calcium (Ca), Phosphorus (P), Nitrogen (N) and Potassium (K). The percentage (%) of nutrient content in treated quail dung is 0.44%, 1.14%, 1.34% and 2.70%, for P, N, K and Ca respectively. Calcium is one of main importance in bivalves for both shell growth and metabolism that increased the weight of Asian clam in this experiment. Previous research was confirmed that bivalve absorbed dissolved calcium and phosphate and deposited it into their shell (Knauer & Southgate, 1999). Until today, Calcium is the only mineral absorption by bivalve that has been studied in detail compared to another nutrient. In aquaculture site, Phosphorus was stimulated the growth of phytoplankton that can served as food for small organisms (Wurts, 2004). This research was focused on pedal feeding of Asian clam to take direct nutrient from treated quail dung, thus the growth of phytoplankton was inhibit in this experiment.

Based on figure 4.1 on week 2, the weight of Asian clam slightly decreased because Asian clam still in adaptation with treated quail dung treatment. Not only that, other factor like Potassium content in treated quail dung also might be affected the weight of Asian clam. Potassium concentration in water are unusually sensitive to freshwater bivalves. With exposure to potassium concentrations, bivalves show a number of responses such as foot swelling, lack of response in foot withdrawal to mechanical stimulation and gaping of shell sstructure (Dietz & Byrne, 1990).

Other nutrient that can be used to increase the weight of Asian clam are protein, carbohydrate, and lipid. Protein is importance as an energy for the period of metamorphosis of bivalve larvae. Positive relationship between the content of protein of microalgae and growth of bivalves juveniles has been reported (Knauer & Southgate, 1999). Next, carbohydrate was important role in bivalve for balancing the consumption at protein and lipid for biosynthesis against their production of energy by catabolism. Microalgae known to support best growth of bivalves that shown considerable variation in their carbohydrate contents, varying from 5 to 30% of their dry weight. Lastly, lipid was importance as a source of energy for the early stages of bivalves.

4.1.2 Movement of Asian Clam

From the table 4.2 the percentages (%) mean movement (mm) of Asian Clam is highest in replication 2 which is 1.48 ± 0.86mm while compared to replication 1 and replication 3 which are 1.39 ± 0.81mm and 1.40 ± 0.82mm. However, there is no significance difference for all the replications.

Table 4.2: Table shows the Percentage (%) mean of movement (±s.d.) for Asian clam (*Corbicula fluminea*). The data has no significance difference

Replication	Percentages (%) mean movement of Asian Clam (mm) (±s.d.)
1	1.39 ± 0.81
2	1.48 ± 0.86
3	1.40 ± 0.82

*the data was rescale times by log

From the graph below the mean of movement increase from 98.66mm on week 1 to 102.33mm on week 2 but decrease suddenly to 96.31mm on week 3 and increase to 110.20mm on week 4. The trend of graph shows that there is slightly increase on second week but drop suddenly on week 3 and increase back for the rest weeks. The data used a cumulative mean from all replicates for each week.

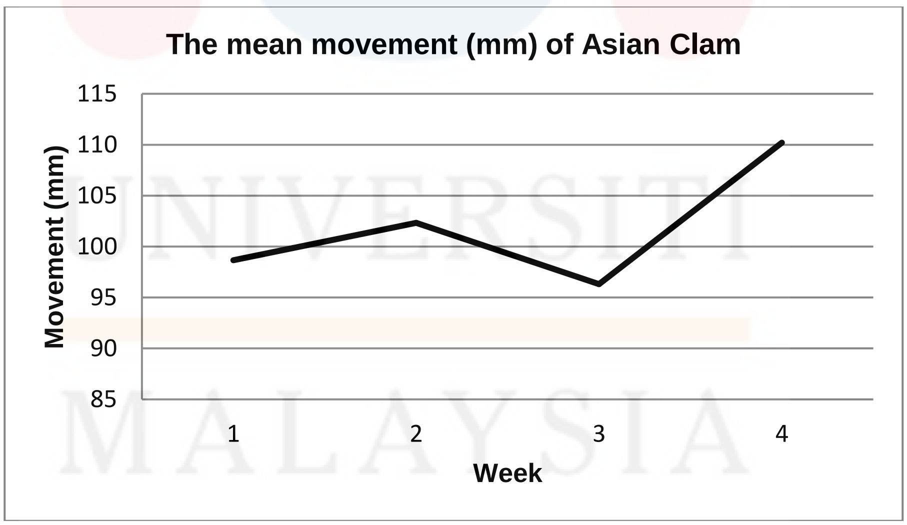

Figure 4.2: the graph shows the movement (mm) of Asian Clam (*Corbicula fluminea*) for 4 weeks**.**

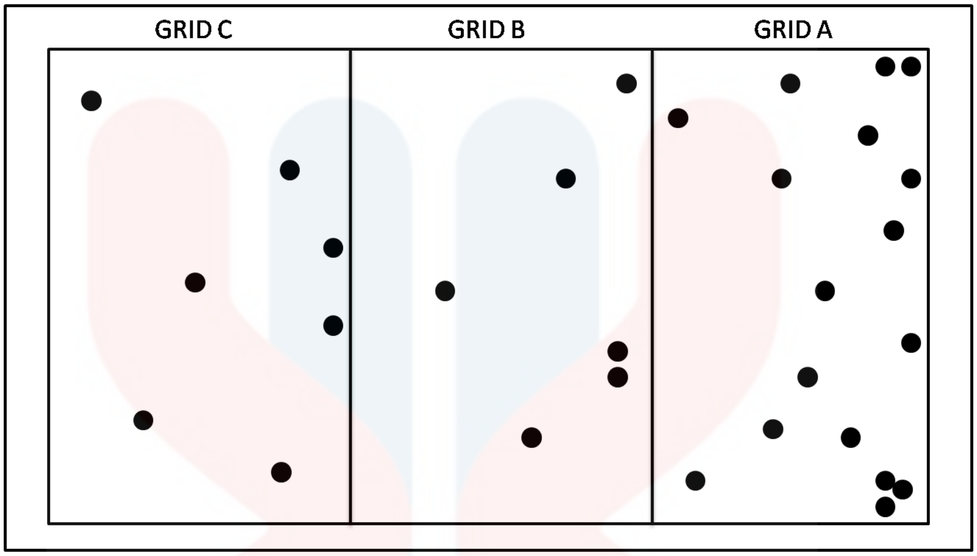

Figure 4.3: The movement of Asian clam from starting at Grid A in cultured tray

Based on Table 4.2, the highest percentages (%) mean movement (mm) of Asian Clam is 1.48 ± 0.86mm and the lowest is 1.39 ± 0.81mm has no significance different between all replication. From graph (Figure 4.2) shown the positive result of the movement (mm) of Asian clam for four week of experiment period. The total of movement was considerable that treated quail dung can be factor of the movement of Asian clam. In this experiment, the feeding of Asian clam was focus on pedal feeding or deposit feeding. Horizontal movement was enhanced when forced was generated by valve through rapid contraction while crawling occurs due to retention of the ciliated foot (Huang et al., 2007). Asian clam special adaptation in surroundings is ability to supplement its filter feeding with deposit feeding, or directly ingestion of organic material from sediment. This is an important adaptation for Asian clam because filter-feeding by itself was not sufficient to provide enough nutrients to fully support the metabolism of Asian clams (Boltovskoy *et al.,* 1995). Compared from filter feeding for juvenile mussels, pedal feeding have shown rapid growth when access to feed in sediment (Hudson & Isom, 1984; Yeager *et al.*, 1994; Gatenby *et al.*, 1996). Besides using pedal feeding to treated quail dung, other factors that affect the movement of Asian clam is temperature, stressful, and predation.

Refer to Figure 4.3; Clumping of Asian clam was occurred at the grid A because the movement toward one another by the presence of chemical signaling between clams (Huang *et al.,* 2007). Clumpiness between Asian clams, especially chemotactic attraction, may affect the formation of dense clumpiness by movement toward one another (Côté & Jelnikar, 1999). Based on the result, theoretically the random walk of Asian clam from grid A to grid C might be to find the source of food provided. At grid A, some of individual burrowing itself into sediment and remains static to feeding by using filter feeding because in closed system, water are circulated every day. The result of movement of Asian clam are not influenced by water current because theoretically if the result influenced or effected by water current, the final point of Asian clam all should be at Grid C.

At grid C, minimum 6 out of 30 (20%) individual every week for each replication was used pedal feeding to take nutrient provided while others was clumping or random walks and took from particle at surrounding by using filter feeding.

4.1.3 Mortality of Asian Clam

From the table 4.3 the numbers of samples are 90 for all three replicates. The percentage (%) mean mortality rates (±s.d) along the experiments are 4.44 ± 4.16 and the percentage (%) mean survival rates (±s.d) are 95.56 ± 4.16.

Table 4.3: Table shows the percentage (%) number of mortality and survival of Asian Clam (*Corbicula fluminea*) for all replicates

The percentage (%) mean of mortality of Asian clam (±s.d)	The percentage (%) mean of survival of Asian clam (±s.d)
4.44 ± 4.16	95.56 ± 4.16

The graph in the figure 4.1.3 shows that the percentage of mortality rate is the highest in replicate 1 which is 10%. While in replicate 2 only 3.33% and replicate 3 was zero mortality rates that is 0%

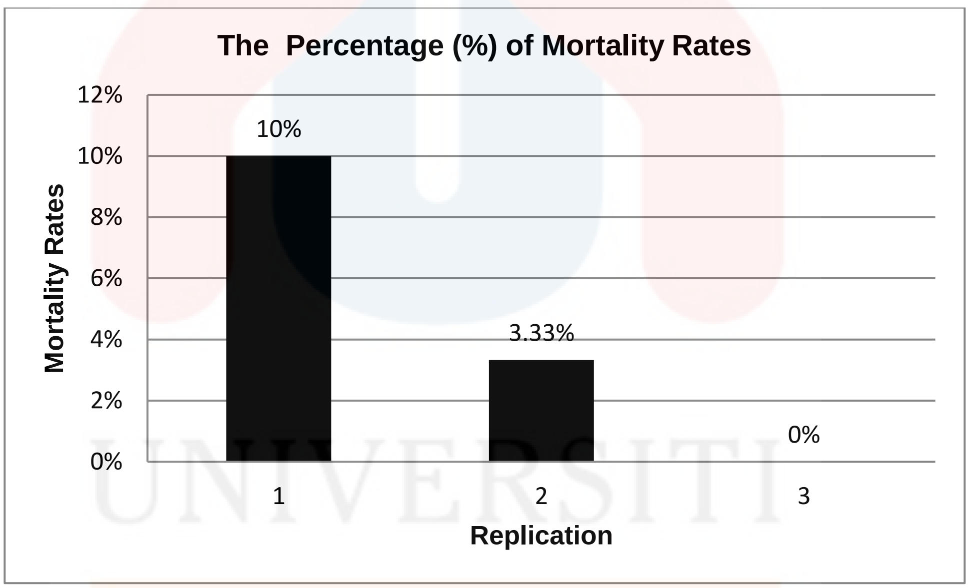

Figure 4.4: The graph shows the percentage of mortality of Asian Clam (*Corbicula fluminea*) along four weeks of the experiment.

During experimental period, the total number of mortality of Asian clam was four individuals from 90 samples (Table 4.3). The percentage (%) mean of mortality of Asian clam (±s.d) are 4.44 ± 4.16. With the lowest mortality rates, it shown that treated quail dung was not harmful to Asian clam. The lowest clam mortality rate was discoverd with organic matter present in the stream (Turek, 2013). It also mentioned that clams in trays with organic matter shown more better condition than compared to with no organic matter. So, the organic matter in sediment was increase the survival rate of Asian clam. In addition, environmental condition can affect the mortality of Asian clam such as siltation, extreme high or low temperature and low dissolved oxygen in water body (Cherry *et al.,* 2005). The study conducted by Wittmann *et al.* (2012), they observed that high concentration of Ammonim ($NH4^+$) mixed with low DO capacity was increased the clam mortality rate. From previous studies, they was stated the low food amount and quality, linked with higher water temperatures will trigger the mortality of clam (McMahon 2002, Ilarri *et al.,* 2011).

In this experiment, environmental condition was frequently monitored to make sure the favourable condition for growth of Asian clam. Along the experimental period, the range of pH is 7.55 ~ 7.86, dissolved oxygen range is 78.9 ~ 87.3 mg/L, salinity range is 0.01 ~ 0.02 ppt and temperature range is 27 – 28 ^oC respectively for all experimental tanks. All of the parameter might be become the main factor of high survival rates of Asian clam in this experiment.

4.2 Correlation between Weight and Movement

Based on the table 4.2 the correlations between percentages (%) mean growths in weight (g) increment and percentages (%) mean movement (mm) for Asian Clam (*Corbicula fluminea*) is 0.330. The result shown a weak correlation between mean growth in weight (g) and movement (mm) because the weight and movement significantly correlate at the $p<0.01$. Any movement (mm) of Asian clam either growth in weight (g) are not strongly influenced by one another.

Table 4.4: Table shows correlation between percentages (%) mean growths in weight (g) increment and percentages (%) mean movement (mm) for Asian Clam (*Corbicula fluminea*).

		Gram	Mm
Gram	Spearman's rho	1	.330
Mm	Spearman's rho	.330	1

Based on this experiment, the movement of Asian clam was caused by pedal feeding toward source of food (Grid C) and influence in increasing weight. Pedal feeding will affect the reduction of foot size thus the clams can enlarge the size of shell (Uryu et al., 1996; Waller et al., 1999). End of the experiment, the different of nutrient uptake by individual can be seen through total of weight increment in Asian clam between Grid C compare with others.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

From this study, the weight increment (g) of Asian clam after fed with treated quail dung was positively increased along the experiment and only decrease slightly on week 2. The result of movement of Asian clam also shows the positive result that means the samples was moved to food sources. For the Spearman's rho correlation, the weight (g) increment and movement (mm) are correlated to each other but the correlation between these two parameters is low (0.330). Therefore, growth in weight (g) and movement (mm) of Asian clam was influenced by each other but small number of sample data makes the result too weak. As a conclusion, treated quail dung used as feed for Asian clam is favorable to the growth and it's not harmful since high the percentage (%) mean of survival of Asian clam (±s.d) that is 95.56 ± 4.16.

Based on the present study, the number of sample should be increased to set more valid data. This close system farming is very good too maximize the production of Asian clam compare to natural resources. The research need to monitor every day because Asian clam always move from starting point until it favorable are that have source of food and good surrounding factor like pH and temperature. Lastly, this research to compare with control group that mimic the natural habitat.

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APPENDIX A

Table A.1: Descriptive table for weight increment (g) and movement (mm).

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum
gram	1	146	1.25956	2.753465	.227878	.80917	1.70996	-5.200	16.364
	2	148	1.26897	2.678977	.220211	.83378	1.70416	-5.753	11.783
	3	150	.96123	2.389475	.195100	.57571	1.34675	-5.505	8.333
	Total	444	1.16191	2.608457	.123792	.91862	1.40520	-5.753	16.364
mm	1	146	1.3860	.81384	.06735	1.2528	1.5191	.00	2.71
	2	148	1.4784	.85556	.07033	1.3394	1.6174	.00	2.75
	3	150	1.3988	.81873	.06685	1.2667	1.5309	.00	2.64
	Total	444	1.4211	.82874	.03933	1.3438	1.4984	.00	2.75

Table A.2: One-way ANOVA for weight increment (g) and shell length increment (mm).

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
gram	Between Groups	9.130	2	4.565	.670	.512
	Within Groups	3005.064	441	6.814		
	Total	3014.193	443			
mm	Between Groups	.741	2	.370	.538	.584
	Within Groups	303.517	441	.688		
	Total	304.258	443			

Table A.3 Spearman's rho correlation table for weight increment (g) and movement (mm).of Asian clam

Correlations

			gram	mm
Spearman's rho	gram	Correlation Coefficient	1.000	.330**
		Sig. (2-tailed)	.	.000
		N	444	444
	mm	Correlation Coefficient	.330**	1.000
		Sig. (2-tailed)	.000	.
		N	444	444

**. Correlation is significant at the 0.01 level (2-tailed).

APPENDIX B

Figure B.1: Samples of Asian Clam marked with individual identification numbering.

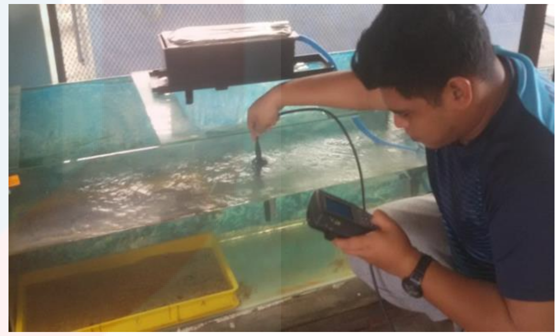

Figure B.2: Monitoring water parameter by using YSI Pro Plus Multi-Parameter

Figure B.3: Measuring the movement of Asian Clam by using measuring tape.

Figure B.4: Asian clam collected during sampling at Sungai Pergau

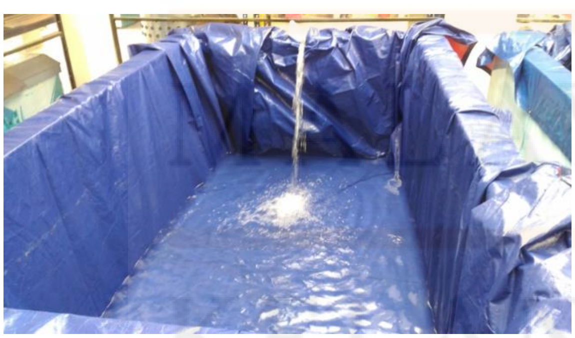

Figure B.5: Holding tank for acclimatization of Asian clam

Figure B.6: Sampling of Asian clam at Sungai Pergau