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STUDY OF THE DEVELOPMENT OF FRESHWATER TAIWAN'S MUSSELS (*Anodonta woodiana,* LEA) LIVING IN TROPICAL AREA

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Abstract

Bivalve *Anodonta woodiana,* Lea is one of economically freshwater mussels. It has high economical value as a sources of animal protein. All these years, it relays on natural catching. For a sustainable resource management, a controlled aquaculture technique should be used to produce the seed. The success of aquaculture requires the availability of information about reproduction and gonad development, especially ovary and gonad somatic index (GSI). The aims of this research is to analyse ovary development of female Taiwan mussel*.* Sample of this research was taken randomly, consisted of 30 individuals for gonad maturity level observations, meanwhile 107 individuals were used to measurethe gonado's somatic index. The results of this research suggested that gonad maturity levels of Taiwan mussel consisted of 5 levels, namely primodium, developing, maturing, ripe and spent. Average values of gonado somatic index for immature Taiwan mussel and mature Taiwan mussel were 3.46 ± 1.46% and 6.00 ±2.29 %, respectively.

Key words: *Anodonta woodiana, gonado maturity levels, gonado somatic index (GSI).*

INTRODUCTION

Taiwan mussel (*Anodonta woodiana*, Lea) is a freshwater mussels of the family of Uniodidae, commonly consumed as a source of food by local community. These animals have the potential to economically beneficial because the meat is a source of protein for humans (Suwignyo, 1975; Suharjo et al., 1977). Moreover, Taiwan mussels can be used as animal food, and in the button industry and in pearl production (Prihatini 1999) as well as inland aquaculture commodities (Suwignyo, et al.1981). The utilization of these animals relay on natural catchment. Rapid utilization of the animal without an appropriate seeding effort would threaten its'sustainability.

The success of Taiwan mussel seeding really depends on our understanding of the reproductive aspects and an important factor to note is the development of its gonad. In the reproduction process, prior to the spawning, the metabolism is largely focused on the gonad's development.

Information about the characteristics of taiwan gonad development is rarely found. This study aimed to determine the level of female Taiwan mussel ovary development. The results from this study were expected to provide information about the ovarian development of female Taiwan mussel in the tropical area.

MATERIALS AND METHODOLOGY

This study was carried out from May to September 2010 in the Laboratory of Genetics and Reproduction, Department of BDP, Faculty of Fisheries and Marine Science, IPB. Preparation of gonad histological preparations was performed at the Laboratory of Pathology, Department of Clinic, Reproduction and Pathology, Faculty of Veterinary Medicine, IPB.

Samples were taken randomly from sites Cisaat, Sukabumi as many as 30 individuals were used to observethe gonad maturity level, while for gonad maturation index (GMI) 107 individuals were used. The individual mussel collected was weighted then dissected and then the dissected muscle gonad was weighted. Furthermore,the gonad was taken then fixed in a fixative solution using boiun solution, then histological preparation were made and colored with heamotoxilin-eosin dyes. The development of female gonads was followed by observing the process of oogenesis occur in ovarian tissue (follicles) using a microscope. According to Morton (1982), the gonad development was divided into five stages, namely: The beginning (primodium), developing (developing), maturation (maturing), mature (ripe) and empty (spent). In addition to female mussels, primary oocytes diameter was measured with a micrometer. Primary oocyte measured was primary oocyte that separated from the folikel wall and the core was visable. The Gonad Somatic Index (GSI) was calculated using the equation adopted from Effendie (1979):

$$GSI = \frac{Wg}{Wt} \times 100$$

Where: GSI = Gonad Somatic Indes (%)
Wg = Gonad wet weigth (g)
Wt = Total wet weigth (g)

RESULT AND DISCUSSION

The sex on the mussel was separate or dioecius. Determination of sex type was externally difficult either internally or externally. Analysis of the level of development of the Taiwan mussel gonads can not be done visually as the gonads covered by a layer of skin ,muscle tissue covered the gills and within the shell firmly closed. If the shell was opened and entire visceral mass was removed, it would kill the shell. The clam gonad developmental level can only be made histologically. Gametogenesis

process continue through out the year in both male and female individuals. In a gonad, various stages of the gonad development occured, microscopic determination to categorize it into one of the stages of development may not be appropriate. Therefore, microscopic analysis of the egg development was required. Picture of the level of development of the gonads or ovaries macroscopically or MLO maps microscopically based on the closing of gamete cells in cells on the ovaries. Furthermore,the determination of MLO following the instructions was pointed out by Morton (1982).

Maturity Level of Ovari(MLO).

From the sample of oocytes at each stage characterized by the appearance of the nucleus,cytoplasm, yolk granules and fat, the data showed the relationship between the diameter and oocyte developmental stages as shown in Table 1.

Table.1. The female Taiwan mussel ovary developmental stage.

Oocyte stage	Diameter (µm)	Characteristic
0	< 30	- Unobservable
I –Primary Gametogenesis	30-40	- Oocytewith little or no yolk
II - Developing	40-90	- Gonad growing bigger - Folicle containing little oocyte
III-Maturing	80-100	- Maturing ovary identifiable - Developed oocyte and having special tools to stick on folicle wall.
IV-Ripe	100-275	- Riped ovary distingushable. - Ovari covered by oocyte forming a big ball, each has nuclleus dan nucleolus, and cytoplasm rich with yolk.
V-Spent	110-275	- Ovary just removing its content (empty) - Folikel left on ovary with less oocyte production, little ripe ova on the lumens. - Necrotic materials seen on lumina tubuli seminiferous and lumina ovary.

From histological observation of ovary and the oocyte size developmental stadium (Table 1), the maturity levels of ovary (MLO) was made based on the criterions suggested by Morton (1982), as shown on Table 2.

Table2. The female Taiwan mussel maturity levels of ovari (MLO)

MLO	Histological Characteristics
I Primodium	Level of primodium (Figure 1) - The egg cells begun to develop - Follicle containing small sized egg cells and unriped oocyte begun to fell the inner wall of the folicel. - The oocyte connector filled the lumens.
II Developing	Active phase of gametogenesis to almost ripe (Figure2): - The follicle wall surrounded by elongated oocyte - Unriped oocyte, peduncle in form inside the follicle, some showing nucleus and nucleolus - Free oocyte in poligonal form with yolk and nucleolus
III Maturing	Maturing levels (Figure3) : - The lumen follicles begun to be filled byfree oocyteand connecting oocyte in ova polygonal forms. - Most follicles filled by free oocytes with yolk and nucleolus.
IV Ripe	Ripe levels (Figure4) : - Ovary filled by oocytein big rounded-forms, having nucleus and nucleolus, as well as cytoplasm rich of yolk. - Follicles uniting - Follicles mostly filled by free oocytes with yolk and nucleolus.
V Spent/Rest	The breeding until rest/spent time (Figure5) : - Decreasing of the number of eggs - Follicles were flatted, some empty - Lumens filled with free oocyte recidues - Spent, empty lumens

Ovaries obtained from the sampling appeared in stage I consideredas early gametogenesis. At this stage,the ovaries showed that the egg began to develop. It was characterized by follicles containing immature oocyte containing ooginia and proliferating on the wall of the

follicle. The follicle wall was filled with oocytes that were round with an average diameter size of 47.5µm (Fig.1).

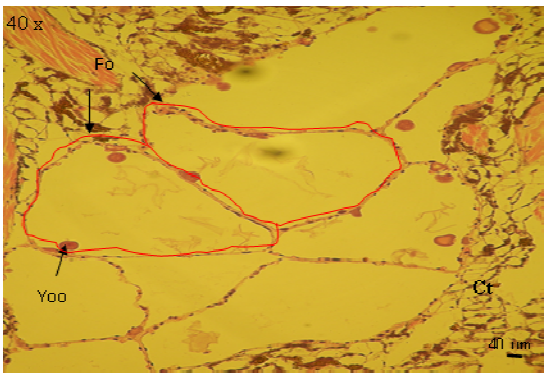

Figure 1 Taiwan mussel ovari (*A. Woodiana*) on early stage (MLO I). Remarks: Fo: Follicle; Ooy: Young oocyte; Ct: Connective tissues

At MLO stage was II, stage is relatively immature. It was characterized by follicles containing immature oocyte ooginia and the proliferating filled along the inside wall of the follicle and the presence of fewer mature oocytes. In phase II MLO, lumen follicles began filled with free oocytes and connective oocyte, in ova-polygonal shaped with an average diameter of oocytes measuring about 92.85 µm. The walls were mostly surrounded by follicular oocytes and some were elongated nuclei and nucleoli appeared. At this stage , connecting oocytes began to fill the lumen of the follicle (Figure 2).

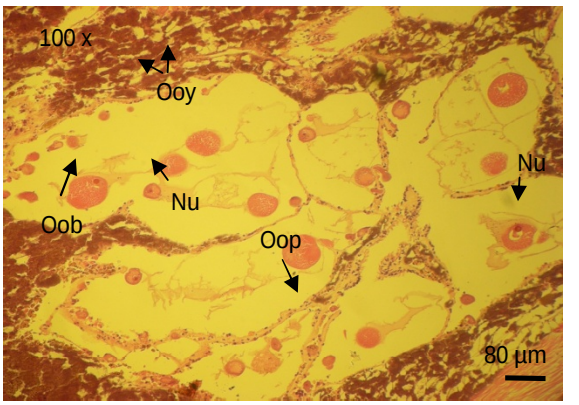

Figure 2 Taiwan mussel ovary (*A. Woodiana*) on development stage (MLO II). Remarks: Nu: Nuclei; Ooy: Young oocyte; Oof: Free oocytes ; Ooc: Connective oocyte

In stage III, the follicle lumen was filled with free oocytes and large-round connectivy oocytes with an average diameter of oocytes measuring about 145.86µm (Figure 3). At this stage the oocyte had grown and had special toolsto attach to the wall of the follicle.

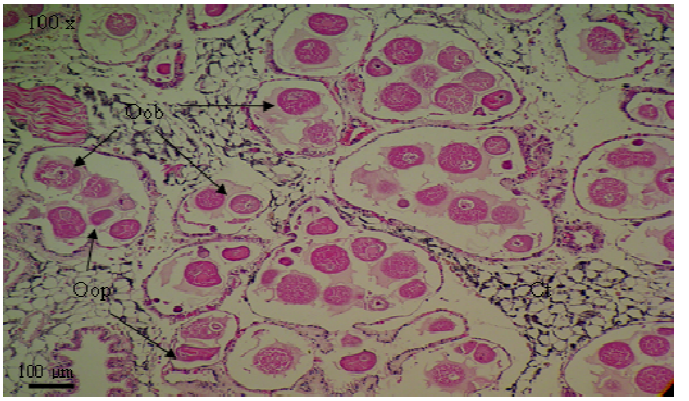

Figure 3 Taiwan mussel ovary (*A. Woodiana*) on riping stage (MLO III). Remarks: Oof: Free oocyte; Ooc: Connective oocyte; Ct: Connective tissues

On stage IV, ovary was filled by oocytes in big-ball forms, having nuclei and nucleioli as well as cytoplasm rich with yolk. The average oocyte diameters was around 218.54 µm (Figure 4).

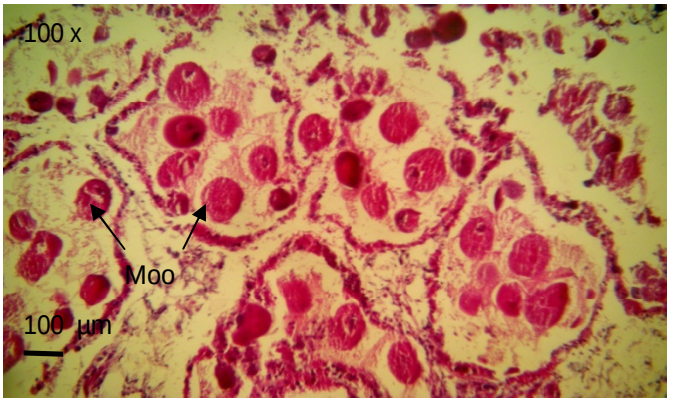

Figure 4 Taiwan mussel ovari (*A. woodiana*) on riping stage (MLO IV). Remarks: Moo = Mature oocyte; Si= Sitoplasm; N= Nuclei; Y= Yolk globune

On stage V, ovary had released its contents, only follicles with few oocytes remained left ripe on the lumens. The average oocyte diameter was around 261.66 µm (Figure 5)

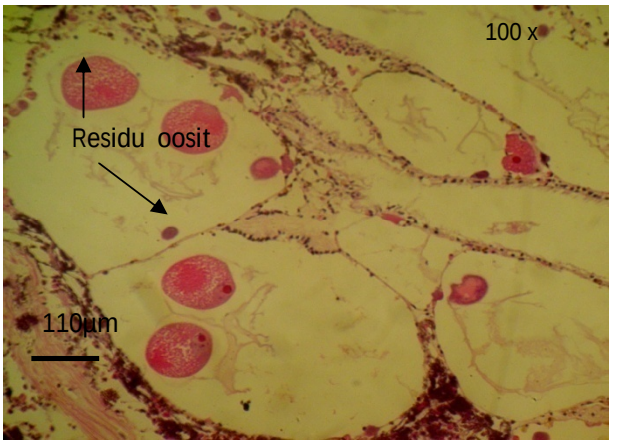

Figure 5 Taiwan mussel ovari (*A. woodiana*) on spent stage (MLO V). Remarks: Yg = Yolk globune; Si= Sitoplasm; N= Nuclei

Gonad Somatic Index (GSI)

This indexis a good indicator to see reproductive activity, because it revealsa close relationship with the reproductive activity of the Taiwan mussel. It is a major distinguishing mark of the gonad maturity based on the weigth. Naturally it is related to the size and weight. This study used the term"Gonad Somatic Index, GSI" as a measurement of the gonads activity. GSI (Gonad Somatic Index) used was the ratio of gonad weight to the body weight in percentage. This value will increase and will reach a maximum at the time of spawning.

GSI is a quantitative method which is useful in estimating reproductive activity. Despite the weakness of this method that is to befollowed by testing of the gonads microscopically,so the indication of developmental maturity level or whatever happened in the gonads would be defonitely known. As well as the GSI values obtained from mussel without incubating larvae was lower than that obtained from mussel incubating larvae, as shown in Table 3.

Table 3 The value of gonad's maturity index of taiwan mussles (*A. woodiana*) hatching the larvae and not hatching the larvae.

Statistic	Not hatching glokidia			Hatching glokidia		
	Gonad wet weight (g)	Total wet weight (g)	GSI (%)	Gonad wet weight (g)	Total wet weight (g)	GSI (%)
Average	1.43	44.63	3.46	3.20	48.99	6.00
SD	0.61	16.47	1.46	3.19	34.11	2.29
Minimum	0.53	10.80	1.16	0.26	6.52	1.60
Maximum	2.60	96.16	6.57	14.43	140.15	13.46

Among the 107 individuals observed, the average value of GSI on the unriped Taiwan mussel was 3.46% with a standard deviation of 1.46%, whereas in the mature mussles ranged from 6.00% with a standard deviation of 2:29%. Here we can see that the condition of the maximum value (GSI = 13.46%) was a condition in which the gonads was during spawning. The highest GSI values obtained when mature stem showed an increase in reproductive activity. This is evident by the finding that the gonads were at mature developmental stage (incubating glokidia). For species which have little nutritive tissue in the gonads, such as pearl oysters, increasing value of GSI interpreted as the process of gametogenesis, and the decline is interpreted as spawning (Giese, 1959 in Saucedo and Monteforte 1997). It is recommended that for Taiwan mussel, the histological and gonad somatic index measurement may used to determine the over all pattern of reproduction.

CONCLUSIONS

The results of this research suggested that female Taiwan mussel gonad maturity consisted of five level sand the average value of GSI on the unriped Taiwan mussel was 3.46% with a standard deviation of 1.46%, whereas in the mature mussel, GSI was 6.00% with a standard deviation of 2.29%. Conditions of maximum value (GSI = 13.46%) was a condition in which the gonads during spawning. The highest GSI values obtained when mature stem shows an increase in reproductive activity.

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