GONADAL DEVELOPMENT AND SPAWNING FREQUENCY OF TILAPIA (*Oreochromis niloticus*) THAT FEEDED BY VITAMIN E SUPPLEMENTATION [Perkembangan Gonad dan Performa Pemijahan Induk Ikan Nila (*Oreochromis Niloticus*) yang diberi Pakan dengan Penambahan Vitamin E

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ABSTRAK

Vitamin E merupakan salah satu mikronutrien penting yang berpengaruh terhadap performa reproduksi ikan. Penelitian penambahan vitamin E dalam pakan induk ikan nila *(Oreochromis niloticus)* bertujuan untuk mengetahui pengaruh vitamin E terhadap perkembangan gonad dan performa pemijahan induk ikan nila. Pakan uji yang digunakan adalah pakan formula dengan kadar protein 35% dan lemak 10% ditambahkan vitamin E (tingkat kemurnian 50%) dengan dosis A) 0, B) 75, C) 150, D) 225, E) 300 and F) 375 mg/kg pakan (kontrol). Induk ikan nila umur 6-7 bulan sebanyak 180 ekor dipelihara dalam 6 jaring ukuran 3x3x1,5m yang diletakkan dalam kolam 6000 m^2 dengan kedalaman air 80 cm. Masing-masing jaring diisi dengan 20 ekor induk betina dan 10 ekor induk jantan dan dipelihara selama 13 minggu pada bulan September sampai dengan November 2011. Hasil penelitian menunjukkan bahwa penambahan vitamin E pada pakan induk ikan nila memberikan nilai indeks gonad somatik lebih tinggi dibandingkan yang kontrol. Penambahan vitamin E sebanyak 225 mg/kg pakan memberikan nilai persentase induk matang gonad yang tertinggi (80%) dan frekuensi pemijahan yang terbanyak yaitu 22 kali selama masa pemeliharaan 13 minggu. Berdasarkan hasil penelitian yang diperoleh dapat disimpulkan bahwa penambahan vitamin E sebanyak 225 mg/kg pakan dapat meningkatkan perkembangan gonad, jumlah induk betina yang matang gonad, persentase total pemijahan dan frekuensi pemijahan pada induk ikan nila.

Kata kunci : vitamin E, frekuensi pemijahan, induk ikan nila, perkembangan gonad.

ABSTRACT

Vitamin E is one of important micronutrient that influence the performance of fish reproduction. The purpose of the study was to know the effect of vitamin E on the gonadal development and spawning frequency of tilapia broodstock. The test diet was formulated containing 35% of crude protein and 10% of crude fat respectively. The feed formula was supplemented with vitamin E (level of purity 50%) as much as A) 0, B) 75, C) 150, D) 225, E) 300 and F) 375 mg/kg feed. One hundred eighty fishes (6-7 months of age) were used in the study and held in 6 nets in 6000 m^2 pond and water level on 80 cm. Each net was stocked with 20 females and 10 males of fish and keep for 13 weeks on September until November 2011. The result of the study showed that supplementation vitamin E in tilapia feed gave higher value of gonado somatic index than tilapia broodstock without supplementation of vitamin E in feed. The result also showed that supplementation vitamin E as much as 225 mg/kg feed gave the highest percentage of maturation (80%) and the highest value of spawning frequency on female tilapia (22 times during 13 weeks of maintenance). Based on the evaluation in those parameters it was concluded that supplementation of α-tocopherol up to 225 mg/kg can be useful for improving gonadal development, the number of mature female, percentage of maturation and value of spawning frequency on female tilapia.

Key words*:* vitamin E, gonadal development, spawning frequency and tilapia broodstock.

INTRODUCTION

Feed is one of the factor that affect the performance of fish broodstock reproduction. Good quality and high nutrient content of feed are needed to improve reproduction activity and to obtain the better performance of broodstock. El-Sayed *et al*. (2003) reported that tilapia broodstock require 35-45% dietary protein for optimum reproduction, spawning efficiency, and larval growth and survival. For supporting breeding program, it is needed the tilapia broodstock that have better performance of reproduction in order to produce good quality fry.

Generally, information about nutrition requirement for fish is only about macro nutrient like protein, fat and carbohydrate whereas micronutrient requirement such as vitamin and mineral is limited. Several vitamins and minerals are important for fish reproduction. Researches showed that the feed quality, including micronutrient, is important factor that having an affect on gonadal maturity, fecundity, quality of egg and larvae (Watanabe, 1988).

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Vitamin E (α–tocopherol) was originally considered as a dietary factor of animal nutrition, which has a role in reproduction. In aquaculture, vitamin E was used for the fortification of feed to improve the growth, resistance to stress and disease as well as for survival of fish and shrimp (Vismara *et al* 2003). As in higher vertebrate, vitamin E deficiency was affects to reproductive performance, causing immature gonads and lower hatching rate and survival of offspring (Izquierdo *et al* 2001). Vitamin E is one of micronutrient that is important for fish feed and had important roles in growth process, reproduction and fish health (Sealey and Gatlin, 2002; Hunt *et al*., 2004). Gammanpila *et al.,* (2007) also reported that vitamin E is one of important micronutrient that influence the performance of fish reproduction. Increasing level of vitamin E in feed will improve success of spawning, fecundity and hatching rate, survival rate of larvae, gonado somatic index and vitellogenesis (Watanabe and Takashima,1977; Kanazawa, 1985). Watanabe (1985) showed that there is increasing content of vitamin E in egg of female broodstock after spawning and decreasing in tissue. It is expected that vitamin have many functions or roles physiologically on spawning process, fertilization and hatching. The greatest activity of vitamin E in animal plasma and tissue is in α–tocopherol form. During the spawning process, α–tocopherol will be distributed to oocyte adipose tissue (Machlin, 1990).

Verakunpiriya *et al* (1996) reported supplementation of vitamin E 200 mg/kg on yellow tail broodstock feed gave the highest value of fertilization, hatching rate and number of larvae. The dietary vitamin E requirement of tilapia broodstock was 100 -200 mg/kg feed (Gomez-Marquez *et al.,* 2003). Result obtained in Darwisito *et al*., (2006) showed that supplementation of 150 mg/kg feed vitamin E and 30 g/kg feed fish oil stimulated gonad development and increased fecundity, hatching rate and survival rate of Nile tilapia larva. The dietary vitamin E requirement of tilapia was reported to be 50 to 100 mg/kg of diet for a diet containing 5% of lipid, increasing to 500 mg/kg of diet for a diet containing 10 -15% of lipid (Satoh *et al.,* 1987)

Base on the above information, the objective of the research was to know the effect of vitamin E on the gonadal development and spawning frequency of tilapia (*Oreochromis niloticus*) broodstock. Result of the study can be used as a reference in determining optimal dosage of vitamin E to improve gonadal development and spawning frequency of tilapia broodstock.

MATERIALS AND METHODS

The study was conducted in tilapia hatchery and pond at research institute of fish breeding. One hundred eighty fishes (6-7 months of age and 561.76 ± 104.28 g of weight) were used in this study and held in 6 nets in 6000 m^2 pond. Each net was stocked with 20 females and 10 males (Khalfalla, *et al*., 2008) and keep for 13 weeks from September-November 2011. The tilapia broodstock was tagged during the observation of gonadal development and spawning frequency.

The test diet was formulated containing 35% of crude protein and 10% of crude fat. The formulated feed was supplemented with vitamin E (level of purity 50%) as much as A) 0, B) 75, C) 150, D) 225, E) 300 and F) 375 mg/kg feed. The feed composition and proximate composition of feed are presented in Table 1 and Table 2.

Fish were fed twice a day (07.00 AM and 04.00 PM) at a feeding rate of 3% fish body weight / day for 13 weeks (Watanabe, 1988). Observation of gonado somatic index and number of spawned broodstock was conducted per week. Percentage of maturation, total of spawning, percentage of spawning total and number of tilapia broodstock recovery was observed at the final of study. Observation of water quality was condected everyday at 06.00 AM and 05.00 PM. Formulas of the parameter observed is followed:

Gonado somatic index (GSI):

GSI (%) = 100 x Gonad weight (g)/Body weight (g) (Schreck dan Moyle,1990)

Table 1 Composition of test diet (%)

Composition (%)	**Diet**					
	A	**B**	**C**	**D**	**E**	**F**
Vitamin E (mg/Kg feed)	0	75	150	225	300	375
Meat Bone Meal	5	5	5	5	5	5
Fish meal	25	25	25	25	25	25
Soy bean meal	30	30	30	30	30	30
Polard	9	9	9	9	9	9
Rice bran	5	5	5	5	5	5
Copra meal	5	5	5	5	5	5
Tapioca	9	9	9	9	9	9
Corn meal	5	5	5	5	5	5
Vitamin mix	2	2	2	2	2	2
DCP*	1.5	1.5	1.5	1.5	1.5	1.5
Mineral mix	0.5	0.5	0.5	0.5	0.5	0.5
Corn oil	1.5	1.5	1.5	1.5	1.5	1.5
Fish oil	1.5	1.5	1.5	1.5	1.5	1.5
Total	100	100	100	100	100	100

*DCP : Dicalcium phosphate

Table 2. Proximate composition and vitamin E (*α-tocopherol*) content of the reference and test diet (percent in dry weight)

	Diet					
Proximate composition (%)	A	B	C	D	E	F
Protein	36.13	35.85	35.83	36.09	35.95	35.52
Fat	9.47	8.72	8.67	9.79	8.17	9.16
Crude fiber	2.57	2.55	1.98	2.58	2.34	2.84
NFE	43.78	44.36	44.50	43.10	45.72	44.41
Vitamin E	12.33	15.99	56.42	66.35	82.26	87.25

NFE: Nitrogen Free Extract

Percentage of maturation (%) = (Number of mature female/Number of fish examined)*100
Percentage of spawning total (%) = (Total of spawning/Number of fish examined)*100

RESULTS

Gonado-somatic index is a very important parameter for understanding gonad development of fish. Result of gonado somatic index give a clear indication about the godanal development of tilapia (*Oreochromis niloticus*) as well as breeding season of fish. Data on gonado somatic index are presented in Figure 1. In this case the highest gonado somatic index was found in broodstock population fed with dosage 375 mg/kg of vitamin E followed by 75, 225, 300, 150 and 0 mg/kg at 13th week. The ANOVA test showed that there was no significant difference in gonado somatic index among the treatments at the end of the experiment (Table 3).

The profile of proportion of mature female (Table 4) showed that supplementation 225 mg/kg vitamin E in tilapia feed gave highest number of mature female and percentage of maturation. Observation of spawning frequency on female tilapia during this study also showed that supplementation 225mg/

Table 3. Mean values of gonado somatic index of female tilapia at 13th week

Dosage of vitamin E (mg/kg)	Gonado Somatic Index (%)
A (0)	1.42±1.02 [a]
B (75)	2.26±1.30[a]
C (150)	1.67±0.67 [a]
D (225)	1.62±1.18 [a]
E (300)	1.74±0.90 [a]
F (375)	2.83±1.19 [a]

Table 4. Proportion of mature female during the experiment

Dosage of vitamin E (mg/kg)	Number of fish examined (fish)	Number of mature female (fish)	Percentage of maturation (%)	Total of spawning (times)	Number of fish recovery (fish)
A (0)	20	11	55	14	3
B (75)	20	7	35	7	0
C (150)	20	14	70	18	4
D (225)	20	16	80	22	6
E (300)	20	15	75	20	4
F (375)	20	12	60	18	4

kg vitamin E in tilapia feed gave highest value of spawning frequency (Table 4).

The result of water quality analysis (Table 5) showed that range of water quality required for tilapia culture.

DISCUSSION

The result of this study showed that feed supplemented with 225 mg/kg vitamin E gave highest value of percentage of maturation and spawning frequency. The number of female mature and spawn on the supplementation 375 mg/kg vitamin E was decrease. Decreasing in reproductive performance of tilapia caused by excess vitamin E was supplemented. Gomez-Marquez *et al.,* (2003) reported that the dietary vitamin E requirement of *Oreochromis niloticа* broodstock was 100-200 mg/kg feed. Hypervitaminosis E results in poor growth, toxic liver reaction, and death (Watanabe *et al.,* 1970).

This study described that supplementation vitamin E affect on gonadal development, proportion of mature and spawning frequency of female tilapia. Feed supplemented with vitamin E up to 225 mg/kg can be useful for improving the number of mature female, percentage of maturation and value of spawning frequency. The research results were in agreement with these of Wilson *et al.* (1984) and He *et al.* (1992), who stated that vitamin E enhances gonadal development of fish and thus affect the reproduction positively.

The significance of vitamin E in fish reproduction was confirmed in earlier studies. In a study of the effects of vitamin E and growth hormone on gonadal maturity in the common carp (*Cyprinus carpio*), dietary vitamin E resulted in a higher gonadosomatic index, larger ova, and more eggs with higher hatchability than the control (Gupta *et al.,* 1987). Further, spawning was complete in fish fed a diet

Table 5. Water quality of tilapia pond culture

Parameters	Range of water quality					
	A (0)	sB (75)	C (150)	D (225)	E (300)	F (375)
Temperature (^oC)	29.80-32.90	29.80-32.90	29.90-32.90	29.80-32.80	29.90-32.90	29.90-33.00
pH	6.56-6.82	6.47-6.68	6.57-6.82	6.56-6.77	6.70-6.83	6.69-6.84
Disolved oxigen(mg/l)	1.19-7.12	1.03-7.32	1.02-7.15	1.10-7.56	1.14-7.29	1.05-7.54
Amonia/ NH_3 (mg/l)	0.08-1.10	0.08-0.97	0.08-1.18	0.08-0.98	0.08-1.19	0.08-1.02
Nitrit / NO_2^-	0.06-0.07	0.05-0.07	0.05-0.08	0.05-0.07	0.05-0.08	0.05-0.07

supplemented with vitamin E but partial in the majority of fish fed diets lacking vitamin E. Vitamin E is essential for fertility and reproduction in fish and fish cannot synthesize vitamin E, so the maternal dietary content of each prior to oogenesis is an important determinant of reproductive fitness (NRC, 1993). Increasing of vitamin E in the diet was also increasing spawning success, egg survival, hatchability and larval survival of Ayu (*Plecoglossus altevilis*), red sea bream (*Pagrus australis*), increasing the gonado-somatic index and vitellogenesis of common carp (*Cyprinus carpio*) (Watanabe and Takashima, 1977; Kanazawa, 1985) and big head carp (*Aristichthys nobilis*) (Santiago and Gonzal, 2000).

Watanabe (1985) showed that the vitamin E content is high in eggs and low in tissues of brood fish after spawning, suggesting some physiological function of this vitamin in spawning, fertilization and hatching. Gupta *et al.* (1987) observed higher gonadosomatic index, bigger ova and complete spawning in three major carps (*Labeo rohita*, *Catla catla* and *Cyprinus carpio*) by adding vitamin E in their diets. In addition, complete spawning occurred in fish fed a diet containing vitamin E, but only partial spawning occurred in the fish fed diets without vitamin E (Gupta *et al.*, 1987). In a different study, Sutjaritvongsanon (1987) reported that a mixture of 35% fish meal, 30% soybean, 20% corn meal, 15% rice bran and 10 mg/kg BHT plus 100 mg vitamin E/kg feed was suitable for stimulating the development of gonad and spawning in goldfish (*Carassius auratus*). Therefore, it seems that vitamin E requirement is species specific as far as its requirement is concerned in gonadal development and breeding performance of fish.

CONCLUSION

This research results showed that supplementation vitamin E (α-tocopherol) affected on gonadal development, proportion of mature and spawning frequency of female tilapia. Consider other way of expression vitamin E up to 225mg/kg can be useful for improving the number of mature female, percentage of maturation and value of spawning frequency.

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