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Utilization of Golden Apple Snail *(Pomacea canaliculata) S*hells as Liming Materials for Pangasius sp Culture in Swamp Fish Pond

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Abstract. Liming ponds is intended to increase swamp soil and water fish ponds pH. The golden apple snail (*Pomacea canalicuata)* is one kinds of agriculture pest which is potentially used as material of lime. The golden apple snail shells containing CaO (91.62%) and MgO (1.66%). This study aims to determine the best dosage of lime derived from golden apple snail shells to increase the pH of soil and water, as well as the survival and growth rate of catfish fingerlings. This study used Completely Randomized Design (CRD) with 5 treatments (4 treatments of different dosage of lime derived from golden apple snails and 1 treatment using calcite and 3 replications. The treatments used consisted of different dosages of lime : P1) 4 ton/ha; P2) 5 ton/ha; P3) 6 ton/ha; P4) 7 ton/ha and P5) calcite 6 ton/ha equivalent to CaO. The result showed that maximal pH value of P4 (lime derived from *P. canaliculata* 7 ton/ha) is almost same as pH of P5 (calcite 6 ton/ha) but P4 is faster to reach than that of P5. At the final day of research P4 has no significant different with calcite 6 ton/ha (P5) for alkalinity, fish growth and feed efficiency.

1 Introduction

The soil's pH of swamps is generally less than 5.9 [1] and water pH of swamps below 4 [2]. The downstream of swamp has pH value of water ranged from 4.7 to 5.6 [3]. Low soil and water pH retarted growth and reproduction eventually caused mortality of fish. [4].

Liming of ponds is intended to increase soil and water fish ponds pH value. Calcite and dolomite are widely used by farmers to increase soil and water pH. However, these limes are derived from natural and unrewenable lime mineral materials. Therefore it is a need to find an alternatve rewenable, domistic waste, or by-product material that can used as lime materials. *Anadara granosa* shells as an alternative liming materials is proven to increase soils and water's pH swamp catfish ponds [2]. *Pomacea canaliculata* (golden apple snail) is one of agricultural pest that the shells are potential to use as liming materials. The golden apple snail shell contain 91.62% CaO and 1.66% MgO. The aims of this research were to

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evaluate the potency of lime derived from *P. canaliculata* shells to raise soil and water pH of swamp fish ponds and to evaluate its effect to survival and growth of *Pangasius sp.*

2. Materials and Methods

The study was conducted from January to March 2018 at Field Experimental Station, Aquaculture Study Program, Faculty of Agriculture, Univesitas Sriwijaya, South Sumatera Province, Indonesia.

2.1 Preparing Lime Materials and Liming

P.canaliculata shells was activated by burning using furnace at temperature of 800°C for an hour,, then mashed and sieved with 60, 40 and 20 mesh-size sieves in order to get lime with 50 % passed 60 mesh-size sieve, 25 % passed 40 mesh-sized sieve, and 25 % passed 20 mesh-size sieve. Five liming treatments were investigated, namely: P1) 4 ton/ha; P2) 5 ton/ha; P3) 6 ton/ha; P4) 7 ton/ha and P5) calcite 6 ton/ha of lime equivalent to CaO. Lime derived from *P.canaliculata* shells and calcite were applied homogeneously on soil ponds and incubated for 7 days at field capacity soil moisture. Water was filled to the ponds and and let equilibrated for 3 days. Fish stocked on ponds and cultured for 60 days.

2.2 Fish Culture

Fiveteens fish ponds filled with 7.500 L swamp water at 7 days after liming. The three hundreds of 5 $\pm$ 0.5 cm length *Pangasius sp* were acclimatized in swamp water for one week before being used in the study. Then, every pond was stocked with 15 fish at 10 days after liming. The fish were fed to satiation three times per day with an artificial diet containing 40% protein. For 60 days of cultured period (starting at 10 days after liming), water samples were collected and analyzed, as well as growth of fish was measured every 20 days.

2.3 Experimental Variables and Analytical Procedurs

Water quality, survival and growth performance variables were observed in the present work. The water's pH, total alkalinity, and total ammonia were monitored every 20 day in all pond. Besides, water temperature and pH were recorded daily. The water pH was measured by using a portable pH meter. The water temperature was observed by using a digital handy thermometer. The analytical determinations of total alkalinity and total ammonia were carried out according to the guidelines presented by APHA [5]. The fish final body weight and length, survival and feed efficiency were observed in all experimental units.

Water quality, survival and growth performance results were statistically analyzed according to the two-way Anova to detect if there was any significant influence due to experimental treatments. When the influence was at least significant, the means were compared using Dunnet test with P5 as control for P1, P2, P3 and P4. The 5% significance level was adopted in all statistical analysis.

2.4 Data Analysis

The fish survival rate was calculated from the initial number of fish and mortality after the experiment was completed. The absolute growth of fish were determined from the mean of initial and final weight and length of fish, respectively for absolute weight growth and length growth. Meanwhile, feed efficiency was calculated by the formula as follows:

$$FE = \{(wt+D)-wo)/F)\} \times 100\% \quad (1)$$

Where : FE = feed efficiency
Wt = total final fish weight
Wo = total initial fish weight
D = weight of dead fish
F = total feed consumption

3 Results and Discussions

The initial Soil pH used in this current study was 3.66 and then soil pH increased due to liming to pH 7.01–7.63 after incubated for 7 days. Regression etween incubation time and pH of soil showed polynomial quadratic patern (Figure 1). Regression between days of culture and pH of soils showed polynomial quadratic patterns for all dosages of lime including calcite (Figure 2). It is showed that application of lime materials derived from *P.canaliculata* shell positively influenced pH of soils. The higher dosage of lime resulted the higher soil pH. Lime derived from *P.canaliculata* shells contained 91.62 % CaO and 21.65 % MgO. Reaction between CaO or MgO and H_2O produced $Ca(OH)_2$ or $Mg(OH)_2$ and eventually increased soil or water pH.

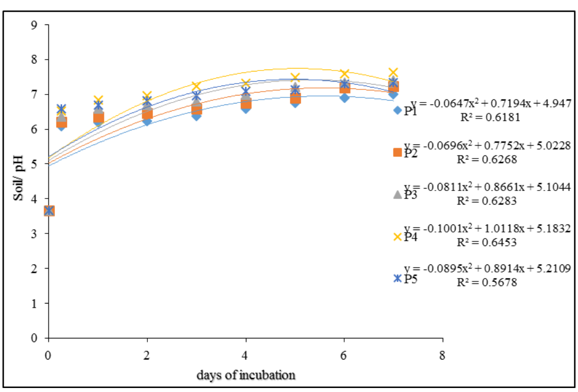

Fig. 1. Relationship between days of incubation with soils pH

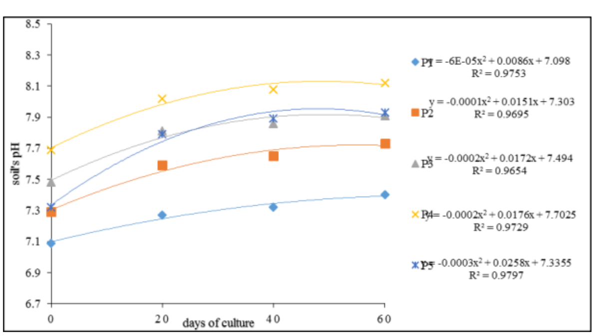

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Fig. 2. Relationship between days of culture and soil's pH

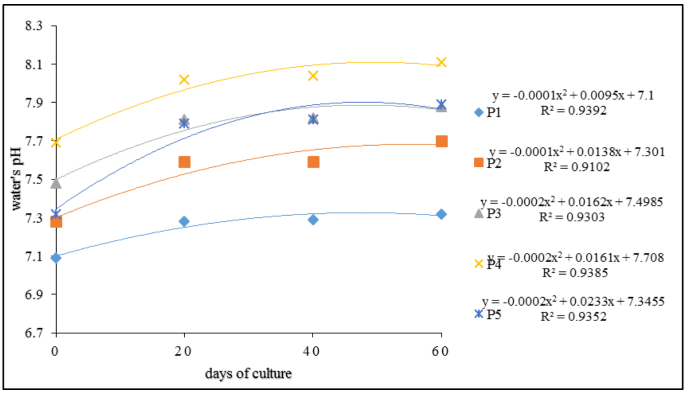

Fig. 3. Relationship between days of culture and water's pH

The initial water pH used in this research was 3.9, then water pH increased following polynomial quadratic patterns for 60 days of fish culture due to lime application (Figure 3). According to equations shown in Fig. 3, the maximum pH and days after lime application to reach maximum water pH can be calculated. The maximum water pH and when it is were 7.33 at 48 days after liming, 7.78 at 69 days after liming, 7.83 at 41 days after liming, 8.03 at 40 days after liming and 8.02 at 58 days after liming, respectively for P1, P2, P3, P4 and P5. The highest maximum water pH among treatments was observed on P4 (7 ton/ha lime derived from *P. canaliculata* shells) with maximum pH value 8.03 at day 40. Meanwhile calcite 6 ton/ha can reach almost same maximal pH value (8.02) but has longer time (58 days after liming) than lime derived from *P. canaliculata* dosage 7 ton/ha. Furthermore, based on the equations (Figure 3) and minimum water pH (6.5) for optimal growth of *Pangasius sp*, the next lime application should be considered after day, 128th and 144th for P4 and P5, respectively.

The water alkalinity increased with increasing of dosage of lime (Figure 4). Liming materials are used widely in aquaculture mainly to neutralize acidity in pond soil and water, to increase alkalinity and hardness of water, and to destroy disease carriers in soil [6]. According to Dunnet test (Table 1) showed that at day-0 of culture, the alkalinity of water of P2 (liming with 5 ton/ha lime derived from *P. canaliculata*) has no significant different with calcite 6 ton/ha (P5), but at day-20,40 and 60, the alkalinity of water of P3 (liming with 6 ton/ha lime derived from *P. canaliculata*) has no significant effect with calcite (P5). P4 (liming with 7 ton/ha lime derived from *P. canaliculata)* has highest alkalinity and significat difference from alkalnity of pond treated with calcite 6 ton/ha.

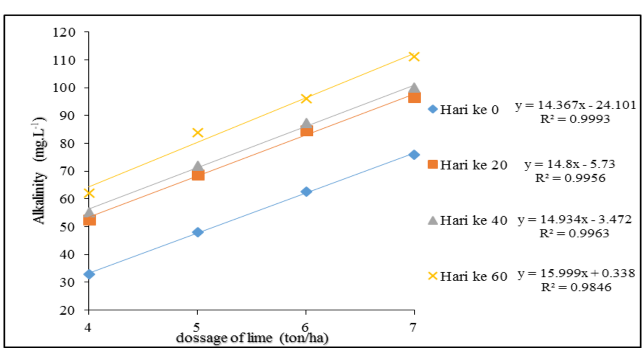

Fig. 4. Relatonship between dosage of lime and alkalinity

Table 1. Dunnet test result for Alkalinity of water

Treatments	Day-0	Day-20	Day-40	Day-60
P1	33.33*	52.67*	55.33*	62.00*
P2	48.00tn	68.67*	72.00*	84.00*
P3	62.67*	84.67tn	87.33tn	96.00tn
P4	76.00*	96.67*	100.00*	111.33*
P5	52.00	80.00	82.00	92.00

*) : significant difference with control (P5), tn : unsignificant difference with control (P5)

The water temperature and dissolved oxygen (DO) of ponds (Table 2) ranged from 27.8 to 32.1 ^{0}C and from 4.7 to 6.0 mg L^{-1}, respectively. All treatment showed that the ammonia concentration increased in the final day of research (day 60th of culture) (Figure. 5). The water temperature and dissolved oxygen of the ponds remained within the appropriate range for normal growth of juvenile *Pangasius sp* [7] ranging from 27ºC up to 30ºC for temperature and > 5 mg L^{-1} for dissolved Oxygen. No significant effect of lime application on dissolved oxygen at the end of rearing period was detected. Some data of temperatures the optimal value, and there were some of data DO less than optimum range but still in tolerance range for *Pangasius sp.* culture.

Table 2. Dissolved Oxygen range and Temperature

Variables	Treatments				
	P1	P2	P3	P4	P5
Temperature(ºC)	27.8-32.1	28.2-31.9	28.2-31.8	28.0-31.9	28.0-31.9
Dissolved Oxygen (mgL^{-1})	5.1-5.8	4.8-5.9	4.8-6.0	4.7-5.8	4.9-5.9

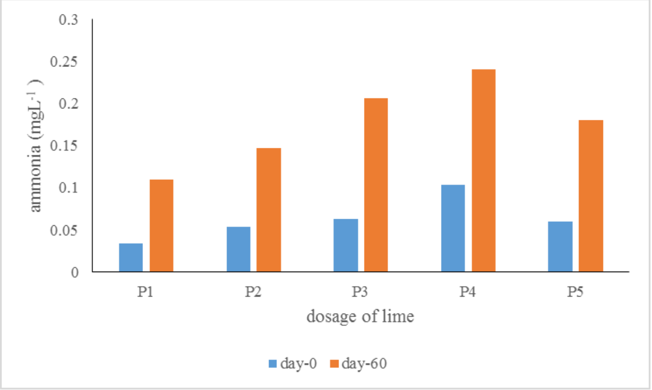

Fig. 5. Ammonia concentration in the initial (day 0 of culture) and final (day 60 of culture)

Table 3. survival, growth and feed efficiency of catfish

Variable	Treatments				
	P1	P2	P3	P4	P5
Survival (%)	100	100	100	100	100
Absolute growth of weight (g)	30.09*	33.53*	37.44tn	40.56*	37.62
Absolute growth of length (cm)	11.71*	12.56*	13.35tn	15.39*	13.57
Feed eficiency (%)	88.67*	91.33*	95.03tn	100.42*	95.11

*) : significant difference with control (P5), tn : unsignificant difference with control (P5)

The survival rate for all treatments was 100%. The highest absolute growth and feed efficiency was achieved on P4 (lime derived from *P. canaliculata* 7 ton/ha equivalent to CaO. The absolute growth (both weight and length), and feed efficiency were significantly affected by dosage of lime appication ($p>0.05$) (Table 3). The high survival rate indicates that the water pH is within the tolerant or optimal values of pH for *Pangasius sp*. Growth. Based on Dunnett test showed that lime derived form *P. canaliculata* dosage 7 ton/ha was unsignificant different with calcite dosage 6 ton/ha. Meanwhile, below that dosage still have lower growth and feed eficiency than calcite 6 ton/ha (P5).

4 Conclusions

Liming materials from *P. canaliculata* shells potential to be an altenative lime for catfish swamp ponds. Maximal water's pH value of lime derived from *P. canaliculata* almost same as calcite (6ton/ha), but the day to reach maximum pH value of calcite longer than *P. canaliculata* shells. Medium with lime and calcite at same dosage (6 ton/ha) has no significant difference of alkalinity. Meanwhile, fish growth and feed eficiency at lime derived form *P. canaliculata* shells 7 ton has no significant difference effect to growth and feed eficiency with calcite 6 ton/ha.

Acknowledgments

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