Evaluation of Golden Apple Snail (*Pomacea canaliculata*) foot tissue meal as an ingredient in the gonad maturation diet of female shrimp *Penaeus vannamei* broodstocks

Mary Jessa Bell B. Pagapulan*, Rex Ferdinand M. Traifalgar
Institute of Aquaculture, College of Fisheries and Ocean Sciences, University of the Philippines-Visayas, Miagao-Iloilo,Philippines
mbpagapulan1@up.edu.ph

ABSTRACT

A 32-day maturation trial evaluated the effects of Golden Apple Snail foot tissue meal on ovarian maturation of Pacific white shrimp (*Penaeus vannamei*) female broodstocks. Five isonitrogenous and isolipidic experimental diets containing increasing levels of golden apple snail foot tissue meal (0, 15g, 30g, 45g, and 60g/100g) were formulated. Polychaetes/Squids and Basal Control Diet were used as the positive and negative controls, respectively. Each treatment with triplicate groups of fifteen unilaterally eyestalk-ablated shrimp female broodstocks at early stages of ovarian development were fed with test diets. The ovarian development was tracked every four days. The results showed that the maximum ovary shadow ratios (OSR) did not significantly differ among treatments. Ovarian maturation time (OMT) is defined as the period between the initial and maximum OSR development. Test diets fed with 25% golden apple snail foot tissue meal and basal control diet were significantly shorter than those of other treatments. Maturation response (MR=proportion (%) of female shrimp broodstocks achieving ovarian maturity within each treatment had some distinctive trends during the maturation trial. The study also indicated that the test diet with 75% golden apple snail foot tissue meal inclusion was the most effective on *Penaeus vannamei* ovarian maturation, followed by the test diet with 50% golden apple snail foot tissue meal inclusion. In conclusion, these results suggested that the golden apple snail foot tissue meal incorporated in the diets for early maturation stages enhanced the ovarian maturation and reproductive performance of P*enaeus vannamei* shrimp broodstocks.

INTRODUCTION

The Pacific white shrimp plays a crucial role in global shrimp production, but disease outbreaks have impacted production levels in the Philippines. Implementing domesticated broodstock, as opposed to wild broodstock, can aid in producing pathogen-free larvae and is a fundamental strategy for successful shrimp farming. Various factors, including broodstock age, origin, endocrine manipulation, genetic variation, and nutrition, have a significant impact on both the quality and quantity of shrimp eggs.

Despite fresh feeds being beneficial for reproductive performance, their potential drawbacks, such as disease transmission and variable nutritional quality, are evident. Compound diets, while advantageous due to easier management, lack defined nutritional requirements for broodstock diet formulation, often leading to unsatisfactory results compared to fresh feed. Squid meal, the primary protein ingredient in artificial diets, is costly, which has led to the exploration of alternative animal protein sources like golden apple snail foot tissue meal. The golden apple snail, a significant pest in rice ecosystems in the Philippines, offers a cost-effective protein source and has been the subject of a limited number of studies on its use in aquaculture, poultry, and livestock production.

OBJECTIVES

To assess the quality of golden apple snail foot tissue meal on the ovarian maturation and reproductive performance of *Penaeus vannamei*

Specific Objectives:

1. To determine the Proximate Composition of Golden Apple Snail foot tissue meal
2. To assess the ovary shadow ratio, ovarian maturation time and maturation response of *P. vannamei* female broodstocks fed with GASFTM
3. To evaluate the Reproductive Performance of *P. vannamei* female broodstocks in terms of spawning rate, total egg production and survival of larvae
4. To evaluate the growth performance of female shrimp broodstocks fed with GASFTM

METHODOLOGY

GOLDEN APPLE SNAIL EXTRACTION AND PROXIMATE COMPOSITION

BROODSTOCK AND EXPERIMENTAL REARING CONDITION

EXPERIMENTAL DESIGN AND TEST DIETS

Table 1. Composition of the basal and experimental diets fed to *Litopenaeus vannamei* broodstock for 32 days.

Ingredients	Fresh Feed Control	g 100 g^{-1} diet (dry weight) Control Basal Diet	25% GASFTM (T1)	50% GASFTM (T2)	75% GASFTM (T3)	100% GASFTM (T4)
Squid Meal	Polychaetes and Squid	60	45	30	15	0
GASFT Meal		0	15	30	45	60
Nutritional Yeast		2	2	2	2	2
Soybean Meal		13	9.2	4.6	4.7	2.5
Acetes Meal		4	6.5	9	9	10
Wheat flour		7	7.8	9.4	8.8	10
Fish oil		2	1	1.5	1	.5
Soybean lecithin		2	2	2	2	2
Mineral mix		1	1	1	1	1
Vitamin mix		1	1	1	1	1
Vitamin A		0.03	0.03	0.03	0.03	0.03
Vitamin C		0.04	0.04	0.04	0.04	0.04
Vitamin E		0.02	0.02	0.02	0.02	0.02
Cholesterol		0	1	1.5	2.5	3
Binder gluten		2	2	2	2	2
Total		100	100	100	100	100

*Analyzed values from UPV-Hatchery, Miagao, Iloilo
[a]Vitamin premix. B-carotene, 3.0 M.I.U kg^{-1}; cholecaciferol, 0.6 M.I.U kg^{-1}; thiamine, 3.60 g kg^{-1}; riboflavin, 7.20 g kg^{-1}; pyridoxine 6.60 g kg^{-1}; cyanocobalamine, 0.02 g kg^{-1}; α-tocopherol, 16.50 g kg^{-1}; menadione, 2.40 g kg^{-1}; niacin, 14.40 g kg^{-1}; pantothenic acid, 4.00 g kg^{-1}; biotin, 0.02 g kg^{-1}; folic acid,1.20 g kg^{-1}; inositol, 30.00 g kg^{-1}; stay C, 100.00 g kg^{-1}.
[b]Mineral premix. P, 12.0%; 12.0%; Mg, 1.5%; Fe, 0.15%; Zn, 0.42%; Cu, 0.21%; K, 7.50%; Co, 0.011%; Mn, 0.160%; Se, 0.001%; Mo, 0.0005%; al, 0.0025%, I, 0.04%.

Experimental Area	UPV Multi-Species, Hatchery
Experimental design	followed a Completely Randomized Design
Treatments	TRT 1: Polychaete worm and squid TRT 2: Basal diet TRT 3: 25%GASFTM TRT 4: 50% GASFTM TRT 5: 75% GASFTM TRT 6: 100% GASFTM
Stocking	15 female broodstocks per tank
Maturation Period	32 days
Lay-out	Flow-thru system
Feeding regime	Controlled feeding (3x daily)

Table 2. Proximate compositions of test diets and Golden Apple Snail Foot Tissue meal (% of dry basis).

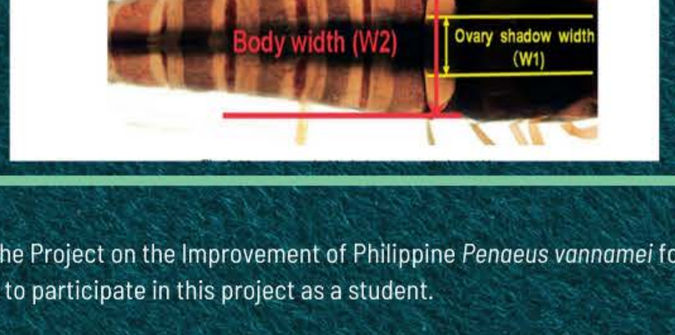
	Diet Groups					
	GASFTM	BS	25%	50%	75%	100%
Crude protein	48.7±.1	44.9±1.61[a]	45.1±1.28[a]	45.4±1.01[a]	45.8±1.27[a]	44.6±.36[a]
Crude lipid	3.8±1.1	13.9±2.18[a]	13.4±2.23[a]	15.0±8.11[a]	15.23±4.1[a]	14.61±3.12[a]
Crude ash	4.6±2.1	8.2±3.21[a]	6.4±1.1[a]	9.2±2.1[a]	8.0±2.1[a]	7.1±1.14[a]

BIOCHEMICAL ANALYSIS

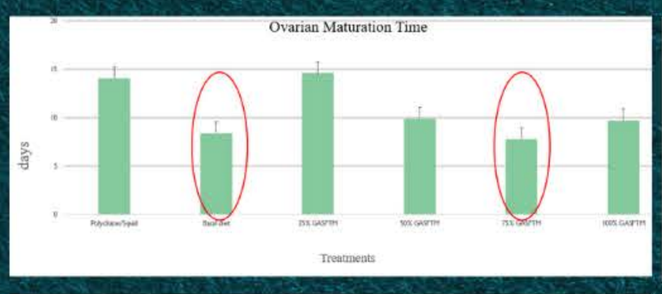
PROXIMATE ANALYSIS:	
CP	Kjeldahl Method
Lipid	Bligh and Dyer (1959)
Ash	AOAC (2001) using furnace
Moisture	AOAC (2001)

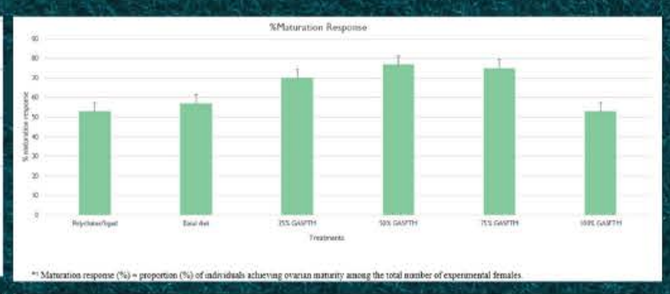
Proximate Composition of GASFTM	Golden Apple Snail Foot Tissue Meal
Crude Protein	48.7
Crude Lipid	3.8
Ash	4.6

MATURATION EVALUATION

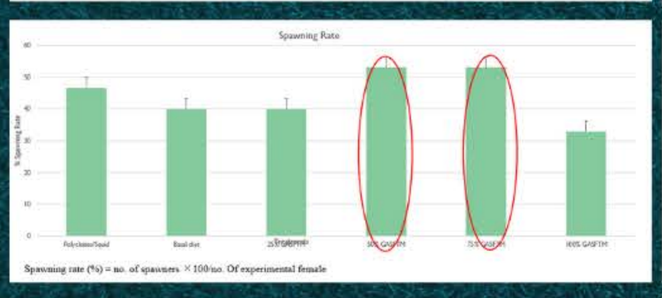


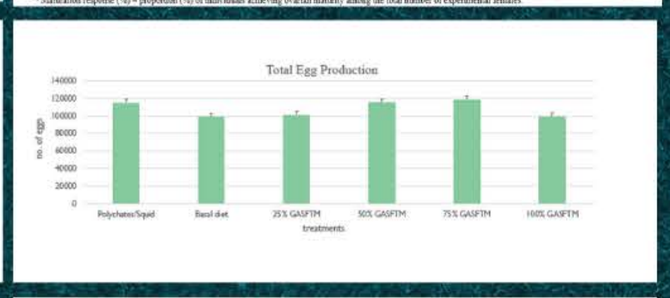
RESULTS





**) Maturation response (%) = proportion (%) of individuals achieving ovarian maturity among the total number of experimental females





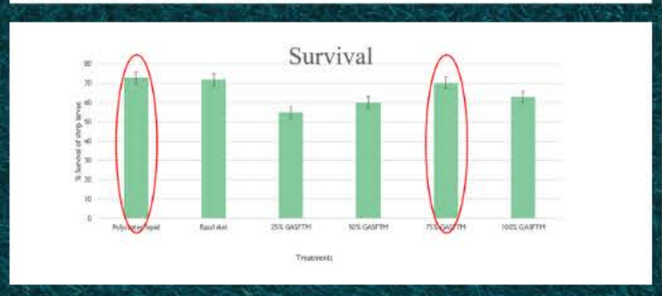
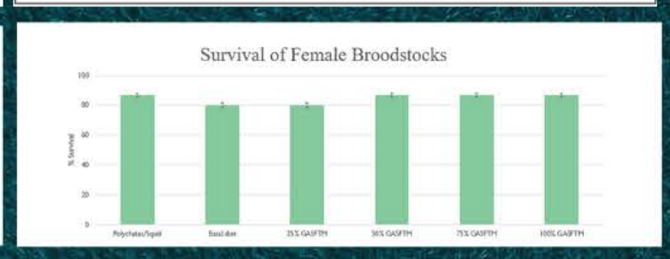


Table 6. Growth performance of female shrimp broodstocks fed with maturation diet

Growth Parameters	Initial ABW	Final ABW	SGR	FCR
Treatments				
Polychates/Squid	36.27±1.42[a]	39.33±1.15[a]	3.22±1.57[a]	1.60±.20[a]
Basal Diet	35.17±3.06[a]	38.33±2.31[a]	3.28±1.78[a]	1.64±0.04[a]
25% GASFTM	36.73±2.05[a]	38.87±1.47[a]	2.40±1.80[a]	1.81±0.02[a]
50% GASFTM	35.37±2.28[a]	38.50±0.87[a]	2.96±2.62[a]	1.73±0.21[a]
75% GASFTM	36.50±1.41[a]	39.50±1.80[a]	3.14±.44[a]	1.63±0.25[a]
100% GASFTM	36.83±2.99[a]	39.37±30.85[a]	2.20±2.50[a]	1.72±0.25[a]

*Values are means=SEM of three replicates.
Specific growth rate (SGR)= [(ln average final weight (g) - ln average initial weight (g) / number of days) x 100]
Feed Conversion Ratio= [weight of feeds (g) / weight gained (g)]



CONCLUSIONS&RECOMMENDATIONS

In this study, it was discovered replacement of a diet consisting of 75% GASFTM and 100% GASFTM to female shrimp broodstock was highly effective in stimulating ovarian maturation. This indicates that incorporating 75% GASFTM and 100% GASFTM into their diet could significantly improve the reproductive capabilities of these individuals. Furthermore, a diet containing 50% GASFTM was also found to have a beneficial impact on ovarian maturation.

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