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EFFECT OF DIFFERENT DIETS ON SURVIVAL OF GIANT PRAWN LARVAE *(MACROBRACHIUM ROSENBERGII* DE MAN*)*

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Abstract

Effect of live food and different compound diets on survival of giant prawn larvae was studied. Two sequential experiments were carried out. The first experiment dealt with five types of diets. Each diet was fed to a group of prawn larvae. The diets were ***Artemia nauplii*** *and four types of compound diet comprising of fish protein, milk protein, and shrimp head extract. The second experiment consisted of alternated feeding, i.e. 12 h compound diet and 12 h* ***Artemia nauplii.*** *The compound diets of this experiment were the same as the first experiment. The larvae receiving a single diet (1st experiment) exhibited lower survival than those of the alternated feeding experiment. In regards to the alternated feeding, the diets comprising fish protein resulted in better larvae survival than the milk protein diets; although there was statistically no significant difference in survival. The diets containing shrimp head extract always gave better survival when compared with those without the shrimp head extract.*

Introduction

Since the major breakthrough by Dr.S.W.Ling, when he discovered that salinity was an important basic requirement for giant prawn larvae to survive and develop through the early life stages, various techniques for raising prawn larvae have been developed in many regions of the world. In Thailand itself both government and private sectors have established prawn hatcheries. At present, more than 50 hatcheries of various sizes are now operational. Nearly all of them are able to produce prawn juveniles from eggs at the survival rates of 10 to 50%

A wide range of larval feeds are used, including *Artemia* naupleii and prepared feed consisting of mussel flesh, fish flesh, whole egg custard, egg yolk custard and soybean curd (tofu), alone or in combination. In considering the operational cost of the prawn hatchery, *Artemia nauplii* is the major cost item, accounting for not less than 60%. Hence, the substitution of *Artemia nauplii* all or in parts by high quality compound diets would significantly lower the cost of larval production.

This investigation was made to compare the survival rates between prawn larvae receiving a single diet, either live food or compound diets, and prawn larvae receiving alternate feedings, i.e. 12 hrs of compound diet and 12 hrs of live food, daily. Besides, the effects of different protein sources (i.e., milk protein and fish protein) on the survival of prawn larvae were studied.

Materials and Methods

The berried females used in this experiment were obtained from the Golden Claw Prawn Farm. For the feeding trials, the berried females were placed in the larval hatching tanks. Larvae in each hatch were calculated by counting larvae in ten 100-ml aliquot samples. The volume of water containing the desired number of larvae was then transfered to the rearing tank.

Fifteen circular fiberglass tanks, 1.2 m diameter x 0.6 m height, were used for rearing the prawn larvae. The tanks were housed in a roofed shed. During the course of larval rearing, brackish water with a salinity of 12 ppt was maintained at 0.5 m depth. This corresponded to a volume of about 500 l. A closed recirculating water system was utilized. Water from these tanks was continuously cleaned by a seperate subsand filter unit.

Several types of food were utilized in the feeding trials. The live food was *Artemia nauplii*. The compound diets could be categorized into two major groups, i.e. fish protein diets and milk protein diets. The fish protein diets comprised of two types, FE and FES. The composition of these diets is shown in Table 1. The milk protein diets comprised of two types, Mp and MpS. The composition of these diets is shown in Table 2.

In processing the fish protein diets, all food components were thoroughly blended, and it was subsequently baked at 175°C for 20 minutes. Milk protein diets were modified from the experimental trout diet as described by Halver[1]. The milk protein diets were processed by dissolving agar in boiled water and other food components were later added. The mixture was left dry at room temperature before use. Proper size of food particles was prepared by passing these compound feeds through a desirable mesh size screen. The levels of protein, fat, carbohydrate, and ash of these compound diets were determined by the method described in Horwitz *et al.*[2]. Choresterol levels were determined by the method described by Parekh and Jung[3]. These nutritive values are shown in Table 3.

The initial stocking rate of prawn larvae in these tanks was 5000 each, or 10 larvae per liter of water. Prior to the feeding trials, the newly stocked prawn larvae were fed with *Artemia nauplii* for a period of 5 days.

As regards to the feeding trials, two sequential experiments were carried out. The first experiment dealt with five types of diets. Each diet was solely fed to each group of prawn larvae. The diets were *Artemia* nauplii and the four types of compound diet. The second experiment involved with the alternated feeding, i.e. 12 hours.

TABLE 1 COMPOSITION OF FISH PROTEIN DIETS.
Values are expressed as the weight percentage of each food component in the diet.

Component	Types of Fish Protein Diets	
	FE	FES
Tuna meat	80.00	60.00
Duck eggs	20.00	15.00
Shrimp head extract	—	25.00

TABLE 2 COMPOSITION OF MILK PROTEIN DIETS.
Values are expressed as the weight percentage of each food component in the diet.

Component	Experimental diet of Halver[1]	Types of Milk Protein Diets	
		Mp	MpS
Vitamin-free casein	38	38	38
Gelatin	12	—	—
Agar	—	18	18
Cod liver oil	2	2	2
Corn oil	7	7	7
White dextrin	28	—	—
Alpha-cellulose mixture	8	8	8
Carboxy methyl cellulose	—	9	9
Vitamins	1	1	1
Miniral mix	4	4	4
Shrimp head extract	—	—	100
Water	200	213	113
Net weight	300	300	300

TABLE 3 NUTRITIVE VALUES OF THE FOUR EXPERIMENTAL DIETS.
Values are expressed in dry weight percentage.

Types of Diet	Protein	Fat	Carbohydrate	Choresterol	Ash
FE[1]	70.9	13.6	2.9	5.9	6.6
FES[2]	67.8	17.8	1.9	6.9	5.5
Mp[3]	44.4	6.8	26.9	0.4	21.4
MpS[4]	53.8	12.4	22.2	2.0	9.6

1. FE = fish + eggs
2. FES = fish + egg + shrimp head extract
3. Mp = milk protein
4. MpS = milk protein + shrimp head extract

compound diets (day time) and 12 hours *Artemia nauplii* (night time). There were three replications (tanks) for each feeding scheme. *Artemia nauplii* were fed in excess quantities. The compound diets were fed at satiation and the frequency of feeding was once every three hours. Uneaten food materials and larval wastes at the tank bottom were removed daily by siphoning. On some occasions during the rearing trials, certain chemical and physical water quality parameters were measured.

Results and Discussion

Yield of metamorphosed prawns and percent survival of prawn larvae receiving a single diet throughout the larval stages were shown in Table 4. The analysis of variance revealed significant difference ($P<0.01$) in the survival rates of the prawn larvae receiving the five diets. Prawns fed with *Artemia nauplii* resulted in the highest percent survival (ave 26.3%). Fish protein diet and milk protein diet containing shrimp head extract resulted in moderate survival rates, i.e. ave. 15.6% and 10.5% repectively. Prawn larvae receiving diets without shrimp head extract resulted in the lowest survival rates (ave. 3.1-5.5%). Metamorphosis of prawn larvae appeared earliest in the prawn fed with diets containing shrimp head extract.

Yield of metamorphosed prawns and percent survival of prawn larvae receiving the alternated feeding (*Artemia*/ compound diet) throughout the larvae stages are shown in Table 5. The control of these four treatments is the treatment receiving only *Artemia* as appeared in Table 4. The analysis of variance show significant difference ($P<0.01$) in the survival rates. Fish protein diet containing shrimp head extract resulted in the highest

TABLE 4 YIELD AND PERCENT SURVIVAL OF PRAWN LARVAE RECEIVING A SINGLE DIET THROUGHOUT THE LARVAL STAGES.

Types of diet	Replication	Metamorphosed prawns		First day of metamorphosis
		Yield	% Survival	
Artemia naupleii	1	1,235	24.7	35
	2	1,408	28.2	29
	3	1,310	26.2	35
	Average	1,318	26.3	33.0
FE	1	302	6.0	32
(Fish + Eggs)	2	83	1.7	35
	3	76	1.5	34
	Average	154	3.1	33.6
FES	1	786	15.7	34
(Fish + Egg +	2	942	18.8	28
Shrimp Head	3	617	12.3	32
Extract	Average	782	15.6	31.3
Mp	1	154	3.1	3.6
(Milk Protein)	2	411	8.2	34
	3	260	5.2	35
	Average	275	5.5	35.0
MpS	1	545	10.9	28
(Milk Protein +	2	528	10.6	30
Shrimp Head	3	512	10.2	39
Extract)	Average	528	10.5	29.3

TABLE 5 YIELD AND PERCENT SURVIVAL OF PRAWN LARVAE RECEIVING THE ALTERNATE FEEDING (12 HOURS COMPOUND DIET AND 12 HOURS *ARTEMIA NAUPLII)* THROUGHOUT THE LARVAL STAGES.

Types of diet	Replication	Metamorphosed prawns		First day of metamorphosis
		Yield	% Survival	
Fe	1	2,049	41.0	28
(Fish + Eggs)	2	2,151	43.0	26
	3	1,400	28.0	28
	Average	1,867	37.3	27.3
FES	1	2,675	53.5	23
(Fish + Eggs +	2	2,799	56.0	21
Shrimp Head	3	1,930	38.6	26
Extract)	Average	2,468	49.4	23.3
Mp	1	1,865	37.3	32
(Milk Protein)	2	1,650	33.0	45
	3	1,180	23.6	33
	Average	1,565	31.3	36.7
MpS	1	1,766	35.3	21
(Milk Protein	2	2,376	47.5	22
+ Shrimp	3	2,192	48.8	21
Head Extract)	Average	2,111	42.2	21.3

percent survival (ave. 49.4%) followed by the milk protein diet containg shrimp head extract (ave. 42.2%). Diets without the shrimp head extract resulted in the lower survival rates, ave. 37.5% for fish protein diet, and ave. 31.3% for milk protein diet. Prawn larvae receiving diets containing shrimp head extract metamorphosed earlier than those that were fed with diets without shrimp head extract.

Based on the above results, we conclude that the survival rates of prawn larvae is better with alternated feedings as compared to single diets. Kinne[4] postulated that most single component diets did not provide a complete nutritional requirement for crustaceans in contrast to multicomponent diets. One of the nutritional difficiency syndromes in crustaceans is the unnatural coloration, such as the apperarance of pale and light blue colour on the bodies. We observed this syndrome in our experiments, especially in the groups of prawn larvae receiving only fish protein diet (FE) of milk protein diet (Mp). Wickins[5] found that the newly hatched *Artemia salina* did not provide a complete nutritional requirement for the shrimp *(Palaemon serratus).*

In the present experiments, we also observed that fish protein diets, either single diet feeding or alternated feeding, in all cases resulted in higher survival rates than the milk protein diets. This may be due to the types and levels of protein in the diets as well as the choresterol contents in the diets. According to the analysis of nutritional values (Table 3), the level of protein in fish protein diets were always higher than the milk protein diets. The types of protein may also influence the survival rates. Sick and Andrews[6] used different sources of protein for feeding the shrimp *Penaeus duorarum,* and found no significant difference in growth and survival among the groups, except for the group which was fed with casein (milk protein). They found that casein gave the poorest growth.

Choresterol is the precursor of molting hormone (ecdysone) in crustaceans, and choresterol in food can be readily utilized by the prawn[7]. Kanazawa *et al*[8]. found that 0.5% choresterol in the diet could give better shrimp growth *(Penaeus japonicus)* than the level of either 0.05% or 0.1% in food. In the present experiments, the choresterol content in fish protein diets were significantly higher than the milk protein diets (Table 3).

In the present investigation, we found that the diets containing shrimp head extract resulted in significantly better survival rates than the diets without the shrimp head extract. This finding is in accord with the findings of Sandifer and Joseph[9]. They found that the diet containg shrimp head extract could produce growth rate of prawn larvae two folds better than the diet without shrimp head extract, and the carotenoid pigment was 15 times higher. Linolenic acid is a kind of fatty acid presents in the shrimp head extract. This kind of fatly acid is essential for growth and survival of prawns[6, 10].

Physico-chemical properties of water in this investigation (Table 6) did not vary greatly. Hence, they might have no effects on growth and survival of the prawn larvae.

TABLE 6 PHYSICO-CHEMICAL PROPERTIES OF -ATER.

Parameters	Range	Average
NH_3-N (mg/l)	0.00-0.10	0.05
NO_2-N (mg/l)	0.01-0.18	0.08
NO_3-N (mg/l)	0.06-1.20	0.38
PO_4 (Ortho.) (mg/l)	0.15-0.55	0.27
D.O. (mg/l)	7.40-7.90	7.61
pH	7.90-8.80	8.40
Salinity (ppt)		12
Temperature (°C)	26.0-28.0	26.8

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บทคัดย่อ

ได้มีการศึกษาผลของอาหารต่างชนิด ทั้งที่เป็นสิ่งมีชีวิตและเป็นอาหารผสมต่ออัตรารอดของลูกกุ้งก้ามกรามวัยอ่อน. การทดลองแบ่งออกเป็นสองขั้นตอน. ในขั้นตอนแรก อาหารห้าชนิดถูกใช้ทดลองเลี้ยง. อาหารเหล่านี้ได้แก่ตัวอ่อน *Artemia* และอาหารผสมอีกสี่ชนิดซึ่งประกอบด้วยโปรตีนจากปลา โปรตีนจากนม และมันจากหัวกุ้ง. อาหารแต่ละชนิดถูกใช้เลี้ยงลูกกุ้งเฉพาะกลุ่มตลอดทั้งวันจนกุ้งถึงระยะคว่ำ. ในขั้นตอนที่สองนั้น เป็นการทดลองเลี้ยงโดยใช้อาหารผสมแบบเดียวกันกับการทดลองขั้นแรก แต่เป็นการทดลองเลี้ยงสลับ กล่าวคือ มีการเลี้ยงลูกกุ้งโดยให้อาหารผสมแต่ละชนิดเฉพาะกลุ่มในเวลากลางวัน, ส่วนในเวลากลางคืนเลี้ยงลูกกุ้งโดยตัวอ่อน *Artemia*. ผลการทดลองพบว่าการให้อาหารชนิดเดียวกันตลอดมีอัตรารอดต่ำกว่าการให้อาหารแบบสลับ. สำหรับการทดลองให้อาหารแบบสลับนั้นอาหารผสมที่ประกอบด้วยโปรตีนจากปลาให้ผลต่ออัตรารอดดีกว่าอาหารผสมที่ประกอบด้วยโปรตีนจากนม. อาหารผสมที่มีส่วนประกอบของมันจากหัวกุ้งให้อัตรารอดดีกว่าอาหารที่ไม่ได้ผสมมันชนิดนี้.