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Topic on

ROLE OF MATURATION DIET IN THE CAPTIVE REPRODUCTION OF MARINE FINFISHES

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Introduction

- In world fish production, Aquaculture contributes 44.1 % and Marine fin fishes contribute 15.9% (SOFIA ,2016). Captive breeding and induced breeding play a major role in Mariculture.
- The technique of induced breeding was first evolved by Houssay in 1930-Argentina. In India it was first attempted by Khan in 1937 on *Cirrhinus mrigala*.
- Maturation is the process of cyclic, morphological changes which male and female gonads undergo to attain full growth and ripeness.

Commercially cultured marine finfishes

- Salmonids
- Sea bream
- Sea bass
- Groupers
- Mullets
- Cobia
- Silver Pompano
- Milk fish
- Snappers

Natural & induced maturation

- **Natural maturation**: Fishes which mature in the natural environmental conditions .
- **Induced maturation**: It can be achieved by photothermal manipulation /diet and hormonal manipulation.

  Photo / thermal manipulation: Photoperiod regulation is widely employed as a tool for controlling the maturation and spawning in many marine fishes (Migaud *et al.,* 2006; Norberg *et al.,* 2001; 2004; Howell *et al.,* 2003).

  Temperate fish species are annual spawners that mainly rely on annually cycling cues like temperature and photoperiod to synchronise .The three main phases of their reproductive cycle like

- Induction (Initiation of oogenesis), & Pre-vitellogenesis
- Vitellogenesis

- The stages including maturation, ovulation and oviposition.

WHY FISH DOES NOT BREED IN CAPTIVITY

- Many cultured farm fishes do not breed in captivity. The reason may be natural instincts and controlling factors including environmental parameters and consequently hormonal. Environmental parameters like photoperiods, rain, temperature, water current
- Hormonal- disturbances arising in environment may cause the insufficient release of hormones in captive conditions
- Other factors like poor foods or insufficient natural foods, exposure to biocides and other pollutants badly affect the maturation of ovary.
- Prevention of migration and their natural search for breeding grounds may also prevent their breeding.
- Man made causes are also possible factors
- Larval survival is dependent on the brood stock diet, because freshly hatched larvae are not feeding, but live on their yolk sac reserves.
- The larvae demand very safe living environment for their normal living
- The quality and quantity of nutrients in egg yolk is dependent on maternal body reserves.
- Brood stock diet formulations are essential for the development of marine fish breeding and propagation.
- Increased egg production and quality of eggs.

Maturation diet:

- Once techniques for induced maturation was identified, diet composition became a critical factor in maintaining brood stock from maturation to spawning.
- Nutrition is profoundly important to reproduction of fishes and the success of reproduction is closely related to nutrient ingestion accompanying ovarian development.
- Diets used for reproduction consist of one or more fresh (or fresh-frozen) marine organism ingredients, with the most common being squid, mussels, clams, shrimp, brine shrimp, and polychaete worms.
- Additionally, fish, shark, mysids, krill, cockles, crab, and other items have been reported as breeding diets.

Classification of maturation diet:

- Live feed – clam, squid, mussels ,

polycheate worms, brine shrimp

- Prepared feeds –amino acid, fatty acid, mineral mix, vitamin mix, choline chloride mix

Plant based maturation diet:

- Herbs which have been proved as a beneficial compound in various biological activities including maturation in fin and shell fishes are documented earlier by earlier workers
- In addition, the beneficial role of herbals to improve immune systems, quality reproduction without any side effects have been studied
- The natural plant products have been reported to have various activities like anti stress, growth promotion, tonic, immunostimulation, aphrodisiac and antimicrobials in the finfish and shrimp larviculture due to the active principle natures such as alkaloids, flavonoids, pigments, phenolics, terpenoids, steroids and essential oils

Diet composition trials

- Diets used for reproduction consist of one or more fresh (or fresh-frozen) marine organism ingredients, with the most common being squid, mussels, clams, shrimp, brine shrimp, and polychaete worms.
- These ingredients are often chopped into approximately 0.5 to 1.0 cm pieces, rinsed, and fed two to five times daily to breeding populations.
- dietary astaxanthin, added at 10 mg/kg to the diet, increased fecundity whereas egg quality was improved through the replacement of half the fish meal with squid meal

Milkfish

- Milk fish is major culture species in Philippines and other south east Asian countries
- In India it is in the beginning phase of culture
- First successful induced breeding of milk fish was conducted at Philippines (Juario,.1984.)
- The fish required for the seed production can be either farm raised or wild caught
- However fishes of 5 years age are best for brood stock, hence, this is a major hurdle in milk fish seed production

- Polyculture of milk fish with other species of fish such as mullet, groupers, and Tilapia is a common practice in many countries

Maturation diet

- Being omnivorous fish, milk fish feed on a wide variety of food items
- Major feed items include, algae lab lab (bacteria, diatoms, green algae) and animal components like protozoans, flat worm, larvae and adults of molluscs, polychaete worms
- In addition to natural food, formulated feed consisting of rice bran, wheat meal, soybean meal, and formulated eel meal can be provided as feed for breeders (Lin, 1985)
- Modified formulated feed consisting of 70% formulated eel, 14.75% wheat germ meal, 14.75% soybean and 0.5% vitamin E was also used as feed for spawners. (Chang et al., 1993)

Model formulated diet with 36% of protein

Sl. No	Ingredient	Percent in diet (%)
1	Fish-meal, anchovy	25.0
2	Soybean meal	34.0
3	Wheat flour	15.0
4	Rice bran	20.9
5	Pellet binder	3.0
6	Fish-oil	2.5
7	Dicalcium phosphate	1.0
8	Vitamin mix	1.0
9	Trace mineral mix	0.5

Result

Fecundity avg. 2 million/kg body weight,survival rate 50 %

Fecundity after inducement of maturation diet : 8 lakh/kg body weight ,survival rate70-80%(liao,I.C.et al 1979)

Maturation diet for Cobia

Cobia, *Rachycentron canadum*, is rapidly gaining importance in many Asian countries as an excellent candidate species for aquaculture due to its fast growth rate, adaptability for captive breeding, low cost of production, good meat quality and high market demand especially for sashimi industry

Under culture conditions, cobia is reported to reach 5-7 kg in body weight in 8-12 months and 10-14 kg in two years. Sexual maturity is reported in males at 1-2 years and in females 2-3 years.

Maturation diet

- The Mandapam Regional Centre of CMFRI initiated research on seed production of cobia during 2008 and successfully developed protocols for captive breeding, seed production and cage farming of cobia
- They were fed with squids, oil sardines and lesser sardines with vitamin premixes
- These fishes were provided with special maturation diets *viz*., squids, cuttlefish, crab, shrimps and chopped oil sardines once in a day

Result

- Normal fecundity :1.2million -1.8 million eggs /kg body weight survival rate 50 %
- Fecundity after maturation diet : 1 million eggs /kg body weight survival rate 75 %

Maturation diet of seabass

- Central Institute of Brackish water Aquaculture, Chennai, initiated seabass breeding and developed special diet for maturation
- The brood stock fish are fed with forage fishes like tilapia and oil sardine @ 5% of their body weight
- The feeding on trash fish is reduced to 1% of the body weight and reared for two months prior to induced spawning.
- Generally, males mature earlier than females during the spawning season.

- Chopped trash fish are given twice daily in the morning at 08.00 hours and afternoon at 17.00 hours at the overall rate of 10% of total biomass in the first two months of culture.
- After two months, feeding is reduced to once daily and given in the afternoon at the rate of 5% of the total biomass.
- Food should be given only when the fish swim near the surface to eat.
- A very recent development on improving the dietary intake of seabass is the introduction
- of moist feed.(BIOLOGY AND FISHERIES OF SOME BRACKISHWATER FOOD FISHES OF INDIA)

Result

- Normal Fecundity ranges from 2.17 million eggs, depending upon the size of spawner.
- Fecundity after maturation diet: 3lakh eggs /kg body weight survival rate 75-85% (Moretti, 1999.)

Maturation diet for grouper

- Groupers are fed to satiation six times each week, four times with fish and twice with squid.
- This feeding schedule may vary between hatcheries, depending on the availability of fish and squid. The fish used as feed are mainly members of the families Clupeidae (herrings) and Scombridae (mackerels).
- The feed is supplemented with a vitamin mix included at 1% of feed. Commercial or custom-formulated vitamin mixes can be used; the components of a formulation originally developed for barramundi broodstock is as follows,

Vitamin premix

Ingredient	Amount/kg premix
A	2 × 106 IU
D3	0.8 × 106 IU

E (DL-α-tocopherol)	40 g
K3	2 g
Ascorbic acid	40 g
Thiamine	4 g
Riboflavin	4 g
Pyridoxine	4 g
Panthothenic acid	10 g
Ingredient	Amount/kg premix
Biotin	100 mg
Nicotinic acid	30 g
Folic acid	1 g
B12	4 mg
Choline chloride	200 g
Inositol	50 g
PABA	20 g
Ethoxyquin	30 g
Dextrose	(to 1.0 kg)

Results

- Normal fecundity of grouper : 3.7 million eggs 40% survival rate
- Fecundity after inducement of maturation diet : 1.41 million eggs 75 % survival rate (chao, T.M.et al,1993)

Maturation diet of Silver pompano

- Sub-adult fishes obtained in commercial catches from trap nets were collected and stocked in a circular sea cage.
- The wild caught fishes were initially stocked in the cage without separating the sexes.
- These fishes were fed once in a day with low value fish (sardines, Pellona and Ilisha sp.) and squid at about 2.5 % of their body weight.
- Vitamins and mineral premix packed in 1 g gelatine capsules were also given twice a week along with feed at the rate of 1% of the food ration, in order to take care of the nutritional deficiencies.
- Fishes with initial weight ranging from 250 to 500 g were stocked. The fishes were reared to maturity when the fishes reached around 1kg size .
- They were cannulated, sexed and tagged with passive integrated transponder (PIT) tags after anesthetising

Result

- Normal fecundity : 1.5 to 2.0 million.
- Fecundity after inducement of maturation diet : 1,33 ,000 to 8,00 ,000 eggs per female survival rate 72% (jeyakumar,2014.)

Pearl spot

- As *E. suratensis* was observed to exhibit such a complex and unique courtship behaviour, involving pairing, nesting and parental care, captive breeding of Etroplus suratensis was undertaken, in specially designed artificial raceway tank provided with simulated natural conditions
- Central Institute of Brackishwater Aquaculture (CIBA), Chennai; using the technique of environmental management, has successfully demonstrated the hatchery seed production of pearl spot
- Adult fish in the weight range of 50-125 g are stocked in ponds @ 5,000 nos./ha. The fish are fed with supplementary feed @ 3.5 per cent of the body weight

- Feeding of the breeders has to be initiated within 3-4 days after stocking.
- Artificial feed prepared with groundnut oil cake 40 per cent, rice bran 45 per cent and fish meal 15 percent, fortified with vitamin and mineral mix @ 2.5 kg per 100 kg feed, is to be supplied daily @ 3-5 per cent of the fish biomass, either in pelleted or in dough form.
- Feed can be supplied in feeding trays kept at the bottom of the pond. The feeding trays should be examined daily and cleaned outside the pond (Alikunhi, 1957).

Result

Normal fecundity :3000-6000 eggs

Fecundity after inducement of maturation diet : 780 – 2955 eggs , survival rate 86 – 90%(Shoji Joseph,2016.)

List of researches & centers under going

- Broodstock nutrition research on marine finfish in Japan- TakeshiWatanabeRobertVassallo-Agius Department of Aquatic Biosciences, Tokyo University of Fisheries, Minato, Tokyo 108-8477, Japan
- Effect of broodstock nutrition on reproductive performance of fish- M.SIzquierdo[a]HFernández-Palacios[a]A.G.JTacon[b] Universidad de Las Palmas de Gran Canaria

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