CIFE Technologies & Innovative Products for Fish Farmers and Entrepreneurs

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Preface

It has been a great pleasure to bring out this booklet on "CIFE Technologies & Innovative Products for Fish Farmers and Entrepreneurs" which is a compilation of technologies developed by CIFE, Mumbai. Earlier, the institute had published leaflets on technologies that were available, which enjoyed a great acceptance amongst the target group. We are happy that some of the technologies covered in those leaflets could be commercialised. This booklet is an updated version of the technologies developed by CIFE in the fields of aquaculture, breeding, feed technology, health management, genetics and processing.

It is aimed at making the technologies accessible to wide audience viz. fish farmers, entrepreneurs and developmental agencies. The booklet covers brief description, applicability and economics of each technology. The primary goal in publishing this booklet is to encourage transfer of technology from lab to land / industry. It is a known problem that the technologies which have been developed by research institutes are not getting transferred to the clientele. I sincerely hope that this booklet would help the end users to adopt these technologies.

I commend all the researchers who developed the technologies and also it is my pleasure to mention Dr G.Venkateshwarlu, Chairman, ITMU and his team who have done a commendable job in bringing this technology profile. I appreciate Mr. D.Bhoomaiah for designing the structure and cover page of the booklet.

(W. S. Lakra)

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1 Giant freshwater prawn seed production using artificial sea water

Giant freshwater prawn, *Macrobrachium rosenbergii* has vast potential for its culture in both maritime as well as inland states including North Eastern States. Desired quantity of quality seeds at desired time is one of the major constraints for expansion of prawn farming particularly in the inland states. Giant freshwater prawn needs 12 ppt saline water to complete its life cycle. The requirement of saline water hampers the establishment of giant prawn hatcheries in the inland states. Keeping in view of this, CIFE, Mumbai has developed a hatchery technology using artificial sea water for the use in inland states.

Description of technology

Hatchery

In order to meet the requirement of saline water for completion of life cycle of giant fresh water prawn, a chemical formula was prepared with six major, six minor and six trace salts to prepare artificial sea water. Since most of the minerals and trace salts are available in natural freshwater, a simple formula with seven major salts was prepared. Initially, laboratory grade chemicals were used for preparation of artificial sea water. Keeping in view of the economic feasibility of the technology, commercial grade salts were used for the preparation of artificial saline water of 12 ppt. In order to prepare artificial sea water desired quantity of filtered fresh water was filled in a thoroughly cleaned tank. Size of the tank and volume of water depends on the production capacity of hatchery. After filling the water, desired quantity of various salts was calculated, weighed and kept ready. The salts were mixed one after other with thorough aeration and kept for 2-3 days with aeration. Then the water was filtered and used for the operation of giant fresh water prawn hatchery. The hatchery operation is same as that followed in the natural sea water hatchery. The hatchery can be operated by following either flow through or recirculatory system. In flow through system, in order to use water economically the siphoned water is collected in a separate tank for treatment and reused in the hatchery operation. Supernatant water from used water tank is pumped into a separate tank provided with biological filter attached to recirculatory system for a period of one week. This helps in removal of ammonia and nitrite from the used water. This water can be used in regular hatchery operation. If water quality is maintained properly, the same water can be used for a period of 3 years or even more with salinity adjustment by adding fresh water, if necessary.

Technology benefits

The establishment of prawn hatcheries in the inland states will help in production of quality seeds locally and enhance the productivity which in turn improves the socio-economic status of farmers and entrepreneurs. Various government and semi-government organizations, NGOs, entrepreneurs and farmers can get benefit out of this technology.

Commercialization status

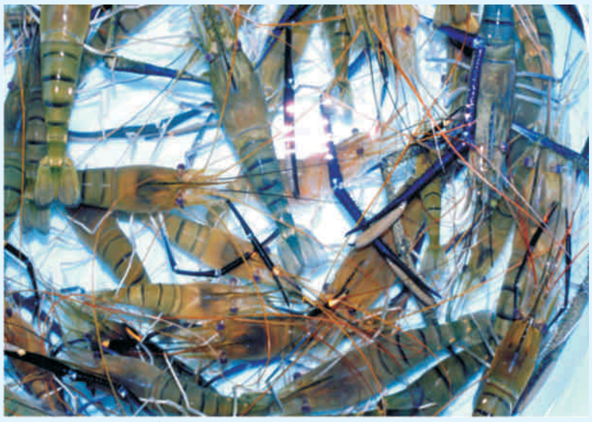
The technology has been demonstrated on experimental scale in Maharashtra, Madhya Pradesh, Uttar Pradesh, Assam, Karnataka, Orissa, Kerela, Andhra Pradesh and West Bengal. Giant freshwater prawn hatcheries using artificial sea water have been established in Tripura, Chattishgarh, Madhya Pradesh, Nagaland and Manipur. MoU has been signed between Department of Fisheries, Government of Assam and CIFE, Mumbai for the establishment of three prawn hatcheries in Assam. One hatchery has been established in Guwahati and the other two hatcheries are under construction at Silchar and Dubri. Another proposal is also in progress for the establishment of a giant freshwater prawn hatchery in Bihar and Uttar Pradesh.

2 Scampi seed production using inland ground saline water

Giant freshwater prawn (*Macrobrachium rosenbergii*), commercially known as scampi, is one of the best aquaculture commodities suitable for culture in fresh and low saline affected lands. In past, the culture of this species was limited to fresh water ponds in coastal states but now its suitability has been well established for farming in tropical, sub-tropical and semi-arid areas. Recently there has been growing demand for the quality seed of this species. However, the non-availability of quality seed in the vicinity has restricted its scope for its farming in areas away from the coast.

Description of technology

Seawater is essential for the survival and growth of prawn larvae. Transportation of seawater/brine to land-locked areas is not only difficult and costly but also bio-unsecure. CIFE, Mumbai has developed a technology to use inland ground saline water as a replacement media for seawater. A prawn hatchery at inland saline site requires all infrastructure facilities similar to that of a coastal hatchery with additional facility of a deionization unit for amending water quality and a saline water bore well having water salinity of more than 12 ppt. The water drawn from the saline aquifer is generally free from suspended particles and pathogens and hence unlike seawater does not require large scale remediation. The optimum levels of calcium, potassium and magnesium required by prawn larvae in ground saline water have been standardized and a simple protocol for amending the ground saline water has been developed. In this protocol the level of calcium in saline water of 12 ppt is reduced through deionization process. The levels of potassium and magnesium are maintained by supplementation with commercial grade/ fertilizer grade salts.



Prawn Brooders

For the operation of a prawn hatchery in north-western parts of the country, assured supply of mature prawn brood stock (berried females) in spring (March-April) season is essential. This helps to take up a single crop culture of 6-7 months duration (May-November) in the area. Since the winter temperature of the area is lethal to prawns in open ponds, special arrangements for temperature control in pond condition are essential so that not only prawns survive in winter but they also mature in spring. This can be made possible by constructing polyhouse structure over the ponds in which the minimum water temperature should be maintained at 19.0 °C which is around 7.5 °C higher than the open ponds. This ensures survival as high as 90% and availability of berried females in the month of March. By attaining early maturity, it will be possible to get hatchery seed in April/ May which is the best stocking time in north-western states of India.

Technology benefits

The prawn seed produced with saline water is bio-secure, cheap and healthy and its availability at the doorsteps may bring boom in prawn farming in north-western states where large saline areas are lying fallow for want of proper technologies. Prawn farming in inland areas will further provide job opportunities, self employment and income generation to the farmers whose lands have become saline and lying fallow. Extraction of saline water will help in lowering down the water table and curb water logging conditions in the area.

3 Tiger shrimp farming in saline affected areas

Tiger shrimp (*Penaeus monodon*) grown in sea/brackish water is considered globally as the best marine shrimp in terms of growth, meat quality and market demand. Tiger shrimp farming is limited to coastal states in India as its culture is practiced only in brackish water. CIFE, Mumbai however has demonstrated that this shrimp can be commercially farmed in inland saline lands using underlying saline water. This has opened new avenues for utilization of waste saline lands and ground saline water for a profitable venture.

Description of technology

Tiger shrimp do not survive in inland saline water due to difference in the chemistry of water with that of seawater. The cause of mortality was assessed through bioassay trials and it was found that poor concentration of potassium in saline water is mainly responsible for mortality. Based on indoor experiments, field trials were carried out at high saline Baniyani Farm (CIFE Regional Centre, Rohtak) during the year 2008 in two non-drainable ponds of size 0.25 ha. each lined with polyethene sheets to prevent seepage and placed with 0.30 m thick layer of soil. These ponds were fed ground saline water of salinity 12 ppt from a bore well. The level of potassium was enhanced in saline water by adding muriate of potash (fertilizer grade) around 50% equivalents to coastal seawater. The methods of husbandry remained the same as that of coastal farms. A production 2.7 tons/ha in 110 days at a stocking density of 10 PLs/ m^3 could be obtained.

Technology benefits

Interception of ground saline water and utilization in aquaculture ponds will lower the ground table, help in soil improvement and reduction in secondary salinization. Since inland saline water is drawn from deep bore wells, it is pathogen free and bio-secure. Like agriculture, a crop of tiger shrimp is of 4 months duration and hence farmers may harness returns in a short time and can take two crops in a year during warmer climate of 8 months (March- November).

Target geographical area

The technology is highly suitable for the farmers of north-western India whose lands have become saline and where agriculture productivity is poor or zero.

Financial aspects:

		INR
1.	Capital cost	8,00,000
2.	Fixed cost	
	Installment of loan	1,14,280
	Interest of capital	96,000
	Sub-total	**2,10,280**
3.	Variable cost	
	Seed (2 lakh numbers per two crops)	90,000
	Feed (2 crops)	2,79,939
	Miscellaneous	2,00,000
	Sub-total	**5,69,939**
4.	Gross income (Sale of 4 tones/ 2 crops)	12,00,000
5.	**Total (2+3)**	**7,80,219**
6.	**Net income (4-5)**	**4,19,714**

4 Culture of Pacific White Shrimp, *Letopenaeus vannamei* in inland saline water

Pacific white shrimp, *Letopenarus vannamei* is one of the new candidate species introduced in Indian coastal aquaculture. Since its commercial introduction in the year 2009, the farming of this exotic species has gained tremendous momentum in India owing to its faster growth rate, tolerance to high stocking density, lower dietary protein requirement and tolerance to wide ranges of salinity and temperature. Following its tremendous success in coastal states, successful attempts were made by CIFE, Mumbai at its Regional Centre, Rohtak to develop practices for profitable aquaculture of *L. vannamei* in inland saline waters.

Description of technology

The major challenges encountered for *L. vannamei* culture were the quality of ground saline water because of its ionic imbalance. Inland saline waters invariably have low levels of potassium, high levels of calcium and variable concentrations of magnesium in comparison to natural sea water.

The cultivation of *L. vannamei* was undertaken in 3 ponds having a total area of 0.60 ha using inland saline water with a salinity range of 13-15 ppt. The ponds were prepared for culture following the standard ways of pond preparation for shrimp culture. As the saline affected soils have high pH (8.0-9.0) no lime was applied. The pond water was fortified with

commercial grade fertilizer, muriate of potash to maintain optimum levels of potassium (about 50 % of the equivalent salinity of potassium concentration in sea water) as the water source was deficient in potassium. The ponds were fertilized with fermented organic slurry prepared with molasses, rice bran, oil cake and yeast to develop natural food organisms in the pond water. After 5 days of fertilization, the ponds were stocked with *L. vannamei* SPF post-larvae procured from Bay Fry Hatchery, Kakinada, Andhra Pradesh. The post larvae were stocked at the rate of 55 nos./m^3. Commercial shrimp feed (CP Aquaculture India Pvt. Ltd and Avanti Feeds Pvt. Ltd.) was used ad-libitum for feeding the animals. For the initial 40 days, the feeding schedule was prepared based on the hapa survival obtained after 96 hours of stocking. For the rest of the culture period, the feeding ration was prepared following the estimated shrimp biomass obtained from the weekly sampling. The water quality parameters like salinity, pH, dissolved oxygen, hardness, calcium, magnesium, alkalinity and potassium were regularly monitored and recorded in the range of 13-15 ppt, 7.8-9.0, 5.4-8.2 ppm, 3200-3700 ppm, 250-320 ppm, 600-670 ppm, 200-230 ppm and 80-100 ppm respectively. An adequate number of

Technology benefits

Interception of ground saline water and utilization in aquaculture ponds will lower the ground table, help in soil improvement and reduction of secondary salinization. Since inland saline water is drawn from bore wells at different depths, it is free from pathogens and bio-secure, unlike coastal areas. As the vast stretch of agriculture land became saline and unfit for any agricultural activity, the farmers can undertake *L. vannamei* culture for 100-120 days like any other agriculture crop and reap an enormous profit.

L. vannamei harvest

maintaining desired level of dissolved oxygen in the pond water. At certain occasions, soil and water probiotics were used for the maintenance of the desired water quality and upkeep of pond bottom health. A total production of 13.4 tons/ha/120 days. The results of the present study proved that inland saline waters can be profitably utilized for *L. vannamei* culture by execution of cost effective ionic amendments.

Target geographical areas

Around 8.62 million hectares of agricultural land has been badly affected with the problem of soil salinity and 1.93 million square kilometres area is under laden with ground saline water in India. Of the total inland saline area about 40% is contributed by Haryana, Uttar Pradesh, Punjab and Rajasthan and at the same time 41-84% of ground water is un-potable in these states. The *L. vannamei* culture technology has enormous scope to implement in these areas.

5 Controlled breeding and seed production of Pengba, *Osteobrama belangeri* - an endangered fish

Pengba, *Osteobrama belangeri* is a native fish of Myanmar and migrated to Manipur, India from River Chinwin of Burma through River Manipur. This fish remained in the river systems of Manipur and Loktak Lake and became an esteemed fish of Manipur. Pengba is 'State Fish' of Manipur and is not available in any other North Eastern States. The fish fetches very high price, ranging from Rs. 300-400/kg. It is placed under endangered category. It is herbivorous and can be utilized for the control of aquatic weeds. To establish the culture of this species, desired quantity of seed is essential. The CIFE, Mumbai has developed the breeding and seed rearing technologies on semi-commercial scale.

Description of Technology

A few numbers of pengba fry were brought by CIFE, Mumbai from Manipur during 2006. The fry were grown to fingerling stage and portions were supplied to CIFE centre, Powarkheda and CIFE centre, Kakinada during 2007. The fingerlings were grown to adult stage. The breeding technique is similar to that of carps. The matured Pengba were successfully bred using 'Ovatide' and 'Ovaprim' spawning agents.

The females and males were simultaneously injected at the rate of 0.30 -0.40 ml and 0.20-0.30 ml per kg body weight of fish respectively. A total of more than 10 lakh spawn were produced at CIFE, Mumbai, CIFE Regional Centre, Kakinada and CIFE Regional Centre, Pawarkheda. Out of these, more than 4,00,000 fry and 50,000 fingerlings were supplied to the farmers of Andhra Pradesh for grow out trials. Some of the stock is maintained at CIFE, Mumbai and its Regional Centers for undertaking breeding and seed production programmes regularly.

Technology benefits

As pengba is placed under endangered category, the technology of breeding and rearing of fry and fingerlings will be helpful in conservation of natural resources. This also provides desired quantity of quality seeds to the farmers and helps in getting better income to the growers due to its high value.

6 Catfish hatchery technology and rearing of seed under three tier system

Catfish seed production is essential for species diversification in freshwater aquaculture. Catfish seed is collected naturally from paddy field or swampy areas. However there is a big gap between supply and demand. During transportation of seed, high rate of mortality occurs due to fluctuation in water parameters like temperature, pH, dissolved Oxygen etc. CIFE, Mumbai has developed a new catfish hatchery comprising of three tier rearing system.

Description of Technology

The main aim of the catfish hatchery unit is to increase the survival percentage of eggs to spawn, spawn to fry and fry to fingerling stage more than 70%. The indoor catfish hatchery has three tier rearing units which are the following.

A.	Breeding unit	:	Breeding tanks (Fixed or Portable)
B.	Hatchery unit	:	Fixed or Portable
C.	Rearing unit	:	Three tier system

A. Breeding unit: The breeding unit consists of an overhead water tank, filter unit, pump, cooling tower, oxygenation tanks and cemented

breeding tanks (3x1x1 m^3) or fiber glass tanks. An oxygenated water supply through shower system is maintained in breeding tanks. In breeding unit five sets of brooders are released in the ratio of 1:1.

B. Hatchery unit: In hatchery unit, a cemented platform (10x1 m^2) is made on which hatchery tubs are arranged parallel to each other. Water supply is provided from over head tanks through common G.I. pipe. Water supply of each tub is controlled by individual valve. The fertilized eggs are uniformly distributed in a single layer in plastic tubs. Fertilized eggs of each set are kept separately in individual tubs. Under normal condition, 3000 eggs can be placed in each tub. In this hatchery, Singhi and Magur eggs can be hatched out with more than 90% survival. Under normal conditions, hatching takes place within 26-28 hours at a water temperature of 27±1 °C.

C. Rearing unit: The rearing unit consists of 3 tiers which are as follows:

First tier: The first tier rearing unit consists of 6 cemented circular tanks (1x1x0.75 m^3). Under first tier system, we can stock the spawn at the rate of 3000 nos./cistern. They are fed with sieved plankton. Each rearing tank is provided with flow through system. The hatchlings are reared in first tier unit at the rate of 1000 nos./l of water. Proper water flow of 1-1.5/minute and water depth of 6 cm is maintained. The spawns are shifted to second tier system after the required time.

Second tier: The second tier system consists of 12 cemented/fiber glass circular tanks (2x1x0.75 m^3). In this unit, spawns are reared for one week. The stocking density of spawn is 300 nos./l of water. Decomposed eggs, fecal matter or decaying matters are siphoned out 2-3 times in a day. Shelters are provided for better survival and growth.

Third tier: Under third tier system, 24 cemented circular tanks are used for rearing the fry. Continuous water flow is maintained. Soil tiles are provided for shelter to avoid unnecessary movement of fry. During this period stocking rate of fry is 25-50 nos./l.

Rearing of fry to fingerlings: After 15 days, fry are reared in specially prepared cement tanks. These tanks are provided with black soil base of 3-4 inch and a water level of 15 to 20 cm. Plankton collected from culture ponds are inoculated into the tanks. Artificial fish feed or prawn powder along with soybean cake is given during the rearing period. After 25 to 30 days they attain a size of 8-10 cm in length and 2 to 3 g in weight. Now these fingerlings are ready to stock in specially prepared pond for grow out culture. Nursery ponds are smaller in size. The depth of water in nursery ponds is about 1 meter. Stocking rate of about 2000/m^3 is maintained.

Technology benefits

This hatchery is simple in design, low cost and can be fabricated in rural areas. The hatchery can be adopted by small and marginal entrepreneurs. Water requirement is very less as compared to other fresh water fishes in terms of hatchery operation and grow out culture. The technology is simple, economic, farmer friendly and can be adopted by rural youth and women entrepreneurs to generate self employment.

7 Culture and fattening technology of mud crabs

Traditional crab fishery exists in some parts of the east and west coasts of India, especially in coastal and estuarine areas of Sunderbans, West Bengal, Chilka Lake, Orissa and the mangrove regions of river Godavari and Krishna, Andhra Pradesh. Owing to domestic as well as export demand, the crab culture has gained momentum. CIFE, Mumbai has initiated a package of practices for crab culture and fattening using two major varieties of crabs, *Scylla serrata* and *Scylla tranquabarica* with variable stocking densities.

Description of Technology

1. Crab culture: A well designed pond is essential for mud crab farming. The pond design includes hideout pipes, earthen mounds, bamboo baskets and *Gracilaria* plants for use as shelter for growing crabs. Pond bundhs should be fenced with net to prevent migration. During the culture experiments the crab seed stocking densities were maintained 0.5 to 1 crab/m^2. Cropping period was observed for 120 to 150 days. Fresh trash fishes were given as supplementary feed at the rate of 3-5% of body weight of crab twice a day. Normal growth rate was observed as 2-3 g/day in the case of *S. tranquebarica* and 1-2 g/day in the case of *S. serrata*. A total production of 600 kg/ha/crop could be achieved in case of *S. serrata* and about 900 kg/ha/crop in case of *S. tranquebarica*.

2. Crab fattening: Rearing of water crabs in suitable earthen ponds, pens and cages for a period of 3-5 weeks is known as fattening. The crabs harvested from ponds or mangrove forests may include some growing crabs which remain very soft and pulpy; these are known as water crabs. Such crabs have no market value and are needed to be cultured for some more time in a separate water body. Fattening is the process wherein water crabs are subjected to culture for a period of 3-5 weeks to become hard shelled crabs. These hard shelled crabs are mixed with other marketable crabs to fetch a market price ranging from Rs. 200-500/kg depending on size range of 400-800 g.

8 Non-inbred seed production technology of carp

Inbreeding is the mating of closely related individuals. Unintentional inbreeding leads to reduced weight gain, increased susceptibility to diseases etc. Non-inbred seed of carps may be produced by well developed mating plans by keeping pedigree records and/or by crossing genetic lines/ parents from unrelated ancestry with superior records. Progeny thus produced is suitable to be developed as future brood stock for further propagation. Suitable breeding plans are also suggested to exploit the genetic potential. CIFE, Mumbai is engaged in high end research and developing technologies that are directly applicable to the field conditions. The technique of production of non-inbred seed of carp is one among them. Farm managers, hatchery owners, brood stock growers and ultimately the farmers will be benefited by this technology.

Description of Technology

Several stocks of rohu from various geographical locations are assembled at a central breeding farm. The potential brooders are tagged with Passive Integrated Transponders Tags (PIT) for individual identification and were maintained at a central breeding farm. Mating plans are developed in such a way that mating is avoided within the stock. The fingerlings are tagged so that their pedigree can be identified and their growth can be monitored. Fry and fingerlings of the carps (rohu) are provided to the government / private hatchery owners who further produce the seed propagation. Based on the identification of the individuals, breeding plan is given for the production of the seed for commercial use. The pedigree and performance record of the

Technology benefits

Hatchery manager will be in a position to maintain the stock of high quality and will be able to provide the certified seed to the farmers. Farmers get the certified quality seed through this technique.

progeny and the farmers to whom these are provided are maintained. Growth of the animals is monitored and productivity can be evidenced by comparing with the progeny of other stocks. Along with this, the hatchery managers are provided the package of practice to raise the brood stock and develop the seed. Tagging, recording the performance of progeny and replacement of the brood stock is streamlined for further research on brood stock development and management for quality seed production.

9 Optimization of spermatozoa requirement for artificial insemination in carp

The technique is employed for the efficient use of carp spermatozoa to fertilize the eggs.

Description of Technology

The technique of cryopreservation of milt is widely used for artificially fertilizing the carp eggs in the hatcheries. For the same, the milt from the best performing individuals is preserved at ultra-low temperatures (-196 °C). In the present experiment, the optimum number of spermatozoa for artificial insemination and effective fertilization of the carp eggs were standardized. Based on the series of experiments it was determined that the ratio of sperms and egg should be 10000: 1 for effective fertilization. The results of this experiment have been published in the Indian Journal of Fisheries and are being used for maximum use of male brooders.

Technology benefits

The technique is extremely useful for optimum utilization of milt procured from selected brooders of carps and getting effective fertilization.

10 Short term preservation of catfish milt

The technology helps in preserving the milt of male individuals of high genetic worth for stock improvement. Progeny thus produced is of outstanding potential as for as major economic traits are concerned.

Description of Technology

CIFE, Mumbai has developed the techniques for the short term preservation of catfish (*Clarias batrachus*) milt. The preserved milt was field tested for its survivability and fertilization capacity. The milt was collected from potential male brooders, diluted with extenders and added with cryoprotectants. Milt was further filled in straws, preserved in vapors of liquid nitrogen and further immersed in the liquid. Survival of the spermatozoa was tested before being used for fertilizing the eggs, freshly procured from the female brood stocks. The milt was found to be potential to fertilize the eggs, although the percentage of fertilization was about 20%.

11 Raising of fish seed in cages

Average fish production from Indian reservoirs is about 15 kg/ha. If a proper stocking is taken up in open water bodies, this production can easily be increased up to 100 kg/ha. For optimum fish production from reservoirs, lakes, ponds, bheels etc., it is necessary to stock them with healthy fingerlings of above 100 mm size. Thus, cage culture offers *in situ* rearing of fry to fingerling before releasing them into the reservoirs and becomes the best option available for enhancement of fish production from large water bodies.

Description of Technology

Webbing of the cages is made of HDPE (high density polyethylene). Mesh size of 6 to 8 mm and cage size of 3m×3m×3m are ideal for large and deeper open water bodies. The frame of the cage can be constructed from bamboo, teak or sal wood (preferably water resistant and light wood). Nut, bolts or other fasteners used to construct the cage should be of rust-resistant material. The frame should be wide enough (1.5 to 2.0 ft) to support the cages and provide a working platform on the cages. This framework is also provided with HDPE barrels functioning as floats. Net cages are allowed at 1.0 m above the water level and fixed with ropes to four corners of the poles. Each cage is also covered from the top by using the same material. Bottom periphery of the cage is provided with sinkers

so as to keep them stretched. Corners of the each cage unit are provided with anchors to keep the cage infrastructure stationery at a definite location in the water body. Stocking of fish is done with fry of length, 35 mm at a stocking density of 50-200 fry/m^3. 60 days of raising period is adequate for raising carp fingerlings in cages. It is advised to clean the webbing at weekly interval by brushing. Biofouling organisms such as algae, sponges and debris, if allowed, will obstruct the water exchange in the cages. Feeding of fish in cages is necessary for higher yield especially if productivity of the reservoir is poor. Formulated feed (rice bran 10%, GOC 40%, maize 7%, soybean 20%, Acetes 20%, vitamin mix 2%, mineral mix 1%) should be given to the fish (carps) at 3-5% of body weight, at least twice a day. At the end of 60 days, 100 to 120 mm sized fingerlings can be harvested. Three or four persons can manage to harvest one fish cage by lifting the net using four corner ropes attached up to the bottom of each cage. All fishes can be pushed at one corner of the cage to scoop out the confined fish at one end of the net and place them in buckets.

Technology benefits

The production of fingerlings through cage aquaculture will improve country`s production in two ways;

(I) By regularly stocking open water bodies like lakes and reservoirs with desired varieties of fingerlings and thereby improving fish catch from these water bodies

(ii) Fish farmers, fishers, cooperative societies, community depending on the reservoir fishery or other open water bodies will be benefited through generation of income and livelihood by the application of this technology.

12 Organic aquaculture through biofertilizers

Present day aquaculture often uses non-biodegradable fertilizers and pesticides containing toxins as well as supplemental feeds which may be responsible for health hazards and environmental degradation. CIFE, Mumbai is involved in developing and disseminating technology that takes care of environmental problems and health hazards of aquatic organisms, and helps in ensuring the human health through production of commercially important aquatic organisms on sustainable basis in eco-friendly manner. Biofertilizers help in maintaining ecological balance through proper up-keep of the environment. Organic produce fetches good market value due to increasing demand globally. It helps in maintaining good health of public. It will also help in earning foreign exchange.

Description of Technology

Nitrogen and phosphorus play a very important role in primary production. These nutrients are provided in aquaculture system from external sources in the form of organic manures and inorganic fertilizers. Certain organisms are capable of fixing atmospheric nitrogen and are capable of producing enzyme phosphatase. Large scale culture of nitrogen-fixing bacteria *Azetobacter chroococcum* and phosphatase-producing bacteria, *Bacillus* species were carried out separately. After achieving the density of 10^9 c.f.u./ml, broth culture of these bacteria were inoculated in sterilized and moist charcoal at room temperature to get 10^6-10^9 c.f.u./g of charcoal. Its shelf life was over three months. This can be applied at the interval of 15 days in freshwater carp culture ponds.

13 Color enhancement of ornamental fish through carotenoid rich feed

The ornamental fish trade is very much dependent on achieving vibrant color. The commercial value of fish reflects this requirement; hence fish keepers are constantly exploring methods of enhancing skin coloration. Color enhancement through the use of natural carotenoids in feed is one of the measures to enhance coloration and brightness of the colorful ornamental fish. Carotenoids are nitrogen free polyene pigments responsible for red, orange, yellow colors occur in hues of plant leaves, fruits, flowers, some fishes, birds, insects and crustaceans. Since carotenoids are only synthesized by plants and modified in animal tissues, fish must obtain them from their diet. It is advisable to ensure that ornamental fishes obtain a constant intake and adequate level of carotenoids in their feed. The use of plant source in fish feed presents a double advantage: besides being rich in carotenoid pigments, they are a direct source of nutrients like protein, lipids and vitamins.

Description of Technology

Among the natural carotenoids sources studied, red marigold flower meal was identified as the richest sources of ß-carotene, canthaxanthin and xanthophylls. Hence, these were incorporated in the ornamental fish feed. The feeds were prepared by supplementing red marigold flower meal at 4% to the control diet replacing the same amount of rice bran. The granular feed was prepared by using the spheronizer. The experimental feeding trial had been conducted in rosy barb using the experimental feeds. Total carotenoids concentration in the muscle and skin of rosy barb after 5 week of experimental feeding trial clearly showed

Control diet

Red marigold diet

that the total carotenoids concentration increased with the supplementation of red marigold meals in the diet. For instance, the total carotenoid content in the fish at the start of experimental feeding trial was 8.53±2.12 µg/g wet weight and at the end of feeding trial was 20.59±4.11 µg/g wet weight. Thus, red marigold petal meal was found to be an effective colour enhancer at a cheaper price without any adverse effect on growth and body composition of fish. The experiment was also repeated in other freshwater ornamental fishes like dwarf gourami and sword tail and the similar results were observed.

Technology benefits

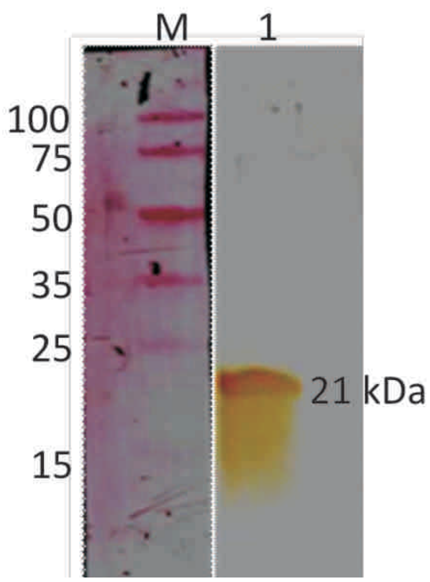
The feed additive can be used by the aquarists especially hobbyist, hatchery managers and breeders to enhance desired colour of ornamental fish to increase the marketable value. This is a proven technology for gold fish, blue gourami, swordtail and other common ornamental fish.

14 Immunodiagnostic kit for white tail disease of Giant freshwater prawn

White-tail disease (WTD) is an acute viral disease of *Macrobrachium rosenbergii* affecting the post-larval and early juvenile stages causing up to 100% mortality resulting huge loss to farmers. The disease is caused by two RNA viruses, *M. rosenbergii* nodavirus (MrNV) and a satellite virus, extra small virus (XSV). The disease can be controlled by early detection of the virus in hatcheries and grow out ponds and eradication of the infected stock and segregating the healthy stock.

Description of Technology

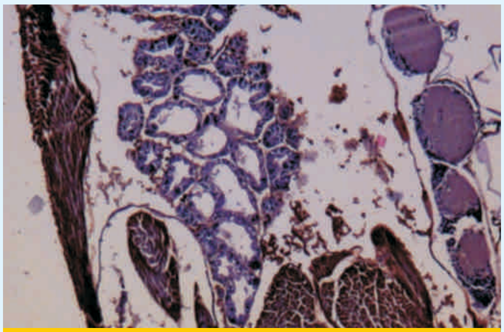
The technology is based on detecting white tail disease affected *M. rosenbergii* post-larvae by immunodot assay using monoclonal antibodies. Monoclonal antibodies have been produced against the recombinant capsid protein of XSV. The monoclonal antibodies are specific to the XSV capsid protein and hence are used to detect the virus in infected samples. The test involves homogenization of the infected (suspected) post-larvae and blotting 2 µl of the clarified homogenate on a nitrocellulose membrane. The membrane is air-dried and blocked with blocking agents. The membrane is then incubated with the monoclonal antibodies for 1 hour. Subsequently the membrane is washed and incubated with anti-mouse HRP conjugate. The membrane is washed and incubated with substrate solution. Positive samples produce a brown precipitate.



The reaction of monoclonal antibodies against the recombinant XSV capsid protein

Market potential

Currently, the market potential of the technology is limited due to the fact that *M. rosenbergii* culture has come down markedly in recent times due to frequent disease outbreaks. However, there is a potential for this technology as WTD is the most pathogenic disease condition in *M. rosenbergii* in the early stages. The target users will be mostly scampi hatcheries and to a certain extent farmers of *M. rosenbergii*.



Technology benefits

Since the test involves homogenization, clarification and subsequent blotting on nitrocellulose membrane and detection by simple washing and incubation steps, the test does not require sophisticated equipment or skilled technician. The test can be performed at hatchery and farm level. The reagents can be packed in the form of a kit. Early detection of the disease will help in minimizing the loss to the hatchery and farmers by isolating the infected stock from the healthy ones.

16 Ready-to-eat fish meat fortified snack (Fish munch)

Extrusion technology is becoming very popular across the world to produce puffed and crispy snacks. Fish munch is one such product in the category of snack food which has been incorporated with fish meat.

Description of Technology

Fish munch is an extruded fish product. Usually starch is used for extrusion because of their temperature tolerance and desirable behavior at high temperature. Addition of protein adversely affects the crunchiness of the product and usually not exceeded beyond 5%. CIFE, Mumbai has developed the unique technique of blending up to 25% fish protein (a level that is equal to the protein content in fish) in to extruded product. A temperature controlled twin screw extruder is used for unique blending of starch and protein from different sources. The extrusion parameters (feeding rate, moisture, barrel temperature, die diameter and screw speed) have been optimized using response surface technique to get desirable product expansion. Three-layered laminated pouch from aluminum and polyester were developed for nitrogen packing and storage. The product has a shelf life of over 4 months. The product showed excellent acceptance in sensory evaluation. Low cost fish has been utilized to make this product cheaper and for better use of the commercially unimportant fish.

Commercialization status

Technology has been transferred to Vijaya Infra Project (Pvt.) Ltd., Mumbai

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17 Ready- to-eat fish sandwich spread in retort pouches

Sandwich is the most popular ready-to-eat food all over the world and its fortification with fish meat is an effective tool against nutritional deficiency.

Description of Technology

A novel technology was developed at CIFE, Mumbai to produce ready-to-eat fish sandwich spread in retort pouches by utilizing low cost fish and fish oil rich in omega-3 fatty acids. The technology involves the following aspects:

- Utilization of low cost fish mince and/or fish oil to produce fish based spread in retort pouches
- Optimization of retorting conditions to get desirable nutritional and textural properties

Heat process schedule was standardized to get an acceptable quality and the nutritive value of sandwich spread was enhanced by incorporating fish oil which was evident from increased levels of EPA and DHA in sandwich spread as determined by GC-MS. The storage characteristics were studied and found that the product showed no significant changes during 12 months of storage period under ambient conditions. Under optimum process conditions, fish oil incorporated sandwich paste made from low cost fish mince did not show any oxidative rancidity. Optimized final product had improved oxidative stability, spreadability and texture.

Market potential

Market for processed foods has been growing at a greater rate due to change in life style and food habits of people. It has been changing from whole, frozen foods through ready-to-cook products to finally ready-to-eat products. The demand for ready-to-eat fish products is increasing both in domestic and international market because of health benefits associated with fish and fishery products.

Financial aspects

- Total investments: Rs. 1600000
- Production capacity: 1600 pouches (200 g each) / day
- Production cost: Rs. 120/Kg sandwich paste
- Packaging cost: Rs. 4 for 100 g; Rs. 6 for 200 g
- Production cost for each pouch of sandwich paste : Rs. 3.75

18 Anti-stress formulation for fish seed transport: CIFELOSTRESS

As fish seed stocked by farmers is frequently handled before reaching the stocking pond, it is important to maintain the fish seed quality by reducing the stress. Transportation and related stress are the key factors which contribute to the low quality of fish seed. CIFE, Mumbai has developed an anti-stress formulation for fish seed transportation.

Description of Technology

CIFELOSTRESS, the anti-stress formulation contains sedatives, buffers and electrolytes. The product helps to reduce transportation costs for fish seed by packing 1.5 times more seed. It helps to reduce mortality during and post transport. Farmers and Fish transporter will be benefited by application of this product while transporting fish seed.

Commercialization status

Technology has been transferred to Aqua Vet Laboratory, Ranchi

19 Anti-stress herbal formulation for live fish / shellfish: CIFECALM

Keeping the fish in stable calm condition for collection of blood sample, length-weight data, delivery of vaccines is a challenge for students, researchers, laboratory technicians, farmers etc. To overcome the peculiar constraint and facilitate proper handling of fish, CIFE has developed an anti-stress herbal formulation for live fish/shellfish.

Description of Technology

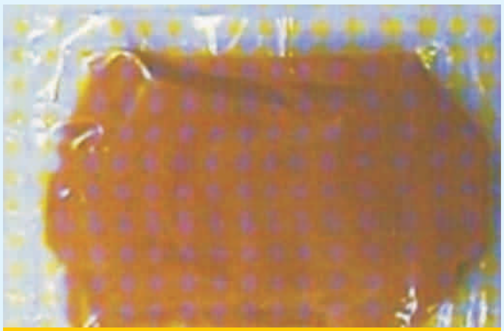
The product helps in tranquilization of fish and shellfish for laboratory purpose. The formulation is an alcoholic extracts of *Ugenia caryophyllata* and *Mentha arvensisin* at appropriate concentration. Generally, 2 drops or 50 µl of CIFECALM per liter of water is required to tranquilize a fish. However, the dosages may vary according to size, species of fish/shellfish

20 Nutrient dense microparticulate diet

Appropriate feed is essential for proper larval development of *Macrobrachium* species. CIFE has developed a nutrient dense nutraceutical based microparticulate diet with protein hydrolysate.

Description of Technology

The larval diet has a particle size ranging from 18 to 50 µm. This diet can replace artemia nauplii as larval feed up to 40%. This will help in reduction of dependence on artemia nauplii thereby reducing the cost of production in turn.



Technology benefits

This larval feed has wide application in prawn hatcheries.