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Preliminary trials in *Artemia* rearing and salt production in earthen salt ponds*

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With the successful *Artemia* inoculation in the salterns of a private fishfarmer, the SEAFDEC Aquaculture Department embarked on a 0.5 ha pilot project that combined trials in *Artemia* rearing with solar salt production during the dry season and with production of milkfish *(Chanos chanos)* fingerlings and/or prawn *(Penaeus monodon, P. indicus, P. merguiensis)* juveniles during the rainy season.

A series of reservoir, evaporation, concentration and crystallization ponds totalling 5,000 sq m were constructed in Guigui, Leganes, Iloilo. Ratio of crystallization (salt bed) area to the rest of the pond area was 1:10, similar to nearby salt ponds (Table 1). Water level in the evaporation ponds was made progressively deeper from 30 to 45 cm to allow for *Artemia* culture in contrast with traditional evaporation ponds which range from 2 to 25 cm deep for maximum daily salinity increase. Reservoir ponds are traditionally deeper (30-80 cm) because they also double as milkfish ponds.

With daily pumping of water from the main supply canal and flow by gravity through the series of evaporation ponds, the original plan was to increase salinity up to 200 ppt before introduction to the crystallization area for better harvest of whatever *Artemia* cysts could be produced. However, water had to be introduced to the salt beds at 140-160 ppt to produce coarse salt which requires less salt to fill one sack compared to the fine salt produced at 200 + ppt. Moreover, rough salt is more acceptable to the average Filipino because it is more familiar.

A total of 250 sacks (1 sack = 50 kg) was produced over a 30-day period (15 March – April 1979) for the 0.5 ha or 16 sacks/ha/day. This compares favorably with traditional solar salt production with an average of 4-20 sacks/ha/day (Table 1). The comparable salt production rates in the pilot area in spite of deepening of water in the evaporation ponds for *Artemia* rearing is an indication that the two activities may be successfully combined.

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* This is part of a paper presented at the International Symposium on the Brine Shrimp, **Artemia salina** held at Corpus Christi, Texas, U.S.A. August 20-23, 1979.

Data on the six *Artemia* inoculations in various ponds on the project site are found in Table 2. All inocula came from Living World (San Francisco Bay strain) cysts hatched into nauplii or reared to adults at the SEAFDEC Tigbauan station and transported 1-1/2 hours by motor vehicle to the ponds located in the Leganes Station. Nauplii were decapsulated (Lavina, n.d.) prior to hatching; adults came from nauplii reared in 1.5-ton fiberglass tanks and fed with *Tetraselmis chuii* and/or rice bran (Sorgeloos, et al., 1979). Stocking was done in the afternoon to avoid high water temperatures – water temperature on all ponds ranged from 27 to 42.5°C at 11:00 a.m. and 25 to 38°C at 4:00 p.m. for the months of April and May.

The 16 May inoculation of both nauplii and adults was relatively successful because after one week, about half of the females were cyst-bearing. The good health of the animals could be attributed to the presence of natural food – lablab, a microbenthic complex of bacteria, diatoms, blue-green algae, protozoans and other microorganisms (Rabanal, 1966; Baliao, 1978) and plankton, established by means of fertilization. With the discovery of some cysts in the water, 30 sacks (1,500 kg) of solar salt were added to increase pond water salinity and ensure buoyancy of the cysts. Unfortunately, this was followed by a total collapse of the *Artemia* population after a few days, most probably due to a high concentration of $CaSO_4$ which may have been toxic to *Artemia* (Vos, 1979). The salinity increase (44 to 53 ppt) also stimulated excessive lab-lab growth which may have led to pollution.

The other noteworthy inoculation was that of 4 June because the riding stage was reached and the animals were in very good health. A plankton bloom in Pond 6 at 94 ppt on June 16 was found to be due to a green flagellate tentatively identified as *Dunaliella* sp. This species holds promise as a natural food to sustain *Artemia* growth in high salinity ponds and efforts are underway to isolate, identify and mass produce the algae. Disappearance of the *Artemia* population could be attributed to the decline of the phytoplankton in the pond.

The failure of the *Artemia* inoculations could be traced to weak *Artemia* nauplii because of addition of ice to transport water, lack of food and shelter, and predation by finfish and other crustacean larvae.

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Table 1. Data on salt ponds in Iloilo Province, Philippines (June 1979)

	Pond A	Pond B	Pond C	Pond D	SEAFDEC Pond
Pond area (ha)	12	15	10	33	5000 sq m
1. Reservoir	–	6*	(milkfish pond)	(milkfish pond)	1250 sq m
2. Evaporation	11.5	4	9	29	3010 sq m
3. Crystallization	0.5	4-5	1	4-5	430 sq m
Res./Evap. pond: Cryst. pond ratio	23:1	2:1	9:1	6:1	10:1
Water depth (cm)					
1. Reservoir	30-60	30-60	30-60	30-60	25
2. Evaporation	2.5-25	2.5-25	2.5-25	2.5-25	30-50
3. Crystallization	5	5	5	5	5
Water supply	pump & gravity	pump & gravity	gravity	pump & gravity	pump & gravity
Salt prod. (sacks/ha/day)**					
1. Minimum	1	7	1	3	8
2. Maximum	25	–	5	15	48
3. Average	21	–	4	10	16
First harvest	5-11 Feb.	5-20 Feb.	8-15 Feb.	10-20 Feb.	–
Last harvest	2nd week June	1st-2nd wk June	6 June	1st-3rd wk June	–
Total no. days actual harvest	80-90	90-105	60-120	60-120	

*With milkfish stock.

**1 sack = approx. 50 kg.

Table 2. Summary of data on Artemia inoculation in SEAFDEC *Artemia*/salt ponds, Leganes, Iloilo, 1979.

Date	Pond No.	Salinity at stocking (ppt)	Pond preparation	No. and age of *Artemia* stocked	Manner of transport	Remarks
March	2	No data	None	5×10^6 nauplii, 1×10^6 adults	In plastic bags containing oxygenated seawater and ice packs.	Nauplii weak after transport, Mass mortality after 4 days; total mortality by 19 March.
March	2	No data	None	1×10^6 nauplii, 3×10^6 adults	In plastic pails containing aerated seawater	Mass mortality after 3-4 days; total mortality by 2 April.
May	3	42	Drying, fertilization with 100 kg dried chicken dung & 15 kg urea; 45 pcs. coconut fronds installed as shelters.	0.55×10^6 nauplii 3×10^6 adults	In plastic bags containing oxygenated seawater	Good lablab growth during stocking. Riding adults observed after 1 week. A few cysts found in water samples 25 May; 1000 kg salt added same day. Another 500 kg salt added 31 May. Total collapse on 3 June; excessive floating and benthic lablab.
May	4	48	Fertilization of water with 10 kg urea; 30 pcs. coconut fronds installed as shelters	0.5×10^6 nauplii 0.29×10^6 adults	In plastic bags containing seawater.	Moderate lablab growth. Population gradually died off.
June	1	50	None	10×10^8 nauplii distributed among 6 ponds	In plastic bags containing oxygenated seawater	Emergency stocking due to excess newly hatched nauplii at the large tank Prawn Hatchery. Immediate predation by fish, crustacean and insect larvae in ponds 1-5, Nauplii survived for 2 weeks in pond 6 which had abundant phytoplankton.
	2	52				
	3	64				
	4	58				
	5	64	20 pcs. coconut fronds			
	6	86	Fertilization w/ 6 kg urea; 30 pcs. coconut fronds			
June	6	94	None; pond water green from previous fertilization	1×10^6 adults	In plastic bags containing oxygenated seawater	Riding adults observed after 1 week. Pond water very dark green due to bloom of *Dunaliella* sp. on 16 June. Strong rains 3rd wk. June. Population gradually disappeared and none observed by 1 July.