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## An Investigation on Taiwan milk fish

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**Abstract:** In this article, I presented an overview of milkfish (*Chanos chanos*) in Taiwan, for providing the investigated information of milkfish body feature, ecological feature, life history, reproductive biology, fry production, culture methods, production, annual retail sales and marketing.

**Keywords:** body feature, culture method, ecological feature, marketing, milkfish, spawning.

### 1. INTRODUCTION

#### 1.1. Identity of milkfish in Taiwan

**Scientific name :** *Chanos chanos*<sup>1</sup> ; **Taiwan name** Milk fish ; **Giant herring** White mullet<sup>1</sup> ; **Place of origin:** Tainan, Kaohsiung, and Pingtung<sup>1</sup>

**1.2. Body feature:** The milkfish had a symmetrical and streamlined shape with a bifurcated caudal fin. The maximum length could be as long as 1.8 meters, but the size of the market was generally less than 50 cm. No teeth and the staple foods were algae and invertebrates<sup>2</sup>. Had a very developed adipose eyelid and almost completely obscuring the fisheye<sup>3</sup>. There were 222 fish bones in the body. The body type was long-oval and flat on the side, and there are silver-white small round scales that were not easy to fall. The lateral line was clear, the ventral surface was round and there are no scales. The mouth was small, there were no teeth in the two jaws and the mouth, and the eyes were fat. The thorn was meaty and delicious. The caudal fin was deeply forked, the body was silver-white, the back was gray-brown, the body was about 40 cm long, and the body weight was about 200 to 400 g<sup>3</sup>. In food market, the milk fish always had

been obvious. The silvery white skin was matched with a tight round scale, which was even more beautiful, and the slender body was dazzling in the water. In professional terms, it's always in the rigor mortis state in food market, And often bent from the middle of the concave head, it was a unique fish pose, in other words, it was in a very fresh state<sup>4</sup>.

**1.3. Ecological feature:** Milkfish was an important fish catch in Southeast Asia. It was a warm-water fish and lived in tropical and subtropical waters<sup>3</sup>. The fish was less able to withstand cold. If the water temperature dropped below 14 °C, it will be frozen to death. Therefore, breeding needed to be prepared for wintering and could adapt to a variety of different salinity habitats, from the fresh water in the river to the estuary mangrove area to the sandy bottom of the ocean or the environment of the coral reef area, all of which were widely distributed in the tropical and subtropical waters of Indonesia and the Pacific Ocean. Southern Taiwan was more common<sup>5</sup>. It was visible in the eastern Pacific Ocean from the north of South America to the south-central part of California. It traveled more frequently in the western Pacific and the Indian Ocean (especially from the southern coast of Taiwan through the bashi-channel to the Indian archipelago.) Its whereabouts were more frequent<sup>6</sup>.

**1.4. Cultured in Taiwan:** At present, there were various breeding methods in Taiwan, such as traditional shallow water culture, deep water culture, fishing bait and seedling breeding, fish and shrimp polyculture and fish and shell polyculture<sup>7</sup>. The former two were the production of food fish, while the bait and seedling breeding mainly produced the 5-inch-sized fry, the bait used in the milkfish industry and the production of 3 to 8 inches of fish for the production of food fish<sup>8</sup>. The fish and shrimp were mixed and raised in the deep-water culture, and some sand shrimp, white shrimp or grass shrimp were mixed as side production.<sup>9</sup>

**1.5. Milkfish and shellfish polyculture:** Clam (*Meretrix lusoria*) larvae were mixed in the milkfish culture pond to remove the enemy, and let them feed on the algae (*Enteromorpha* sp. and *Chaetomorpha* sp.) to avoid their damage to growth and survival of the clam. It feed on moss, organic garbage, etc., so it was usually kept in the clam Pond in the area of Changhua to Tainan<sup>10</sup>, as a means of removing debris from the pool. Before the clam was ready to be harvested, the fee will be opened for fishing in public. Because the milkfish swan fast and explosive, so it was quite easy to get hooked. It was one of the fish species that fishermen in southern and southern Taiwan liked to fish. If all milkfish not be caught by fishermen, the farmers will put the pool water and catch the fish. It usually controlled to harvest before the autumn<sup>8</sup>.

The milkfish before the age of one year was about 600 grams, and the winter milkfish could reach about 50 to 70 centimeters and 1 to 1.5 kilograms<sup>10</sup>. Because of the neurotic relationship, the farmed milkfish must pay considerable attention to their living environment, so that it will not be a waste painstaking phenomenon. The artificially raised milkfish did not need to worry about quality. Because the fish were not cold-tolerant, the water temperature of the fish-pool was too low and will cause a lot of death.

The spawning period was from April to September every year, the female breeding fish age was 6 years old or above, the male breeding fish age was 5 years old or above, the reproductive body type was 5.7kg, the number of eggs was 80.1 million, and the reproductive water temperature was 27.30°C. Salinity was 30.35<sup>4</sup>.

## 2. MATERIALS AND METHODS

**Cultured in the world:** In addition to Taiwan farming milkfish, the Southeast Asian countries such as the Philippines and Indonesia also had milkfish farming. Taiwan's milkfish farming technology was believed to have been introduced to Taiwan by the Dutch from Indonesia<sup>11</sup>.

**Material and method of shallow water culture:** The shallow water culture was mainly made up of land that could not be farmed and cultivated algae as bait by using low-cost organic fertilizer and solar energy. The optimum growth temperature of the milkfish was about 25 ° C<sup>10</sup>. If the temperature was lower than 14 ° C, the movement would become slower than 9 ° C and die. Traditional milkfish farming generally used a wide range of flat fishing rods. This type of shallow water was suitable only for the southwestern part of Taiwan, so the traditional milkfish rods were concentrated here. The soil of the surrounding milkfish had better made with clay soil. It was not only easy to build dikes, and also had water retention and fertility at the bottom of by shovel. The size of the pond was 5- 6 hectares. The season of the milkfish cultured was from April to November in Taiwan. The other times, the wintering of the milkfish and the preparation of the pond were carried out<sup>12</sup>.

## 2.1. The main process was followed

### 2.1.1. Pond preparation<sup>8</sup>

- **Drainage, drying pool:** After the pool water was discharged, the embankment should be refurbished and dried
- **Fertilization:** The amount of fertilizer contained in the subsoil was based on personal business habits and the fertility of the pond.
- **Water injection:** After fertilization, the water should be injected about 10 cm to facilitate the cultivation of the bottom algae, the mainly blue-green algae and diatom.
- **Drainage of ditch water:** The pond will be drained in the second half of the second drying season.

**2.2. Stocking:** The stocking capacity of the pond, according to the amount of winter fish, body size, pond bottom algae were good and bad, and management. The stocked fish could be roughly divided into old fish (wintering fish) and new fish<sup>7</sup>

#### A. Old fish

Old fish could be divided into two kinds of milkfish, one was that was self-overwintering, and the other was the sapling of the wintering small seedlings cultivated by the breeding ground. The former could be divided into three types: large, medium and small, and the large size were about 100-150g<sup>12</sup>. Medium size was about 50-100 g and small size was 20-50 g. If the milkfish was to be caught early, the larger will be stocked. At least 2 types of self-overwintering old fish were required, there were 3 types was the most ideal. In general, this type of old fish stocks about 2000-2500 per hectare. Seedlings were generally purchased from breeding pond, body length 4-6 cm, the stocking amount was about 1500-2000. In total, the total stocking amount was about 3500-4500, can be adjusted, but try to avoid massing the same body-size. Due to the large fish to be caught, the stocking was about 4000-5000, and the size was 200 g and 80 g. The stocking method was to release the live pigs first, then transport them back to the seedlings and then put them into the fish, and then moved them into the growing pool.<sup>13</sup>

#### B. New fish

The stocking time and time of new fry were different with the old fish, stocking number and its growth. Generally buy 3-4 batches of fry (head water, two water , 3 water, 4 water . in May, June and July), each batch of about 1500 , totaling about 6000 , were stocked according to the above method before and after

the old fish were caught<sup>13</sup>. In addition to the head water and some of the two water fish caught in the same year, the rest will become the old fish of the next year at the end of the year. However, due to the large demand for fish in the market, it is only stocking new fish fry twice for the year of stocking old fish fry, and the amount of the two stocking were about 5000-6000<sup>14</sup>. When it comes to the size of the fish market (200 g in the early days and 400-600 g in the near), it was necessary to consider starting harvesting. Generally, 100-150 g of fish were stocked in April, harvested at the end of May and early June, weighing 300-450 g per fish; medium-sized old fish were harvested in mid-June; small old fish were harvested in July, and each fish weight was 300-400g; seedlings began to be harvested in August, each fish weight 300-350 g; new fry began to be captured at the end of September and early October, each fish body-weight was 200-300 g. The number of stocks decreased, and the first stockings were harvested in July, and the second batch of stocker was harvested in September and October, about 2-3 times<sup>15</sup>. Before harvesting, the thorn net was usually used in the corner of the pool to round up the tail and determine the size of the net, commonly known as the "test network."

If it was sold in a nearby area, it could be harvested at 2 or 3 in the middle of the night; if it was sent to a remote market, it will be early to afternoon. The milkfish usually feeds in the daytime, so when fishing during the day, the food in the belly should be discharged, so that the fish could be kept fresh, commonly known as "disinfection." "Drinking belly" is performed 2 hours before the capture. Used the red gill net or pull the scorpion back and stroke 2-4 times to make the fish frightened and defecate. The fishing gill net was made up of scorpion, and was towed by 6 people on the shore. At the back of the gill net, two people drive the raft to transport the raft and beat the water with bamboo poles to reduce the frightened fish from jumping out of the water. Pierce the net. At the corner of the pool, the net is rolled into a spiral raft, and the milkfish of the scorpion net was taken out and sent to the bamboo raft<sup>8</sup>. According to the size of the body, it was installed separately, about 31.8 kg per raft (when it was transported back to the weight, it will increase or decrease).

The method of decoration varies according to the place of sale. In the south, the fish body was bent into a chrysanthemum flower; in the north, it is placed straight, the tail was placed on the head, and the head was oriented in a certain direction<sup>12</sup>. After loading, it will be shipped back by one person, and the others will be arrested for the second time (depending on the number of fish and the first catch). Generally, the first net captures 60%. About 30% of leftover were caught at the second network), if the amount of sputum was not up to the scheduled, continue to add fish in other pools. After transporting back, took 31.8 kg of each basket, add the crushed ice, and transport it to the fish cargo transport line (at 7:00 pm)<sup>11</sup>. The transport line will then install the fish market to be sent according to the needs of the owner. On the raft, add crushed ice to send.

### 2.3. Wintering

The end of October and the beginning of November in Taiwan, due to the temperature drop, the north wind began to have dangerous, the milkfish did not grow. The fish that could not capture for the market must be driven into the wintering pond. Due to the intensive pool fish during the winter, the water temperature was reduced, making it vulnerable to disease and death. Mortality is sometimes as high as 80% and the loss was enormous<sup>8</sup>.

**2.3.1. Wintering preparation:** The milkfish must begin for wintering preparations after October. First, the pool water was drained, the bottom of the pool was leveled, and the pests in the shallow flat were snails, salt water, etc. With 0.1 kg or 5ppm tea removed. After the pests were removed, the bottom of the pool was dried and then fertilized. Fertilization was based on rice bran, about 0.5 kg per ping. After fertilization, water was injected and dried to cultivate bottom algae. After the winter ditch was drained, used the pick or iron to pick up the sludge as much as possible, repaired the ditch, and arrange it into a

bowl shape, then by daylight<sup>16</sup>. Disinfect with sun exposure or disinfection with 0.3-0.5 kg lime per ping. After the levee was exposed by sun, it was beaten with the embankment to make it strong. Secondly, changed the wind proof scaffolding and covered it with windproof thatch<sup>17</sup>.

**2.3.2. Put fish into the ditch:** After the above-mentioned work was completed, the fish must be used to let the fish in the ditch, and then into the wintering ditch according to the size of the fish. Be careful when you order, avoid fish body abrasions and mixed fish. The density of stocking was closely related to the wintering mortality rate. Above 2.3 kg/m, the mortality rate was significantly increased, exceeding 2.7 kg/m. Even if the shallow flat was increased, it will cause extremely high mortality. In order to avoid excessive storage and loss, the most appropriate density is 1.3-2.0 kg/m<sup>3</sup>, but if it was pumping equipment, it could be increased to 3.0 kg/m<sup>17,11</sup>.

### 2.3.3. Wintering management

**A. Routine:** During the wintering of milkfish, due to the small extent of the shallow water culture, the algae were limited in the bottom<sup>15</sup>. If the cast was not enough, it was easy to produce big head disease (large head, flat and no meat), and the disease resistance was reduced, which was prone to death. Therefore, in the warmer days, it was necessary to invest in rice bran or peanut cake, but the use of similar materials in the near-neck was more common, generally better than peanuts, because it was less likely to cause water quality deterioration. The investment should be at the shallow water level, avoided to thrown in the ditch and polluting the bottom of the ditch. The high-density storage in the wintering ditch, the water quality was easy to degenerate, and the water must be properly changed. If the water color was yellow acid water, soy sauce water, rice water, red water ditch, or several different ribbons appear in the ditch, they must be changed immediately<sup>16</sup>. Water change work was generally carried out in the warmer, sunny days, in the morning, so that after a period of exposure to increase the temperature, and then into the water at night high tide. Although the water exchange work was important, it should not be excessively frequent. Otherwise, it will form the skinny water, which was prone to fish mites and mites, which reduced the resistance of the fish and was prone to disease. Therefore, some people will inject water and fertilizer after changing the water. During the wintering period, when there was too much sludge in the pool, you could drive the fish into the shallow flat or the side of the ditch on a sunny day, and then used a mud shovel to smash it onto the embankment to reduce pollution<sup>10</sup>.

**B. cold current attack:** According to the weather report, when the cold current was known, the milkfish in the shallow flat must be directed into the ditch, the water gate of the ditch and the shallow flat was closed, and the wind window was closed<sup>5</sup>. And changed the fresh sea water and increased the dissolved oxygen. When the cold was flowing, tried to avoid walking around the winter ditch, and disturbed the fish to rise and freeze. If a large cold current, emergency measures must be taken to prevent the water temperature from dropping. Cold-proof PE foam cloth could be directly covered on the water surface to reduce the disappearance of heat in the ditch, which could increase water temperature to 1.5-2.0 ° C at night and cloudy days. And will open on sunny days<sup>12</sup>.

### 2.4. Late wintering

After Taiwan entered March, the weather gradually became warmer and began to blow southerly winds. The weather became hotter and there were more sediment in the ditch, accelerated oxidation, and increased oxygen consumption, which caused floating heads to occur in the morning. At this time, attention should be paid to changing pool water, and at the same time, the windproof shed and thatch will be removed to increase the wind for increasing dissolved oxygen. At the beginning of April, when the cultivation pool was ready, you could release the wintering fish, and then remove all the windproof shed thatch, and sorted for reuse in the next year<sup>10</sup>.

### 3. RESULT AND DISCUSSION

**Production and cost:** The annual production of shallow water milkfish in Taiwan was about 2,000-2,500 kg per hectare, which most of the old fish account about 2/3-1/4, and the new fish was about 1/3-1/4. In recent years tended to acquisition the larger fish, and the proportion of new fish was reduced. And many shallow-headed milkfish had been converted to other water-producing products, such as shrimp, clams or other fish, and some had been converted to bait farming. The seedlings of Taiwan's milkfish were almost all artificial seedlings. The price was about 0.1-0.2 NT\$(New Taiwan Dollars), which was much cheaper than before. However, when the labor and the raw materials were high and the breeding cost was greatly improved, the fish price did not increase but fall, so if the land cost was not counted, If the yield per hectare was 2,000kg to 2,500 kg, the price of fish will be 50, NT\$(New Taiwan Dollars) and more than 40 NT\$(New Taiwan Dollars) will be profitable.

**A: Marketing of milkfish:** It was not the consumption of whole body. The most important thing was partial marketing. The market demand was divided into different parts, and the marketing of different market needed be compared to the way of selling whole fish. Products that were more commercially valuable and not in the same state could meet the needs and needs of different consumer groups.

**B. Marketing of body spot differentiation:** In the edible treatment, milkfish could be divided into front and rear sections, the middle and the internal organs, the front and rear sections were the fish head and the fish tail, and the middle spot was the fish belly and the fish back. If the processing yield was obtained, the milkfish could be divided into the three spots, fish belly and fish dorsal each accounted for 30%, the sum was 60%, and the others accounted to 40%. Among them, the price of fish belly was the best, followed by fish dorsal.

**C. Marketing of processed goods of milkfish;** Taiwan consumer edible fish bells and some fish belly were also exported. Most of the fish dorsals were processed into dried fish floss and other products, which can be processed into fishmeal in fish head, fish tail and internal organs, as feed or fertilizer. In Taiwan, in addition to the historical emotions of Taiwanese fish, the art of eating culture and eating was the best in the world. Taiwanese could really be proud of "the milk raised by Taiwan". The milkfish industry could be managed sustainably in Taiwan. According to the data of the Tainan city Fisheries Section of the Agriculture Bureau, the area of milkfish cultured in Tainan City was about 4,980 hectares, and the output was about 24,000 tons, which was the largest in Taiwan. The annual output value was about NT\$(New Taiwan Dollars) 1.7 billion, mainly distributed in Qizhan District, Annan District and Beimen District. , Xuejia District and General Area, the production period was from August to November. The price of fish in Tainan was about 38-40 Taiwan dollars /piece, and the food market purchase price was about 38 NT\$ / TKG (Taiwan Kilo Gram). The price was still stable and the breeding cost was about 32~36 NT\$ / TKG. According to the news (2018-08-03 22:26 Central News Agency) of Tainan city Fisheries Section of the Agriculture Bureau, most of the milkfish produced in Tainan were currently exported and freshly sold. In 2017, the whole Taiwanese milkfish was exported to 8,780 metric tons. The main exporting countries were Saudi Arabia, the United States and the United Arab Emirates.

### 4. CONCLUSION

Milkfish (*Chanos chanos*) was one of the most important farmed fish in Taiwan. The milkfish was the only species in the family of the milkfish, which was a warm-water marine fish. It was widely cultivated in the Asia-Pacific region and was now Southeast Asia and the most important farmed species in the region<sup>17</sup>.

For Indonesia, the Philippines and Taiwan, milkfish farming had important economic value<sup>18</sup>. Since 2000,

Taiwan's total annual output had exceeded 450000 metric tons<sup>19</sup>. However, the production of milkfish was at its limit, the most important reason being the restriction on the supply of larvae. Traditionally, the production of milkfish was dependent on the capture of wild fry, but the artificial hatchery of the fish of the milkfish had successfully completed artificial breeding. At present, the production of milkfish was mainly from artificial breeding. In Taiwan's successful and developed enterprises, the export of milkfish artificially propagated fry had an important position in Taiwan economy<sup>14</sup>.

The milkfish had fine meat and high nutritional value. Taiwanese ate milkfish and ate it from head to tail and developed a delicious local flavor. In the Tainan region, the milkfish farmers always served the friends with milkfish meats, and Tainan people could cook up to five or sixty kinds of milkfish dishes with different flavors.

## REFERENCES

1. T. Bagarinao, and S. Kumagai, Occurrence and distribution of milkfish, *Chanos chanos* off the western coast of Panay Island, Philippines. *Environmental Biology of Fishes*. 1987, 19: 155-160.
2. Su Weicheng, Milk fish 160. FRI Special Publication NO.9. Fisheries Research Institute, COA. 2007.
3. G. V. Hilomen-Garcia, Morphological abnormalities in hatchery-bred milkfish for (*Chanos chanos* Forsskal) fry and juveniles. *Aquaculture*, 1997, 152: 155-166.
4. F.S. Chiang, C. H. Sun, J. M. Yu. Technical efficiency of milkfish (*Chanos chanos*) production in Taiwan; an application of the stochastic frontier production function. *Aquaculture*, 2004, 230: 99-116.
5. J. M. Leis, and S. E. Reader, Distributional ecology of milkfish, *Chanos chanos*, larvae in the Great Barrier Reef and Coral Sea near Lizard Island, Australia. *Environmental Biology of Fishes*, 1991, 30: 395-405.
6. W. J. FitzGerald, Milkfish Aquaculture in the Pacific: Potential for the Tunal Longline Fishery Bait Market. Secretary of the Pacific-Community, Aquaculture Section. Noumea, New Caledonia. 2004, 61 p.
7. I. C. Liao. Aquaculture practices in Taiwan and its visions. *Journal of the Fisheries society of Taiwan*. 2005, 32: 193-206.
8. Su Weicheng, Milk fish 160. FRI Special Publication NO.9. Fisheries Research Institute, COA. 2007.
9. J. Lucas, and P. C. Southgate, *Aquaculture: Farming Aquatic Animals and Plants*. Blackwell, USA. 502p.
10. C. S. Lee. Aquaculture of milkfish (*Chanos chanos*). Tungkang Marine Laboratory, Taiwan and the oceanic institute. Hawaii, USA. 1995. Aquaculture Series no. 1. 141p.
11. C. Lückstädt, U. Focken and K. Becker. Is there size-dependent feeding behavior of Milk fish (*Chanos chanos*) cultured semiintensively in the Philippines? In Book of Abstracts, 6<sup>th</sup> Asian Fisheries Forum, Asian Fisheries Society, Kaohsiung, Taiwan. 2001. 81 p.
12. J. C. Kuo, F. G. Liu and I C. Liao. The Production analysis of milkfish *Chanos chanos* farming in Taiwan. *Journal of Taiwan Fisheries Research*. 2005, 8: 9-26.
13. L. T. Lin, My experiences in artificial propagation of milkfish-studies on natural spawning of pond-reared broodstock. In production and culture of milkfish (C. S. Lee and I. C. Liao eds.), The Oceanic Institute, Honolulu, Hawaii and Tungkang Marine Laboratory, Tungkang, Taiwan, 1985, 185-203.

14. Franklin S. Martinez, Mei-Chen Tseng and Sin-Ping Yeh. Milkfish (*Chanos chanos*) Culture: Situations and Trends. J. Fish. Soc. Taiwan, 2006, 33(3): 229-244.
15. FAO. The State of World Fisheries and Aquaculture 2008. Food and Agriculture Organization of the United Nations. 2009. Rome, Italy.
16. Huang Qingyun, Talking about the use of artesian wells for the wintering pond of the milkfish, China Fisheries, 1985, 27.
17. W. J. Tucker; Marine Fish Culture. 1<sup>st</sup> edition. Kluwer, Harbor Branch Oceanographic Institution and Florida Institute of Technology, 1998, Melbourne, FL, USA. 750 p.
18. C.L. Marte, P. Cruz, E.E.C. Flores; Recent developments in freshwater and marine cage aquaculture in the Philippines. In: Cage Aquaculture in Asia, Proceedings of the First International Symposium on Cage Aquaculture in Asia, 2-6 November 1999. Liao I.C., Lin C.K. (eds.), 2010. pp 83-96. Asian Fisheries Society, Manila, Philippines and World Aquaculture Society-Southeast Asian Chapter, Bangkok, Thailand.
19. W. J. FitzGerald; Milkfish Aquaculture in the Pacific: Potential for the Tunal Longline Fishery Bait Market. Secretary of the Pacific Community, Aquaculture Section. Noumea, 2004.

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