EPIDEMIOLOGICAL ASPECTS OF AQUACULTURE IN RELATION TO FISH BORNE TREMATODIASIS IN MALAYSIA

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Abstract. Epidemiological studies have been conducted to determine the association between fish and disease. The fish were obtained from rivers, streams, ponds and lakes but few from aquaculture farms. While no defined studies have been carried out in Malaysia, baseline data show that fish obtained from aquaculture farms (mixed farming) contributed to cases of opisthorchiasis and clonorchiasis.

INTRODUCTION

Fish borne trematodiasis is a major public health problem and is of concern in all endemic countries especially where fresh water fish serves as a major protein source. This epidemiological feature of consuming fresh water fish has been observed in communities who live in highlands or interior areas far from coastal towns where meat and meat products are expensive. Ecology, socio-cultural factors, human dietary habits (both new and old), development of reservoirs, irrigation systems or water catchment areas, lack or improper disposal of human feces, traditional fish curing and preservation technics, traditional medicine requirements, lack or wanton association between fish and fish products with diseases are some of the factors that have contributed to the sustenance and propagation of these diseases in the endemic communities. The dependence of the rural populations on agricultural products, the conglomeration of populations in areas where water is readily available from ponds, lakes or reservoirs and the soil being fertile, have also propagated most of the fish borne trematodiasis. With the advent of time, the natural history of these diseases has taken a turn to chronicity with high morbidity and low mortality and increase in incidence and prevalence rates.

Over time, with the increasing population growth, the demand for cheap protein products such as fish, those health conscious with healthy food requirements (low fat), low yield of fish from the oceans, the inability of the fisherman to go to the seas during certain seasons has compelled or necessitated government, quasi-government and private agencies to produce high quality food products through aqua-culture in a cost-effective way with the assistance of the fisheries and agricultural organizations.

Cultivation or aquaculture technology in its primitive stage back to about 1,100 BC and originated when it was practiced with common carp in China (Hickling, 1968). Aquaculture persisted in China for about 1,300 years before it began to spread to Japan via Korea as early as 200 AD (McLarney, 1987) and certain neighboring countries where fish and aquatic plants were specially grown in ponds fertilized with human excreta and waste water. The aquaculture practices in these countries dates back to nearly 330-400 years. In certain areas in Japan, Korea, China, Taiwan and Viet Nam fish are still raised in fish ponds commonly fertilized with human and animal feces. These serve as an excellent nutrient for growth of plant and animal life upon which snails and fish feed. Though food fish culture originated in China, the culture of fish for recreational purposes originated in Germany in the middle of the 18th century (McLarney, 1987) with the establishment of the first trout hatchery in 1741. This form of farming caught on in many countries and has served the recreational fisherman as well as the housewife purchasing fish for food.

While aquaculture is approximately 3,000 years old it has not provided more than a small fraction of the fish consumed by humans. According to the Food and Agricultural Organization (1990) though aquaculture has grown rapidly during the last 25 years, it still provides little more than 10% of the world's fish harvest.

Before discussing the epidemiological aspects, the term 'aquaculture' needs to be defined. The Food and Agricultural Organization of the United Nations defines aquaculture as "the farming of aquatic organisms, including fish, mollusks, crustaceans and aquatic plants". Farming implies some form of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators, etc (Pitts, 1991). Pitts (1991) goes on further to say "for statistical purposes, aquatic organisms which are harvested by an individual or corporate body which has owned them throughout their rearing period contribute to aquaculture while aquatic organisms which are exploitable by the public as a common property resource, with or without appropriate license, are the harvest of fisheries". Shell (1991) defines aquaculture "as the intentional intervention in the production of animals and plants in water".

The cultured aquatic animals include cold blooded crustaceans (shrimps and crabs), mollusks (oysters and clams) and some of the more primitive vertebrates (fish). Recently, frogs, tadpoles, turtles, sea-squirts, abalone, sturgeon, striped bars, red fish, crocodiles and alligator culture has been added to this list. To most public health practitioners, aquaculture refers only to cultivation of fish. Other aquatic organisms, though cultivated through the aquaculture process for consumption by humans or animals are inadvertently left out or never discussed. It should be borne in mind by most public health practitioners that from the epidemiological transmission point of view, aquaculture should encompass all farming of aquatic organisms and plants and these needs to be clearly defined. The role these organisms or plants play in the transmission of disease in their areas should be adequately known so that public health measures can then be instituted to contain the diseases in question.

EPIDEMIOLOGICAL ASPECTS OF AQUACULTURE

In the epidemiologic triad of host, pathogen and environment, a few variables need to be considered in terms of aquaculture farming and disease endemicity. In the human host a number of important variables include: anthropology: man's eating or dietary habits, cultural habits, behavioral habits, type of human settlements, waste disposal systems, fecal disposal systems, distribution of disease within the young and adult, stages of disease (acute versus chronic), frequency of disease, symptomatic versus asymptomatic, frequency of symptoms and proximity to aquaculture farms.

In terms of environment, location of aquaculture farms, privately or government owned, type of fish or shell fish cultured, source of fish, ecological niche and data, types of snail host present, susceptibility of fish to human pathogens, types of reservoir hosts whether there are common domestic animals present within mans environment, climatic factors, soil conditions, types of ponds - artificial or natural water bodies, source of water supply whether silage water, waste water, level of pollution and whether contains excreta.

In terms or pathogens, one would include viruses, bacteria, fungi and parasitic organisms *eg* Protozoa (*Entamoeba histolytica, Giardia intestinalis, Toxoplasma gondii, Cryptosporidium, Isospora, Sarcocystis),* cestode that include *Diphyllobothrium latum* and *Spirometra* species, nematodes like *Capillaria philippinensis, Ascaris lumbricoides, Trichuris trichiura, Gnathostoma* species or trematodes which constitute the major disease organisms in man. Consumption of these fish-borne infections can lead to a number of conditions like diarrhea, anemia, growth retardation, ascites, abscesses and nodule formation, cholecystitis, cholelithiasis, pyogenic cholangitis, cholangiocarcinoma to name a few.

While a number of epidemiological studies have been conducted to detrmine an association between fish and parasitic diseases obtained from lakes, streams and ponds from a number of endemic countries, there are hardly any on aquaculture farming. Most of the epidemiological studies carried out on the health effects of waste water reuse suffered methodological problems. Blumenthal *et al* (1991) conducted a cross-sectional study on the impact of excreta use in aquaculture in Indonesia and of waste water use in irrigation in Mexico. The study in Indonesia involved an exposed group using waste water/excreta with no treatment, a control group, with no waste water and an intermediate group, where waste water/excreta was used but some healthy protection measure existed. In Mexico, the intermediate group used waste water from a storage reservoir which met the new WHO guidelines for restricted irrigation. While in Indonesia the intermediate group did not have domestic

exposure to pond water. The WHO bacterial guideline for fish pond water was forty times higher.

The results showed that in Indonesia, the prevalence of diarrheal diseases was low in adults and was unrelated to exposure while it was high in children below 5 years. Multiple logistic regression analysis gave an Odds ratio of 1.4 ($p = 0.06$) for consumer exposure, 1.9 ($p = 0.01$) for recreational or occupational exposure and 1.6 ($p = 0.01$) for domestic exposure. Allowances was made for all exposures and confounding factors. The preliminary analysis of the wet season data in Mexico suggested an increased risks of *Ascaris* infection and diarrheal diseases from the use of raw waste water are removed when water of WHO guidelines quality from strong reservoirs is used.

ROLE OF AQUACULTURE FARMING IN THE EPIDEMIOLOGY OF FOOD BORNE PARASITOSES IN MALAYSIA

Crude or primitive aquaculture farming could have started in Malaysia way back with the arrival of the Chinese community in the early part of the 14th century. Over the years, mining pools, rivers, ponds, small lakes within their dwellings had been converted for aquaculture practices. The interesting feature observed in these crude aqua farming areas is the presence of toilets and pig pens near the sites or over the ponds which to this day can be seen in some districts in Malaysia. Another interesting feature observed in certain towns and cities is the localization and crowding of illegal immigrants living in makeshift houses within the vicinity of large lakes or ponds. The source of water supply for cooking, washing and drinking are from these lakes. Toilets are erected on the periphery of these lakes. The same lakes are recreation spots for fishing. So, the vicious cycle of fish, snails and human host is then established. How far fish borne infections exists in these communities or in those who catch fish as a recreational pass time is unknown as surveys have never been carried out in the human population or fish population.

In Malaysia, large areas have been assigned for aquaculture and irrigation based agriculture. Human trematodiasis, particularly opisthorchiasis, clonorchiasis, echinostomiasis is endemic in Malaysia with the presence of the parasites, the fish and snail intermediate hosts. In certain localities, streams and rivers are still used extensively for fecal disposal. In certain rural areas, overhung latrines are still in sight. Fish is reared in nearly all the ponds in Malaysia including water plants such as water plants such as water cress. Water hyacinth, a form of fish food, is allowed to grow in these ponds. Overhung latrines were in existence for some time but with the construction of new water supply these are being phased out though in the interior areas these are still found.

The Government of Malaysia has given wide publicity to aquaculture farming include recreational fishing. At the same time there are many farms which breed crabs, frogs, shrimps, prawns and snails including fish for export. These commercial farms are run by private individuals without much quality control and hence their role in disease transmission is suspected. There are no mechanisms available to control production or exportation. The fishery officers are not even able to control these aquaculture farms existing in their districts as they are carried out clandestinely. Among water plants, the water cress, water lily, lotus and water bamboo are cultivated in ponds where fishes are reared. Whether these have a role to play in the transmission of trematodiasis in Malaysia has never been explored though the intermediate hosts both snails and fish are found in abundance (Shekhar, 1995)

The first documented case of clonorchiasis involved a Chinese patient and five of his family members (King, 1968). They had no history of travel outside Malaysia but admitted to eating fish fry flown from Hong Kong. Incidently, fish fry is a delicacy usually consumed during the family reunion dinner on the eve of Chinese New Year. Bisseru and Lim (1969) conducted a cross-sectional survey of 97 medical students and 13 relatives for parasite infection. Out of this total, 11 (10%) cases of opisthorchiasis in the Chinese community were detected. Of these, 4 (0.4%) were confirmed indigenous cases.

To test the hypotheses that clonorchiasis/opisthorchiasis existed in Malaysia, Bisseru and Lim (1969) purchased raw fish dishes "Yue San Woh", "Yoh San Chuk" and "Gong Chon Mee" from various restaurants in Kuala Lumpur and found encysted metacercaria of *Opisthorchis viverrini.* Retrospective questioning revealed that all these fishes had been obtained from local aquaculture farms. Bisseru (1970) later conducted a survey and showed that two

common grass carp, of the *Cyprinidae* genus, namely *Ctenopharyngodon idellus* and *Aristichthys nobilis* obtained from aquaculture farms to be the intermediate host for *Clonorchis sinensis*. Incidently, between the 1960's to 1980's, Malaysia had imported these fishes from mainland China and Taiwan and they were specially reared in commercial aquaculture ponds for local consumption. It is definitely certain that *O. viverrini* exists in Malaysia as Rohde (1904) had found an infection rate of 7% in cats though epidemiological data was unavailable. The rationale that if *O. viverrini* had been discovered as early as the 1900's in the cat community if definitely proves that this disease is indigenous and endemic in Malaysia. In the absence of epidemiological data, one can only speculate that these cats could have acquired the infection from households who were consuming fishes obtained from these crude aquaculture ponds or the cats were fed fishes caught from these ponds directly.

Of all the 23 cases of clonorchiasis reported in Malaysia, half of the cases had acquired infection oversees while the rest were indigenous cases (Shekhar *et al*, 1995). The common denominator linking all these cases were either consumption of raw fish related dishes overseas or locally. Most of these patients were asymptomatic and were incidental findings.

So far, no other fish borne trematodiasis has been reported in Malaysia. Apart from *O. viverrini* and *C. sinensis, Metagonimus yokogawai* and *Heterophyes heterophyes* have not been reported in Malaysia, *Gastrodiscoides hominis* and *Echinostoma malayanum* have been reported in Malaysia but the prevalence of these infections in the community is unknown and has never been investigated. It could also mean that these parasites are unable to establish themselves in the Malaysian community as they cook their fish well before consumption so that the metacercarial stages are killed.

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