HYGIENIC EVALUATION OF THE FOOD FISHES, *TILAPIA MELANOPLEURA* AND *TILAPIA MOSSAMBICA* NURTURED IN SEWAGE EFFLUENT

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Population increase in the world today, and especially in the tropical and sub-tropical regions, has spotlighted the need for additional first-class protein. One of the simplest methods of rearing such protein in areas under 2,000 feet above sea level and where water temperatures remain between 23 and 35 degrees Centigrade, is by growing the fish of the *Tilapia* genus in shallow ponds. These very prolific fish are stocked into ponds, on the bottom of which the water weed *Vallisneria* has been planted and established before flooding; they feed largely on this weed, but will feed equally well on any waste fruit or vegetable matter, including Napier fodder and sugar cane tops.

If the fish are put into ponds with *Vallisneria* weed, any agent that will accelerate the growth of the weed will increase fish growth, especially in the warmer months in Natal, when the appetite of the fish is gargantuan, and growth becomes logarithmic. Thus, Crass,[1] working at the Umgeni Dam Hatchery, has achieved enormous pond yields as compared with control ponds, simply by stocking them with ducks at the rate of 500 muscovy ducks per acre: the duck droppings fertilize the *Vallisneria* and increase growth of other plant and animal life upon which the fish feed at various stages of their development.

Thus it is not surprising to learn that in certain built-up areas, effluent from sewage plants is used to nurture fish. The classical example is near Munich in Germany where large quantities of carp and trout are raised in sewage effluent, interestingly enough, for the *gourmet* trade.

In the present context, the fish have been used in the biological control of mosquito larvae in the sewage ponds[2] and their rapid growth and reproduction makes their disposal a problem. As there are large numbers of Bantu people in the area who are only too keen to get hold of the fish, we thought it would be wise to conduct a pilot scheme to ensure that the fish would not possibly spread pathogenic bacteria. Further, certain people, such as the Pondos from the Transkei, still eat fish in a raw or semi-raw state, and such a study became imperative when one recalls that in the area in which these fish are grown are many members of coastal fish-eating tribes.

The Kwa Mashu Sewage Scheme

At Kwa Mashu near Durban, there is a conventional sewage-treatment plant which has to cope with 1,600,000 gallons of sewage daily. Effluent from the humus (final) tank of the plant is released into a series of three maturation ponds (Ponds 1, 2 and 3), and thence into the river when the *E. coli* count has reached about 10/ml. (The Piesang River itself is so polluted that the counts in the river where the final effluent flows in, are up to 1,000,000 *E. coli*/ ml.[3]) In times of great increase in the daily amount of sewage to be treated, a certain amount of settled sewage is allowed to by-pass the treatment plant and fed into Pond 1. If this daily by-pass is 150,000 gallons, then the *E. coli* counts in effluent leaving Pond 1 for Pond 2, lie between 1,000 - 6,500/ ml.: if the by-pass is 300,000 gallons this count is 4,000 - 12,000/ml. It is interesting to note, that even with these by-passes in critical periods, the *E. coli* counts in the final effluent from Pond 3 into a polluted river is only 10/ml. with 150,000 and 11 - 23/ml. with 300,000 gallons by-pass. In the normal course of events effluent from Pond 1 to Pond 2 contains 500 - 2,500 *E. coli*./ml.[3]

However, as the fish were growing at a time during which maximum by-pass was necessary, we regard them as being nurtured in water containing the maximum amount of *E. coli* present in the effluent from Pond 1 to Pond 2. (We took fish from Pond 2 for examination.)

In this pond there was no *Vallisneria* growth, and examination[4] of the stomach contents of the fish netted on 9 January 1963 (both *Tilapia melanopleura* and *Tilapia mossambica*) showed mainly filamentous algae, diatoms, fish eggs, chironomid larvae, seeds, bits of grass, and unidentifiable miscellaneous debris.

METHODS AND MATERIALS

Six fish (average length, 250 mm.) of both the species of *Tilapia* were netted from Pond 2 on 26 June 1963 and submitted to a private laboratory for bacterial study. The fish were dissected with sterile scalpels, and bacteriological specimens were taken from the following regions:

1. Skin (under the scales).
2. Gills.
3. Intestinal contents.
4. From the flesh.

A direct gram stain was performed on slides made from these regions, and cultures were made on standard nutrients. The results were reported as follows:

Gram stain:

Skin and scales: Gram-negative bacilli.
Gills: Gram-negative and Gram-positive bacilli.
Intestine: Gram-negative bacilli, and subtilis.
Flesh: Gram-negative bacilli.

Culture:

Skin—yielded a growth of *Proteus* organism.
Gills, flesh and intestine—Yielded a growth of a *paracolon* organism.
Salmonella and Shigella organisms were not isolated.

CONCLUSIONS

Bacteriological examination was made upon fish nurtured in the second of the three maturation ponds of the sewage plant of the Kwa Mashu Township near Durban. Portions of fish of the species *Tilapia melanopleura* and *Tilapia mossambica* that were subjected to examination were the skin and scales, the gills, the intestinal contents and the flesh. No significantly pathogenic organisms were found in this study. This shows these fish entirely safe for human consumption when properly cooked, in spite of the fact that they grew during periods when settled sewage by-passed the plant directly into the pond. To those people eating the fish raw or semi-cooked there would appear to be no danger in the present context to eating them. There is almost certainly wide scope for the application of sewage effluent to fresh water fish farming in this country.

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