POST-HARVEST PROCESSING OF OYSTERS AND MUSSELS

Rogelio Q. Gacutan
SEAFDEC Aquaculture Department

POST-HARVEST PROCESSING OF OYSTERS AND MUSSELS

Rogelio Q. Gacutan

Not much preparative processing is accorded to oysters or mussels between harvest and consumption. In the Philippines, oysters and mussels are eaten within the same day of purchase for fear of product spoilage.

The relatively fast rate of degradation suggests a rapid microbial action. Microbiologically, oysters and mussels are a veritable depository of a wide spectrum of microbes and this is linked to their unique property of being able to concentrate, within their tissues, whatever bacteria are found in the external medium.

An oyster or mussel 3 inches long would, in a day, normally pass through its system 10 to 15 gallons of water (Hulburt and Hulburt, 1975). Considering that this water has its own natural load of microbes it would be easy for one to imagine the level of contamination that the oyster or mussel has initially.

Oysters harvested from culture sites which normally are muddy are packed right away into wooden boxes, bamboo baskets or sacks without washing or diminution of adhering soil particles and fouling organisms. These are then stored for a few hours in such containers, transported to markets for sale, and laid out on warm market stalls.

In transit, the oysters pick up an undetermined yet substantial load of microbes (mesophiles) to add to the initial number. Once in the market, the seller, as if motivated by a desire to keep fresh and prolong the shelf life of the product, keeps on sprinkling water. The practice only serves to spread soil-borne microbes on the table, increasing the possibility of their entry into the mussel flesh from which they should have kept away in the first place.

Fattening before/after harvest

In many places around the world, the harvested oysters or mussels are not brought immediately to markets for sale; these are transferred to specially designated areas either for "fattening" or for cleansing, depending on the location, season, etc.

In Marenne-Oleron, France, for instance, 28-month old oysters, on the approach of winter, are collected from the parcs and placed in 35 cm deep ponds ("claires") for 2 to 6 months (Anderson, 1977).

These claires are connected to the sea by a system of canals and gates that make possible regulation of the water flow and depth. In the claires is carried out the "greening" of the epithelium and gills with thick cultures of Navicula ostrearia. The green color conferred is the basis for acceptance. The "fines de claires" are kept in these facilities for 2 months at a density of 10-15/m^2 while the "les speciales," 6 months at 3-5/m^2.

In Prince Edward Island, Canada the "relay" system is resorted to. Since all oysters are grown in contaminated public beds, these are moved upon harvest to uncontaminated leased grounds during the spring for a whole summer before marketing (MacKenzie, 1975). Although the move is for cleansing it is obviously for further growth, too.

In the Netherlands town of Waddenzee where mussels are cultured in muddy substrates the mussels are dredged at harvest and therefore in the process imbibe lots of silt and particles (Hulburt and Hulburt, 1975). Undesirable for consumption at this stage, they are moved down the Dutch Coast to the Rhine near Belgium and deposited on the sandy bottom of the bay. This operation likewise is obviously for cleansing and strengthening.

The need for cleansing

Extensive investigations have been made on the public health aspect of oyster and mussel microbiology since Dodgson's (1928) study. As disease carriers they are able to harbor populations of Salmonella and Shigella as well as less pathogenic coliforms within their tissues. In fact the growth of the above-named genera in tissue homogenates continue to form the bases of control measures for the prevention of shellfish-borne gastroenteritis.

Isolated reports noted the presence of various pathogenic or potentially pathogenic organisms such as Spirochaetae anodontae (Fantham, 1907); Saprospira and Cistispira (Dmitroff, 1926); "Vibrios" (Elliot, 1926; Gacutan, 1974); Vibrio parahaemolyticus (Aoki et.al, 1967; Bartley and Slanetz, 1971), Mina herellea and Neisseria (Gacutan, 1974).

In the Philippines, the few studies on oysters have aptly dealth with coliforms (Salafranca, 1952; 1953) and on the natural bacteria flora with emphasis on spoilage-causing genera (Gacutan, 1974). Salafranca's first study (1952) positively showed the presence of coliforms and other indicators of pollution; the second discussed preparative treatments of oysters for consumption for the purpose of deactivating these organisms.

Although limited to a few sources (Salafranca got his samples from areas adjoining Manila and Binakayan; Gacutan bought his from Cubao Farmers Market and from Cavite) results of the studies may be expected of samples from throughout the archipelago and therefore could serve as models.

Carrying the work further, Gacutan (1978, unpubl. results) studied the various coliform genera and species isolable from Iloilo City oysters. The sampling lasted from September 1977 to January 1978. The potentially pathogenic Enterobacteriaceae observed were Eascherichea coli, Klebsiella pneumoniae, K. ozanae, Citrobacter freundii, Enterobacyer cloacae and E. agglomerans. The first 2 were observed in monthly samplings; the rest sporadically. It is to be emphasized that the better known causes of gastroenteric infections -- Salmonella, Shigella (and Virbio) were deliberately not included for some technical difficulties.

The need for detoxification, depuration

Fortunately the Philippine oyster industry is not faced with the immense problem of paralytic shellfish poisoning (PSP) which is experienced in temperate countries especially the US, Canada, Scotland, Norway, UK and Portugal (Loosanoff, 1973). This type of poisoning results from ingestion of bivalves which have consumed the dinoflagellates Gonyaulax catenella and G. tamarensis (Quayle, 1969; Prakas et.al, 1971; Loosanoff, 1973).

There is however a need to purge oysters of coliforms, Entebacteriaceae, and other potential pathogens in view of reports of gastroenteric disturbances due to oyster/mussel consumption. In other words, oyster should be depurated before sale in markets.

In countries with strict laws, the sale of oysters and mussels grown in areas confirmed to be polluted with sewage, and even the culture, may be restricted and shores closed. This was resorted to in the advent of human population growth centers as in Southern Mississippi specifically the traditionally oyster-rich Pascagoula river in 1961. Biloxi Bay in 1967, St. Louis Bay and Graveland Bayou in 1975 (MacKenzie,1975). Reef closures due to pollution however leads to economic dislocation of small, subsistence oystermen. Certainly, there are other solutions.

The fattening process in claires being done in Marenne-Oleron, France, the relay system in Prince Edward Island, and the transfer from muddy to sandy substrata in Waddenzee are essentially depuration processes. There are instances when more refined and slightly more advanced technology is resorted to.

In Marenne-Oleron, after the oysters are harvested from the claires, the owner-culturist is required by law to transfer the same to cement basins to expel pseudofeces from the viscera (Anderson, 1977). The oysters are then sorted by size and shape, placed in baskets, and certified as to quality grade ("fines de claire," "speciales," etc.) and transported for marketing.

Each country has its own depuration policy. France and US have no fixed laws to abide by except when PSP is reported; while Spain and the Netherlands are two countries with very strict regulations. In Spain, any oyster/mussel earmarked for sale fresh in the country or outside must, by law, be depurated for 48 hours (Hulburt and Hulburt, 1975).

The depuration process, duration

The technology is relatively simple. Seawater (clean as sterilized) is pumped into large holding tanks and the load of impurities is quantified. The proper amount of chlorine (in France, ozone is used) is added and allowed to evaporate. The mussels/oysters are then placed on rocks in tanks, and the purified (treated) water is slowly pumped over for 48 hours. The oysters/mussels, now clean are placed in bags, sealed, tagged and rinsed. The draining takes 3 hours. These are then shipped unrefrigerated in closed trucks. When properly depurated, the samples should keep for 3 days (Hulburt and Hulburt, 1975).

The time involved to completely purge oysters of their coliform load should vary with each sample. While oysters are assured clean in 48 hours as in the above case, oysters from Mexico are deemed cleansed in 7 days (Ogle et.al, 1977).

Processing to prolong keeping time and quality of oysters

Extensive characterization of the natural bacterial flora in the US (Colwell and Liston, 1960; Vasconcelos and Lee, 1972) showed a predominance of Pseudomonas, Vibrio, Achromobacter, Flavobacterium, to name a few. These two research groups have consistently shown a relatively high initial load of Pseudomonas and Achromobacter, two genera linked with proteolysis. Philippine oysters (Gacutan, 1974) are characterized by a very low initial Pseudomonas content but very high Flavobacterium load. The latter is an indication of freshness.

On these counts, Philippine oysters should keep longer if processed properly. There is a tendency for Filipinos to eat their oysters immediately after steaming, never trying to keep some for the next day. Mussels are sometimes processed into a "bagoong" kind of preparation popular in the south. Raw-stock mussels are shucked, placed in bottles and salted for a fermentative process that assures an improved flavor, and, more importantly, freedom from pathogenic organisms.

In other countries, oysters-mussels intended for canning are placed in steaming machines for cooking. The shells open automatically during the heating, are shucked by hand, and placed in brine solution. The meats then float, enabling the worker to skim them off, washed, and placed in cans. Sauces are then added, heated in retorts and sealed (Hulburt and Hulburt, 1975; MacKenzie, 1977). Raw-stock mussels after cold shucking are placed in plastic containers, quick-frozen and sold.

References

Anderson, S.L. 1977. Proc. World Marcult. Soc. 8:373-386.

Aoki, Y., Hsu, S.T. and D. Chun. 1967. Endem. Dis. Bull. Nagasaki University. 8:191.

Bartley, C.H. and L.W. Slanetz. 1971. Appl. Microbiol. 21:965-966.

Colwell, R.R. and J. Liston. 1966. Appl. Microbiol. 8:104-109.

Dmitroff, V.T. 1926. J. Bact. 12:135-177.

Dodgson, R.W. 1926. Minn. Agr. Fish. Invest. Ser. II, 10:1-498.

Elliot, C. 1926. Am. J. Hyg. 6:755-776.

Fantham, H.B. 1907. Ann. Mag. Nat. Hist. (London) Ser.(7) 19:493-501.

Gacutan, R.Q. 1974. M.S. thesis (Unpubl.), U.P.

Hulburt, C.G. and S.W. Hulburt. 1975. Mar. Fish. Rev. 37(10):10-18.

Loosanoff, V.L. 1973. Proc. World Mar. Soc. 4:341-352.

MacKenzie, C.L. 1975. Mar. Fish Rev. 37(3):21-35.

MacKenzie, C.L. 1977. Mar. Fish. Rev. 39(1):1-13.

Ogle, J., Ray, S.M. and W.J. Wardle. 1977. Proc. World Maricult. Soc. 8:447-452.

Prakash, A., Medcof, J.C. and A.D. Tennant. 1971. Fish. Res. Board Canada Bull. 177:1-87.

Quayle, D.B. 1969. Fish Res. Board Canada Bull. 168:1-68.

Salafranca, E.S. 1952. J. Phil. Publ. Health Assn.

Salafranca, E.S. 1953. Phil. J. Fish. 2:90-106.

Vasconcelos, G.J. and J.S. Lee. 1972. Appl. Microbiol. 23:11-16.