Grain 09: Fish health and welfare, quality of fish products

Responsible: Domenico Caruso, IRD

Introduction:

World trade and the growing demand for fishery products have since the last decade completely upset the landscape of the tropical aquaculture, particularly in Asia, which alone Of 90% of global aquaculture production.

The production of certain species, particularly of freshwater, has levels of growth and production. This augmentation constant is due to both the increase a large number of new But also to a significant change in productive practices.

The introduction of new species, new modes of production and Intensification induce and amplify the pathological phenomena considered as a major constraint on the breeding and sustainability of these tropical sectors of animal production (Bondad-Reantaso, Subasinghe et al., 2005).

But aquaculture pathology is not a new problem exclusively linked to intensification and / or increase in production; In fact the epidemics have always been problematic. Already in 1935, Buschkiel Serious economic damage caused by massive infestations of ciliated protozoan Ichthyophthirius multifilis in various farms in Indonesia.

Socio-economic impact

The economic cost of infectious diseases is considerable in the industry aquaculture. It includes, of course, direct losses related to fish mortality; but also the "indirect" losses related; Impact on growth and loss of the costs of curative treatments put in place to combat as well as the depreciation of fish that have survived or become unfit for consumption.

The socio-economic consequences for fish production are difficult to be determined ; The diversity of productive realities, the absence of health and / or an organized collection of its data are causes. Nevertheless, economic losses are sensitive to all production; And in the producing countries of South-East Asia it is the smallest fish farmers who are the most heavily affected by animal mortality.

For example, in Bangladesh, economic losses are higher (19.6%) among fish farmers poorer and have a reduced technical (Faruk et al. 2004). In Thailand, socio-economic surveys have identified mortality as the cause dominance of the abandonment of the professional activity on the part of the fish-Clarias spp. (Panayotou et al., 1982)

Even in a country such as Nepal, which does not experience the productive growth of others countries, the high incidence of pathologies is considered a development of carpiculture in the country (Sharma, Leung, 1998). Generally, studies of the economic impact of diseases are carried out at the following major epizootics in livestock farms.

In Bangladesh, in the years 1988-89, the first enzootie of the Epizootic Ulcerative Syndrome (EUS) caused economic losses greater than 3.4 Million US $ (Khan & Lilley, 2002); And the KHV epidemic in

Carp in Java in Indonesia in 2002 resulted in losses amounting to 5.5 million of US $. The same disease in two lakes in Japan in 2003 estimated loss of US $ 1.4 million in wild carp. The bacteria responsible for enzootic diseases are also very dangerous; The impact of streptococcal infection on tilapia in the lake Taal in the Philippines was estimated at more than US $ 4 million (Bondad-Rentaso 2004). At the global level, the losses caused by this infection are estimated at over US $ 100 million per year (Shoemaker & Klesius, 1997).

In China, between 1992 and 1994, losses due to septicaemic bacteremia caused by Aeromonas hydrophila, Yersinia and Vibrio ruckeri fluviatilis in freshwater fish have been estimated at over US $ 120 million Between years 1990 and (Wei, 2002).

According to studies by researchers at the Oslo Veterinary University (Aunusmo et al 2006); For the year 2004 the economic losses suffered by the sector of Atlantic salmon production would be € 246 million; Of which the major (82%) is related to mortality during the rearing period. Purchase of products therapeutics also has a strong impact and the costs of purchasing medicines for the control of salmon lice increase the costs of production of 5-20% (Rae, 2002).

In France, diseases also have a significant impact on livestock production. The Flavobacterium psychrophilum can cause up to 70% mortality in Juvenile rainbow trout in some acute epizootics. The loss economic benefits were estimated at 10 million euros for the region of Aquitaine alone (Guichard, 2004).

The extent of epizootic and enzootic pathologies thus constitutes a handicap important for fish farming; In particular for emerging sectors, subject to strong competition and global trade rules. F

Fish Disease: Interactions between the Environment, the Pathogen and the Host

The health risk of pathologies in fish farming is mainly related to livestock intensive, which reveals the presence of bio-aggressors present in the environment aquatic. In the natural environment, bio-aggressors are pre-existing in the environment Exterior, sometimes even present on their hosts. Whether it is bacteria or parasites, any animal harbors a certain quantity, compatible with its own survival, and as long as this balance is respected, the life of the animal is not in danger. In particular, this is often the case for parasitoses.

On the other hand, under conditions of intensive breeding, bio-aggressors in particular enzootic, are "raised" at the same time as the fish. Intensification is a technical choice well known in breeding, this choice leads to minimize the to increase the tonnage produced and / or shorten the production cycle.

This inevitably leads to animal concentration and changes in conditions of fish life according to various technological interventions (the increase of number of bio-aggressors present, sorting, various manipulations, transport, unbalanced diet, accumulation of waste, introduction of cash or of sensitive individuals or carriers of disease, etc.).

These conditions thus give rise to a physiopathological state known as stress disorder which, when it is too long, induces fish beyond their capacity of physiological adaptation. Therefore,

the disease is linked to a break in the balance between the animal and its bio-aggressors provoked more often by a stressful event within the breeding. This rupture can occur under the action of a factor isolated from the environment (Ex. fall of O^2, operation of sorting) or more often by the association of many of these factors.

Thus, in the face of a piscicultural pathology, it is necessary to take these various factors that can compete, isolated or collectively, in determinism of the disease. these factors, which go beyond host-pathogen interactions, when they are modifiable by the intervention of man, are called risk factors; Other factors which are not modifiable by the intervention of man are defined risk markers (eg age of fish or sex) and should also be taken into account as factors predisposing fish to disease. The emergence of a disease will be all the more likely if the exposure, number and intensity, to risk factors and markers is high. The multifactorial aspect should not, of course, undermine the role of pathogens. There are many known pathogens; Sometimes common between fish species, but often specific to high fish. Various bacterial diseases are often responsible for the breeding, but also certain pests such as the Ichthyophthirius a multifiliis ciliated protozoa which can rapidly cause 100% mortality in rearing. The more and more efficient diagnostic methods make it possible to differentiate and recognize new pathogens. These diagnoses are by analytical laboratories specializing in aquatic pathology and are often indispensable in order to determine appropriate treatments.

Limiting the impact of bio-aggressors is therefore a priority for the breeder; However concentrate efforts on an exclusively pharmaceutical approach preventive and / or therapeutic treatment would be insufficient. Indeed, good management should not be limited exclusively to action against pathogenic also consider specific practices in livestock production.

For example, against salmon lice in Norway in Chile, good health management include separation into age classes, all in all out, the alternation of fallow between production cycles and regular monitoring of prevalence of caged and open sea lice (Saksida et al., 2011).

Therefore, considering the multifactorial nature of fish diseases, it is possible to act on various levers in order to reduce the impact of the diseases, better control of husbandry practices, by reducing risk assessment and the epidemiological evaluation of the various diseases.

Animal welfare

There are two major questions on the subject: the meaning or definition of well-being and the best way to measure it objectively. The Farmed Animal Welfare Council (FAWC, 1996) suggests that animal welfare should satisfy the concept the "Five Freedoms": "Freedom from hunger and thirst, discomfort, pain, injuries, illness, fear and distress, as well as the freedom to express normal behavior ".

Rather, it defines ideal states rather than specific levels of well-being acceptable.

An example of recognized practices that may undermine the well-being of fish is presented in the following table.

Practice	Demonstrated effects on the well-being of Pisces
Transport:	Induces physiological stress requiring extended recovery

Handling and Fisheries:	Provoke a reaction of stress Neuroendocrine in many species farmed fish and reduce the Resistance to diseases. The manipulations increase vulnerability to I. multifilis ciliated Parasite in the catfish channel
Containment and short time of overcrowding:	Increase in plasma levels of cortisol and glucose in various species of fish.
Inappropriate Densities:	Compromise well-being in some fish species (Trout, salmon, bar sea bream ..). On the other hand, are advantages. The genes coding the Heat Shock Proteins are overexpressed at the bar.
Social contacts required:	Aggression can cause injury particularly when there is competition for the food. Social pressure reduces growth, immune defenses and increases vulnerability to diseases
Deterioration of quality of water:	Various negative effects have been linked to deterioration of water quality
Light bright and photo manipulation period :	Various species of fish avoid the light too bright and conversely a light can drive growth
Deprivation of food:	Increases dorsal fin erosion in trout and increases the level of glucose in Atlantic salmon.
Treatment of diseases	Therapeutic treatments can be stressful for fish
Inevitable contacts with the predators :	Increase the level of cortisol, the rate of ventilation and food intake
Slaughter:	All slaughter methods are stressful, but some are less than others. Bars (D. labrax) killed by cold in ice water have a high level of glucose and lower plasma lactate levels than those killed by Other methods, in particular by asphyxiation in the air and electro-stunning

An unresolved and controversial issue in the discussions on animals is whether the animals exposed to undesirable experiments (Wounds, confinement or other negative action) suffer what humans call suffering. Anatomically the fish are devoid of the neocortex, which plays a major role in the subjective experience of pain. This might suggest, in the absence of this cerebral structure, the fish can not suffer. Nevertheless, some fish with sophisticated behaviors, probably can suffer, even if it can be different in the degree and nature which man has of this state.

Nevertheless, among the specialists there is a relative consensus around the the notion that painful stimuli are deleterious to fish; That whatever or the actual perception of the fish. Therefore, nociception or more widely experience other harmful conditions on the part of the fish raise concerns about the well-being of individuals.

Although the concept of stress does not fully capture the complexity of well-being animal, monitoring behavioral, hormonal, physiological, then possibly pathological stress syndrome can give us, at at least in part, an image of the welfare of farmed fish.

However, it is important to recognize that physiological stress is not synonymous with suffering (Dawkins, 1998). Thus, for example, the agitation which precedes the distribution of food in a tank is favorable to the most agitated fish to compete with its fellow competitors.

Various biological parameters corresponding to the physiological changes which during the stress phase are often used as indicators of wellness. Cortisol is the main stress hormone. It is produced by adrenal cortical tissue and it induced by cascade mechanisms of modifications on other biological variables, such as glucose, lactate, ions plasmates, immune functions, gene expression, etc. However, we are forced to recognize that, outside the experimental framework, the exploration of these parameters are often difficult to interpret and ground.

Nevertheless, in breeding, chronic stress, so a disappointing condition of well-being, is accompanied by the decline in performance, the alteration of the state the physical health of fish, by the emergence of more frequent and and higher mortality rates.

These observations can provide measurable "indicators" not only the health status of livestock and extrapolation of the welfare state of the livestock.

However, it is necessary to relativize and these indicators in a more general context. It is necessary (and difficult) to limit to differentiate those who are "normal" within a breeding of those which could represent a harm to the good between animals.

Thus, although the link between well-being and health is also complex to be determined, health status and health performance indicators, provide solid information on both the conduction of livestock also attention paid to the welfare of the fish.

In conclusion and in no case, animal welfare is not a simple concept. he is even more complicated in the field of fish farming where domestication of these animals is recent and where the biological and techniques, make potentially stressful the simplest of practices which are capable of harming the welfare of fish.

The health risk of aquaculture production for humans.

From a nutritional point of view, aquatic products are products with high nutritional value (Table).

In addition, these good nutritional characteristics are supported by a low health risk for the consumer.

According to FDA estimates, the risk of the ingestion of a portion of 113 g of any product of the fishing is 1/250000; ten times less than for chicken. But within fishery products there are large disparities:

- Risk of fish and crustaceans 1 / 5.000.000
- Risk shellfish raw or undercooked 1/250 (Archer, 1989).
- Fish is a Food low Health risk

However, this epidemiological finding of low risk should not that many possibilities of contamination exist for the products of the Fisheries and aquaculture.

To recall foodborne diseases or Food Borne Diseases can be defined as following :

Primary contaminations may have a natural origin, be due to poollution or caused by erroneous farming practices, including health practices. Other contaminations, known as secondary contamination, may influence also very important. For fish, as for others contaminated animals had a cause-effect relationship that is structured under a diagram of Ishikawa or 5M. We will see in the table the major risks related to the ingestion of fish from fish farming and we will develop in particular Biological Risks and antibiotic risks (residues)

Among the parasitic larval forms of trematodes (FBT) are most important. Nearly 40 million people are affected by larval forms of these parasites and more than 10% of the world's population is under threat of these zoonoses. FBTs have been recognized as a public health problem In Southeast Asia. The main trmatodes responsible for FBTs are shown in the following table.

Another parasite covered for man is a nematode of the genus Anisakis spp. larvae are concentrated on the nets at the abdominal wall in eyes of the viscera.

The bacteria are rarely a significant source of foodborne illness linked to the consumption of fish. The reason for this low prevalence is due to that bacterial multiplication is associated very often with alterations early flesh of fish; Which makes it unfit for consumption. This the process of alteration depends essentially on the initial contamination of the raw material and by secondary contamination.

Details of the bacteria that may be present in fish are given in Table.

Major foodborne illnesses of viral origin are related to enteric viruses, and more than 120 enteric viruses are reported in humans. These diseases are the consumption of contaminated shellfish which are concentrated in the their flesh and their water the viruses present in the contaminated water. There is no information on the transmission of viral agents to humans through fish, which does not mean that fish can not be passive vectors of human enteric viruses (Norwalk, enterovirus, coronavirus or other viruses.

Scientific work demonstrates that the prevalence of hepatitis A virus is above 4% in the Sarotherodon melanotheron in Ivory Coast (Gershy-Damet et al., 1987). The digestive tract is the most contaminated organ, but at levels contamination in water, the muscle may also be contaminated. (Fattal et al 1992; Fattal et al., 1993).

The pathology of fish has strong specificities (for example impossibility of strict sanitary isolation of aquaculture facilities; few of developed vaccines) that often lead fish farmers to consider chemotherapy as the only solution against fish diseases.

Antibiotics are used primarily for therapeutic purposes, but are also used as prophylactic agents. Because of the serious deficiencies sanitary measures in fish farms, the indiscriminate use of antimicrobials poses significant problems for the future of aquaculture; that is particularly worrying in Southeast Asia (Hernández Serrano, 2005, Cabello, 2006).

Thus, a major contaminant of a chemical nature in fishery products is linked to the presence of the residues of antibiotics present in the flesh fishes. Specific sanitary controls are organized in Europe and in producing countries with maximum residue limits (MRLs) imposed by the legislator.

In addition to residue-related aspects, the unreasonable use of antibiotics sustainable contamination of the environment, which, through complex phenomena microbial agents (fish pathogens, but also germs of the environment) to acquire mechanisms of resistance to antimicrobial agents. This acquired resistance can easily be propagated by exchange of genetic material with other pathogens of various origins; Y Including human pathogens. The unreasonable use of antibiotics real problem for breeding therapy; But it may also represent a risk for public health.