ORNAMENTAL AQUATIC TRADE ASSOCIATION LTD

"The voice of the ornamental fish industry"

Wessex House, 40 Station Road, Westbury, Wiltshire, BA13 3JN, UK

Telephone:+44(0)8700 434013 Fax:+44(0)1373 301236

info@ornamentalfish.org www.ornamentalfish.org www.aquaticsworldwide.org

ANTIBIOTICS IN THE ORNAMENTAL INDUSTRY

Since they were first discovered antibiotics have revolutionised the treatment of a whole range of previously deadly diseases in man and animals. That said the greatest step forward in reducing human disease was the introduction of municipal sewage systems and a ready supply of clean drinking water. Equally it is true that the greatest gains in fish health are to be made by careful husbandry; after all fish have spent hundreds of thousands, if not millions, of years evolving mechanisms to deal with the disease causing organisms in their environment. Despite this antibiotics have their place in treating fish diseases and fish farming. Further information will be provided in future Newsletters.

Antibiotics have received massive adverse publicity over the past couple of years. The reason, in the first instance, was the growth in prevalence of antibiotic resistant bacteria in hospitals. This was generally blamed on doctors for over prescribing antibiotics. Blame was also put on the general public for insisting that they receive antibiotics for illnesses, like the common cold, which being viral in origin are not killed by them.

Over the last couple of years the veterinary use of antibiotics has been the subject of media attention. In farming antibiotics can be used as growth promoters, to treat specific diseases or as prophylactics. In particular the use in the veterinary sphere of antibiotics either used in human medicine or closely related to those used in human medicine has given rise to public debate.

The concern is that their use could:

1. promote the emergence of resistant strains of bacteria
2. remain in the meat of the treated animals and thus enter the human food chain.

An additional concern has been that bacteria that do not cause problems to humans could transmit their resistance to other species of bacteria which might cause illness to human.

Already a report has appeared in the press implicating misuse of antibiotics on a fish farm for the resistance to treatment of an infection in a woman who died. The problem was apparently caused by a Vibrio sp. Bacteria which infected a puncture wound cause by the spines in the dorsal fin of a gilthead bream. 20 other people have been reported as being infected by similar bacteria following puncture wounds in the hands caused by handling Tilapia sps. This resulted in swelling and uncontrollable bleeding from the wound. In half the cases the hands were amputated to save the patient. Vibrio ssp. bacteria are very common in water and the species involved in this incident usually cause no problems.

An item on fish diseases which can also cause diseases in man will be included in a future Newsletter.

Resistance is not new?

Resistance to antibiotics is not a new phenomona. Bacteria resistant to ampicillin, trimethoprim, nalidixic acid, tetracycline, ceftazimide, carbenicillin, cefazolin and cephamandole were found in 2000 year old ice from the Arctic. These same bacteria were not resistant to streptomycin, gentamycin, chloramphenicol or ciprofloxacin. That said resistance to most antibiotics is absent from bacteria collections in the early part of this century.

Why is there any natural resistance to antibiotics?

The simple answer is because antibiotics are largely natural in origin. In places like the soil many species of bacteria and fungi grow together and compete for space. To help compete they release chemicals to inhibit the growth of their competitors so that they are not overwhelmed. It is these chemicals which were first isolated and used as antibiotics. More recently these chemicals, or man-made versions of them, have been produced in large quantities in factories.

How do resistant populations arise?
Bacteria are usually present in vast numbers. Between the individual bacteria are genetic differences. Within each population will be a small number that are by chance resistant to a therapeutic dose of antibiotic.

In the ideal world the animals own immune system will kill this very small residual population. If for any reason the immune system is not functioning optimally, or the antibiotic dose leaves a large number of bacteria alive, (for instance if too small a dose is given, or the treatment is not completed), then these will multiply to give a population, the vast majority of which are resistant further attempts to treat them.

Increasing the dose of antibiotic may remedy the situation, however it must be remembered that all treatments are biocides. These work because they kill biological systems. It is usually only a matter of the dose used which determines that bacteria are killed by a treatment but fish are not. If the dose is increased too much then the bacteria and the fish may be killed.

Do resistant populations last forever?

Generally it is thought that once the antibiotic is removed, the population may gradually revert to the normal antibiotic susceptible form. Thus if resistant strains have built up in a farm, continued use of antibiotics is not the only way forward. However last year a paper did appear in the scientific press challenging this view and proposing that in some instances antibiotic resistant bacterial populations were persistent. Are all bacteria bad? The answer is no. Humans rely on some bacteria to produce vital nutrients in our intestines, such as vitamin K, without which our blood would not clot. Many other bacteria species grow harmlessly in and on the bodies of animals and plants. Their removal may leave gaps into which pathogens (disease causing bacteria) may grow and become established. Remember when you dig a new flower bed the weeds always get there first!

Antibiotics - magic bullets?

Some categories of antibiotics kill a wider spectrum of bacteria than others. That said antibiotics do not specifically kill a single species or strain of bacteria. Indeed one of the problems associated with antibiotics use is that they kill both pathogenic and useful or harmless bacteria. Antibiotics are not well aimed "magic bullets" that hit a very specific target but more closely resemble shotgun pellets whose effects spread outside the intended target to a greater or lesser extent.

What range of antibiotics is available to industry?

The conditions under which antibiotics are supplied vary around the world. In some areas they are available "over the counter" from retailers. In other regions they are available only by prescription from veterinary surgeon. The range available is also quite variable. In 1995 the use of over 25 antibiotics were permitted for use in fish in Japan while only four were licenced in the UK.

How can antibiotic resistance spread?

Once a genetic mutation, giving rise to a resistant bacteria, has occurred it can develop as quickly as the bacteria can replicate itself (this can be either by sexual or asexual means). As we all know bacteria can divide an enormous rate given the correct conditions.

However there is another way that resistance can be spread very rapidly both within and BETWEEN bacterial species. The technical term for the process is plasmid transfer. Plasmids are pieces of genetic materials that bacteria can release and absorb. Thus a bacteria of species A could release plasmids which in turn could be absorbed by other individuals of species A or indeed species B, C and D.

It is the spread of plasmids among species that gives rise to the fear that antibiotic resistance in bacteria usually associated with animals could spread to bacteria causing disease in humans. There are those who say this could happen and those who equally strongly argue that it could not: the jury is out on this issue! Monitoring the antibiotic resistance profiles of bacteria on imported food and animals including ornamental fish has been started by some governments. Official reports of these findings have already been published mentioning the presence of antibiotic resistant bacteria on ornamental fish.

The Norwegian salmon industry and the use of antibiotics

The growth of salmon in Europe over the last twenty years has been dramatic, perhaps nowhere more so than Norway. Just as in every stock rearing system intensification gave rise to disease. Some of these diseases were treated with antibiotics. (For those receiving this by E-mail see also the attached Word chart). By 1987 48 tonnes of antibiotic were used in the production of 60,000 tonnes of salmon. By the mid-nineties salmon production had risen to 350,000 tonnes annually but antibiotic usage was measured in kilograms. 1987 was the year that major advances in the availability of vaccines were made. In future Newsletters we will review the use of vaccines, immunostimulants and the potential of the even newer techniques of probiotics and prebiotics in the ornamental fish industry.