

Newsletter

November 2002

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AQUATIC ANIMAL HEALTH IN INTERVET CHILE

Intervet products have been sold in Chile for many years in the animal health sector. Although involved for several years beforehand, Intervet officially entered the Chilean aquatic animal health market in 2000, recognizing that Chile is “the Norway of the South” in regard to salmon farming, an area of great importance and growth in recent times.

Intervet has now established a specialized aquatic animal health commercial and technical support office in the national capital of Chilean aquaculture, Puerto Montt. Responsible for the aquatic animal health interests of Intervet in Chile are two veterinarians, Dr. Oscar Parra and Dr. Sergio Vásquez.

At present, Intervet has Compact IPN® available for the Chilean salmon industry. This is a state-of-the-art recombinant vaccine for the control of Infectious Pancreatic Necrosis Virus (IPNV). The product has demonstrated its efficacy at

farm level in the last two years in Chile. In addition, this antigen is a key component of Intervet's top selling 6-component salmon vaccines in Norway, accounting for nearly 55% of all vaccine doses sold. Furthermore, during Jan. – Sept. 2002, Intervet had 66% of the Norwegian salmon and trout vaccine market.



Location of the new Aquatic Animal Health office of Intervet Chile Ltda. in Puerto Montt

The research and development teams of Intervet in both Norway and The Netherlands, in conjunction with our technical and marketing managers in Chile, are committed to the

development of new vaccines for control of the main diseases affecting cultured salmonid species in Chile. Safer and higher quality vaccines and pharmaceuticals will be brought to the Chilean market by Intervet over the next few years.



A member of a salmon vaccination team administering Compact®-IPN in Chile

The aquatic animal health commercial office of Intervet Chile in Puerto Montt is located on Benavente St., no. 405, office 408. Tel./Fax (56) (65) 274006.

For further information, contact:
Oscar Parra - mobile: (56-9) 825 4730; e-mail: oscar.parra@intervet.com
Sergio Vásquez - mobile: (56-9) 825 4706; e-mail: sergio.vasquez@intervet.com

INTERVET STRENGTHENS GLOBAL AQUATIC ANIMAL HEALTH ACTIVITIES

Intervet recently announced that Alistair Brown will manage all their global aquatic animal health activities from November 1, 2002. Mr. Brown joined Intervet in 1995. Up to now, he was General Manager of Intervet Norbio

(Norway), with responsibility for the coldwater fish sector covering salmonids and marine species.

In addition, he will now be responsible for warmwater and temperate fish species, and shrimp. Products for these species are developed by Intervet at their R&D sites in Singapore and The Netherlands (see Newsletters issues 1 and 4).

NORVAX® FURVIB

Norvax® FurVib is a trivalent combination vaccine for salmonid fish developed from inactivated bacterial strains of *Aeromonas salmonicida* subsp. *salmonicida* and *Vibrio anguillarum* serotype O1 and O2. Based on a unique two component adjuvant system consisting of the immunostimulant beta-1,3-glucan and a particular non-mineral oil, Norvax® FurVib has proven to provide vaccinated fish with a protection level as high as 100% for the vibrio components and 95% for the furunculosis component. Norvax® FurVib has been tailor made comprising the aquatic environmental parameters and the extensively evaluated requests of the aquaculture industry.

The efficacy of Norvax® FurVib has been extensively tested in numerous laboratory and field experiments. Norvax® FurVib has proven to induce good protection against infections with vibriosis and furunculosis as shown in the following table.

Challenge strain	Group	Mortality (%)	Relative Percent Survival
<i>A. salm</i> subsp. <i>salm.</i>	Control	82	
	Norvax® FurVib	4	95
<i>A. salm</i> subsp. <i>salm.</i>	Control	78	
	Norvax® FurVib	2	97
<i>V. ang.</i> serovar O1	Control	82	
	Norvax® FurVib	6	93
<i>V. ang.</i> serovar O1	Control	80	
	Norvax® FurVib	4	95

V. ang. serovar O2	Control	98	96
	Norvax® FurVib	4	
V. ang. serovar O2	Control	100	
	Norvax® FurVib	0	100

In summary, Norvax® FurVib is an easy to administer, highly effective fish vaccine, protecting your fish during their live span, thus making your business a more healthy and predictable one.

FURUNCULOSIS AND VIBRIOSIS IN SALMONIDS

Furunculosis

Furunculosis, caused by the bacterium *Aeromonas salmonicida* subsp. *salmonicida* (*A. salm*), is one of the most serious infectious diseases of wild and farmed salmonids throughout the world, except South America. Furunculosis was, for a long time, regarded as a disease occurring exclusively in salmonids. However, during the last decade, several cases of *A. salm* infections have been reported in non-salmonids. In most cases, these non-salmonids had some form of contact with salmonid populations with clinical outbreaks or that were latent carriers of the causative agent. Furunculosis is an acute to chronic condition, with a variety of clinical signs. The disease generally appears to develop as a septicaemia and is often fatal. Affected fish often show darkening of skin, lethargy and inappetence. Haemorrhages may occur at the base of fins and the abdominal walls, heart and liver. Enlargement of the spleen and inflammation of the lower intestine are common features of chronic infections but, in acute outbreaks, fish may die rapidly with few signs. The disease is named after the raised liquefactive muscle lesions (furuncles) that sometimes occur in chronically infected fish.

The major route of transmission appears to be via infected fish and contaminated water. Although the disease causes mortality at all ages, the most serious losses occur during Spring-Autumn in the seawater farms. An important aspect of furunculosis is the carrier state, which is often established after the fish have been exposed to *A. salm*. Clinical outbreaks and mortality appear to be triggered

by stress factors such as crowding, poor water quality, fright, high temperature and physical trauma.

Causative agent

Aeromonas salmonicida subsp. *salmonicida* is a Gram-negative, facultatively anaerobic, non-motile rod (1.3-2.0 by 0.8-1.3 µm). The pathogenicity of *A. salm* is dependent on an external surface layer to the outer cell membrane called A-layer. The A-layer is mainly composed of a 50 kD protein called A-protein. The A-layer provides *A. salm* with a protective barrier against the defence mechanism of fish hosts.

Lipopolysaccharide (LPS), another major cell envelope antigen, is composed of three moieties: lipid A, a core oligosaccharide and an O-polysaccharide (O-antigen) that is exposed at the cell surface. Like the A-protein, the O-antigen appears to assist *A. salm* in resisting the host's normal bactericidal mechanisms. Evidence for further polysaccharide (PS) antigen, distinct from LPS, has also been reported.

While cell surface antigens are important in enabling *A. salm* to survive within fish, much of the pathology of furunculosis is attributable to extracellular products (ECP) released during bacterial growth and multiplication. The ECP of typical strains of *A. salm* comprise at least 25 proteins, including a number of enzymes and toxins, as well as other factors. Many ECP components have yet to be identified and characterised, including the lethal toxin.

Vibriosis

Vibriosis is a bacterial disease of seawater and migratory fish, and the severity of vibriosis has increased proportionate to the development and expansion of fish farming worldwide. It has a global distribution with epizootics on all continents and a wide range of fish. The disease causes significant losses in cultured Pacific salmon, Atlantic salmon and rainbow trout, and in cultured non-salmonids, including cod, eel, yellowtail, red sea bream and sea bass. The main species causing the disease is *Vibrio anguillarum*.

Clinical signs of the disease are bleedings at the base of the fins, around the vent and gills, inside the mouth and over the body surface. Internally, bleedings appear on the viscera and in the musculature. The intestine is often inflamed, distended and filled with clear viscous fluid.

Vibriosis is a stress-related disease and is associated with a number of factors such as high water temperatures, rapid changes in water temperature or salinity, over-crowding or poor water quality. Outbreaks of vibriosis mainly occur in Spring and Autumn. Farmed salmonids are transferred to seawater and are most sensitive to vibriosis at sizes between 30-150 grams for Atlantic salmon and between 40-80 grams for rainbow trout.

Causative agent

Vibrio anguillarum is characterised by a vibronic or comma shape. It is a Gram-negative, fermentative, oxidase-positive, motile bacterium that requires sodium ions for growth and is sensitive to the pteridine vibriostat O/129. The antigens are heat stable LPS in the cell wall. Various proteins in the outer membrane were also found to be antigenic.

It has been shown that extracellular products such as toxic materials, haemolysin and protease, as well as other undefined materials, may contribute to the pathogenesis of fish vibriosis.

More than twenty different serovars of *V. anguillarum* (designated O1 to O23) have been described. Serovars O1 and O2 occur worldwide and are those most often found in connection with diseases in fish, particularly in salmonids.

Prevention and Control

General methods

Control of furunculosis and vibriosis is best achieved by maintenance of water quality, good husbandry and low stocking densities. This is not, however, always possible and, where outbreaks occur, treatment with antibiotics is the only option. In areas where a disease is not endemic, it is possible to exclude the causative agents by a legislative policy such as: 1) restrictions on importation/movement of live fish/eggs and 2) slaughter and disinfection in infected fish farms.

Antibiotics

Treatment of established infections with antimicrobial compounds has been and will be extensively used for the control of many infectious diseases. However, their value is limited since clinically infected fish do not eat and therefore cannot be treated. A successful treatment is dependent on a rapid diagnosis and immediate treatment.

Vaccination

Vaccination has proven to be an efficacious method in preventing furunculosis and vibriosis. Vaccines are preparations of inactivated antigens derived from pathogenic organisms, which will stimulate the immune system to increase the resistance to disease from subsequent infection by a pathogen.

Therefore, the method of choice for prevention of the disease is vaccination with inactivated whole cells or subunits and an appropriate adjuvant for enhancing the immune response (see above regarding Norvax® FurVib).

EUROPEAN SEABASS AND SEABREAM IMMERSION VACCINATION

During their life fish are continuously exposed to a variety of hostile agents living in their natural environment. Fortunately, nature has gifted fish with several defense mechanisms. The first barrier is the epithelium of the skin and gills that contains the necessary mechanisms to protect fish in a broad but also a specific way. Immersion vaccination appeals partly to the ability of the skin to recognize and remember pathogens it was once in contact with. This vaccination method is particularly suitable for small fish below the injectable size (25 grams) and economically beneficial in terms of time and labour. Furthermore, it is easy, requiring only minimal equipment and handling and being not very stressful for the fish.

How does immersion vaccination work? Briefly, a vaccine consists of particulate antigen in the form of killed bacteria as well as soluble components. By immersing the fish in water containing the diluted vaccine, the suspended antigens from the vaccine can be "absorbed" by the skin and gills. They will then be processed for the building up of the local and systemic immune response. After immersion vaccination, specialised cells, such as antibody-secreting cells residing in the skin and gill epithelium, take care of the local immune response. They will be the first ones to come into action and protect the fish when exposed to the live pathogen later in its life. Other cells located in the epithelium of skin and gills, such as macrophages, also absorb vaccine antigens and transport them to specialised tissues, kidney and spleen, where the systemic immune response is built up.



The bottom line is that, after immersion in the vaccine solution, the fish has acquired the ability to remember and recognize the pathogen, the ability to combat it and, most importantly, to be protected against infection and clinical disease due to this pathogen.

Several factors play a role in the quality of the build up of the immune response: fish-related factors, vaccine-related factors and environment-related factors. Under the fish-related factors, the health status of the fish at time of vaccination is primary. It is important to vaccinate fish that have intact skin and gills, with no lesions caused by bacteria, parasites or physical trauma because this influences the uptake of antigen by the right cells. Stress influences the systemic immune response in a negative way. Any concomitant bacterial, viral or parasitic infection will cause a diminished immune response as it will mobilize some of the immune cells that are then not available for adequate processing of the vaccine antigen.

Practically, immersion vaccination of seabass and seabream fry and juveniles is performed as follows:

The duration of immersion can be short (dip: seconds to minutes) or long (bath: several minutes to hours). Usually for dip vaccination, the vaccine antigen is more concentrated as the volume of vaccine water is much smaller. For this method the fish are gently transferred to a vaccination bucket and then released to their rearing tank again.

On the other hand, in bath vaccination, fish remain in their rearing tank but with reduced

water level and the vaccine is added to the tank water. Dip vaccination is the preferred method because more antigen is taken up by each individual fish, therefore inducing a better quantitative and qualitative immune response.



METHODOLOGY

Fish and shellfish vaccination IV. Strategy for Reduction of Side Effects with Injection Vaccination - 2

This is the second of four sections in an article on the importance of water temperature, fish size and light (photoperiod) on the development of side effects after intraperitoneal injection vaccination of Atlantic salmon. These are the results of a collaborative research project involving Matre Aquaculture Research Station and Intervet Norbio, both located in Bergen, Norway. The key people involved at Matre Aquaculture Research Station were Arne Berg (Researcher), Tom Hansen (Manager) and Eva-Kristine Hansen (Master's student, University of Bergen).

Temperature shortly after vaccination

Four groups of fish were subjected to different water temperature regimes (see table). Two

groups were vaccinated at 13 °C and two groups at 6 °C. After 4 weeks at these temperatures, one of the groups vaccinated at 13 °C was lowered to 6 °C and one of the groups vaccinated at 6 °C was raised to 13 °C. The other two groups were maintained at their original temperature as controls. After these two 4-week periods, all four groups were subjected to the same (ambient) temperature until harvest.

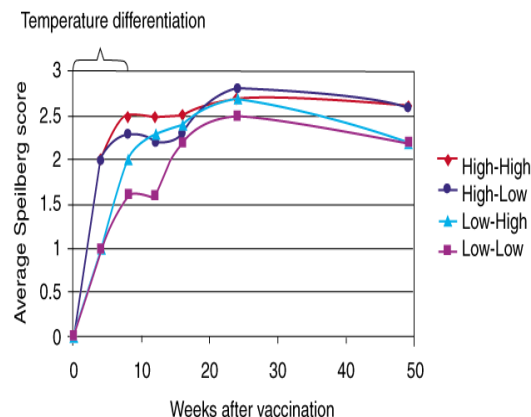
Objective of trial	Investigate the importance of different temperature regimes shortly after vaccination with respect to the development of side effects
Time of vaccination	March 1998
Time of sea transfer	May 1998
Weight (g) at vaccination	87
Time of temperature differentiation	0-8 weeks after vaccination
Temperature groups	High-High: 13 °C for 8 weeks High-Low: 13 °C for 4 weeks; 6 °C for 4 weeks Low-High: 6 °C for 4 weeks; 13 °C for 4 weeks Low-Low: 6 °C for 8 weeks
Evaluation of side effects	Up to and including 49 weeks after vaccination

The group that had been continuously subjected to the highest temperature developed the most severe side effects, while the group that had been continuously subjected to the lowest temperature had the least side effects. There was also a tendency for less severe side effects in the groups subjected to the “spring temperature regime” (Low-High) as compared with the “autumn temperature regime” (High-Low). These differences in side effects were most noticeable 8 weeks after vaccination, but diminished through the trial period after all groups were subjected to the same (and relatively high) temperature.

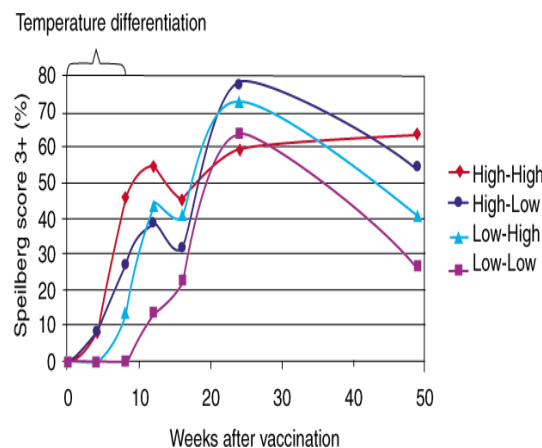
Summary

Four different temperature regimes in the period 0-8 weeks after vaccination, resulted in a clear correlation between temperature and the

development of side effects. Low temperatures gave a low degree of side effects while high temperatures gave a higher degree of side effects.



Development of side effects in relation to temperature shortly after vaccination.



Frequency of severe side effects (Spielberg score of ≥ 3) in relation to temperature shortly after vaccination.

Temperature a long time after vaccination

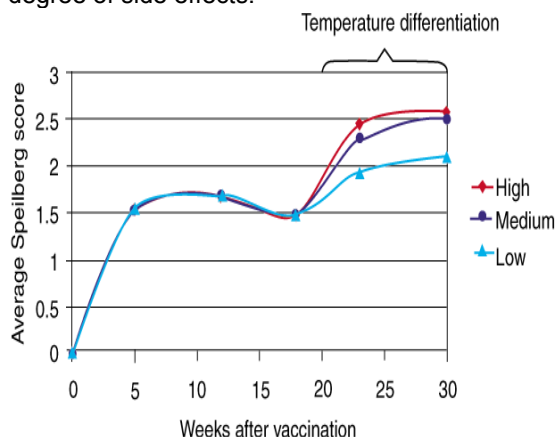
Three groups of fish were subjected to different temperature regimes a long time after they were vaccinated (see table). Up to and including 20 weeks after vaccination, the trial population was kept at a constant temperature. Then the population was divided into three groups that were subjected to temperatures of 13 °C, 7 °C and 5 °C, respectively.

Objective of trial	Investigate the importance of different temperature regimes a long time after vaccination with respect to the development of side effects
Time of vaccination	October 1998
Time of sea transfer	April 1999
Weight (g) at vaccination	81
Time of temperature differentiation	20-30 weeks after vaccination
Temperature groups	High: Average 13 °C Medium: Average 7 °C Low: Average 5 °C
Evaluation of side effects	Up to and including 30 weeks after vaccination

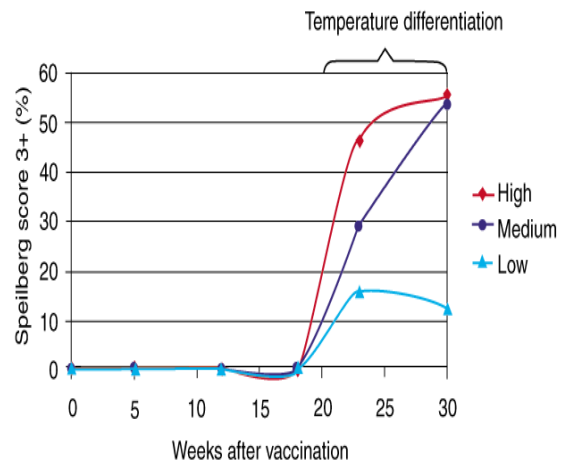
This trial showed no differences in the degree of side effects between the groups which were subjected to temperatures of 13 °C and 7 °C. However, the group subjected to 5 °C had less severe side effects than the groups that had been subjected to higher temperatures.

Summary

Three different temperature regimes in the period 20-30 weeks after vaccination, resulted in a clear correlation between temperature and the development of side effects. The lowest temperature gave the lowest degree of side effects while higher temperatures gave a higher degree of side effects.



Development of side effects in relation to temperature a long time after vaccination.



Frequency of severe side effects (Spielberg score of ≥ 3) in relation to temperature a long time after vaccination.

SUMMARIES OF SCIENTIFIC PUBLICATIONS

In ovo methods for utilizing the modified live *Edwardsiella ictaluri* vaccine against enteric septicemia in channel catfish

Aquaculture. 203: 221-227, 2002

Shoemaker, CA, Klesius, PH, Evans, JJ (USA)
Eyed channel catfish (*Ictalurus punctatus*) eggs were vaccinated by immersion exposure (10 min) with either the modified live *Edwardsiella ictaluri* isolate RE-33 grown in brain heart infusion broth (trial 1) or the lyophilized AQUAVAC-ESC^(TM) vaccine (trial 2). AQUAVAC-ESC^(TM) is the modified live *E. ictaluri* isolate (RE-33) that was licensed, produced and marketed as a vaccine against enteric septicemia of catfish by **Intervet**. Trial 1 consisted of vaccinated (RE-33 *E. ictaluri* at 1×10^5 CFU/ml) and non-vaccinated (controls) treatments with the eyed eggs hatching into fry 4 days following treatment. No mortality was recorded in these fish for 33 days post vaccination. In trial 2, three treatments were used: single vaccinated, vaccinated and fry booster vaccinated 7 days following initial immunization; and non-vaccinated (controls). The vaccination in trial 2 was carried out according to the manufacturer's recommendation for use on channel catfish fry (i.e. AQUAVAC-ESC^(TM) label). In trial 2, the eyed eggs hatched 24 h post vaccination and no control fish or single-vaccinated fish died following vaccination. Three fry died in the booster vaccinated treatment. No rifampicin-

resistant *E. ictaluri* was isolated from these dead fish. Thirty-three (trial 1) and sixty days (trial 2) following vaccination, fish were challenged with *E. ictaluri* (isolate AL-93-75) at 1×10^7 CFU/ml. In trial 1, the relative percentage survival (RPS) of vaccinates was 87.9; however, data did not fit Amend's criteria of 60% mortality in the non-vaccinated treatment and no significant difference was seen between mortality of the vaccinates or control treatments in trial 1 [Dev. Biol. Stand. 49 (1981) 447]. In trial 2, mean percentage mortality in the non-vaccinated treatment (controls) (64.2 ± 5.8) was significantly higher ($p=0.003$) than mean percentage mortality in the single vaccinated treatment and booster vaccinated treatment (25.8 ± 5.1 and 46.7 ± 0.8 , respectively). Relative percentage survival was 59.7 in the single vaccinated treatment and 27.3 in the booster vaccinates. Safety and efficacy of the modified live *E. ictaluri* vaccine (AQUAVAC-ESCTM) was demonstrated in eyed channel catfish eggs following single vaccination. Booster vaccination did not enhance vaccine efficacy; however, timing of the booster may have been too soon following initial vaccination of eyed eggs.

Evidence that infectious stages of *Tetracapsula bryosalmonae* for rainbow trout *Oncorhynchus mykiss* are present throughout the year

Diseases of Aquatic Organisms 46:31-40, 2001
Gay M, Okamura B, de Kinkelin P (France, UK)
Proliferative kidney disease (PKD) is a hyperplastic condition of the lymphoid tissue of salmonids infected with the spores of *Tetracapsula bryosalmonae*, a myxozoan parasite formerly designated PKX, which has recently been described as a parasite of several species of bryozoans. The occurrence of PKD is generally associated with seasonal increase in water temperature, with research indicating that transmission of the disease does not occur below 12 to 13°C. This suggested that the infectious stages are absent from about November to March/April. Here we document the transmission of PKD at water temperatures and seasons previously considered to be non permissive for PKD infection. The exposure of naive rainbow trout *Oncorhynchus mykiss* (Walbaum) to PKD-infected water ranging from 8 to 13°C during the Autumn, Winter and early Spring, resulted in the infection of kidney interstitium once the trout were transferred to 16°C. In addition, cohabitation studies were conducted with the bryozoan host *Fredericella*

sultana collected from a river at times of low seasonal temperatures because this bryozoan species overwinters as living colonies. Cohabitation of trout with colonies of *F. sultana* in parasite-free city water at 16°C, also led to renal lymphoid tissue infection with the parasite and even to nephromegaly. Our results provide evidence that the infectious stages of *T. bryosalmonae* for rainbow trout were present in the water throughout the entire year and that the impact of temperature on the development of PKD is primarily a result of the kinetics of *Tetracapsula* multiplication in bryozoan and fish hosts.

***Flavobacterium psychrophilum* in Baltic salmon *Salmo salar* brood fish and their offspring**

Diseases of Aquatic Organisms 37:159-163, 1999

Ekman E, Börjeson H, Johansson N (Sweden)
Baltic salmon brood fish were investigated for the presence of *Flavobacterium psychrophilum* in the kidney, spleen, brain and sexual products (ovarian fluid, unfertilised eggs and milt). Samples for bacteriology were taken at capture, when the fish were ascending their native river to spawn, and after a period of captivity in indoor pools, at stripping. During captivity, abnormal wiggling behaviour was recorded in some of the fish. Bacterial samples were taken to determine if *F. psychrophilum* had any role in the aetiology of the condition. Furthermore, the presence of *F. psychrophilum* on egg surfaces during incubation was investigated. *F. psychrophilum* was isolated from internal organs and/or sexual products in 7 out of 50 (14.0%) fish sampled at capture and 63 out of 272 (23.2%) fish sampled at stripping. The bacteria was isolated from either spleen or gonads in 2 out of 19 (10.5%) fish with abnormal wiggling behaviour but no bacteria was isolated from the brain. No *F. psychrophilum* was isolated from eggs at the eyed stage. Just before hatching, the bacterium was isolated from 5 out of 15 (33.3%) family groups. The present study shows that Baltic salmon brood fish are carriers of *F. psychrophilum* during their spawning migration. The presence of the bacteria in sexual products from both females and males indicates that transmission from the brood fish to the offspring should be considered an important route of infection.

Antigenic characterization of a marine fish iridovirus from grouper, *Epinephelus* spp.

J. Virol. Methods 106: 89, 2002

Qin Q, Shi C, Gin K, Lam T. (Singapore)

Iridoviruses, recognized as causative agents of serious systemic diseases, have been identified from more than 20 fish species. Antigenic properties of a pathogenic iridovirus isolated from grouper, *Epinephelus* spp., in Singapore (SGIV) were investigated using rabbit IgG against the virus. Antisera were prepared by immunization of rabbit with purified virions. The rabbit IgG was purified from antiserum using a protein A-agarose column and adsorbed onto acetone-dried grouper (GP) cells. The viral surface-exposed antigens were visualized by a combination of immunogold transmission electron-microscopy and by indirect immunofluorescence, and the viral antigenic related proteins were discriminated by Western blot. The cross immunofluorescence assay showed that the grouper virus isolate was serologically close to viruses of the genus Ranavirus of family Iridoviridae. The viral antigens were detected from virus infected-cell cultures as early as 4 h of post infection using IFAT, and could be detectable in virus-infected fish blood as early as 3 days post infection. Immuno-dot assays revealed that the rabbit anti-SGIV IgG allowed sensitive detection of SGIV viral antigens. This study will facilitate the development of diagnostic techniques and vaccines for grouper iridovirus.

Efficacy of different administration routes for vaccination against *Vibrio anguillarum* in Atlantic halibut (*Hippoglossus hippoglossus* L.)

Fish Shellfish Immunol. 12:283-285, 2002

Bowden TJ, Menoyo-Luque D, Bricknell IR, Wergeland H (UK)

Atlantic halibut (*Hippoglossus hippoglossus* L.) is a potentially important new species to cold-water aquaculture. Development of a viable industrial farming technique has been hampered by continued pathogen problems within the rearing cycle and there are several reports that indicated how susceptible juvenile halibut are to bacterial and viral diseases. Interest has been expressed, within the industry, over the possibility of vaccinating suitably sized animals to protect against the more common aquaculture pathogens. *Vibrio* spp. are of particular concern due to their ubiquitous nature and the relatively frequent occurrence of these pathogens within marine aquaculture. We have previously investigated

the susceptibility of Atlantic halibut to infection by *Vibrio anguillarum* and the efficacy of intraperitoneal injected delivery of a commercial vaccine in protecting against the disease. Given the very high rate of protection offered by immunisation we wanted to investigate the effect of alternate routes of administration on the efficacy of the vaccine.

Diseases, prophylaxis and treatment of the Atlantic halibut *Hippoglossus hippoglossus*: a review

Diseases Aquatic Organisms 48:57-74, 2001

Bergh O, Nilsen F, Samuelsen OB (Norway)

After substantial investments in research, the Atlantic halibut *Hippoglossus hippoglossus* is now being cultivated commercially in Norway, Iceland, Scotland and Canada. As with other domesticated species, disease problems have been experienced. This review summarizes the current state of knowledge of diseases of the Atlantic halibut, and their diagnosis, prophylaxis and treatment. In economic terms, the most important losses have been suffered at the larval and juvenile stages. The most important infections are caused by nodaviruses, causative agents of Viral Encephalopathy and Retinopathy (VER), which are the major reason why Norway's production of halibut fry has been level since 1995. An aquatic birnavirus, Infectious Pancreatic Necrosis Virus, is also an important agent of mortality. *Vibrio anguillarum*, *Flexibacter ovolyticus* and atypical *Aeromonas salmonicida* are the major bacterial pathogens. The protozoan parasites recorded include Ichthyobodo sp., the microsporidium *Enterocytozoon* sp., *Trichodina hippoglossi*, and the metazoan pathogens include myxozoans, helminths, *Entobdella hippoglossi*, *Lepeophtheirus hippoglossi* and other parasitic copepods. Experimental vaccines have been tested against *V. anguillarum* and atypical *A. salmonicida*, with good results. A recombinant vaccine against nodaviruses is under development. A few trials have been carried out on non-specific immunostimulants, but no such treatment is currently available. A number of efficacy and pharmacokinetic trials with various antibacterial agents have also been published.

Immune responses of teleost fish

Australian Vet. J. 79:570-574, 2001

Watts M, Munday BL, Burke CM. (Australia)

In fish all the pre-requisites to mount a specific immune response are present, but the main differences from the mammalian system are that the secondary response is relatively minor

and IgG is not present. In teleosts mainly IgM is present, and IgD has been recently described but its function is, as yet, unknown. However, different forms of fish IgM and its observed flexibility of structure may compensate for a lack of Ig class diversity. The innate immune response of teleosts is highly developed. Multiple forms of key constitutive and inducible components, such as lysozyme, C3, alpha2-macroglobulin and C-reactive protein, are present, and may enhance immune recognition. Low ambient temperature appears to have an impact on all aspects of the immune response, particularly the T-dependent specific immune response due to the non-adaptive lipid composition of T-cell membranes. Temperature effects on the nonspecific immune system are less well characterised, but there is evidence that low temperatures are also suppressive. Knowledge of immune system function becomes essential for disease prevention strategies such as the development of vaccines, selection for increased disease resistance and identification of genes suitable for transgenesis.

Induced ovulation of *Pangasius bocourti* (Sauvage, 1880) with a progressive hCG treatment

Aquaculture 213:199-206, 2002

Cacot P, Legendre M, Dan TQ, Tung LT, Liem PT, Mariojouis C, Lazard J (France, Indonesia, Vietnam)

The Mekong catfish *Pangasius bocourti* (Pangasiidae, Siluriforme) has been widely cultured in southern Vietnam in floating cages since 1989 (15,000 tonnes annually). However, the supply of fingerlings has been dependent on catches from the wild, which has led to a reduction in the natural resources. Reproduction of *P. bocourti* was studied with brooders reared in earthen ponds or in floating cages on the Mekong River. Brooders did not show any sexual dimorphism but females were more developed than males in terms of body weight (+26%) and fork length (+7%). Induction of oocytes maturation and ovulation required a progressive hormonal treatment in two steps. Several daily injections of hCG at a low dose (500 IU kg⁻¹) were applied first. These injections induced the development of ovarian follicles, indicated by an increase in their diameter. The second step consisted of two successive hCG injections applied at higher doses (1500 and 2500 IU kg⁻¹) at an 8-10-h interval, which induced oocytes maturation, followed by ovulation at 19±3 h after the first injection. Mean ovulation and hatching rates were 66% and

55%, respectively. Ovulation was generally induced once a year for each female although a second ovulation could be obtained for some individuals in the same reproductive season. Fecundity was highly variable, from 400 to 16,700 ova kg⁻¹, and average fecundity in ponds was twice as high as in cages.

Local company contact details:

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It is our hope and intention that all the information contained in this Newsletter is accurate; however, the Newsletter is intended solely to supply useful information to the aquaculture industry. Thus, Intervet International B.V. is not liable for any inaccuracies contained in this Newsletter.

Intervet Aquatic Animal Health Newsletter

Co-ordination, final copy editor and contributor: Dr. William Enright
Major contributor: Annick Bolland DVM

Other contributors to this issue:
Dr. Odd Magne Rødseth, Research Manager, Intervet Norbio, Bergen, Norway.
Dr. Zilong Tan and Dr. Ellen Ho, Intervet Singapore.