AQUATALK
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An alternative to fish meal

BY JENNY TYE
OFFICE OF RESEARCH

An economical alternative to fish meal as a protein source in aquaculture feeds is being pursued by U of G researchers.

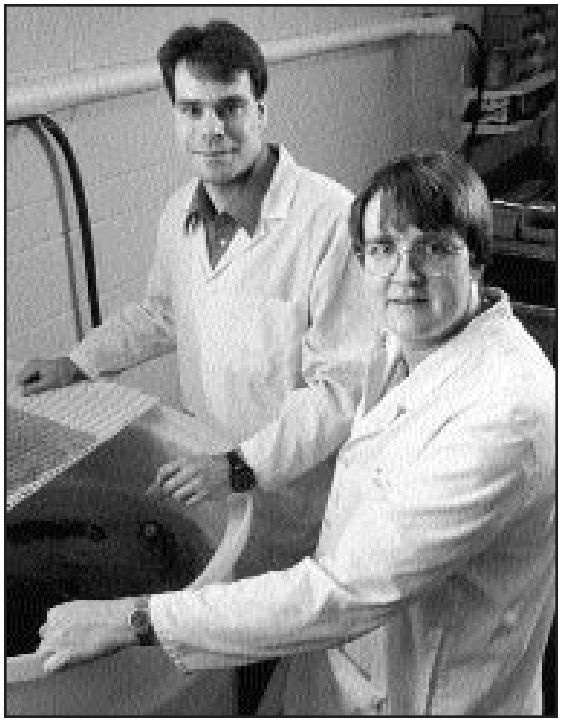
Fish meal is an excellent protein source for salmonids — a family of fish which includes arctic charr, rainbow trout and salmon. However, the wordwide availability of this product is decreasing and its price is on the rise.

So research scientists Dominique Bureau and Young Cho, Department of Human Biology and Nutritional Sciences, are trying to determine if rendered animal products, produced from terrestrial livestock, could be used as a replacement for fish meal in salmonid diets.

"Feed is one of the fish farmers biggest operational expenses," says Bureau. "We want to see if rendered animal protein products, which are less expensive than fish meals, can efficiently meet the protein needs of salmonids."

Rendered animal protein ingredients, including feather meal, blood meal, poultry by-products meal, bone meal and meat meal, are made by processing or recycling animal by-products not consumed by humans. As a way to efficiently use all animal parts, bones and other material from meat processing plants and slaughter houses are processed, cooked and dried to produce fine ground meats rich in protein.

MARTIN SCHWALBE



Research scientist Dominique Bureau (left), seen here with technician Andrew Harris, is looking for an alternative to fish meal as a protein source in aquaculture feeds.

These products are used extensively in various animal feeds but has traditionally not been widely used in fish diets because certain animal protein products are known for having a high ash content, fairly poor digestibility and variable quality.

Protein renderers don't always have full control over what animal material they receive at any time, which accounts for the variation in the quality of products. And differences in their processing techniques and equipment also lead to differences between products. Sometimes, animal material is overcooked.

But Bureau says that protein renderers are fine-tuning their processes, to improve the nutritive quality of their products.

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Still, fish feed formulators have little recent information about the nutritive value and acceptability of these ingredients produced in Canada. No one has actually tested whether the protein ingredients from different suppliers maintain compositional consistency and if they are appropriate for fish consumption.

That's where Bureau and Cho come in. They are measuring the digestibility of these products and performing feeding trials using the protein products. During these trials, they monitor the growth of the rainbow trout and determine feed efficiency.

If these protein products prove to be high quality, feed producers will have more protein ingredient options. Since rendered animal products are currently less expensive than fish meal, this may mean lower feed prices in the future.

"By using the information we gather from our experiments, feed manufactures may turn to rendered animal products as a more economical source of protein for fish diets," says Bureau. "This will hopefully be reflected in reduced feed prices."

This research is sponsored by the Ontario Ministry of Agriculture, Food and Rural Affairs, the Canadian Renderers' Association, The Fats and Proteins Research Foundation and Rothsay Incorporated and is being carried out in part at the Alma Aquaculture Research

The Aquaculture Extension Centre, in conjunction with the Ontario Aquaculture Association, recently organized a technology workshop for commercial egg producers and fish breeders in Ontario. Dr. Roy Danzmann, along with M.Sc. student Tony Fishback and research associate Tim Jackson, presented an update on their molecular genetics research aimed at improving selection performance in fish. Drs. Laura Mckay and Ian McMillan highlighted the results of a two-year study examining the development of commercial spring-spawning strains of rainbow trout for Ontario's aquaculture industry. The Extension Centre hosts a regular series of workshops for both beginner and experienced farmers.
For further information call 519-824-4120 ext. 2689.

RDM

Mastering aquaculture

BY GREGOR REID, MSc. (Aquaculture)

Did you know there is a Masters of Science in Aquaculture program at the University of Guelph? This program, started in the fall of 1993, offers students a unique and exciting learning opportunity and has attracted people from both coasts and as far away as Hong Kong and Greece.

Unlike other Masters' studies, students who participate in this program are not required to write a thesis. Instead, they learn about a vast array of disciplines related to fish culture.

"Since there are so many technologies and skills involved in managing an aquaculture business, a highly specialized technical training approach such as a thesis-writing initiative may not be entirely appropriate," says Prof. Richard Moccia, program coordinator.

Besides learning aquaculture fundamentals, students gain extensive knowledge in marketing management, extension methods, fish nutrition, managerial skills, environmental impact assessment, animal welfare, pathology, biotechnology and pursue a special research project in an area specific to the student's interest. Students also gain hands-on training at the Alma Aquaculture Research Station, a state-of-the-art, land-based facility built by the province for joint research between industry, academia and government. The facility also serves as a useful teaching tool for the program.

So far, a total of eleven students have graduated from this program. These graduates are prepared for an industry which requires innovation and broad-based technical knowledge. The recurring theme of this degree is the promotion of problem solving skills and the concept of lateral thinking.

"This M.Sc. program will provide students with the skills to solve numerous and challenging problems in the aquaculture industry," says Moccia. "Today's graduates must maintain flexility and versatility if they are to survive the present dynamic working environment."

The egg comes first

BY JENNY TYE
OFFICE OF RESEARCH

For hatchery operators, maximizing reproductive efficiency is the key to better business.

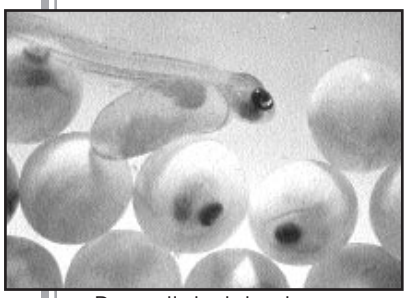
In an effort to diversify aquaculture, farmers are learning how to breed and grow new fish species. However, every species has unique needs and characteristics. Insuring the success of a newly cultured species like arctic charr (*Salvenlinus alpinus*) is no easy matter.

Since 1992, Ph.D. student M. Naeem Khan and Prof. John Leatherland, Department of Biomedical Sciences, University of Guelph, have worked on a two-part project to study reproductive biology and early embryonic life of arctic charr. This research is expected to have a direct bearing on hatchery success and on the choices of cultured fish available to fish farmers and consumers.

"Canadian fish hatchery operators are always looking for new species to breed and sell for production at fish farms," says Khan. "In order to successfully raise a new fish species a large amount of information about its reproduction and early life is essential. That's where we come in."

Water conditions in northern Canada where arctic charr live are quite different from conditions typical in a hatchery. Northern Canadian waters are vast, cold, well oxygenated and relatively free of pollutants. It is difficult to mimic these conditions in a hatchery. Khan says that 'artificial' environments can have a huge bearing on both the timing and the success of reproduction.

At the Alma Aquaculture Research Station, Khan monitored the reproductive cycle of female arctic charr living in typical hatchery conditions. He measured various blood steroid hormones such as progestogens, androgens and estrogens, particularly the presence of a progestogen that induces sexual maturation in fish called maturation inducing hormone (MIH).



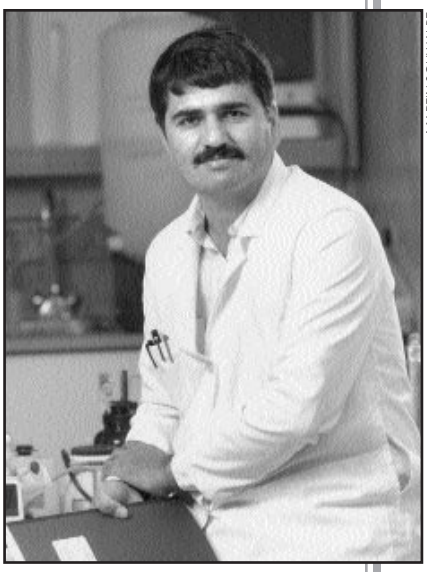
RICHARD MOCCIA

Recently hatched trout embryo.

When a female arctic charr reaches the age of sexual maturity she begins her annual reproductive cycle. Every cycle, six or seven days before she is ready to spawn, eggs are released into her body cavity, a process called ovulation. There are no outward signs of this event, but it's essential for hatchery workers to know when ovulation occurs so they can work towards high fertilization rates. There's only a short window in which the farmer can harvest eggs from the females' body cavity and mix them with spermatozoa. If the eggs are not successfully fertilized it means large gaps in production will occur, resulting in financial loss for the operator.

Monitoring hormones is the key to determining this fertilization window. By following hormone levels, Khan has been able to map out the typical reproductive cycle of female arctic charr in captivity. This information may be useful to increase breeding success.

Khan also studied young, arctic charr embryos during a critical time in their development. Under normal circumstances, over 80% of the 3,000 or more eggs produced per female are successfully fertilized. However, in hatcheries, for reasons not entirely known, over 30 to 40 percent of these embryos will die between fertilization and day 100 of development.



MARTIN SCHWALBE

Making a splash: Ph.D. graduate M. Naeem Khan has spent the past four years studying arctic charr to help Ontario fish farms diversify and increase their output.

Hatchery success depends on minimizing embryo mortality during this time frame. By studying embryos at early stage of development, Khan learned that embryos have the ability to metabolize, detoxify and excrete hormones. This information has the potential to improve survival rates during the critical time window. Hatchery managers may be able to artificially use hormones to speed up the growth and development of an embryo. Since embryos can metabolize many steroid hormones, such as cortisol, progestogens, androgens, estrogens and others, using these chemicals to stimulate the development of embryos would be futile. They would simply be metabolized and excreted by the fish. However, Khan also found that the arctic charr embryos can convert the MIH precursor to active MIH. This finding was surprising to Khan. Now, Leatherland's lab is busy looking for the role of MIH and studying its potential use to stimulate early embryonic development.

"The information which we have gathered should help hatchery owners understand more about reproduction of arctic charr and other fish species," says Khan. "We want to help hatcheries diversify and increase their output, and it's hoped that this research will help minimize the fish lost during early development."

This research is sponsored by Natural Sciences and Engineering Council of Canada and the Ontario Ministry of Agriculture, Food and Rural Affairs. Khan's postgraduate programme was sponsored by Asian Development Bank (ADB) and Government of Pakistan. Studies were conducted, in part, at the Alma Aquaculture Research Station.

FISH BITS

Bacterial diseases are the leading cause of morbidity and mortality in Ontario aquaculture. Bacteria cause respiratory, skin, reproductive and other organ diseases in fish. Researchers at Guelph are developing rapid and highly sensitive techniques to identify these pathogens to help improve the health management and productivity of our farmed fish.

RDM

Do fish have psychological needs?

BY JENNY TYE
OFFICE OF RESEARCH

If fish could only express their feelings it would make all the difference to fish welfare.

Until recently, no one had thought much about welfare issues pertaining to fish. Many feel that unlike mammals, fish are incapable of feeling pain or experiencing stress the same way other creatures do.

But now, researchers are beginning to examine and evaluate the sensory capabilities and psychological needs of fish to determine if welfare action is necessary.

Once it's known what areas of fish welfare are most pertinent to define and debate, these ideas may lead to the establishment of voluntary codes of practice for industry and government use.

"The aquaculture industry is a rapidly expanding sector of livestock production," says Prof. Richard Moccia, coordinator of the Alma Aquaculture Research Station. "It's important that we seriously discuss whether fish have legitimate needs beyond basic life support, so that welfare measures can be taken before the industry becomes too rigidly set in its methods."

Moccia feels the most important issue which needs to be addressed by welfare experts and researchers concerns fish and pain. Studies monitoring reflexes, neurological responses and hormone levels in fish have demonstrated that fish do indeed respond to physical stimulation and experience stress. However, that doesn't prove that fish experience pain the way other animals do.

There is evidence to suggest that the health and growth of aquatic species is affected by the stress of overcrowding and transportation, as is the case with many other animals. As well, some fish species are more highly evolved than others and display some cognitive abilities; some fish even show signs of familiarity with their care giver. However, it's still unclear whether fish have psychological needs.

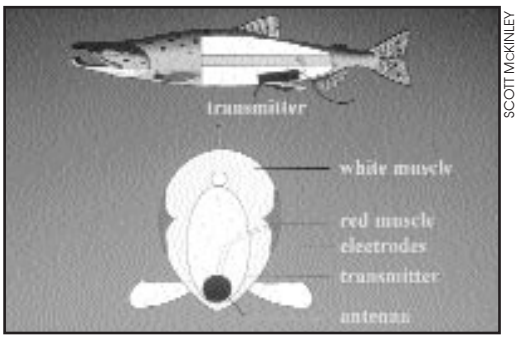
And if different species of fish have differing sensory capabilities, this must be taken into consideration when farming or doing research. Moccia believes more studies must be done in this area before any rational welfare decisions can be made.

One study, a collaboration of the Biotelemetry Group at the University of Waterloo and the University of Guelph, hopes to give scientists and fish farmers insight into fish stress responses to various captive culture conditions. Waterloo researchers Scott McKinley, Gary Anderson, Toni Beddow and student Julie Brodeur will be using telemetry equipment at the Alma Aquaculture Research Station to monitor if fish experience stress at various density levels.

Telemetry devices have recently been developed that enable researchers to collect biological information from free-swimming fish. The equipment consists of a small transmitter which is inserted under the skin or into the body cavity of the animals. It measures physiological responses such as heart rate, ventilation rate and muscle activity.

Besides the intrinsic need to eliminate pain and suffering in any captive livestock species, taking notice of welfare issues can have positive implications for fish farming businesses. Although stress may not affect growth of fish, it may play a role in disease development.

"Fish farmers could benefit from this sort of information by learning how to continually monitor crowding stress and changes in the tank environment," says Beddow. "Reducing stress levels could increase feed conversion efficiency and also reduce the susceptibility of fish to disease."



SCOTT McKINLEY

Transmitter used to monitor muscle activity in a free-swimming fish.

Moccia sees that the rise of technology used to manipulate aquatic animals to improve their production efficiency, as another important issue that needs to be addressed. There are a number of systems and technologies used by the industry which require evaluation by animal welfare experts, including reproductive manipulation, transportation, growth manipulation, production systems, harvesting practices and euthanasia methods.

Also, the implications of transgenic technology, both good and bad, should be explored.

"Determining where all animals fit into the animal welfare picture is very difficult and subjective because, of course, we compare and rank the importance of all animals in accordance to ourselves," says Moccia. "Formally debating welfare issues will help to insure that we are able to base our placement choices on objective, scientific information and not just aesthetics."

AQUATALK reports on news from the University of Guelph/OMAFRA fish production research program. It is published three times a year by the Office of Research, University of Guelph, with the support of the University of Guelph/OMAFRA Aquaculture Centre.

Executive Editor: Prof. Richard Moccia
Editor: Owen Roberts, Office of Research
Project co-ordination: Jenny Tye, SPARK (Students Producing Awareness of Research Knowledge)
Design: Brian Fray Designs Inc.

Please address correspondence to Prof. Richard Moccia, Aquaculture Centre, Department of Animal and Poultry Science, University of Guelph, Guelph, Ontario N1G 2W1
Phone: (519) 824-4120 Ext. 6216 fax: (519) 767-0573
e-mail: aquacentre@aps.uoguelph.ca