AQUATALK
AQUACULTURE NEWS AT THE UNIVERSITY OF GUELPH
UNIVERSITY of GUELPH
VOL. I NO. 3 SUMMER 1997

Health basics

Getting intimate with fish immunity

BY JENNY TYE

Tools essential for studying the immune system of rainbow trout — the major cultured fish species in Ontario — have been developed by University of Guelph researchers.

For Profs. Roselynn Stevenson and Lucy Mutharia, Department of Microbiology, understanding the fish immune response is a top priority. They say the development of the right tools, called monoclonal antibodies, was a major hurdle in the study of fish immune function.

The researchers can now establish a knowledge base that will help them, and others, enhance fish health performance and stock health.

This has huge implications for aquaculture.

"Immunological information has many practical uses in aquaculture," says Stevenson. "This information will help farmers make rational fish health decisions and help everyone understand the factors which can trigger or prevent disease in fish stocks."

Focussing on how fish fight disease

The fish immune system is very different than that of mammals. Little is known about how fish fight disease. By studying the dynamics of fish immune cells, the researchers can learn how different cells behave when a fish is under stress, or challenged by bacterial, viral or parasitic pathogens.

But before Mutharia and Stevenson could characterize and track leukocytes (a type of immune cell), they had to develop the right tools: monoclonal antibodies. A monoclonal antibody targets or matches a specific area on the surface of a fish immune cell. A group of monoclonals can help researchers count, track and generate profiles of these cells, providing the information needed to understand them. That's vital for the study of the immune system.

MARTIN SCHWALBE

Roselynn Stevenson and Lucy Mutharia are working to better understand the fish immune system.

After three years of developmental work, Stevenson and Mutharia are now using monoclonals to determine the dynamics of leukocytes under different situations.

There are many advantages to understanding the fish immune system.

Stevenson says that by learning the normal pattern of trout immune responses, researchers will later be able

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INSIDE...

Swimming in unchartered waters

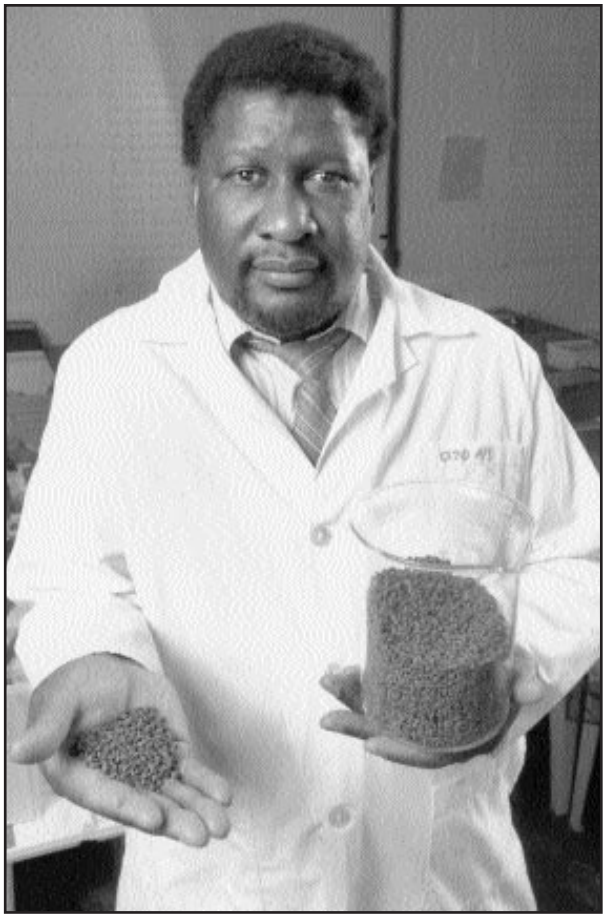
BY JENNY TYE

There's no longer a need to guess about arctic charr nutrition — vital nutrient information and diet-formulating methods for producing cost-effective and high-performance arctic charr diets have been developed at the University of Guelph.

Recent Ph.D. graduate, Richard Gurure, and Prof. Richard Moccia, Animal and Poultry Science, have found that arctic charr require between 37-42 per cent dietary protein and 2.1-2.4 per cent dietary lysine, an essential amino acid.

They also found that diet modeling with computers may be a feasible and effective way for feed manufacturers to determine the nutritional needs of newly cultured fish species like charr, without going through the expensive and laborious feeding trials now required.

MARTIN SCHWALBE



Richard Gurure says there's no longer a need to guess about arctic charr nutrition.

Although much is known about the physiology and the conditions needed for the growth and production of arctic charr, there's scant information about this species' nutrient requirements. Farmers often feed charr food developed specifically for rainbow trout or salmon...and then hope for the best. This is inefficient because protein, a major component of fish feed, is the most expensive part of fish diets — it constitutes 20-25 per cent of a farm's operational costs.

Realizing the need for refinements in this area, Gurure set to work to find the specific dietary protein and amino acid requirements for charr. For this, he undertook three types of studies.

The goal of the first study was to determine the nutrient digestibility of various feedstuffs by charr. This was an essential beginning to Gurure's work because fish can only digest and use a certain percentage of their nutrient intake to generate body mass. The rest of the nutrients are excreted.

Second, Gurure determined how much of each essential amino acid charr require in their diets, within an approximate range. Essential amino acids (EAAs) are the building blocks of protein that animals must gain from their diet. The amino acid composition of a fish carcass corresponds approximately to the percentage of each EAA the fish requires from its food.

Next, he determined specific amino acid and protein requirements of the fish. For this, he fed nine different levels of protein and lysine to groups of young growing fish and measured their growth responses. These levels — determined in the feeding studies —

FISH BITS

Radon Hazards

The Aquaculture Extension Centre recently co-sponsored a workshop with the Radiation Protection Service, Ministry of Labour, to examine potential radon exposure in aquaculture. Fish farmers were taught ways to deal with radon in ground water. This workshop was a prelude to a province-wide investigation of radon occurance and its main objective was to help fish farmers identify and control health risks in their working environment.

Prof. Richard Moccia

were within the range of protein and lysine he found in charr carcasses, with compensation for the known digestibility of the nutrients.

Lysine is usually the first most limiting amino acid in a carnivorous fish's diet. Since this nutrient is first used up by the fish, its absence will significantly slow or stop growth in the animal. Gurure used a variety of growth responses to estimate requirements for maximal growth.

(Graduate student Lincoln Simmons is now completing studies to determine methionine requirements, the second most limiting amino acid of fish diets.)

As a way to integrate the information he found, Gurure, with the help of Prof. John Cant, Animal & Poultry Science, evaluated and improved existing computer diet models to be used for the development of arctic charr diets. The use of models to determine nutrient requirements can cut down on time and money. If computer models are valid and are calibrated accurately, they can be used to predict diet needs without live animal experimentation.

"The development of cost-effective and high-performance diets is a real concern for both farmers and feed manufacturers," says Moccia. "We've successfully addressed these concerns and come up with effective solutions."

Gurure first evaluated a model called the ideal protein model, used to estimate the EAA requirements of other fish and animal species. He wanted to determine if this model could accurately predict information about arctic charr's nutrient requirements. This model combines digestibility data, carcass or amino acid profiles and protein requirements, to estimate the fish's requirements for all other essential amino acids in its diet.

Gurure also adapted another model, called the Dynamic Fish Model, to charr. This computer model can predict all of the fish's nutrient requirements, and map out the exact metabolic fate of each nutrient in the fish. It can help predict whether amino acids that are consumed are broken down, excreted as intact amino acids or deposited as additional body protein. As well, it can determine what percentage of each nutrient is used to generate energy or maintain basal metabolism.

Fish grow differently depending on the ratio of fat to protein used to generate energy for metabolism. Gurure adapted the Dynamic Fish Model, previously developed for the African catfish, to include known physiological and biochemical data about arctic charr from the literature and information incorporated from his own protein and lysine requirement studies.

"Modeling and information integration is an important step forward in aquaculture,"says Gurure. "The use of valid modeling systems will cut down on expensive experimentation, improve the accuracy of feed manufacturing and will allow fish manufacturers to use nutrition information from a variety of sources in the literature."

Several other faculty were also involved in this project, including Profs. Jim Atkinson (Gurure's co-advisor), Steven Leeson, Kees de Lange and Young Cho. This research was sponsored by the Ontario Ministry of Agriculture, Food and Rural Affairs.

Netting the Internet

The Aquaculture Extension Centre recently held a workshop at U of G to help Ontario aquaculturists understand how to explore the Internet. Seventeen fish farmers, each with their own computer terminal, were guided through a series of applications, including how to log on to the World Wide Web, search, download and print information, access specific sites, send and receive electronic mail, as well as many other tasks. The session will be offered again in the fall of 1997.

Prof. Richard Moccia

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to detect immune system disturbances and relate these disturbances to factors in the animal's environment. This is useful for disease prevention.

Also, because a fish's immune activity is determined partly by the genetics of its parents, intimate knowledge of fish immune systems may help farmers carry out more rational breeding strategies based on disease tolerance.

This study was sponsored by the Ontario Ministry of Agriculture, Food and Rural Affairs and the Strategic Grants Program of Natural Sciences and Engineering Research Council.

Alma staff delivers

Behind the scenes at Alma

BY JENNY TYE

The Alma Aquaculture Research Station (AARS) is a great facility with the technology needed to house and monitor thousands of fish and numerous research projects...but it's the people behind the scenes at Alma that really make things happen.

The station is run by four staff members with diverse backgrounds. They're in tune with the facilities, station research and the industry.

"The Alma station is a tremendous resource for fish researchers at the University of Guelph," says Biomedical Science researcher John Leatherland. "If we didn't have access to such a facility and the skilled and dedicated staff that run it, we certainly couldn't do the same scale of work that we presently do."

Michael Gary Burke has been manager of AARS since 1989. He's responsible for daily management, interacting with researchers and providing information and resources to the aquaculture industry.

With an extensive background in the general sciences, research, fish reproduction and commercial production, he understands the dynamics and potential of aquaculture and the real issues that face fish farmers.

"Most farmers can't really apply basic experimental research to their businesses," says Burke. "Since this station was once a fish farm, scientists are not only able to do basic work, but they can try out research ideas on a practical and commercial scale."

Neil MacBeth started at AARS in 1990. His training is in zoology, and aquaculture technology, as well as having experience at various fish farms and government facilities. He lives on-site and maintains the security of the station.

He advises fish farmers to — above all else — keep their facilities "clean and simple". His experience has taught him that fish farming problems are often husbandry related.

LAURA McKAY

From left to right: Michael Kirk, Neil MacBeth, Michael Burke and David Bevan are the people who make things happen at the Alma Aquaculture Research Station.

He also believes that openness between farmers breeds success.

"Secrecy actually hinders individual farms and the industry as a whole," says MacBeth. "Shared information gets ideas flowing and promotes growth."

Michael Kirk brings his own energy, excitement and enthusiasm to the team. His major interest is early rearing of fish. He started working at AARS in 1993. Kirk's trained in fisheries biology and has research and government experience.

"Farmers should never be afraid to try out new ideas," says Kirk. "New ideas lead to industry evolution and that's usually for the better."

David J. Bevan has a diverse background in environmental science, teaching, technology, research and aquaculture. He's worked at AARS for eight years. At the station he helps prepare fact sheets and reports for distribution to the industry and public. He also helps coordinate aquaculture training courses and teaches the technical aspects of the University's aquaculture masters program, along with station director Prof. Richard Moccia.

"Technology transfer and education are important for the growth of this young industry," says Bevan. "The masters program offered here is truly an excellent way to marry academic and practical experience."

Everyone at Alma is knowledgeable and skilled in aquaculture and that's what sets this station and its staff apart from many others.

"And, because they all love their work and are dedicated to it, they operate at a higher level," says Moccia. "We simply couldn't operate without these key individuals."

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

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