

Heterophils to the Rescue!

They're the Royal Canadian Mounties of the immune system—the heroes who show up in the nick of time—and they take on all bacterial invaders, be they salmonella, listeria, pasteurilla, or *E. coli*. They're infection-fighting white blood cells called heterophils, and Michael H. Kogut has found a way to make them do his bidding to protect young poultry. He is a poultry immunologist in the ARS Food and Feed Safety Research Unit at College Station, Texas.

When bacteria invade the intestines and try to pass through the intestinal wall to the bloodstream—gateway to all the organs—heterophils surround and devour the invaders. The problem: The body's mechanisms that put heterophils into play typically aren't functional until the host, whether a child or a chick, is about a week old, allowing plenty of time for bacteria to gain a toehold. Kogut says the solution is natural substances called cytokines that are produced by white blood cells.

"We've found a particular type of cytokine called lymphokine that causes heterophils to come to where the bacteria are and devour them," says Kogut. "By giving lymphokines to newly hatched chicks, we're simply giving the chicks' immune systems a little kickstart."

In tests, Kogut and colleagues have shown that if day-old chicks are given lymphokines, heterophils are on hand within hours to provide the kind of protection that a bird's immune system could take a week to develop naturally. A single dose suffices until the bird's own immune system kicks in.

"We've done experiments with lymphokines taken from older birds that were immune to salmonella and shown those same lymphokines can protect chicks against coccidia, the parasites that cause coccidiosis," says



Treatment stalls a variety of poultry bacteria.

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Kogut. "This can apparently protect against anything that's invasive."

Kogut has been working with cytokines since his research days at the University of Arkansas at Fayetteville. When he joined ARS in May 1992, the cytokine study came with him. Kogut and Billy M. Hargis of Texas A&M University's veterinary pathology department have collaborated on studies showing lymphokine injections could significantly reduce organ invasion by *Salmonella enteritidis*, a type of salmonella found primarily in eggs.

"We've now worked with *S. typhimurium*, *S. gallinarum*, and *S. arizoni*," Kogut notes. "These are all serologically distinct bacteria, and the same lymphokines will protect against all of them."

In hundreds of experiments over 4 years and involving an estimated 5,000 birds, day-old chicks and turkeys have been treated with lymphokines, then dosed with up to a million disease-causing bacteria per bird. For comparison, other birds received the bacteria but no protective lymphokines.

"We usually wait 24 hours, then check the birds' organs for signs of salmonella," Kogut explains. "Eighty percent of the birds that didn't receive lymphokines have salmonella in their organs, compared with less than 10 percent of the treated birds."

"We've developed a permanent cell line that we can grow in tissue culture and produce lymphokines in large quantities," says Kogut. "We have a cooperative research and development agreement with Eli Lilly & Co. of Indianapolis, Indiana, to develop lymphokine-based protective products for poultry."

Unlike other products such as CF-3, a bacterial blend developed at the College Station lab [See "Natural Microbes Curb Salmonella," *Agricultural Research*, November 1994, pp. 22–26.], the lymphokine-based treatment won't prevent salmonella and other bacteria from colonizing the bird's intestines. But it will prevent the salmonella from hitching a ride in the bird's bloodstream to organs such as the ovaries, where eggs are produced. And it could play a key role in protecting U.S. poultry health, Kogut adds.

"*Salmonella gallinarum* is killing 70 to 80 percent of infected flocks in Mexico," he notes. "Also, there's a type of *S. enteritidis* called phage type 4 that is killing hundreds of thousands of chickens in Europe and China. We've had only small outbreaks of it, but the potential is here for a big outbreak. A weapon like the lymphokines could help us go on the offensive against getting it here on a broad scale."—By **Sandy Miller Hays, ARS.**

Michael H. Kogut is in the USDA-ARS Food and Feed Safety Research Unit, 2881 F&B Rd., College Station, TX 77835; phone (409) 260-9221, fax (409) 260-9332, e-mail kogut@usda.tamu.edu ♦