Pat Johnson receives grant to further follicular development research in poultry.

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By: Melanie Soberon

Pat Johnson, a Cornell professor of animal science, recently received a three year grant from the USDA in support of research to better understand the process of follicular development in hens. This research is of practical importance to poultry producers, particularly broiler producers, because broiler hens are considerably less productive in terms of egg production than their laying hen counterparts. While it has been to the advantage of laying hen producers to select for high egg production, other traits such as muscling and growth have been emphasized in the breeding of broiler strains of poultry.

Johnson has observed that broiler hens fed *ad libitum* develop a multitude of follicles with suboptimal ovulation. These follicles become overgrown, as can be seen in the top part of Figure 1. By restricting the hens' feed, the follicles will begin to exhibit a more normal growth pattern, similar to that seen in the laying hen ovaries depicted in the bottom of Figure 1. Even when feed restriction is utilized, egg production of broilers is still not comparable to that of egg-laying strains.

"We don't know the relationship between feeding and the production of these

Figures 1&2. Follicles on the ovaries of chickens fed *ad libitum* (shown above) and chickens fed restricted diets (shown belowt).

oversized follicles," said Johnson. "We have some hints that there are hormones which are different between egg-laying and broiler strains that may regulate the progression of follicular development."

Johnson has reason to believe that a hormone produced in a cell layer surrounding oocytes, called anti-mullerian hormone (AMH), may be partially responsible for this phenomenon.

"We've found that broiler hens have higher levels of AMH than laying hens," Johnson said. "Moreover, when we restrict feed intake, the AMH level also decreases."

AMH may help regulate how the follicle responds to follicle stimulating hormone (FSH), a hormone that causes the follicle to mature, and it may also regulate how follicles are selected for ovulation.

Another longstanding research project for Johnson is the use of the hen as a model for ovarian cancer.

"In women, the risk of ovarian cancer increases with an increased number of ovulations," Johnson said. "Research has shown that women who take birth control pills (which prevent ovulation from occurring) a number of years or who have had several pregnancies and lengthy lactations, have a significantly reduced risk for ovarian cancer."

The hen is an excellent model for ovarian cancer because it is one of the few animals that develops ovarian cancer spontaneously. Most animals don't repetitively ovulate – they often achieve a pregnancy, lactate and then become seasonally anestrous, after which they ovulate and become pregnant again. The exception is the domestic hen, which has been bred and selected to be a prolific ovulator.

There are differences among strains of birds, however, that indicate the risk of ovarian cancer is not completely attributable to the number of ovulations. Some strains of chickens have a rate of cancer incidence up to 55 percent by age three or four but the cancer incidence in other strains is not nearly this high. Another important factor for the incidence of ovarian cancer in chickens is age. Hens do not show signs of cancer until after two years of age. By that time, broilers have already been harvested and for many commercial egg-laying chickens, their peak productivity is also over. Some of the chickens used in Johnson's research, however, are seven years of age.

"The risk for ovarian cancer in women is around one percent," Johnson said, "and it's usually detected in later stages because the symptoms are often vague. If it could be detected in its early stages, it would be great because women with early detection of ovarian cancer have a much higher chance of recovery."

Therefore, the idea behind Johnson's research is to use an animal model, in the form of the hen, to detect the early signs of ovarian cancer in hopes of facilitating earlier diagnoses in women.

"We really want to know early changes that predict ovarian cancer," she said. "It would be really great to find an early indicator of ovarian cancer that could be detected in a blood test."

Johnson acknowledges the support of the department and college for their facilitation of her research as well as research support specialist Dr. Jim Giles and graduate students Lindsey Trevino and Mary Ellen Urick. She also acknowledges active collaborations with Penn State University, the Roswell Park Cancer Institute and Cornell's College of Veterinary Medicine Cancer Biology group.

"Agricultural access to the birds is difficult and costly," said Johnson. "The resources we have in the farms at the ag school are very valuable."

Johnson received her bachelor's degree in Zoology at Connecticut College in New London, CT. She later earned her PhD at Cornell University in Physiology where she first started working with poultry. After completing her post-doctorate at the University of Illinois, Johnson accepted a position in the Poultry Science Department at Cornell University in 1987, and subsequently moved to the Department of Animal Science in 1991.