



Students Check Pesticide Metabolism

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Animal Sciences

A research tool that lets scientists examine the workings of individual organs helped in a recent study of cow livers' detoxification of DDE, a pesticide related to DDT.

The machine, an all-glass perfusion chamber, can keep an organ functioning for several hours after it has been removed from an animal. Based on techniques refined for decades, the machine was built at the University of Arizona in the late 1960s. The UA machine has been used primarily to study metabolism of various substances by cows' livers, but it has been applied to study udders and other organs, too.

Recently, graduate students Kassim Mohammed and Jean E. D. Arnold dovetailed a cow feeding study into a liver perfusion study of DDE.

Due to environmental hazards, agricultural use of the pesticide DDT has been banned in the United States since 1973. However, it is still used in many developing countries to fight malaria-carrying mosquitoes and other pests. DDE is the less-toxic but very stable and enduring break-down product of DDT. It is also a component of a mite-control pesticide used in cotton production.

Mohammed, who is from Iraq, fed 12 cows a daily ration containing 0, .25, .5, or 1 part-per-million of DDE for 32 days. He measured DDE levels in milk samples from these cows during the test feeding period and for 32 days after all cows were put back on DDE-free diets.

Photograph: Jean Arnold secures blood-circulation tubing to a perfusion chamber for studying cows' liver metabolism of DDE pesticide. (Photos by Ted Bundy.)

At all feeding levels except in the DDE-free control group, DDE showed up in milk at rates higher than permitted by U.S. Food and Drug Administration standards. However, DDE levels dropped rapidly when cows were taken off the tainted feed.

Results from Mohammed's study can help dairymen determine how much of any feedstuff contaminated with DDE can be used without adulterating their cows' milk.

Arnold then perfused a liver from one cow in each feeding group with a large amount of DDE. She found that those with highest prior exposure to DDE metabolized DDE fastest. The liver is the cow's primary organ for detoxifying harmful substances in the blood.

A team of students and laboratory workers perfused one liver per day for 4 days at the UA Meats Laboratory. Within minutes after each cow was sacrificed, its liver was hooked up to the perfusion machine. Blood from the same animal was treated to prevent clotting, then placed into a reservoir in the machine. The perfusion apparatus circulates blood through the organ, restoring its oxygen supply on each pass-through while keeping the organ and blood at body temperature.

As soon as each liver was connected to the machine, researchers took a sample of blood coming from the outflow vein. Then they added a dose of 20 parts-per-million DDE to the blood in the inflow artery. Samples of the blood from the vein were taken at 15-minute intervals for 2 hours.

Arnold measured DDE in blood sampled before and after the DDE dose, using sensitive gas chromatography. She prepared the test samples by methods developed by Dr. Richard Maiorino, a former graduate student in the UA Pesticide Analysis Laboratory.

The organ perfusion chamber gives the advantage of looking at one organ's functioning independent of the effects of other parts of the body. Also, the cycling of blood many times through the organ magnifies the organ's own effect on substances in the blood, making that effect easier to measure.

These traits suggest the machine's value in continuing studies of nutrition and of effects from the burgeoning number of manufactured chemicals that play important roles in our society and environment.



Top: Kassim Mohammed (left) and Dr. Frank Whiting prepare a cow's liver for perfusion testing.
Lower: Tubes are inserted for circulating blood through the liver.
Bottom left: With the organ in the perfusion chamber, Diana Amado, Jennifer Cashman, Whiting and Arnold make final connections.

