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FACT SHEET #37

Cornell University Program on
Breast Cancer and Environmental Risk Factors
in New York State (BCERF)

Consumer Concerns About Hormones in Food

This fact sheet addresses some of the consumer concerns that have been brought to BCERF regarding health effects of hormones used by the meat and dairy industries. Evidence available so far, though not conclusive, does not link hormone residues in meat or milk with any human health effect.

What are hormones?

Hormones are chemicals that are produced naturally in the bodies of all animals, including humans. They are chemical messages released into the blood by hormone-producing organs that travel to and affect different parts of the body. Hormones may be produced in small amounts, but they control important body functions such as growth, development and reproduction.

Hormones can have different chemistry. They can be steroids or proteins. Steroid hormones are active in the body when eaten. For example, birth control pills are steroid hormones and can be taken orally. In contrast, protein hormones are broken down in the stomach, and lose their ability to act in the body when eaten. Therefore, ordinarily, protein hormones need to be injected into the body to have an effect. For example, insulin is a protein hormone. Diabetic patients need to be injected with insulin for treatment.

Why are hormones used in food production?

Certain hormones can make young animals gain weight faster. They help reduce the waiting time and the amount of feed eaten by an animal before slaughter in meat industries. In dairy cows, hormones can be used to increase milk production. Thus, hormones can increase the profitability of the meat and dairy industries.

Why are consumers concerned about hormones in foods?

While a variety of hormones are produced by our bodies and are essential for normal development of healthy tissues, synthetic steroid hormones used as pharmaceutical drugs, have been found to affect cancer risk. For example, diethylstilbestrol (DES), a synthetic estrogen drug used in the 1960s was withdrawn from use after it was found to increase the risk of vaginal cancer in daughters of treated women. Lifetime exposure to natural steroid hormone estrogen is also associated with an increased risk for breast cancer (see BCERF Fact Sheet #9 *Estrogen and Breast Cancer Risk: What is the Relationship?*). Hence, consumers are concerned about whether they are being exposed to hormones used to treat animals, and whether these hormones affect human health. We try to address this complex issue based on scientific evidence that is currently available.

History of hormone use in food production

As early as the 1930s, it was realized that cows injected with material drawn from bovine (cow) pituitary glands (hormone secreting organ) produced more milk. Later, the bovine growth hormone (bGH) from the pituitary glands was found to be responsible for this effect. However, at that time, technology did not exist to harvest enough of this material for large-scale use in animals. In

the 1980s, it became possible to produce large quantities of pure bGH by using recombinant DNA technology. In 1993, the Food and Drug Administration (FDA) approved the recombinant bovine growth hormone (rbGH), also known as bovine somatotropin (rbST) for use in dairy cattle. Recent estimates by the manufacturer of this hormone indicate that 30% of the cows in the United States (US) may be treated with rbGH.

The female sex hormone estrogen was also shown to affect growth rates in cattle and poultry in the 1930s. Once the chemistry of estrogen was understood, it became possible to make the hormone synthetically in large amounts. Synthetic estrogens started being used to increase the size of cattle and chickens in the early 1950s. DES was one of the first synthetic estrogens made and used commercially in the US to fatten chickens. DES was also used as a drug in human medicine. DES was found to cause cancer and its use in food production was phased out in the late 1970s.

What are the different hormones used now by the meat and dairy industries?

There are six different kinds of steroid hormones that are currently approved by FDA for use in food production in the US: estradiol, progesterone, testosterone, zeranol, trenbolone acetate, and melengestrol acetate. Estradiol and progesterone are natural female sex hormones; testosterone is the natural male sex hormone; zeranol, trenbolone acetate and melengesterol acetate are synthetic growth promoters (hormone-like chemicals that can make animals grow faster). Currently, federal regulations allow these hormones to be used on growing cattle and sheep, but not on poultry (chickens, turkeys, ducks) or hogs (pigs). The above hormones are not as useful in increasing weight gain of poultry or hogs.

As mentioned earlier, FDA allows the use of the protein hormone rbGH to increase milk production in dairy cattle. This protein hormone is not used on beef cattle.

How are the hormones introduced into the animals?

Steroid hormones are usually released into the animal from a pellet (ear implant) that is put under the skin of the ear. The ears of the animals are thrown away at slaughter. Improper use of pellet implants in other parts of the animal can result in higher levels of hormone residues to remain in the edible meat. Federal regulations prohibit their use in this manner. Melengestrol acetate is also available in a form that can be added to animal feed.

Dairy cattle may be injected under the skin with rbGH. This hormone is available in packages of single dose injections to reduce chances of accidental overdose.

Do federal agencies monitor for the presence of these hormones in food?

Estradiol, progesterone and testosterone are sex hormones that are made naturally by animals. No regulatory monitoring of these hormones is possible, since it is not possible to separate or tell the difference between the hormones used for treatment from those made by the animal's own body. However, it is possible to detect residues of zeranol and trembolone acetate in the animal's meat. FDA has set the tolerance levels for these hormones. A tolerance is the maximum amount of a particular residue that may be permitted in or on food (see BCERF Fact Sheet #25 on *Pesticide Residue Monitoring and Food Safety*). The Food Safety Inspection Service (FSIS) of the US Department of Agriculture (USDA) monitors meat from cattle for zeranol residues. FSIS also monitors meats for DES residues from any illegal use (DES use is no longer permitted). In response to concern about cases of early puberty in Puerto Rico described below, a large number of meat samples were tested for hormone residues in the mid- to late 1980s. No zeranol or DES residues were found in the meat samples in this survey.

Do hormones remain in the milk or meat of treated animals?

The levels of naturally produced hormones vary from animal to animal, and a range in these levels is known to be normal. Because it is not possible to differentiate between the hormones produced naturally by the animal and those used to treat the animal, it is difficult to determine exactly how much of the hormone used for treatment remains in the meat or the milk. Studies indicate that if correct treatment and slaughter procedures

are followed, the levels of these hormones may be slightly higher in the treated animal's meat or milk, but are still within the normal range of natural variation known to occur in untreated animals. Scientists are currently trying to develop better methods to measure steroid hormone residues left in edible meat from a treated animal.

Can steroid hormones in meat affect the age of puberty for girls?

Early puberty in girls has been found to be associated with a higher risk for breast cancer. Height, weight, diet, exercise, and family history have all been found to influence age of puberty (see BCERF Fact Sheet #8, *Childhood Life Events and the Risk of Breast Cancer*). Steroid hormones in food were suspected to cause early puberty in girls in some reports. However, exposure to higher than natural levels of steroid hormones through hormone-treated meat or poultry has never been documented. Large epidemiological studies have not been done to see whether or not early puberty in developing girls is associated with having eaten growth hormone-treated foods.

A concern about an increase in cases of girls reaching puberty or menarche early (at age eight or younger) in Puerto Rico, led to an investigation in the early 1980s by the Centers for Disease Control (CDC). Samples of meat and chicken from Puerto Rico were tested for steroid hormone residues. One laboratory found a chicken sample from a local market to have higher than normal level of estrogen. Also, residues of zeranol were reported in the blood of some of the girls who had reached puberty early. However, these results could not be verified by other laboratories. Following CDC's investigation, USDA tested 150 to 200 beef, poultry and milk samples from Puerto Rico in 1985, and found no residues of DES, zeranol or estrogen in these samples.

In another study in Italy, steroid hormone residues in beef and poultry in school meals were suspected as the cause of breast enlargement in very young girls and boys. However, the suspect beef and poultry samples were not available to test for the presence of hormones. Without proof that exposure to higher levels of steroid hormones occurred through food, it is not possible to conclude whether or not eating hormone-treated meat or poultry caused the breast enlargement in these cases.

Can eating meat from hormone-treated animals affect breast cancer risk?

Evidence does not exist to answer this question. The amount of steroid hormone that is eaten through meat of a treated animal is negligible compared to what the human body produces each day. The breast cancer risk of women who eat meat from hormone-treated animals has not been compared with the risk of women who eat meat from untreated animals.

Can drinking milk, or eating dairy products from hormone-treated animals affect breast cancer risk?

Once again, evidence does not exist to answer this question. Use of rbGH for dairy cattle has been in practice in US for only six to seven years. Breast cancer can take many years to develop. It is too early to study the breast cancer risk of women who drink milk and eat milk products from hormone-treated animals.

Can hormones that remain in milk affect human health?

Scientists at FDA's Center for Veterinary Medicine have reviewed the studies submitted by the manufacturers of rbGH. FDA scientists have concluded that eating foods with slightly higher levels of rbGH would not affect human health. This is because the amount of rbGH that is in milk or milk products as a result of treatment of the animals is insignificant compared to the amount of growth hormone that is naturally produced by our bodies. Also, rbGH is a protein hormone and is digested into smaller fragments (peptides and amino acids) when eaten. The rbGH hormone used on dairy cattle is effective in promoting growth in cows, but does not work in humans. Scientists know that rbGH is not recognized as a hormone by human cells.

There are gaps in our knowledge about whether rbGH used to treat dairy cattle can cause indirect effects. These gaps lead to uncertainties and debates, some of which are addressed below.

What do we know about growth factors in milk of treated animals?

The wholesomeness of milk is not affected by rbGH treatment. However, some subtle changes do take place in the treated animal. The growth hormone typically acts by triggering the cells to make other chemicals, called growth factors. These growth factors actually cause the increase in growth rate and milk production. Milk from rbGH-treated cattle has been found to have slightly higher levels of the naturally produced protein called insulin-dependent growth factor-1 (IGF-1). IGF-1 is a protein, and is digested into smaller pieces in the stomach.

Scientists at FDA have considered the evidence from studies of cancer risk in people who have naturally high body levels of IGF-1. Higher levels of IGF-1 in blood have been found in women with breast cancer compared to women without breast cancer in the Harvard-based Nurses' Health Study. Scientists are investigating if IGF-1 is just present at higher levels in breast cancer patients or if it has a role in increasing the risk for the disease. In laboratory studies, breast cancer cells growing on a plastic dish, grow at a faster rate when bathed in a solution containing IGF-1. However, IGF-1 also plays an important role in helping normal cells grow. Hence, from these few studies, we cannot conclude whether or not IGF-1 increases breast cancer risk.

FDA scientists have concluded that IGF-1 in milk is unlikely to present any human food safety concern for the following reasons: 1) IGF-1 levels in cow's milk from untreated animals vary in nature, depending on the number of calves and the lactation stage; 2) IGF-1 is also present in human breast milk, at levels higher than in hormone-treated cow's milk; 3) IGF-1 in milk is not expected to act as a growth factor in people who drink it because it gets digested in the stomach; 4) IGF-1 needs to be injected into the blood to have a growth-promoting effect; and 5) increased IGF-1 levels in food are not expected to result in higher blood levels of IGF-1 in humans who eat the food.

Concern about milk-related allergies

A detailed discussion of this topic is beyond the scope of this fact sheet. A brief outline of the issue is presented here, along with references for more information.

Digested or broken down fragments of proteins absorbed through the stomach can cause the immune system to produce antibodies, which sometimes can lead to milk-related allergies. There have been studies done to investigate whether the immune system can react to fragments of rbGH and IGF-1 absorbed through the stomach. Reviewers of these studies at Health Canada (the Canadian counterpart to FDA) expressed a concern that in one study, some of the laboratory rats that were fed high levels of rbGH for 90 days developed antibodies against it (http://www.hc-sc.gc.ca/english/archives/rbst). Scientists at FDA evaluated these studies in rats and concluded that only animals that were fed a very large amount of rbGH in food produced antibodies against it. Such large amounts of rbGH are not expected to occur in the milk that humans drink ("Report on the Food and Drug Administration's Review of the Safety of Bovine Somatotropin" available at: http://www.fda.gov/cvm; a copy of this report can be requested by calling: 310-574-1755).

Studies have also looked at whether IGF-1 fed to laboratory rats and digested in the stomach can affect the immune system. No immune effects were observed in these studies, but the animals were fed IGF-1 for only two weeks. No studies have been done on the effects of feeding rats or other experimental animals with IGF-1 over longer periods of time.

Are hormone-treated animals healthy?

There is a concern that because of increased milking, hormone-treated cows may become more prone to infection of the udders, called mastitis. This could lead to more antibiotics being used to treat the cows, in turn leading to more residues of antibiotics to remain in the milk. Frequent exposure to antibiotic residues through milk or dairy products is a health concern for people over the long term. In the normal body, there are bacteria that live in the gut and mouth and help in the digestion of food in the gut. These "friendly" bacteria do not normally cause disease since the immune system keeps them in check. However, if the immune system is weak, these "friendly" bacteria can invade tissues and cause infection. Bacteria in the normal body that come across small amounts of antibiotics frequently, can develop ways to survive the antibiotics and become "antibiotic resistant." In cases of infection and illness, it then

becomes more difficult to control such resistant bacteria with the available antibiotics.

Some increase in incidence of antibiotic residues was observed in cow's milk following the use of rbGH. At the same time as rbGH started being used, some of the major dairy states in US switched over to a new and improved method to test for antibiotic residues. It is difficult to determine whether the increase in incidence of antibiotic residues in milk was due to increased use, or better testing methods. New York State (NYS) was one of the states that had not changed its method to test for antibiotic residues in milk at that time. The incidence of antibiotic residues in milk from NYS was not found to be higher after the approval of rbGH use. This suggests that the increased incidence of antibiotic residues observed in some states may have been due to better testing methods rather than an increase in use of antibiotics for treatment of mastitis. An Expert Committee at FDA's Center for Veterinary Medicine has concluded that while rbGH use may cause a slight increase in mastitis, dairy management practices that are currently in use should prevent any increase in antibiotic residues in milk.

Are growth hormones used elsewhere in the world?

The debate on whether growth hormones should or should not be used for food production has become a very political issue. In 1989, the European Community (now European Union) issued a ban on all meat from animals treated with steroid growth hormones, which is still in effect. The use of steroid hormones for beef cattle is permitted in Canada.

Countries within the European Union do not allow the use of the protein hormone rbGH, for dairy cattle. In 1999, the Canadian government refused approval for the sale of rbGH for dairy cattle, based on concerns about the health effects including mastitis in treated animals.

Conclusions

Studies done so far do not provide evidence to state that hormone residues in meat or dairy products cause any human health effects. However, a conclusion on lack of human health effect can only be made after large-scale studies compare the health of people who eat meat or dairy products from hormone-treated animals, to people who eat a similar diet, but from untreated animals.

Where is more research needed?

Some of the consumer concerns in this fact sheet cannot be answered conclusively without further studies:

- Exposure to hormones in meat was suspected as the cause for early puberty in girls in Puerto Rico and Italy, but was never verified. To conclusively answer the question, large-scale epidemiological studies would be needed to compare the age of puberty in girls who eat meat from hormone-treated animals to those who eat meat from untreated animals. Such studies would need to make sure that other known influences that affect the age of puberty in girls are not playing a role.

- Short-term studies in laboratory rats have not indicated a concern about milk-related allergies or immune effects from exposure to rbGH or IGF-1 in milk or dairy products. However, short-term studies cannot be used to rule out all possibilities of any immune, or unexpected health effects after long-term exposure. Studies in laboratory animals on effects of life-long exposure to milk from rbGH-treated cows may help answer this question.

Some healthy diet tips that also help reduce exposure to hormones used in food production

While currently available evidence does not indicate a link between eating meat, milk or dairy products from hormone-treated animals and any health effects, adopting some known healthy diet habits (see below) can help reduce exposure to hormones used in meat, poultry and dairy production.

- Eat a varied diet, rich in fruits, grains and vegetables.
- Eat meats in moderation, well cooked, but not charred.
- Eat more lean muscle meat, less liver and fat.

Note: Other BCERF Fact Sheets discussthe research on the relationship between eating dairy products, meat, poultry and fish, and the risk of breast cancer: (See BCERF Fact Sheet # 33 *Dairy Foods and the Risk of Breast Cancer* and BCERF Fact Sheet #39 *Meat, Poultry and Fish and the Risk of Breast Cancer.*

An extensive bibliography on *Consumer Concerns About Hormones in Food* is available on the BCERF web site: http://www.cfe.cornell.edu/bcerf/

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