Information Sheet
Phytoestrogens

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What is a "phytoestrogen?"

Phytoestrogens are estrogenic compounds found in plants (*phyto* = plants) that have a similar chemical structure to mammalian estrogen (17 *β*–estradiol). Because of this similarity, once ingested from the diet, phytoestrogens can enter circulation and bind to estrogen receptors in the body, mimicking (or blocking) the effects of the body's naturally-occurring 17 *β*–estradiol. Estrogen occurs naturally in both males and females and plays a role in sexual development, reproduction, and behavior.

Where are phytoestrogens found?

Estrogenic compounds are found in nearly all plant and animal tissues. The phytoestrogens in animal feedstuffs are mainly lignans and flavonoids (isoflavones, coumestans, and phenyl flavonoids) which are found in cereal grains, legumes (beans), and oilseeds. The content of phytoestrogens varies among plant species. For example, the content of phytoestrogens is high in legumes such as clover, alfalfa, and soybeans, but is higher in red clover than in white clover[1]. From a human nutrition stand-point, phytoestrogens are found in many cereal grains, beans, peas, fruits, and vegetables. Table 1 (on the back of this sheet) shows the estrogen content of some common foods / feeds. Interestingly, recent studies analyzing commercial milk products revealed that organic milk had a higher content of phytoestrogens (in the form of isolfavonoids) than did conventionally-produced milk[2,3,4]. This difference can most likely be attributed to feeding a diet higher in legumes than concentrates on organic dairy farms.

What is the concern with phytoestrogens?

There is some public concern that because animals consume plants containing phytoestrogens that animal products (meat, milk, and eggs) consumed by humans may have negative health effects. Children and the fetus in utero are considered at greater risk than adults from exposure to excess hormone levels simply because their normal hormonal physiological state is lower than adults[5]. However, research has shown more positive effects than negative effects when estrogens from plant-origins are consumed in the human diet. For example, a diet high in phytoestrogens (think soy protein-based diets) may play a protective role against cardiovascular disease and both breast and prostate cancer because phytoestrogens compete with 17 *β*–estradiol (which has been implicated with these types of cancers)[6]. For this reason, it is largely considered that phytoestrogens have mostly an "anti-estrogenic" action in humans[4].

From an animal nutrition standpoint, the biggest concern about phytoestrogens is infertility in grazing animals (particularly ruminants) maintained on pastures rich in legumes, namely red clover. It has been reported that unlike in humans, where phytoestrogens seem to have an "anti-estrogenic" effect, phytoestrogens seem to more closely mimic the action of 17 *β*–estradiol in sheep and cattle[4]. Whereas males are relatively unaffected, female ruminants may become temporarily infertile. In cattle, reproductive problems such as cystic ovaries, irregular estrus, or anestrus can result in failure to conceive when the diet is high in estrogenic feeds. Sheep seem to be the most sensitive to phytoestogren levels and can suffer from a syndrome referred to as "clover disease," which is characterized by infertility, low lambing rates, uteran prolapse and dystocia in ewes. It has been reported that prolonged exposure to estrogenic pasture can cause ewes to become permanently infertile.[7]

Red clover (whether fed as pasture, silage, or hay) seems to be most estrogenic in the spring and then the estrogenicity declines after flowering. Unfortunately, phytoestrogens can have a deleterious effect on the reproductive health of ruminants without causing any visible clinical signs. Therefore, the most effective way to detect if phytoestrogens are the cause of infertility in a beef cow herd or a sheep flock is by measuring the estrogen concentration in the forage. Typically, the infertility is temporary and can be resolved within 1 month after removal from the estrogenic feed/pasture.[7]

References

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[4]Hoikkala, A., E. Mustonen, I. Saastamolnen, T. Jokela, J. Taponen, H. Saloniemi, and K. Wahala. 2007. High levels of equol in organic skimmed Finnish cow milk. Mol. Nutr. Food Res. 51:782-786.

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[6]Murkies, A. L., G. Wilcox, and S. R. Davis. 1998. Phytoestrogens. J. Clinical Endocrinology and Metabolism. 83:297-303.

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Table 1. Daily endogenous hormone production (reported in nanograms) in relation to amounts in a birth control pill and certain other foods.

Source	Estrogen (ng)
Pre-pubertal girl, daily	54,000
Pre-pubertal boy, daily	41,500
Adolescent girl	93,000
Pregnant woman, daily	480,000
Non-pregnant woman, daily	3,415,000
Normal adult man, daily	136,000
Birth control pill (Ortho-Cyclen®)	35,000
3 oz. of soybean oil	1,680,000
3 oz. of wheat germ	3,400
3 oz. of eggs	2,625
3 oz. of cabbage	2,016
3 oz. of ice cream	520
3 oz. of peas	340
3 oz. of potatoes	225
3 oz. of milk	11
3 oz. of steak from implanted beef animal	1.9
3 oz. of steak from non-implanted beef animal	1.3

Chart References: Adapted from S. L. Archibeque (2010, Colorado State University); Hoffman and Evers (1986); FSIS-USDA (1994); ORTHO-McNeil Pharmaceutical, Inc. (1998)

What about possible estrogen residues from hormonal growth implants used in beef production?

Part of public concern involving estrogens in the diet may be in discerning (or the confusion) between phytoestrogens, that naturally occur in plants, and estrogenic residues that may exist due to the use of steroid-based growth promotants in the production of some beef products. The estrogens used in steroid hormone implants are different from the phytoestrogens that occur naturally in plants. The FDA first approved steroid growth hormones in 1956 for increasing growth, feed efficiency, and carcass leanness in cattle. Currently, there are five hormones (progesterone, testosterone, 17 β–estradiol, zeranol, and trenbolone acetate) that have been approved for implants in cattle. While there may be justifiable concern over the long-term consumption of beef products that may contain elevated estrogen residues, the concentration of estrogens present in beef is negligible compared to the estrogens consuming plant-based foods as shown in the table above.[5]