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Hormones and Milk

The subject of hormones and cow's milk may elicit concern among consumers and raise questions about the safety and healthfulness of milk. All cow's milk, conventional and organic, naturally contains miniscule amounts of hormones. While some dairy farmers treat their cows with a synthetic hormone to increase milk production, this hormone is not added to milk, and the safety of milk from cows treated with this hormone has been verified by government health officials and supported by health professional organizations. This report reviews scientific findings confirming milk's safety for human health and dispels misperceptions related to hormones and milk.

Scientific Status Report

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Introduction

Cow's milk naturally contains a number of steroid and protein (peptide) hormones in minute amounts.[1,2,3,4,5,6,7] Steroid hormones include the glucocorticoids (cortisol and corticosterone) and the sex hormones – progesterone, 17 ß-estradiol (E2), estrone (E1), and estradiol (E3).[1,2,6,7] Protein hormones in milk include prolactin, gonadotropin-releasing hormone, insulin-like growth factor-I (IGF-I) and bovine somatotropin.[1,2,8] Despite some consumer concern about the safety and potential health effects of hormones in cow's milk, scientific findings fail to support this concern.[6,7,8]

Estrogens

Not only is the concentration of hormones in cow's milk very low, but it also is difficult to compare levels of specific hormones such as estrogen reported in various studies because of differences in units used to express hormones, forms of the hormones measured, and assays for different breeds with different physiological status, feeding regimens, etc.[3] The estrogen levels in cow's milk vary according to the level of fat and the physiological status of the cow.[3,6]

Although the concentration of estrogens in cow's milk varies, it is extremely low relative to the endogenous production of estrogens in humans and, therefore, is of little physiological significance or unlikely to pose a health risk.[3,4,6] Researchers state that "premenopausal women produce at least 35,000 times as much E1 and 163,000 times as much E2 daily as would be consumed in 1 serving of 2% milk".[6] Orally ingested estrogens are metabolized in the body and therefore are of low bioavailability, which supports their lack of a significant effect on human physiology.[9]

An analysis of estrogen levels in commercial milk products found that mean levels of estradiol (E2) in one cup (8 fluid ounces) of cow's ranges from 0.1 (skim milk) to 0.3 (whole milk) nanograms (ng) (a nanogram is a billionth of a gram); levels of estrone (E1, which is less biologically potent than E2) ranged from 0.7 (skim milk) to 1.9 (whole milk) ng/serving.[6] Because estrogens are fat-soluble, it is not surprising that the concentrations of E1 and E2 are higher in whole milk than in lower fat or fat-free milks.[3,5,6]

The concentration of estrogens is lower in milk from non-pregnant than pregnant cows and highest from cows in the third trimester of gestation.[3,5] However, milk from pregnant cows does not substantially increase the concentration of estrogen in the bulk tank of milk from an entire herd. The average cow is not pregnant until 150 days after calving and then it takes another 100 days for a detectable estrogen in milk. Thus, the concentration of estrogen in milk is low/normal for 250 out of 370 (67%) days of lactation. Further, 10 to 15% of cows never get pregnant but stay in the herd, and producers may choose to not breed an additional 5% of cows.[3]

Processing (pasteurization-homogenization) of milk has little effect on its concentration of estrogens.[3,6] Also, there are no substantial differences in estrogen levels between conventional and organic milks.[6] Conventional dairy farmers may supplement their cows with reproductive hormones including estrogen and progesterone to support reproductive management, but the level of estrogen and other sex hormones in the milk is not affected by this practice.[9] A study of milk sampled from individual cows and from retail milk found that three servings of whole milk naturally contained tenfold to hundredfold **less** estrogens (estrone and estrone sulfate) than the U.S. Food and Drug Administration (FDA) guidelines for safe consumption (i.e.,1% or less than the lowest amount produced by the human body each day).[7] Three servings of whole milk contained only 0.01 to 0.1% of the similar hormones produced in

humans.[7] Compared to the Food and Agricultural Organization/World Health Organization's upper acceptable daily intake of exogenous E2, daily intake of dairy products is estimated to supply only about 0.25%.[10] Despite the suggestion that estrogens present in cow's milk may contribute to cancer in estrogen-responsive organs, a review of epidemiological evidence fails to support an association between intake of dairy foods and risk of cancers of the breast, ovaries, and endometrium.[11] A recent review in Pediatrics states that milk from estrogen-treated cows appears to be safe for children, although it calls for further research to study the impact on children of exposure through milk and meat to estrogen and other sex hormones. [10]

Recombinant Bovine Somatotropin (rbST)

In 1993, the FDA approved the use of the synthetic hormone, recombinant bovine somatrotropin (rbST), in lactating cows to increase milk yield, achieve improvements in the milk-to-feed ratio, and to decrease waste.[12,13] The decision to use rbST is left to each individual farmer. Somatotropin is a naturally occurring protein hormone that regulates growth and lactation and is produced by the pituitary gland in both man and animals.[14,15,16,17,18,19]

Before its approval, several questions regarding the safety of rbST, in particular its effects on human health and nutritionally status, were critically examined.[19] These related to the presence of rbST residues in milk and the effect of rbST on milk's nutrient composition. Bovine somatotropin (bST) is naturally present in trace amounts in milk (i.e., 1 to 10 ng per ml) from untreated cows.[14,15,16,17,18,19] Independent studies of rbST carried out by the FDA, state agricultural departments, some pharmaceutical companies, and scientists found that milk from cows supplemented with rbST contained no more bST than other milks.[14,15,16,17,18,19]

Administering rbST to cows does not significantly change milk's composition or nutritional quality.[8,15,16,19] Any minor differences in milk composition reported between rbST-supplemented and unsupplemented cows are within the normal biological ranges.[15,16]

According to scientific experts, the consumption of rbST in milk does not have any physiological effect on humans.[8,14,15,16,17,18,19,20] First of all, rbST is species-specific, which means that bST is not biologically active in humans, even if injected.[8,15,16,19] bST is a protein which is broken down to amino acids and peptides in the gastrointestinal tract, and hence, are components which have no hormonal activity (see discussion in Vicini J et al. 2008). Also, pasteurization destroys 90% of bST in milk.[8,15,17] Furthermore, any trace amounts of bST ingested in milk are broken down into inactive fragments (i.e., constituent amino acids) by enzymes in the gastrointestinal tract, just like any other protein.[8,15,16,17]

Although insulin-like growth factor I (IGF-I), a protein hormone controlled by bST, is slightly elevated in the milk of rbST-treated cows, data indicate that IGF-I levels in milk from rbST-treated cows are within the normal range and are lower than levels found naturally in human blood and other tissues.[15,16,17] Moreover, in animal studies, this protein hormone is safe, even in high doses.[15,19] IGF-I comprises one-tenth of one millionth of total milk proteins.[21] Like all other dietary proteins, IGF-I is broken down by enzymes in the digestive tract prior to absorption. Studies providing physiological to pharmacological amounts of dietary IGF-I have demonstrated that negligible amounts are absorbed as intact proteins.[21] Studies conducted in premature infants and young adults provide evidence that IGF-1 consumed as a component of foods or given as an oral supplement is not absorbed in humans – and therefore has no biological activity. [22,23] However, dietary protein's beneficial effect on bone is attributed in part to its ability to increase blood levels of IGF-I, which supports bone formation.[24]

Critics of rbST purport that rbST increases a cow's risk of mastitis (udder inflammation), thereby exposing milk drinkers to additional animal antibiotics used in treatment. However, an FDA advisory committee concluded that other factors (e.g., season, age of the cow) are more likely than rbST to be associated with mastitis.[25] Importantly, FDA has established safeguards to prevent unsafe levels of antibiotic residues from entering the milk supply.[26]

The safety of dairy foods from rbST-treated cows for human health is supported by the FDA,[27]scientists from Washington University School of Medicine in St. Louis and Cornell University in Ithaca, NY in their review of the evidence,[16] a National Institutes of Health Technology Assessment Panel,[17] the Office of Technology Assessment,[18] and a joint FAO/WHO Expert Committee on Food Additives.[28] A Cornell University study indicates that the use of rbST not only increases milk production efficiency, but also may have some environmental advantages (e.g., reduced feedstuff and water use, cropland area, nitrogen and phosphorus excretion, greenhouse gas emissions, and fossil fuel use.[29]

FDA does not require special labeling for milk from rbST-treated cows. All milk contains minute amounts of bST regardless of whether from untreated cows or cows treated with rbST. Food companies that do not use milk from cows supplemented with rbST can voluntarily label their products with this information as long as it is truthful and not misleading and complies with FDA guidance. For example the following label statement can be used "From cows not treated with rbST.No significant difference has been shown between milk derived from rbST-treated and non-rbST treated cows. [30] By law, USDA-certified organic milk cannot come from cows treated with hormones.[31]

Cow's Milk and Early Puberty

There is no conclusive scientific evidence to support the suggestion that consumption of milk, whether from cows treated with rbST or naturally containing bST and other hormones, causes early puberty.[32]All milk, including human milk, naturally contains minute amounts of hormones, which are broken down by digestion rendering them biologically inactive in humans.[6] Although some epidemiological studies suggest a decrease in the age of onset of puberty in girls and boys over several decades,[33,34,35] this trend remains controversial in part due to different measures used to characterize the timing of puberty.[36] Also, the potential causes and long-term effects of early puberty remain unclear.[36]

Several observational studies link higher body mass index or increased body fatness with earlier initiation or progression of pubertal development.[33,34,36,37,38,39] A review of epidemiological studies found that overweight girls tend to reach puberty earlier than their peers who are not overweight.[36] Adverse health and psychological effects associated with early puberty (e.g., risk for metabolic syndrome, diabetes, and reproductive cancers) appear to be linked to overweight/obesity.[36]

Multiple theories – socioeconomic conditions, psychological factors (e.g., stress), nutritional status, dietary quality, single nutrients, chronic diseases, birth weight, and early postnatal growth – have been examined for their effect on puberty timing. [36,40,41,42,43,44] A recent study in China, which followed the same group of children for about 13 years, showed that neither breastfeeding nor cow's milk consumption early in life were associated with age of onset of puberty.[44] The researchers concluded that "any observed associations of breastfeeding or childhood milk consumption with puberty need to be interpreted with caution".[44] Current studies examining various factors with the timing of puberty indicate associations, not true cause and effect relationships.The causes and public health implications of early puberty need further exploration.

An observation arguing against the milk-early puberty theory is that children's milk consumption has decreased (not increased) in recent decades,[45] a time coinciding with the earlier age of onset of puberty reported in some studies. Consuming two to three servings, depending on age, of low-fat or fat-free milk or equivalent milk products every day is important for children and adolescents who are building peak bone mass.[46]

Conclusion

All cow's milk, conventional and organic, naturally contains minute amounts of hormones.[6,7,8] Research indicates that because these hormones are metabolized in the body, they are of low bioavailability and have little physiological effect in humans.[6,8] Scientific evidence fails to demonstrate that the presence of hormones in cow's milk is a health concern.[6,7,8]

Levels of estrogen, a steroid hormone, in cow's milk not only are extremely low and well below the FDA's guidelines for safe consumption, but also are many times lower than the endogenous production of estrogens in humans.[3,6,7] Bovine somatotropin (bST), a protein hormone, is present in miniscule amounts in all milk.[8] Some dairy farmers may use the FDA-approved synthetic hormone recombinant bovine somatotropin (rbST) in lactating cows to increase milk yield. This synthetic hormone is not added to milk and the composition of milk from rbST treated and untreated cows is the same.[8] Based on a review of the scientific evidence, the FDA concludes that milk from cows treated with rbST is safe for human consumption.[27] In addition, scientific experts have independently supported this conclusion.[10,16,17,18,20,28]

There is no conclusive scientific evidence to support the suggestion that the minute amounts of hormones in cow's milk cause early puberty. While some observational studies indicate a trend of decreasing age of puberty over the past several decades, this trend and its consequences remain controversial.[36] Several factors, notably overweight/body fatness, are linked to an earlier age of puberty. The causes and health implications of early puberty need further investigation. Cow's milk and milk products are recognized as safe, nutritious foods important for children's and adults' health.[46]

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