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Organic Milk Versus Conventional Milk As Functional Milk

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ABSTRACT

Chronic diseases progress slowly and generally cause symptoms in middle age onward. It is widely known that there is a close link between diets and chronic diseases in human. Foods which have specific target functions and preventive impacts on human health as well as their basic nutritional effects are defined as functional foods. These foods may decrease risk for chronic diseases due to having health preventive impacts on human health. Milk is an useful baverage for during childhood and adolescence because of its macro and micro nutrients. Milk composition is affected by mainly genetic, nutrition, season, lactation stage etc. Therefore, there are some differences in milk components between organic and conventional milk because of especially heredities of herds and nutrition. Seasonal variations in pasture, amount of grains and forages (fresh or conserved) cause changes in milk fatty acid composition of organic and conventional milk. Furthermore, organic production regulations limit the use of starch-based concentrates and supplements; therefore, some nutrients' concentrations (protein, thiamine, vitamin B_1 and B_2, I etc) in organic milk may be expected to be lower than those of conventional milk. In this paper, organic and conventional milk components have been reviewed in term of functional milk.

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Fonksiyonel Süt Olarak Organik Süt- Konvansiyonel Süt

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ÖZET

İnsanlarda görülen kronik hastalıklar ile beslenme arasında yakın bir ilişkinin olduğu bilinmektedir. Besleyici etkileri yanısıra spesifik hedef fonksiyonlara sahip ve insan sağlığı üzerine koruyucu etkileri olan fonksiyonel gıdalar insanlardaki kronik hastalık riskini azaltabilir. Süt, çocukluk ve ergenlik döneminde, içerdiği makro ve mikro besin maddeleri nedeniyle yararlı bir içecektir. Süt bileşimi ağırlıklı olarak genetik, beslenme, mevsim, laktasyon dönemi vb. durumlardan etkilenir. Bu nedenle, özellikle sürülerin kalıtımsal yapısı ve beslenmesine bağlı olarak organik ve konvansiyonel süt arasında süt bileşenleri yönünden bazı farklılıklar vardır. Otlaklardaki mevsime bağlı değişiklikler, tahıl miktarı ve kaba yemler (taze veya konserve) organik ve konvansiyonel sütün süt yağ asidi bileşiminde değişikliklere neden olur. Ayrıca organik üretim, nişasta temelli konsantreleri ve katkıları sınırlar. Bu nedenle, organik sütteki bazı besin maddelerinin (protein, tiamin, B_1 ve B_2 vitaminleri, I vb.) konsantrasyonlarının konvansiyonel sütte bulunanlara göre daha düşük olması beklenebilir. Bu makalede organik ve konvansiyonel süt bileşenleri fonksiyonel süt yönünden değerlendirilmiştir.

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Introduction

Chronic diseases such as cardiovascular diseases, osteoporosis, diabetes and dementia which progress slowly are non-infectious and many of them cause symptoms in middle age onward. Foods which have specific target functions and provide a health benefit as well as their basic nutritional effects are called as functional foods.

Milk is a heterogeneous mixture of lacteal secretion consisted of well balanced nutrients. Milk is consisted of fat, protein, lactose, ash, and their quantities are depending on animal species. However within the same species, the milk composition may show a difference because of genetic, lactation stage, milking schedule, season, nutrition etc.

Milk has some beneficial effects on human health and supplies some biologically active components for human. Bioactive compounds of milk show important physiological and biochemical activities which are crucial for human health (Park, 2009). Fresh milk includes antimicrobial agents having bacteriostatic or bactericidal activities. Mammalian milk includes varied enzymes (Fox, 2003) such as digestion enzymes (amylase, proteinase, phoshatase etc), antioxidant and antimicrobial enzymes (lysozyme, catalase, superoxide dismutase, lactoperoxidase etc) which protect mammals againsts pathogens and maintain milk stability. Pouliot and Gauthier (2006) state that milk contains some biologically active compounds such as enzymes, antimicrobial peptides, growth factors, immunoglobulins, oligosaccharides. Walther and Sieber (2011) mention that caseins, beta-lactoglobulin and alfa-lactoalbumin which are digested into bioactive peptides which have antihypertensive, immunomodulating, mineral-binding, antioxidative and antimicrobial activities. In this paper, organic and conventional milk components have been reviewed in term of functional milk.

Milk Fat and Fatty Acids

Cow milk fat contains 5% polyunsaturated fatty acids, 70% saturated fatty acids and 25% monounsaturated fatty acids (Tyagi et al., 2012). Conjugated linoleic acid (CLA) is one or more positional and geometric isomers of linoleic acid with conjugated double bonds. Milk and dairy products are rich in CLA (over 20 isomers of CLA) and cis-9, trans-11 is predominant. This fatty acid has some beneficial effects (anticarcinogen, protective effect against arteriosclerosis) on human health (MacDonald, 2000). It has been reported that it reduces LDH cholesterol and the risk for heart disease (Beppu et al., 2006; Choi et al., 2007; Smit et al., 2010)

Milk fat synthesis and composition are affected by nutrition of ruminants (Chilliard et al., 2007). Fat content of milk may be changed by the diet which particularly affects rumen fermentation. Milk fat synthesis in ruminants is mainly related to the acetate/propionate concentration ratio in the rumen (Ergün et al., 2014). Although the diets contain at least 60% forages in organic dairy farms, higher amount of starch-based concentrates are excessively used in conventional dairy farms compared with organic dairy farms. Therefore, an increased level of concentrate may cause a decline in milk fat concentration. Forages contain higher amounts of α-linolenic acid (ALA) than cereals which are rich in linoleic acid (LA) (Khiaosa-Ard et al., 2010). Green pastures are good source for ALA and can shift the milk fatty acid composition (Gomez-Cortes et al., 2009). Couvreur et al. (2006) mention that increasing in the amounts of dietary pasture causes linear increases in C18:3 n-3, vaccenic acid (VA) and CLA but decreases in C10:0-C16:0. Shingfield et al. (2007) state that the beneficial effects of pastures on milk fatty acid composition (ALA, VA, CLA) are associated with the high content of ALA partly biohydrogenated into VA in the rumen, absorbed in the gut and secreted into milk. Both milk ALA and CLA contents may be improved by increasing pasture intake (de Renobales et al., 2012).

Legume-based pastures have higher CLA, ALA and lower saturated fatty acid than those of ryegrass pastures. The CLA and ALA contents of milk fat have been increased by crown daisy (*Chrysanthemum coronarium* L.) and sulla (*Hedysarum coronarium* L.) consumptions, respectively (Addis et al., 2005). However, botanical structure of pasture or plants, phenological stages of plants and plant species cause differences in the fatty acid composition of milk. Dewhurst et al. (2006) report that polyunsaturated fatty acid (PUFA) and CLA contents of milk fat are highest in spring and autumn. Seasonal variations in pasture causes changes in milk fatty acid composition. Adler et al. (2013) states that pasture on long-term organic farms has a lower proportion of legumes compared with short-term organic farms. Differences between two organic systems for fatty acids (C9 to C12:0) of milk are explained by the variations in pasture composition. Soyeurt et al. (2007) report 20% of the variability shown in milk fatty acid composition because of genetics. In most conventional dairy farms, Holstein is the main breed for milk production whereas Holsteins are not preferred by organic dairy farms. Therefore, general statements are less appropriate (Honorato et al., 2014).

Milk Protein

Although protein content of cow milk is unresponsive to dietary variations and management (Walker et al., 2004), genetic, lactation stage, breed significantly affect on milk protein concentration (Maurice-Van Eijndhoven et al., 2011), some researchers (Bilik and Lopuszanska-Rusek, 2010; Kuczynka et al., 2012) state increased amounts of protein in conventional milk. There is a tendency for conventional milk to include a higher level of protein (Müller and Sauerwein, 2010).

There is a positive correlation between milk protein concentration and metabolisable energy and, even less protein intake. Cabrita et al. (2007) state that milk production and protein content are affected by dietary crude protein and starch levels. The rate of protein synthesis in the mammary gland may be increased by dietary supplementation of starch-based concentrates (Rius et al., 2010). Regulations for organic dairy farms limit the use of starch-based concentrates thus lower protein levels may be expected in organic milk.

Lactose

Lactose is the major carbohydrate of milk. Lactose is fermented to lactic acid which decreases pH value, affects the physical features of casein and stimulates digestibility, bars the growth of potential harmful bacteria. Lactulose is an another disaccharide arising during heat process and ensures to stimulate the growth and activities of probiotic bacteria such as bifidobacteria and lactobacili. It is stated that starch and crude protein levels of diets may affect lactose concentration in milk (Rius et al., 2010). However, Jenkins and McGuire (2006) report that nutrition of cows unusually do not cause change in lactose concentration except for extraordinary circumstances. It is mentioned that there is no significant difference in lactose contents between organic and conventionally produced milk (Nauta et al., 2006; Bilik and Lopuszanska-Rusek, 2010).

Minerals

Milk is rich in calcium which is mainly reponsible for bone health. Another promising hypothesis about calcium is that it may plays role in reducing the risk for colorectal cancer (Glade, 1999; Sesink et al., 2001), osteoclasis during menopause etc. Milk Ca, Mg an P concentrations are higher in breeds which have higher casein and phospholipid concentrations (Hermansen et al. 1994). Cubon et al. (2008) state higher Ca concentrations in bulk organic milk. I and Se concentrations in milk mainly depend on diets. Dietary I is easily introduced into milk. Cows grazing pasture have lower I concentration than cows also consuming concentrate (Gabryszuk et al. 2008). Haugh et al. (2007) report that milk I concentrations are influenced by season and changes in diet depending on the season. Selenium supplementation of cow diets increases milk selenoproteins which can inhibits colon tumorigenesis in rats (Parodi, 2007). Pilarczyk et al. (2011) state that cow, which consume a diet based on hay, cereals, and pasture in the regions having low soil Se value, have lower Se concentrations in milk than cows consuming total mix ration. Some researcher (Johner et al., 2012; Rey-Crespo et al., 2013) reports that I concentration in organic milk is dramatically lower that of conventional milk during summer when pasture feeding increases. Selenium concentration in milk obtained from organic herd that consuming a diet high in hay and maize silage is signifğicantly higher than that of conventional cows which access to pasture (Pilarczyk et al., 2011). Fall and Emanuelson (2011) state that there is no difference between Se concentrations in milk of organic and conventional cows during winter because of the similarity in diets.

Vitamins

Milk includes fat-soluble and water-soluble vitamins. α-tocopherol and β-carotene contents of milk depend on the diet combination (Mogensen et al., 2012). The highest levels of these provitamins are found in fresh forages and ensiling, wilting and storage can cause the losses of them in crops (Blank et al., 2003). However, milk obtained from cows fed diets rich in fresh forages or larger amounts of concentrate can contain similar α-tocopherol and β-carotene contents in winter because of lack of fresh forages (Fall and Emanuelson, 2011).

Organic milk is susceptible to oxidation because of a higher amount of PUFA. Conserved or dried forages and cereals are poor in α-tocopherol and β-carotene compared with fresh forages (Kay et al., 2005). Bergamo et al. (2003) and Slots et al. (2008) state that higher levels of α-tocopherol and β-carotene in organic milk. Zagorska and Ciprovica (2008) report that thiamine and vitamin B_1 and B_2 are lower in organic milk samples. Thiamine and riboflavin are present in cereals, and a higher intake of grains in the diet can cause an increase in conventional milk thiamine and riboflavin concentration (Gołda et al., 2004).

Conclusion

Milk is useful beverage for throughout whole life periods because of its nutrients and bioactive components. Furthermore, there is an increasing interest in functional foods due to their potential effects such as anti-carcinogenic, anti-diabetic, anti-atherogenic on human health. Organic milk production system differs from conventional system because of regulations for organic dairy farming. Organic milk production system relies on the dairy cows' natural nutritional and behavioral requirements. Therefore, organic and non organic milk constituents may differ from each other because of especially heredities of herds, the differences in feeding standards and also diet combination. While protein level and some minerals of organic milk can be lower than those of non organic milk, fatty acid combination, CLA concentration and provitamins of organic milk may be higher than those of non organic milk bacause of pastures and green grass.

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