

Nutritional interest of milk and dairy products: Some scientific data to fuel the debate

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In 1909, the International Congress on Prevention of Fraud in Paris, France, defined milk as “The integral product of the full and uninterrupted milking of a healthy, well-nourished and not overworked milk-producing female. It should be collected under hygienic conditions and should not contain colostrum” (translated from Larousse Agricole, 2002). This legal description evidently applied to milk intended for human consumption, as no mention was made of its use to feed the offspring. It is also interesting to note that this early definition of milk focused on its production, with a special emphasis on health status of the lactating animal and the sanitary conditions of the milking process. The great nutritional value of milk, as well as its increased availability due to the industrialization of production and processing, has led to high levels of consumption.

For this reason, milk and dairy products are recognized in several countries around the world to have a great symbolic value (Bourre, 2010). It is therefore not surprising that they are among the foods that are currently attracting the most discussion and controversy, not to say virulent attack (Cohen, 1997). Some reported criticisms rely on the fact that milk and dairy products are not the only source of specific nutrients; at least when these nutrients are taken individually. Several authors also drew connections between milk intake and the incidence of several diseases in humans. These criticisms are, of course, a matter of debate. This issue of *Animal Frontiers* regroups articles summarizing the current state of knowledge on the nutritional value of milk and its potential role in disease causation and prevention. We hope this information will feed discussions or support the recommendations on the place that milk could or should have in a balanced diet.

Direct evidence for the practice of dairying dates back to the seventh millennium BC (Evershed et al., 2008). Milking dairy species was probably seen a long time ago as a convenient way to obtain food from animals without having to slaughter them. Dunne et al. (2012) reported indication for extensive processing of

dairy products in pottery vessels in the Libyan Sahara during the Middle Pastoral period (approximately 5200–3800 BC). Geographic coincidence among high diversity in cattle milk genes, locations of the European Neo-

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lithic cattle farming, and current lactose tolerance in Europeans has been reported, suggesting a gene–culture coevolution between cattle and humans (Beja-Pereira et al., 2003). These findings emphasize the importance of milk for survival of many human communities.

In a first paper, Dr. Ian Givens, Dr. Katherine Livingstone and Ágnes Fekete from the University of Reading, and Drs. Janet Pickering and Peter



Elwood from Cardiff University School of Medicine, all from UK, with their colleague Dr. Anestis Dougkas from Lund University, Sweden, reviewed several cohort studies related to dairy consumption at different stages of life (Givens et al., 2014). Owing to epidemiological data on intake of dairy products (e.g., cheese, yogurt, butter) being scarce, the paper focuses on fluid milk. In particular, Dr. Givens and his colleagues report on the effects of milk as a source of nutrients to support growth in children and shed light on the association between milk drinking and the incidence of several diseases or altered physiological states (e.g., heart disease, stroke, diabetes, arterial stiffness and high blood pressure, obesity).

In a second paper, Dr. Joost van Neerven (2014) from FrieslandCampina and Wageningen University, The Netherlands, summarizes the influence of colostrum and raw milk on immune functions, which are thought to contribute to the protection against infections and allergies. On the one hand, colostrum is not marketed and consumed as such by humans. Bovine colostrum on the other hand could serve as a substrate for the preparation of protein-enriched extracts to be used in pharmacological applications (Montoni et al., 2009). Dr. van Neerven underlines that active proteins are also present in mature raw milk. It is interesting to note that some of the studied populations in epidemiologic surveys to assess the effects of untreated milk are children growing on dairy farms. In the general population, however, consumption of raw milk still represents a health-threatening issue, even under hygienic conditions of modern dairy farming (Langer et al., 2012). Commercialized milk must therefore be subjected to heat treatment, which results in denaturation of active milk proteins, thus inactivating their functional effects. It is consequently recommended to pursue research aiming at developing milder processes to meet the safety regulations, while overcoming denaturation of bioactive compounds.

In the next paper, Benoît Graulet from the Centre INRA de Clermont-Ferrand/Theix, France, is underlining the hard task of covering vitamin requirements, a major public concern regarding health in several populations around the globe. Dietary guidelines from different countries are recommending two to three servings of milk or alternatives for adult men and women (Health Canada, 2011; Institut National de Prévention et d'Éducation pour la Santé-France, 2002; and USDA, 2014). Assuming an intake of two servings per day, whole milk would have a significant contribution to the reference intake of adults for several vitamins (22 to 32% of vitamin A; 34 to 100% of vitamin D; 64 to 92% of vitamin B2; 34 to 42% vitamin B5; and 84 to 112% of vitamin B12). More data are presented by Dr. Graulet in his paper, along with the biological activities of vitamins, as well as animal, management, and dietary factors affecting vitamin concentrations in milk from dairy cows.

In a complementary short paper, Drs. Jacques Matte, Michel Britten, and Christiane Girard from Agriculture and Agri-Food Canada, Québec, Canada, focus on the importance of milk as a source of vitamin B12 in human diet (Matte et al., 2014). Ruminant animals such as dairy cows are important contributors to the supply of cobalamin (vitamin B12) in the



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food chain, as this molecule is synthesized by their stomach microbiota. This paper reviews the current knowledge on the effect of milk processing on milk vitamin B12 content as well as the bioavailability of this vitamin from milk as compared with synthetic supplements.

Milk is also an excellent source of minerals, specifically calcium and phosphorus. In this regard, the importance of milk as a source of calcium has led Flatz and Rotthauwe (1973) to propose what is called the Calcium Assimilation Hypothesis. These authors postulated that the increased proportion of lactose tolerance in European populations was due to the selective advantage of lactase producers causing an enhancement of calcium absorption from milk, in an environment with low ultraviolet irradiation and low dietary supply of vitamin D. Since then, dairy calcium has been the subject of several investigations in relation to human health over the years (Ibeagha-Awemu et al., 2009). Milk is also recognized as a good source of selenium. However, a review of the literature data shows that the concentrations of this trace element are quite variable in milk, ranging from 0.05 to 1.65 $\mu\text{mol/L}$ (Ceballos et al., 2009). A glass of milk could then provide as low as 1, and as high as 33 μg , of selenium, which would represent between 2 and 64% of the recommended daily intake. In the current issue, Drs. Claudia Cobo-Angel and Alejandro Ceballos-Márquez from the Universidad de Caldas, Colombia, and Dr. Jeffrey Wichtel from the University of Prince Edward Island, Canada, review the effects of selenium in human health and the subtle equilibrium between a deficit or an excess of this element in the diet (Cobo-Angel et al., 2014). They also report on the

cause of variation in milk selenium content, along with the possibility of tailoring dairy products to meet requirements of the population.

Finally, processing of milk is known to generate co-products such as whey during cheese making or buttermilk in the course of butter churning. Although qualified as “by-products,” these milk fractions contain specific nutrients that have been evaluated for their effects in humans. As an example, whey protein supplements have been shown to improve body composition (maintain lean mass and reduce fat mass) in healthy adults and to increase lean body mass gain in those performing resistance training (Hayes and Cribb, 2008). In the last paper of the current issue, Dr. Valerie Conway, from the University Institute of Geriatrics of Sherbrooke, with her colleagues Sylvie Gauthier and Yves Pouliot from the Institute of Nutrition and Functional Foods at Université Laval, Québec, Canada, report on the fine composition of buttermilk, along with its health-promoting effects, including reduced blood pressure and decreased plasma cholesterol, which could contribute to an improved cardiovascular health (Conway et al., 2014).

In summary, for millennia, in many cultures around the world, milk has been a major constituent of human diet and has served as an excellent source of nutrients essential to survival. Is this prominent part of milk still appropriate in modern diets? We do hope that this issue of *Animal*

Frontiers will help fuel the debate on the role of milk and dairy products on human health based on scientific evidences.

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