

NUTRITIONAL ATTRIBUTES OF BOVINE MILK'S DURING LIFE STAGES

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Bovine milk

Overview Bovine milk has traditionally provided the most abundant quantity and ranges of nutrients to all life stages following breastfeeding. The nutrients in milk are particularly beneficial to children and aging adults; its natural abilities to enhance bone health, promote protein synthesis, enhance immunity and aid gut health.

To obtain the full health benefits it is recommended to consume whole or semi-skimmed milk as these present the most abundance source of bioavailable nutrition including water- and fat-soluble vitamins, minerals, essential amino acids and essential fatty acids.

Background Archaeological discoveries have identified the use of ruminant milk dating back to the seventh millennia BC, through profiling fat residues on the shards of ceramics in Europe (University College London, 2019). These fat residues were from bovine and goat milk.

Bovine milk is the most commonly consumed milk, globally; 93% (inc. buffalo). Followed by 2.4% goat, 1.4% sheep and 0.3% camel or other (USDA, 2019). Bovine milks have seen a recent drop in consumption by approx. 6%. This is due to multiple factors including; concerns towards animal welfare, increased prevalence of intolerances and allergies, dairy's associated negative environmental impact and the move towards flexitarian and vegan ethical paradigms (Sousa and Bolanz, 2017).

Bovine milk facts

- Average dairy farm produces 2500 litres of milk per day (AHDB 2019).
- In 2015-16 only 6% of adults reported that they had avoided milk for 3 months or more (NCIB 2017).
- Most milk consumed is accompanied by another food or beverage; in tea, coffee, smoothies, with cereal (AHDB 2018).
- Milk contains all essential amino acids (McCance & Widdowson 2017).
- Milk provides 19% of calcium in UK adults (The dairy council, 2016).

Nutrients Bovine milk is one of the most nutrient dense foods available for human consumption and has historically been a staple nutrient source for both children and adults. The average bovine milk consumption is estimated at 84.9kg/year per capita. However, this differs significantly by location and socio-economic status. The main difference being in developing and developed regions, where the daily intake of milk in developed populations is as high as 213kg/year, compared to 55kg/year in developing countries. The lowest recorded milk intake of is 24kg/year in southeast and southern Asia, where milk and milk-based foods are not considered a staple food/drink (Zingone et al., 2017).

Infants, children and the elderly are the demographics at the highest risk of malnutrition (Hickson, 2016). In children this is due to the high energy needs and the short gastric capacity and in aging adults and the elderly the combined loss of appetite and intestinal ability to uptake sufficient nutrients. Milk contains key nutrients that are highly bio-available milk can make a substantial contribution in the growth and development in children, maintenance of bone density in females and the prevention/ slowing of sarcopenia in adults (Michaelsen et al., 2009).

Bovine milk products are good sources of nutrients such as calcium, protein, B vitamins including vitamin B12, selenium and iodine; all of which are essential nutrients for healthy development and health maintenance throughout all human life stages. Milk products are also highly adaptable for adding nutrient delivery in active and sports nutrition markets, aiding muscle development and repair and providing calcium in children and aging adult's health (Breen, 2019).

The first 1,000 days: a window of opportunity? The first 1,000 days of an infant's life, from conception until their second birthday, is a key time to safeguard their lifelong health. This is when environmental factors – such as nutrition – can influence rapidly developing organs and body systems (WHO, 2018).

Good nutrition during the 1,000-day period between the start of a woman's pregnancy and her child's second birthday is critical to the future health, wellbeing and success of her child. The right nutrition during this window can have a profound impact on a child's ability to grow and learn.

Malnutrition is an underlying cause of 2.6 million child deaths each year globally. 1 Millions more children survive but suffer lifelong physical and cognitive impairments because they did not get the nutrients they needed early in their lives when their growing bodies and minds were most vulnerable. 'When children start their lives malnourished, the negative effects are largely irreversible' (Woolston et al, 2019).

Pregnancy and infancy are the most important periods for neurological development (Pauling 2019). Mothers and babies need quality nutrition to lay the foundations for the child's future cognitive, motor and social skills, school success and productivity. Children with restricted brain development in early life are at risk for later neurological problems, poor school achievement, early school drop-out, low-killed employment and poor care of their own children, thus contributing to the intergenerational transmission of poverty (Save the children, 2018). Many children are born undernourished because their mothers are undernourished. As much as half of all child stunting occurs in utero, underscoring the critical importance of better nutrition for women and girls (Williamson, 2006).

Increased nutrient demands in pregnancy and lactation; SACN recommends the increased intake of protein, folic acid, calcium, phosphorus, zinc, magnesium, and selenium, thiamine, vitamins A, C and D pre and during pregnancy. These nutrients are also essential for those breastfeeding to provide full neurological and physiological developments.

The Reference Nutrient Intake (RNI) is set at 0.75 g of protein per kilogram bodyweight per day in adults. Protein requirements increase in pregnancy by an additional 6 g/d and during lactation an additional 11 g/d during 0-6 months and then by 8 g/d after 6 months.

Energy requirements for pregnant women increase by approx. 200 kcal/day, but only in the final three months of pregnancy. Bovine milk can help meet the needs of the mother and deliver the essential nutrients to the developing foetus.

- Although a pregnant woman's calcium needs do not increase throughout pregnancy (they remain at approx. 700mg/d), it is essential that enough calcium is taken throughout this period as it will help with the hardening of the unborn baby's bones.
- During breastfeeding calcium needs increase by 550mg to 1250mg per day. This is because some calcium will be lost in the breast milk produced.

- Milk and yogurt pose no risk during pregnancy and are a good way of helping to meet nutrient requirements (FSA 2019).
- During pregnancy and breastfeeding the increased demand for protein, folic acid, calcium, phosphorus, zinc, magnesium, and selenium and vitamins thiamine, vitamins A, C and ;, all of which are contained in dairy milk and milk products
- These nutrients are also essential for those breastfeeding to continue to gain full neurological and physiological developments.

Early life nutritional programming Many environmental factors have an impact on later health, but diet and early life nutritional exposure are particularly significant. By making the right nutritional choices from conception to toddlerhood, mothers can make a significant difference to their children's long-term health. There is a growing body of evidence that early life nutritional programming (ELNP) can affect both physiology and behaviour. ELNP can affect both behaviour and physiology (WHO 2019).

Behavioural effects:

- Influences early feeding habits
- Impacts on taste preference
- Affects food texture preferences

Physiological effects

- *Metabolic* – processes may be set during early life, determining how the body learns to break down, absorb and use nutrients for lifelong growth and development.
- *Immune* – immune system development may be influenced, affecting the future risk of asthma and allergic diseases.
- *Cognitive* – brain development may be influenced, with potentially long-term effects on cognitive function and behaviour.

Healthcare professionals' nutritional intervention from conception to toddlerhood may have a lifelong impact, supporting optimal health with the potential to positively influence long term health outcomes (Skerret, 2016).

Dairy milk and milk products can play an important part in a healthy balanced diet for children.

- During childhood, bones continue to grow and develop, and it is important that children have the right nutrients to build strong and healthy bones, and to lay the foundations for lifelong bone health (BMC 2019).
- Dairy products provide children with important nutrients such as calcium and protein.
- Dairy products can also provide a source of vitamin B2 which contributes to the maintenance of normal skin and vitamin B12 which is needed to make red blood cells.
- Whole milk provides extra energy and vitamin A, which are important for growing children.
- Only breast milk or formula milk should be given as a main drink to children under one as cow's milk does not contain the right balance of nutrients to meet a baby's needs at this age. After six months, cow's milk can be used for cooking and can be introduced as a main drink after the age of one (BDA 2018).

The benefits of dairy products for adolescents

- During adolescence requirements for many nutrients, including calcium, are increased.
- The reason for the increased calcium need is that during this time, adolescents will experience rapid growth as bones begin to grow in length and strengthen. It is estimated for example, that almost 90% of a person's bone strength will have been achieved by the age of 18, highlighting the importance of adopting a balanced diet, including calcium-rich foods in the lead up to adulthood (WHO, 2010).
- Many teenagers, particularly girls, fail to meet the requirements of calcium (National Diet & Nutrition Survey 2017).
- Dairy will also provide protein and vitamin B2 and vitamin B12
- A diet which provides the nutrients required for good bone health during adolescence can be one of the important parts of determining the state of a person's bones later in life (SACN, 2015).

The benefits of dairy products for adults

- Most bone development is laid down by the age of 18, yet bones will continue to strengthen until the mid-thirties which means it is important for adults to continue to consume calcium as part of a balanced diet (Kao 2019).
- Following the mid-thirties it is normal for a person's body to slowly begin to decrease in bone density. For women, there is a marked increase in bone loss around pre, peri and post menopause (BNF 2019) This can result in brittle bones and increased risk of fracture; both of which are associated with decreased quality of healthy aging.
- Getting enough calcium is important for both men and women.
- Dairy products provide a wide range of important nutrients including protein, phosphorus, zinc, selenium, iodine and B vitamins.

Overall summary-

- Dairy products provide naturally occurring essential and important nutrients for all life stage health in one single source, with one ingredient.
- Protein fractions within in bovine milks provide one of the distinguishing beneficial health factors for human health and its nutritional content.
- Protein fractions that are unique in milk contain immune support, aid gut health and aid the uptake of minerals and vitamins.
- Protein fractions such as Lactoferrin, aids the uptake of iron and, Apha-lac is important for the reduction of cell mutation through the process of apoptosis. Apoptosis is considered a vital component of various processes including normal cell turnover, proper development and functioning of the immune system, hormone-dependent atrophy and embryonic development.
- Milks protein content is a popular property of milk, whey and casein. With a market demand for healthy ageing, growth and development and in the active/sports markets.
- Dairy presents positive health effects with regards to several non-communicable diseases, e.g. dairy consumption is correlated with lower risk of obesity in children and lower risk of developing type 2 diabetes (especially through the consumption of fermented dairy products).
- Regular dairy consumption has shown a positive effect on the reduction of risk to stroke and hypertension.

- Dairy consumption has a positive effect on the bone mineral density.
- According to the World Cancer Research Fund, there is probable evidence that dairy consumption decreases the risk of colorectal, bladder, gastric and breast cancer.

‘Bovine milk and dairy milk-based products are one of the most nutrient rich, single source foods/drinks. Providing protein (Inc. all essential amino acids), carbohydrates, fats (Inc. essential fatty acids) minerals and vitamin’s fundamental to support neurological and physiological developments and maintenance at all life stages. Of which are highly bioavailable. The versatility of bovine milk and dairy milk-based products can be to be conveniently consumed and easily implemented into a nutrient rich, affordable and balanced’ NR.