

Milk: The ideal nutritional base for beverage applications

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Summary

- Milk is well-established as a natural, safe and nutritious food, providing essential nutrients to maintain health status across all stages of life.
- The nutritional profile of milk can be used as a base to produce beverages with specific composition. For example, beverages can be tailored to meet specific nutrient requirements for infants, medical, sports and lifestyle/health applications.
- Ireland is a leading manufacturer of high quality functional dairy ingredients that can form the nutritional platform upon which these nutritional beverages are built.
- Ireland produces ~ 12 % of global infant formula exports, providing a vital channel for utilisation of its dairy ingredients (skim milk, milk and whey protein ingredients and lactose).
- Manufacturers of nutritional beverages (across the life categories) have access to an increasingly wide range of whey protein based ingredients. Depending on location, these can be available in liquid, concentrate or powdered formats.
- Advances in processing technologies, coupled with an in-depth understanding of protein chemistry, has allowed Ireland to differentiate our dairy ingredient portfolio, generating new opportunities in export markets, where Irish milk provides consumers with the essential nutrients for growth and development.

The importance of the nutritional beverage sector to Ireland

The global nature of the nutritional beverage sector, and in particular the infant formula industry, is underpinned by strong brand representation from the multinational companies in Ireland. This provides Ireland's Dairy processors with a vital route to market across large geographical regions. This sector is recognized as an important channel for utilization of skim milk, whey and lactose. The dairy and nutritional beverage manufacturers have invested in significant processing infrastructure in Ireland, and this is used to produce high quality ingredients and/or finished nutritional (e.g., infant, adult and medical) and lifestyle products (e.g., sports and recreational). The investment in the latest processing technologies by the Irish industry coincided with the abolition of quotas in 2015 to maximise the value of the subsequent increased milk volume. This has placed Ireland in a strategic position to engage new and emerging markets, supported by science and innovation, to deliver new dairy ingredients that provide targeted nutrition from infant to adult. This strategy requires delivery of consistent quality milk, which enables manufacturers to meet consumer requirements based on macro- (protein, fat and carbohydrate) and micro- (minerals, vitamins and others) nutrient levels within a product, delivering targeted nutrition.

Teagasc research in the area of nutritional beverages focuses on two key areas: (i) product safety, both microbiologically and from a contaminants perspective, to protect the consumer; and (ii) ability to manufacture to a target composition based on a nutritional and/or functional requirement. Much has already been achieved technologically over the years. For example, the research carried out on the whey protein ingredient α -lactalbumin, which is now commercially used in infant formula. Furthermore, many ingredients (and beverages in which they are used) are preserved in spray dried powder form, and Teagasc has developed a major research program in powder technology and associated functionality.

Significant developments in whey ingredients for nutritional applications

Whey, the by-product of cheese, contains many nutritional components and has been a key focus ingredient with a wide variety of applications, including infant formula and sports nutrition. Technological advancements in concentration and separation of proteins from the whey stream have allowed a range of protein concentrates, isolates and hydrolysates to be produced, maximising the value of the co-product from cheese manufacture. Physiological function of components from whey has evolved as an important research area for Teagasc and the dairy industry. For instance, evidence that whey proteins and their peptides have health benefits beyond their basic nutritional value has increased markedly in recent years. Furthermore, a wide range of beneficial bioactivities can be linked to whey protein in its various derivative forms, including concentrate, isolate, hydrolysate, and individual protein and peptide fractions. This in turn has resulted in new nutrition products that support the early infant immune system. Infant formula incorporating whey protein hydrolysates are less allergenic compared to standard preparations, and there is some evidence to suggest that it may decrease the risk of allergies later in life. In other applications, whey protein concentrates are used for muscle development and repair, which is developing into a major market focused on sports applications. Studies led by Teagasc reported a significant diversification of the gut microbiota of the Irish rugby team, attributed to the consumption of a protein rich diet, compared to a cohort from the general public. More specifically, health benefits have been attributed to the presence of highly valuable individual proteins in whey. For Ireland, this has a particular focus related to the infant formula and sports sectors. Teagasc (and other research providers) have shown that whey protein may also play a role in influencing infant and adult gut microbiota.

New Teagasc infrastructure to support development of ingredients for nutritional beverage applications

Teagasc are investing in new infrastructure to support the Irish industry through the Dairy Research Programme at both Moorepark and Ashtown. These new investments will be complementary to the existing research infrastructure and expertise, and will facilitate science-based innovations and solutions for local and international nutritional beverage companies. As part of this expansion, Moorepark Technology Limited (MTL), which is the pilot plant facility at the Teagasc, Moorepark site, is currently undergoing a €10 million expansion. MTL is owned in partnership between the Irish dairy processing sector and Teagasc (57% share), and is capable of reproducing all dairy related products, ingredients and beverages, serving as an important conduit for research and development for the Irish dairy industry. The expansion includes investment in the latest state of the art processing equipment for separation, heating and drying of dairy ingredients and/or nutritional beverages, while working synergistically with the research capabilities within the Teagasc food program. The combination of the research support and pre-commercial scale pilot plant has also led to the concept of the Food Innovation Hub for industry. This Food Innovation Hub integrates three major components: the state of the art pilot plant facility at MTL (the “hardware”); the research capability of the Teagasc Food Research Centre at Moorepark (the “software”); and custom designed secure company laboratory and office units (the “Industry Units”). This facility is currently at the design stage with building expected to get underway in Q3 of this year.

Teagasc have also made strategic investments in analytical instrumentation capable of measuring all the nutrients in dairy ingredients and finished nutritional beverages (e.g. infant formula). A key component here is the ability to determine powder reconstitution properties, which requires an understanding of food structure as a diagnostic tool. Powerful microscopic techniques are used to visualise the behaviour of these powders in water, which is a key quality attribute. These techniques give researchers at Teagasc the capability to map industrial processing parameters used during manufacture of nutritional beverages, and ultimately track how ingredients interact during the process.

Conclusions

Milk is a nutritional beverage that can be valorised into many different product streams such as cheese, whey, butter, yogurt and a variety of powdered ingredients. Advances in processing equipment such as membrane separation have led to the development of a wide range of dairy ingredients, which can be utilised as a source of nutrients for nutritional and lifestyle beverages with a range of applications. Many of these developments rely on whey ingredients because of their functional and nutritional characteristics. The diversity of processing equipment within Teagasc, including separation, concentration and stabilisation technologies, and associated research expertise is a key enabler supporting pre-commercial product and process development with the industry. Teagasc have developed a critical mass in dairy research, supported by the state's national investment policy through both Enterprise Ireland and the Department of Agriculture, Food and the Marine, to support the expansion of the ingredient and nutritional formulations sector within the food industry. The alignment of Teagasc's research programme with global trends in nutrition is strategically important, as it helps to underpin the research and development activities of dairy processors and infant formula companies in Ireland. The unique characteristics of milk which provide a diverse range of essential nutrients will continue to provide opportunities for significant economic growth in both the dairy and nutritional beverage sectors.

