

Blending dairy and cereal



Fermented dairy-cereal blends present a new potential for Irish ingredients and **TEAGASC** and UCC researchers have been researching the development and characteristics of different blends.

The benefits of dairy-cereal blends as foods

Cereal and dairy constitute two of the five major food groups, with the average respective proportions of each, as a percentage of total food consumed per person, varying from an estimated 18.6 % and 6.2 % in developing countries to 10.2 % and 12.4 % in developed countries. They are frequently combined to create blends or composites, which provide a means of innovating products with the additive nutritional, textural and sensory functionalities of both food groups. The addition of milk solids to cereal-based products enhances the content of important nutrients, including essential amino acids, linoleic acid, fat-soluble vitamins, calcium and phosphorous. Fermentation of the dairy components (e.g., fermented milk) enhances the nutritional status by increasing the bioavailability of cationic elements such as calcium (Ca), magnesium (Mg), zinc (Zn), copper (Cu) and iron (Fe), promoting the release of bioactive peptides encrypted within the casein, increasing the levels of essential amino acids and B vitamins, and reducing the lactose content. Conversely, the addition of cereal, such as oats, wheat or barley, to dairy-based beverages imparts viscosity/texture, and enhances the content of dietary fibre, including β -glucan, to a degree dependent on the type of cereal and its pre-treatment prior to blending. Research suggests that the inclusion of β -glucan in the human diet reduces the glycaemic index, blood cholesterol and the incidence of coronary heart disease, and improves gastrointestinal function. Consequently, fermented milk-cereal beverages are being increasingly promoted for their nutritional benefits –

<https://patentscope.wipo.int/search/en/detail.jsf?docId=WO2019090119&tab=PCTBIBLIO>. However, phytic acid (inositol-phosphate) in cereals chelates multivalent cationic metals including Fe, Zn and Ca, and can thereby reduce their absorption in the gastrointestinal tract and increase the risk of mineral deficiencies in humans and other monogastric animals that lack the phytase enzyme.

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Commercial dairy-cereal blends

Commercial examples of dairy-cereal blends include yoghurt-cereal bars, co-fermented dairy-cereal beverages, nutritional snack biscuits/bars, and dehydrated blends such as Super Cereal Plus (SCP), kishk and tarhana, which may be reconstituted to prepare fortified blended foods (FBFs), nutritious soups or beverages. SCP, a



FIGURE 1: Fermented milk plus cereal giving a fortified blended food powder that is reconstituted and cooked to make a nutritional dish.

category of FBF supplied by the World Food Programme, is designed to improve the diet of young children, aged six to 59 months, in food-insecure regions. It is a powdered product formulated by dry blending heat-treated wheat, dehulled soya bean, sugar, skim milk powder, refined soya bean oil, and a vitamin/mineral mixture. Kishk is a dried fermented milk-/cereal-based product that has been traditionally consumed in the Middle East, where it is reconstituted and cooked to form a porridge or soup, or used as an ingredient in savoury and sweet dishes. Tarhana, a dehydrated fermented milk/cereal product of Turkey and Greece, resembles kishk but differs in its formulation, whereby parboiled wheat is substituted by wheat flour, and baker's yeast (*Saccharomyces cerevisiae*), and diced vegetables and spices are included as additional ingredients.

Studies at Teagasc Moorepark and UCC

Development of fortified blended foods using dairy-cereal blends

A collaborative project between Teagasc Food Research Centre, Moorepark, and the School of Food and Nutritional Sciences in UCC has, since 2015, been researching the development and characterisation of FBFs based on Irish-sourced dairy ingredients and cereals. The developed process involves a series of steps: de-hulling, parboiling and milling the cereal; blending fermented milk (~17 % dry matter [DM]) and parboiled cereal (~94 % DM) at a weight ratio of 2.9-4.4:1 (depending on the protein content of the cereal); co-fermentation of the blend at 35 °C for 24-72 h; shelf-drying at 46 °C; milling to a particle size of ≤ 1 mm; fortification with vitamins, minerals and essential free fatty acids; vacuum packing in PE60/Met shrink pouches; and, storage (Figure 1). Parboiling of the cereal and co-fermentation of the fermented milk-cereal blend were adapted as strategies to reduce phytic acid content.

The FBFs are a rich source of protein, essential amino acids, fatty acids, vitamins, minerals, antioxidants, β -glucan and lutein. Key factors affecting the composition (and hence nutrient value) and consistency/viscosity characteristics of the reconstituted FBFs have been identified: cereal type; fermented milk-to-cereal ratio; co-fermentation time; and, storage conditions. Most notably, FBFs made with oats instead of wheat had higher contents of starch, β -glucan, lysine and Fe, and lower levels iodine (I), Mg and Zn, were thicker and tackier during cooking, and were more prone to becoming stiffer and stodgy after cooking. Overall, the consistency of oat-based FBFs was porridge like, while that of wheat- or barley-based FBFs was more fluid and soup like.

Increasing the ratio of fermented milk-to-cereal coincided with higher contents of protein, lactose, fat, Ca, Zn, P, and vitamins A and E, lower contents of phytic acid and β -glucan, and lower viscosity after reconstitution and cooking. Increasing the fermentation time from zero to 72 h reduced the quantities of phytic acid and lactose, and the viscosity during, and after, cooking the reconstituted FBF. The FBF powders were quite stable on storage at 15 °C for up to 18 months; conversely, storage at 30 °C or 37 °C led to deterioration in essential fatty acids, colour, vitamin C or E activities, antioxidant activity and reconstitution behaviour of the FBFs, to a degree affected by storage time and cereal type.

Product opportunity/benefit

The project findings provide new know-how and insight into the design of innovative food products (e.g., powdered FBFs, beverages) combining the nutritive, techno-functional, and flavour properties of dairy and cereal. Such products present a new export opportunity for Irish-based dairy ingredients and cereals.

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