Mineral Fortification in Yoghurt Products

by Markus Gerhart and Martin Schottenheimer

The global functional foods market is dominated by dairy products, with sales valued at 9.23 bn USD in 2010[1]. Despite already being a well-developed market in many countries, manufacturers are continuing to innovate, driven by the consumers demand for products that fit into their diet and nutritional needs. In consequence, the scope for the growth of new, innovative, and healthier products is steadily increasing [2, 3].

This success is based on various pillars. In general, dairy products are perceived to be healthy and fortification makes them even healthier. They are a popular part of the diet and their consumption is a daily routine. This favors their usage as a carrier for functional foods that should be consumed regularly. Milk products are already a good source of calcium and fortification leads to products that can contribute more than 50% of the daily requirements to the diet.

Functional yoghurt or drinking yoghurt products have been impacted in the EU by the recent health claims regulation, as the usage of claims on popular functional ingredients like pre- or prebiotics is restricted. However, there is still room in the market for new products [3]. Especially minerals like calcium, magnesium or zinc can offer a wide range of claim options that address the top health topics like bone health, immunity, energy or cognitive functions. These health benefits can be clearly defined and are easy for the consumer to understand.

Recent examples like “Yoplait Calin+” or “Danone Densia” underline what is still possible in the market. Containing 50% RDA of calcium per serving plus vitamin D and referring to bone health, these products set a new benchmark for calcium fortified yoghurts.

However, feasibility of mineral addition has to be considered, as milk products are a complex food matrix and high fortification levels are challenging. With the right selection of the appropriate mineral compound and the proper application success is possible.

Based on our history and expertise on mineral fortification, Jungbunzlauer has recently started a cooperation with the University of Hohenheim in Germany to fully understand the applicability of mineral salts in yoghurt products [4].

This article discusses important nutritional and technological aspects of mineral fortification of yoghurt products. It provides the major findings of our internal lab work and our cooperation with the University of Hohenheim with specific focus on calcium, magnesium and zinc fortification in yoghurt as well as drinking yoghurt.

When fortifying high viscous dairy products such as yoghurts, Greek yoghurt or curd cheese (petit Swiss) organoleptic properties like taste or mouth feel are major issues. Low soluble minerals as tricalcium citrate, trimagnesium citrate nonahydrate or zinc citrate are the preferred choice as dissolution is not required and negative effects on taste dominate at higher concentrations, when using soluble minerals.

Minerals are generally applied via the fruit preparation (Figure 1). Their low pH value and high citric acid/fruit acid concentration increase mineral solubility. On the one hand this can help to facilitate a proper distribution. On the other hand when inorganic minerals like carbonates or phosphates are used, a neutralization reaction between free calcium ions and abundant citric acid may take place over time. This may result in an uncontrolled de-novo growth of especially calcium citrate crystals, which leads to grittiness, destabilizes the fruit preparation and impacts the mouth feel and shelf life of the fortified products.
yoghurt. In our trials, yoghurts fortified with mineral citrates do not show such a phenomenon.

With increasing fortification, micronization of minerals is indispensable. Ultrafine particles ease dispersion and reduce sedimentation within the fruit preparation and improve texture and mouth feel of the final product. Jungbunzlauer’s tricalcium citrate can even be suspended in yoghurts at concentrations of more than 500 mg calcium per 125 mg serving (62.5% EU RDA). In case of magnesium and zinc similar or even higher RDA can be achieved with trimagnesium citrate and zinc citrate.

In plain yoghurts, a liquid mineral suspension can be applied and the addition of starch has shown to stabilize these suspensions by reducing sedimentation.

Fortification of lower viscous dairy products

Drinking yoghurt is produced from yoghurt and has therefore a similar pH (~ pH 4) while the viscosity tends to be much lower. Like yoghurts, these products are best fortified via fruit preparations. As the addition of low or insoluble minerals is preferred, sedimentation may become a challenge. Besides the usage of micronized minerals also viscosity adjustment is of high importance.

Options comprise:
- Usage of exopolysaccharide cultures for the fermentation
- Higher usage levels of pectin in fruit preparations
- Reduction of added water
- Reduction of the homogenization pressure (e.g. 75/15 bar)

A viscosity above 225 mPa·s enables fortification levels similar to the ones achievable in yoghurt.

Table 1 provides the key findings of our trials in yoghurt and drinking yoghurt. This toolbox serves as a guidance to develop new product concepts with magnesium, calcium, zinc or blends thereof with fortification levels up to 75% EU RDA. Our trials show that high fortification yoghurt as well as drinking yoghurt is feasible, without compromising taste or product stability.

Outlook

The challenge for dairy product manufacturers is to provide products with highest mineral content and appealing sensory properties. Since micronized tricalcium citrate has been available, it...
has replaced inorganic as well as organ-
ic salts such as calcium lactate in dairy
applications and enabled manufactures
to fortify products to more than 50% RDA of calcium per serving.

The combination of outstanding techno-
logical properties and high nutritional
value (bioavailability) makes micron-
ized tricalcium citrate the number
one option for calcium fortified milk
products\[5\]. In contrast to calcium,
fortification with magnesium and zinc
is not as established in the market.
Especially in Europe, where health
claims on products are regulated by
the new EFSA health claim regulation,
magnesium and zinc offer various op-
tions for new product concepts. With
the raising awareness for these two
minerals and their various beneficial ef-
fects on human health they should gain
importance in dairy products soon as
such or together with calcium and other
nutritional ingredients.

As technological hurdles will increase
with higher fortification levels, trimag-
nesium citrate and zinc citrate will be
able to prove their superior performance
in dairy applications.

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The Authors
Markus Gerhart is Product Manager Special
Salts for Jungbunzlauer in Ladenburg,
Germany.
Martin Schottenheimer is Project Manager
Food at the Application Technology Center
of Jungbunzlauer in Ladenburg.

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Milk, liquid”, “Drinking Yogurts & Liquid
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