A short review of the evidence for the safety of lactic acid-producing probiotics in infants.

Lactate is a simple hydroxycarboxylic acid, existing as optical isomers L- and D- lactate. Lactic acid is produced during carbohydrate metabolism. The vastly predominant isomer in human blood is L-lactate, which is generated in mammalian cells. However, D-lactate is also produced by cells but in low concentrations. Both isomers are metabolised in humans by the enzymes L- and D- lactate dehydrogenase (LDH) into pyruvate.

The most common probiotics which generate D- and L-lactate isomers are Lactobacillus, Streptococcus and Enterococcus, but there are others.

Lactobacillus acidophilus NCFM is a well characterised (1) Gram-positive probiotic bacterium with an excellent safety record, which is lactic acid producing. An important question is whether D- or L-lactate production is desirable in the context of an infant probiotic.

The evidence in humans for D-lactate acidosis is very limited and specific and has only been reported in short bowel syndrome where there is significantly abnormal and excessive carbohydrate metabolism. D-lactate acidosis occurs at levels above 3mmol/L.

There is, however, good safety data on the use of D-lactate producing probiotic bacteria in a placebo-controlled study in human infants (2). This showed that in babies receiving a Lactic-acid producing probiotic the level of D-lactate, and those who had only received a placebo, ranged from 20-130micromols/L – there were no differences between the groups. Furthermore, no safety or acidosis symptom issues were identified.

Furthermore, one interesting study showed that in patients with short bowel bacterial overgrowth, the administration of D-lactate producing Lactobacilli actually reduced the levels of D-lactate acidosis. Lactic acid producing probiotics are known to inhibit Gram-negative pathogenic bacteria in the gut by producing a variety of anti-microbial molecules and modulating host immune functions, as well as controlling the availability of nutrients leading to a reduction in bacterial overgrowth (3,4).

Lactate is also a primary energy source for neurones (5) throughout life, and in the developing brain lactate is critical for myelin production by oligodendrocytes – the “aerobic” glycolysis in the brain shows that glucose continues to be converted to glycolytic products including lactate throughout life (6).

Meta-analysis data for the safety and efficacy of probiotics indicates that a multistrain combination of Lactobacillus and Bifidobacteria are the most effective combination for reducing NEC, mortality, and sepsis in infants, both in trial (7) and real-world practices (8).

The probiotic consumer market promotes numerous claims, and counterclaims, designed to gain a competitive advantage, and simplistic arguments are frequently used as ‘evidence’. One such claim is that D-lactate acidosis is linked to poor human health outcomes e.g., chronic diseases. These claims are often at odds with clinical experience, which reflect high levels of safety and, controversially, improvements in human health which EU, US and UK regulators are unable to sanction as probiotics are classed as foods, not pharmaceuticals.

In conclusion, there is no evidence, both from the scientific literature, nor from real world use reporting, that lactic acidosis arises from the use of lactic acid producing probiotics in infants. The evidence does however point to reductions in important health outcomes. Any health or safety

claims made based on a single molecule (such as lactic acid) does not fully consider the extraordinarily complex metabolic environment of the microbiome.

It is also simplistic to view lactate as being 'exclusively harmful' – its critical role in neuronal myelination, brain development and metabolism is an example of the positive benefits of lactic acid on human health.

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