Yogurt, living cultures, and gut health

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ABSTRACT

Bacteria used to ferment milk to obtain yogurt belong to thermophilic, bile-sensitive species of lactic acid bacteria, which are not ideally suited for survival into the human gut. However, assessing the viability of these bacteria through the digestive tract may be relevant to evaluate their potential to deliver some beneficial effects for the well-being of the consumer. The well-known reduction in the symptoms caused by lactose malabsorption is not the only benefit provided by yogurt starter cultures; some additional effects will be reviewed here, with special attention paid to data that may suggest a strain-dependent effect, features that are not present with lactose hydrolysis. Am J Clin Nutr 2014;99(suppl):1248S–50S.

Traditionally, yogurt is considered to be a fermented dairy food carrying viable bacteria with health-promoting effects. Lactobacillus delbrueckii subspecies bulgaricus and Streptococcus thermophilus have generally been used as starters for milk fermentation in yogurt production [for a recent review, see Mohammadi et al (1)]. The concentration of these organisms in the human or animal gastrointestinal tract has been poorly examined (2) in comparison with the full range of studies devoted to assessing yogurt starter cultures in the human gut has rarely been assessed at high amounts in the intestine (2). Moreover, the viability of probiotic bacteria intentionally added to food.

One of the most scientifically recognized health effects delivered by yogurt cultures is the reduction in symptoms caused by lactose malabsorption, which requires the presence of viable cells at ingestion but not during intestinal transit (4). This effect is shared by all yogurt starter cultures and results from the presence of the lactose-hydrolyzing enzyme in all strains of the used species of lactic acid bacteria. This species-related trait is recognized at the regulatory level by the FAO, WHO (5, 6), and the European Food Safety Authority (EFSA) (7) and does not require survival and reproduction of the bacterial cells during intestinal transit.

On the other hand, the large majority of clinical studies involving “probiotic” bacteria that show some effects on health have found that benefits are related to the ability of beneficial bacteria to survive and multiply in the gastrointestinal tract and to persist at high amounts in the intestine (2). Moreover, the viability of yogurt starter cultures in the human gut has rarely been assessed in comparison with the full range of studies devoted to assessing survival of probiotic bacteria intentionally added to food.

Studies reporting the fate of L. bulgaricus and S. thermophilus in sections of the human gut show that survival in the upper part of the gastrointestinal tract is low (ie, only 1% of the bacteria are able to reach the duodenum) (8). The low survival rate of these bacteria in the upper part of the gastrointestinal tract has led to few studies being conducted in fecal samples of individuals consuming yogurt. Results of the assessment of viability in stools of L. bulgaricus and S. thermophilus ingested by humans in yogurt are summarized in Table 1.

García-Albiach et al (9) reported essentially negative results and concluded that they were “consistently unable to detect viable yogurt lactic acid bacteria in fecal samples after repeated yogurt consumption by healthy volunteers.” They also noticed a difference between results obtained at the DNA level when fresh or pasteurized yogurt was consumed: “L. bulgaricus and/or S. thermophilus DNA remains were detected by hybridization assays in only 10% of volunteers who had ingested fresh yogurt.” This study could suggest that yogurt cultures are unable to survive intestinal transit and that heat treatment impairs the potential of dead cells to remain intact during the transit. However, 2 additional studies (10, 11), in which the authors used less yogurt per day but with a higher concentration of viable bacteria, reported a different scenario: both trials detected L. bulgaricus cells in fecal samples, whereas viable cocci were recovered only in the trial by Mater et al (10). These results may be explained by the following: 1) the higher amount of ingested cells, 2) differences in the recovery/detection methods, or 3) differences in the used strains.

Puzzled by the third hypothesis, I searched the existing literature to verify if there are some indications for strain specificity of certain beneficial actions possibly exerted by different strains of yogurt cultures. Data produced by our laboratory have shown a marked difference in the chromosomal arrangements, as determined by pulsed field gel electrophoresis analysis (12), of

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several strains taxonomically identified as *S. thermophilus*. This observation may also indicate a potential difference in the phenotypic behavior. Two major outcomes resulted from this search: one related to the action toward the immune system exerted by an *L. bulgaricus* strain, and second, of the ability of some yogurt cultures to enrich the vitamin content of yogurt, both of which appear to be strain-dependent.

The action on the immune system is not really a new item in the area of yogurt research, but the novelty of the series of studies published by a Japanese group (13) is that they have shown both in vitro and in vivo the immune modulation exerted by a specific strain of *L. bulgaricus*, and also identified the bacterial component responsible for this action. The *L. bulgaricus* strain OLL1073R-1 was shown to produce a capsular polysaccharide, which has a marked effect on the immune system in mice (14, 15). This specific strain was initially studied for its extracellular polysaccharide, which has a responsible for this action. The subjects were initially studied for its extracellular polysaccharide, which has a responsible for this action. The same group published in 2001 (18) a similar article in which the thiamine, riboflavin, and vitamin B-6 status of healthy adults who consumed yogurt was not influenced by bacterial flora of the examined yogurt; therefore, it seems highly possible that vitamin production could be strain related, and future genomic studies will be relevant (19) to select the most actively producing vitamin cultures. It is possible to conclude therefore that a new research line is open for scientists: to assess and exploit the strain-specific beneficial properties of traditional yogurt starter cultures.

An additional example of a beneficial action exerted by yogurt cultures, which is not related to lactose digestion, is the improvement of the vitamin B profile in adults (17, 18), with special attention paid to young healthy women (17). A group of nutritionists based in Vienna, Austria, conducted a study in which volunteers consumed 100 g probiotic (*n* = 17) or conventional (*n* = 16) yogurt daily for 2 wk and 200 g/d for another 2 wk. Plasma and urine concentrations of thiamine, riboflavin, and pyridoxine were determined. The main outcome was that plasma concentrations of thiamine increased in both groups (*P* < 0.01).

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### TABLE 2
Overview of results obtained in humans by using *Lactobacillus bulgaricus*

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Duration</th>
<th>Outcomes</th>
<th>Results</th>
</tr>
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<tbody>
<tr>
<td><em>n</em> = 113 aged 59–84 y; median age = 74.5 y</td>
<td>12 wk</td>
<td>Quality-of-life questionnaires, blood sampling for immune variables, daily dairy consumption</td>
<td>Risk of common cold was 2.6 times as low (OR: 0.39; <em>P</em> = 0.019) in the treated group as in the placebo group. The increase in natural killer cell activity was significantly higher in the treated group.</td>
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1 Data are from reference 13.
REFERENCES