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# Probiotics: facts and myths

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## ABSTRACT

In recent years there has been a significant upsurge in research on the characterisation and verification of the potential health benefits associated with the use of probiotics. In addition, the market for probiotics continues to expand exponentially as consumers (mostly healthy individuals) rely on health claims made by manufacturers to make their choices. This review appraises the available evidence for and against the health claims associated with probiotics. The use of probiotics in promoting gastrointestinal health and immunity, and their use in the prevention of urogenital infections, allergies and cancer are reviewed. Furthermore, issues surrounding the use of probiotics in healthy individuals, the safety of probiotics and regulatory concerns are addressed. There is scientific evidence that specific strains of probiotic microorganisms confer health benefits on the host and are safe for human use. However, this evidence cannot be extrapolated to other strains, as these effects are strain-specific. Probiotics have potential health benefits for conditions such as gastrointestinal infections, genitourinary infections, allergies and certain bowel disorders, all of which afflict a considerable proportion of the global population. However, considerable work is still needed to confirm these potential health benefits.

**Keywords** Allergy, diarrhoea, gastrointestinal health, immunity, probiotics, review, urogenital infection

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## INTRODUCTION

Probiotics are defined as live microorganisms that, when administered in adequate amounts, confer a beneficial effect on the health of the host [1]. The original observation of the positive role of some bacteria can be credited to the pioneering work of Metchnikoff in the early 1900s [2], which suggested that these beneficial bacteria could be administered with a view to replacing harmful microbes with useful ones. The term probiotic, meaning 'for life', was first coined in the 1960s by Lilly and Stillwell [3].

In recent years, there has been an upsurge in research into probiotics, as well as growing commercial interest in the probiotic food concept. This increased research has resulted in significant advances in our understanding and ability to characterise specific probiotic organisms, as well as attempts to verify their attributed health benefits. Probiotic food constitutes a sizeable part of the functional food market [4], and continues to grow at an exponential rate, with the potential for market growth estimated at a staggering US$120 million per month [5,6]. However, this commercial exploitation of the probiotic food concept is still associated with a large body of unsubstantiated claims. After many years of popularity in the Japanese and European markets, manufacturers of these products are venturing into new markets, including the Arabian Gulf region, as evidenced by the variety of probiotic food products now available in supermarkets and healthfood stores. The perception that fermented milk or yoghurt is beneficial is already widespread within this region because, traditionally, these products have been used by local healers for the treatment of diverse conditions such as skin allergies, stomach upsets, especially diarrhoea, and vaginal discharges.

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However, major concerns regarding the quality, labelling and verification of claims attributed to some of these products still remain [7–9]. In the UK, where 3.5 million individuals take probiotic supplements in some form daily, a panel of European experts found that a number of probiotics tested had incorrect labelling, markedly reduced numbers of strains, and the presence of strains not included on labels, including the potentially pathogenic *Enterococcus faecium* (found in nine products) [9]. This is a cause for concern, and calls for an international consensus on evaluating the efficacy and safety of these products.

## PROBIOTIC MICROORGANISMS AND FOOD PRODUCTS

Two main genera of Gram-positive bacteria, *Lactobacillus* and *Bifidobacterium*, are used extensively as probiotics [1,10]. However, other genera, such as *Escherichia*, *Enterococcus* and *Saccharomyces*, have also been marketed as probiotics [10,11], although concerns still remain regarding the safe use of these organisms for this purpose [12–14]. Current evidence indicates that probiotic effects are strain-specific; therefore, a beneficial effect attributed to one strain cannot be assumed to be provided by another strain, even when it belongs to the same species [15]. Table 1 shows some of the organisms used commonly as priobiotics.

According to recent Food and Agriculture Organization (FAO) and WHO guidelines [1,16], probiotic organisms used in food must be capable of surviving passage through the gut; i.e., they must have the ability to resist gastric juices and exposure to bile. Furthermore, they must be able to proliferate and colonise the digestive tract. In addition, they must be safe and effective, and maintain their effectiveness and potency for the duration of the shelf-life of the product.

**Table 1.** Examples of microorganisms that are considered to be probiotics

| *Lactobacillus* spp. | *Bifidobacterium* spp. | Others |
|---|---|---|
| *L acidophilus* | *B. bifidum* | *Escherichia coli* Nissle |
| *L. casei* | *B. breve* | *Saccharomyces boulardii* |
| *L. crispatus* | *B. infantis* | *Streptococcus thermophilus*[a] |
| *L. delbrueckii* subsp. *bulgaricus*[a] | *B. longum* | *Enterococcus faecium*[b] |
| *L. fermentum* | *B. lactis* | |
| *L. gasseri* | *B. adolescentis* | |
| *L. johnsonii* | | |
| *L. paracasei* | | |
| *L. plantarum* | | |
| *L. reuteri* | | |
| *L. rhamnosus* | | |

[a]There is still debate about the probiotic activity.
[b]Safety concerns remain because of potential pathogenicity and vancomycin resistance.

Dairy products, including yoghurt, fermented milk products and cheese, remain at the forefront of probiotic food development. There is a common perception among consumers that yoghurt *per se* is a probiotic food product. Is this a fact or a myth? Even among experts in this field there is still a debate about whether or not the yoghurt starter cultures *Lactobacillus bulgaricus* and *Streptococcus thermophilus* should be considered as probiotics [17,18]. These organisms are sensitive to conditions in the digestive tract and do not achieve very high numbers in the gut, although some beneficial effects, such as improved lactose digestion and immune system enhancement, have been associated with their use [19]. Yoghurt with added live probiotic strains is now available commercially, and a number of such products that have emerged as leaders in the European market are now also marketed internationally. In the USA, the National Yoghurt Association has introduced a 'Live Active Culture Seal' to identify refrigerated or frozen yoghurt products that contain at least $10^8$ or $10^7$ viable lactic acid bacteria/g at the time of manufacture (http://www.aboutyogurt.com/lacYogurt/). However, these counts do not differentiate between true probiotic strains and starter cultures; hence they are still not reflective of true probiotic products.

## BENEFICIAL HEALTH EFFECTS OF PROBIOTICS

Although some of the effects of probiotics have been documented clearly, research is still ongoing in other areas, with important questions remaining unanswered. However, when considering the potential health benefits, it is crucial to remember that different probiotic strains are associated with different health benefits. The overall body of evidence suggests a beneficial effect with the use of certain probiotic microorganisms.

### Immunity

One of the common claims used in the marketing of probiotic products is that they help boost immune status. Although in-vitro and in-vivo