Health Benefits of Probiotics

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Probiotics can be defined as microorganisms claimed to provide, when consumed, many health benefits. These microorganisms have to be alive when administered and the health effects they produce are strain-specific. The concept of using probiotics to treat health conditions was first introduced by the scientist and Nobel Laureate Elie Metchinkoff. He stated in 1907 that: "the dependence of the intestinal microbes on the food makes it possible to adopt measures to modify the flora in our bodies and to replace harmful microbes by useful microbes".
The mechanism of action of probiotics in the hosting intestins is not yet clearly understood and in a simplified way, four propositions have been suggested:
1. Competition for nutrients: Probiotics may be competing with pathogens for the same essential nutrients therefore making less food available for the pathogen to use.
2. Blocking of Adhesion Sites: By binding to adhesion sites, probiotics reduce pathogen colonization by preventing pathogens attachment.
3. Immune stimulation: Probiotics can trigger an immune response against the pathogens leading to their destruction via cytokines production.
4. Direct antagonism: Probiotics can release bacteriocins which kill the pathogens directly.

Probiotics should be administered in adequate numbers. The dose given has to be able to trigger the targeted effect on the host. Usually an intake of around 107 to 108 probiotic cell/gram with a serving size close to 100 to 200mg per day is considered as the optimal dose.
The most wildly used probiotics are:

The figure .1. Best resumes how probiotics work. (figure 1)

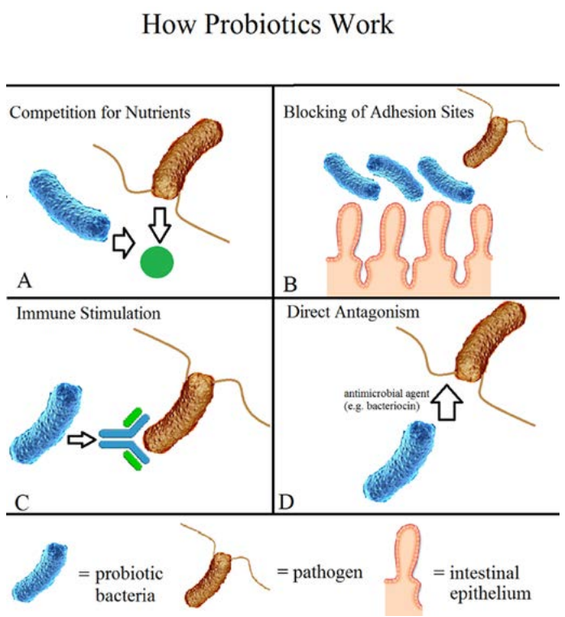

Figure.1. Mechanism of action of probiotics.

lactobacillusacidophilus, Lactobacillus rhamnosus GG, Saccharomyces boulardii, Bifidobacteriumbifidum and Bacillus coagulans.

Live probiotic cultures are found in fermented dairy products such as yogurt and also in some probiotic fortified food. Tablets and capsules as well as powders and sachets containing the bacteria in freeze-dried form are also available to acquire in pharmacies.
In vivo and molecular Studies have showed the preventive effects of probiotics on Colorectal Cancer. Probiotics intake can delay the onset of Colorectal Cancer in patients and these findings could be explained by the following points:
• Modifying the composition of the intestinal microflora thus favoring the presence of the "good" bacteria.
• inactivation of oncogenic and mutagenic compounds.
• competition with pathogenic and putrefactive microbiota.
• enhancement of the host's immune response
• anti-proliferative effects through regulation of apoptosis and cell differentiation.
• fermentation of undigested food.
• inhibition of tyrosine kinase signaling pathways.

Probiotics have also been linked to improving clinical signs and symptoms of Type 2 Diabetes.Studies have shown thatone of the features common to metabolic diseases such as T2D is a mild chronic inflammatory state and probiotics have proven to reduce oxidative stress and inflammation. The table below (figure.2) shows the positive effects of administering probiotics on diabetic patients.

The human intestinal microbiota presents a vast set of antigens which may participate in the modulation of immunological diseases. An intestinal barrier presenting full integrity ensures specific interactions between the luminal antigens and the host. Functional disruption of this barrier such as an increase in permeability may contribute to an increased expression of inflammatory cytokines whichmay lead to insulin resistance and T2D. Although their beneficial effect on diabetes has been proven in experimental and clinical research, the molecular mechanism on how how probiotics delay the onset of type

2 diabetes and improve its clinical symptoms are not yet fully understood.

In conclusion, no doubt that promoting the growth of the good bacteria, strengthening the gut's immunity and lowering inflammation are all contributing factors to the positive effects of probiotics on chronic diseases and people's health in general. Nevertheless, the precise molecular mechanism behind the action of probiotics is not yet clearly elucidated and is still under research.

Table 2 Effects of probiotics administration on diabetes mellitus - clinical studies

References	Probiotic	Study design/subjects	Sample Size	Quantity	Study period	Results
[8]	*Lactobacillus acidophilus* and *Bifidobacterium bifidum*	Double-blinded, placebo-controlled, randomized study, T2D females aged 50–65 years	Placebo group: n = 10; Probiotic group: n = 10	2 daily doses of 100 mL symbiotic shake containing 4×10^8 CFU/100 mL *Lactobacillus acidophilus*, 4×10^8 CFU/100 mL *Bifidobacterium bifidum*	45 days	↓ Glycemia
[9]	*Lactobacillus acidophilus* La5 and *Bifidobacterium lactis* Bb12	Double-blinded, randomized controlled clinical trial, T2D patients aged 30–60 years	Placebo group: n = 32; Probiotic group: n = 32	300 g/day of probiotic and conventional yogurt day 1: $7{,}23 \times 10^6$ of *L. acidophilus* La5 and 6.04×10^6 cfu/g of *B. lactis* Bb12	6 weeks	↓ Fasting blood glucose and HbA1c ↑ Erythrocyte SOD and GPx ↑ Total antioxidant capacity
[10]	*L. acidophilus* NCFM	Double-blinded, placebo-controlled, randomized study, T2D males	Placebo group: n = 24; Probiotic group: n = 24	-	4 weeks	Preserved insulin sensitivity No effect on systemic inflammatory response
[117]	*Lactobacillus rhamnosus* GG (ATCC 53 103) and *Bifidobacterium lactis* Bb12	Prospective, randomized study, mother–baby pairs	Dietetic intervention + probiotics: n = 85; Dietetic intervention + placebo: n = 86; Control + placebo: n = 85	Lactobacillus rhamnosus GG: 10^{10} CFU/day; Bifidobacterium lactis Bb12: 10^{10} CFU/day	33 months	↓ Risk of GDM
[118]	*Lactobacillus rhamnosus* GG, ATCC 53 103 and *Bifidobacterium lactis* Bb12	Randomized, prospective, parallel-group, combined dietary counselling, pregnant women	Diet + probiotics: n = 85; Diet + placebo: n = 86; Control + placebo: n = 85	Lactobacillus rhamnosus: 10^{10} CFU/day; Bifidobacterium lactis Bb12: 10^{10} CFU/day	18 months	↓ Blood glucose ↓ Insulin ↓ Insulin sensitivity
[119]	*L. plantarum* WCFS1	Double-blinded, randomized crossover study, healthy subjects	n = 14	10^{12} CFU	6 hours	↓ Degradation of transepithelial electrical resistance ↑ ZO-1 in tight junctions

GDM: gestational diabetes mellitus; GPx: Glutathione peroxidase; HbA1c: Glycated hemoglobin; SOD: Superoxide dismutase; T2D: type II diabetes mellitus; ZO-1: zonula occludens-1.

Fig.2.Positive effects of probiotics in diabetes.