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Role of probiotics in health and diseases

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Abstract

Probiotics are found inside our body, in food as dairy product and in the form of supplements. It's very beneficial for health, especially for digestive system. So, it become very obvious to increase the use of probiotics as a supplement for treating or preventing some diseases such as food allergy, autism, cholesterol and others. The purpose of this study is to review the current documentation for the claims of health benefits derived from the use of probiotics. Articles relating to modes of action and randomized control trials of treatment were reviewed by searching PubMed, google using terms 'probiotic', '' autism", "lactic acid bactera" and so on. Intestinal micro biota plays an important role in the mechanism of allergic diseases through maintaining balance of the Type1T helper/ Type2T helper (Th1/Th2), transforming growth factor beta (TGF-β) expression and production of $Foxp3^+$ regulatory T (Treg) cells. On other hand, there is a difference in gut microbiota for Autism Spectrum Disorders (ASD) children with a control group. Moreover, some strains and species of lactic acid bacteria (LAB) reduce serum and liver cholesterol and triglycerides with high-fat diet. This review supports the safety of probiotics but further studies are required to facilitate better treatment and hence improved efficacy.

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Introduction

The latest definition of probiotics set by the Food and Agriculture Organization (FAO) and World Health Organization (WHO) is "Live microorganisms which when administered in adequate amounts confer a health benefit to the host" (Anukam and Reid, 2007). Some probiotic strains commonly used are bifido bacteria, Lactobacillus acidophilus-group, Lactobacillus casei, Lactobacillus reuteri, Lactobacillus rhamnosus, Bacillus coagulans, Escherichia coli especially strain Nissle 1917, Enterococcus faeciumSF68 from enterococci species, and the yeast Saccharomyces boulardii (Pandey *et al.*, 2015). These probiotic strains may be in a single form or combined as a mixture of two or more strains. Accordingly, the benefits of probiotic mixtures found to be more efficient than single strains, which may be due to the interaction between strains (Chapman *et al.*, 2011). Good sources of probiotics are dairy and dairy products (Liong, 2011). For centuries, lactic acid bacteria (LAB), bifido bacteria, and other microorganisms obtained from fermented milk have been used (Fontana *et al.*, 2013) as probiotics. Gastro- intestinal tract (GIT) is another very important source of probiotics because the adult human gut contains more than 500 different types of bacteria. Many of the probiotic strains that are used today like L. gasseri and L. reuteri have been isolated from this source (Ryan *et al.*, 2008).

The benefits of probiotics on health include treatments and prevention of some diseases such as Diarrhea, Irritable bowel syndrome (IBS), Lactose intolerance, Immunomodulation diseases, Cardiovascular diseases, Cancer, and Obesity (Pandey *et al.*, 2015). Faujdar *et al.* (2016) found probiotics effect on oral health such as dental caries, periodontal diseases, halitosis or bad breath and in addition related with disappearance of food allergy semblance, lowering of blood cholesterol. Furthermore, some existing evidence proves the effect of probiotics on weight management in humans (Sanchez *et al.*, 2013). In the present review, we have tried to focus on the role of probiotics in food allergy, autism and cholesterol level.

Probiotics and food allergy

Food allergy is a reverse immune response to special kinds of food. It is estimated that food allergy affects about 8% of children and 4% of adults (Liew *et al.,* 2009; Gupta *et al.,* 2007). Several studies prove that a "healthy" intestinal micro-biota facilitates the development of immune tolerance (Francino, 2014; Hooper *et al.*, 2012). Interventional studies suggest that probiotics could be protective against the development of many diseases and food allergy (Menini *et al.*, 2017, Yang *et al.*, 2017), Intestinal micro-biota has been demonstrated to play an important role in maintaining the Th1/Th2 balance(Gigante *et al.*, 2011), which is the key mechanism involved in allergic diseases.

The common species of probiotics existing in most people, Bifido bacteria and lactobacilli, can affect immune function by various pathways. Probiotics supplementation was illustrated to induce TGF-β expression, which ameliorates food allergy by suppressing Th2 response, and inducing $Foxp3^{+}$Treg production (Kim *et al.*, 2014; Barletta *et al.*, 2013). Another mechanism by which the commensal flora promotes tolerance is the production of short-chain fatty acids (SCFAs), generated by bacterial fermentation of dietary fibres. SCFA act on T cells *via* a G-protein-coupled receptor (GPR43) and protect mice from intestinal inflammation by expanding colonic Treg cells (Smith *et al.,* 2013). Nevertheless, it is not clear to what extent oral administration of probiotics can affect gut micro-biota composition, thus inhibiting food allergy development. Using ovalbumin (OVA)-sensitized murine model, it was showed that probiotics improved allergic symptoms (Yang *et al.*, 2017), including reducing OVA specific-IgE, and -IgG1 levels in the serum, Th2 cytokines release in spleen, and the occurrence of diarrhea(Yang *et al.*, 2017).Recommendation to the use of probiotics for the prevention of food allergy or is based on few studies (Fiocchi *et al.*, 2016), At this point, it is necessary to understand more precisely the micro-biota composition of healthy humans and the ideal probiotic able to prevent or fight specific disease hcusas allergy and asthma (Mennini *et al.*,

2017).

Probiotics and autism

Autism Spectrum Disorders (ASD) according to American Psychiatric Association definition comprises a complex group of disorders of brain development characterized by social and communication impairment along with presence of repetitive and restrictive behaviours(Santocchi *et al.*, 2016). According to the report of the Centers for Disease Control and Prevention the prevalence of autism children is1 in 68 children in the United States (78% increase since 2007) and it is about 4.5 times more common among boys (1 in 42) than girls (1 in 189)(Navarro *et al.,* 2016).Recent meta-analysis emphasizes that children with ASD experience significantly more general gastrointestinal (GI) symptoms, such as constipation and abdominal pain and higher rate of diarrhoea (McElhanon *et al.,* 2014). Several reports refer the GI symptoms to the significant difference in the intestinal bacteria in gut of ASD patients compared with healthy children (Cao *et al.*, 2013).

Parracho *et al.* (2005) reported that differences in the gut micro-flora were confirmed in ASD children where the ratio was high in Clostridium histolyticum group bacteria compared with a healthy control group. ASD children also have high levels of Lactobacilli and lower levels of Bifido bacterium than other controls (Adams *et al.,* 2011; Finegold *et al.*, 2002). The imbalance in the gut of children may be due to differences in beneficial bacteria (Williams *et al.*, 2011).

Grossi *et al.* (2016) reported that the probiotic treatment given to 12 year's boy with ASD reduced the severity of abdominal symptoms and improved autistic core symptoms. The medication used was VSL #3, which is a multi-strain mixture of ten probiotics and the treatment, lasted 4 weeks followed by a four month follow-up. While Shaaban *et al.* (2017) found an increase in the colony counts of Bifido bacteria and Lactobacilli levels, with a significant reduction in their body weight as well as significant improvements in the severity of autism, and gastrointestinal symptoms compared to the baseline evaluated at the start of the study, where the dose was 100×10^6 CFUs of three probiotic strains supplement Lactobacillus acidophilus, Lactobacillus rhamnosus and Bifido bacteria longum, for 3 months in 30 autistic children from 5 to 9 years old. Lately, the entire microbiota has a part of the gut-brain axis (Grenham *et al.*, 2011), and can modulate brain function by forming a critical link in the bidirectional interaction between nervous system and intestine. Depending on the previous studies probiotics can be an effective and non-pharmacological treatment for children with ASD, not only for GI symptoms also for behavioural and neurophysiological patterns (Santocchi *et al.,* 2016).

Probiotics and cholesterol

High levels of serum cholesterol positively correlated with coronary heart disease (Kumar *et al.*, 2012).Cardiovascular disease (CVD) remains the leading cause of death and disability worldwide, including China, mostly due to ischaemic heart disease (IHD) and stroke (including both hemorrhagic and ischemic stroke) (Mortality GBD Causes of Death Collaborators). Many investigators are paying close attention to LAB strains and its cholesterol-reducing effects in vitro or in vivo (Kumar *et al.*, 2012; Ooi and Liong, 2010). The ability to reduce blood cholesterol varies among strains and species of LAB (Hosono and Tono-Oka, 1995). Recently, several studies have illustrated the cholesterol-lowering effects of LAB or fermented milk products in animal models (Damodharan *et al.,* 2016; Xie *et al.*, 2011), also in Human (Jones *et al.*, 2012; Schaafsma *et al.*, 1998). Of note, the six genera of Lactobacillus, Lactococcus, Leuconostoc, Enterococcus, Luteococcus, and Streptococcus were detected in the Tibetan traditional fermented yak milk (Liu *et al.*, 2015). Ding *et al.*, (2017) screened cholesterol-lowering lactic acid bacteria from traditional fermented Tibetan yak milk in rats fed a high cholesterol diet. Results showed that the strain of L. plantarum Lp3 had a high Cholesterol-reducing rate (73.3%) and administration of Lp3 to rats fed a high-cholesterol diet promoted distinguished falls in

serum and liver cholesterol and triglycerides levels, and reduced lipid deposition in the cytoplasm of rat's liver tissue.

Conclusion

The balance of micro-biota in the intestine restored to mitigate GI problems and to relieve food allergy symptoms.GI and behavioural symptoms in ASD children can be modulated by probiotics, and some strains could be a potential probiotics to treat hyperlipidemia and can be used in functional food. More studies are required on assessing new strains of probiotics and their relevance in biomedical/clinical research.

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