

Probiotics: truths and illusions

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Nowadays, the field of probiotics has gained significant attention due to their important role in improving human health. Probiotics are live microorganisms that, when administered in adequate quantities, confer health benefits to the host. These microorganisms can be obtained through dietary supplements or certain fermented foods (1, 2). Numerous reports have been presented regarding the preventive and therapeutic properties of probiotics, and this subject has increasingly gained attention. A substantial number of articles are published worldwide, which provide basic information, while the quantity of human studies in this regard is limited. In this issue of the Iranian Journal of Microbiology, four articles are being published, occurring entirely by chance, and all of them refer to the benefits of probiotics, the three related to this commentary are mentioned below.

Our purpose in this commentary is to inform those who are interested in the field of microbiology, clinicians, food and pharmaceutical industries, and science and research policymakers that in addition to research and emphasis on the potential benefits of using and prescribing probiotics, more research should be done to evaluate their safety under *in vitro* and *in vivo* condition. This is crucial because without documented evidence of their use in human societies, advertised probiotic products are likely to be ineffective and may even have adverse effects. Therefore, it

is essential to invest in and conduct comprehensive research on probiotics across various phases and diverse populations.

Probiotics are beneficial to human health, among benefits the following can be mentioned: Many studies have shown the role of probiotics in gut health and their potential in the treatment of some specific digestive disorders, for example, the effectiveness of probiotics in improving symptoms of irritable bowel syndrome (3, 4), infectious diarrhea (5), and antibiotic-associated diarrhea (6) has been extensively studied. Furthermore, the role of probiotics in stimulating the activity of natural killer cells (7) and adjusting the balance of pro-inflammatory and anti-inflammatory cytokines has been shown in many studies (8, 9). Studies have also shown that probiotics affect brain function by producing neurotransmitters such as serotonin and gamma-aminobutyric acid (GABA) (10-12). Other research has also shown the usefulness of probiotics in weight loss (13, 14). Moreover, probiotics have shown a positive effect on respiratory tract infections (15). Also, the positive effects of probiotics have been shown in the prevention of allergic diseases such as allergic rhinitis (15). In addition, the antiviral effect of probiotics in the case of *Lactobacillus reuteri* (*L. reuteri*) on human herpes virus type 1 (HSV-1) has also been investigated (16). In another study, the adjuvant therapy potential of compounds derived

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from probiotics called postbiotics in colorectal cancer has been investigated (17). Also, some probiotic strains have been suggested as preventive factors and adjuvant therapy for kidney stones and nephrolithiasis (18).

On the other hand, there are some limitations to the prescription and consumption of probiotics which are discussed further. It is important to consider strain-specific probiotics because different strains may have various mechanisms and can depend on dosage (15, 19, 20). In addition, the lack of standard regulations in this field is important, and special attention should be paid to quality control standards to have a reliable probiotic product, research and articles in this field should be valued (21). Individual approaches to the use of probiotics may be important to achieve the desired results because several factors, such as genetics, and lifestyle affect the effectiveness of probiotics in humans (22).

Neglected yet significant issues. Although a lot of research has been done on the benefits of probiotics, it is necessary to check whether this claim is also possible in the conditions of the living organism and *in vivo*. For example, in the case of lactic acid bacteria, this challenge has been shown because it requires the survival of a large number of cells in the small intestine. Many probiotic bacteria are unable to tolerate difficult conditions such as oxygen conditions during distribution and low pH following fermentation (23).

Another important issue is that many of the claims presented by the manufacturers have not been confirmed and the issue of personalizing probiotics is also raised due to the different individual microbiota (24). It should be noted that research on acute diarrhea in children in developed countries has shown that probiotics have not had adequate clinical effect (5). The important point in prescribing probiotics is that it is not recommended for immunocompromised patients such as cancer patients, transplant recipients, pregnant women, and patients with artificial valves because probiotics are living organisms and there is a possibility of infection in these people (21, 25, 26). Also, research shows inaccuracy in the labeling of probiotic food products and it has been shown that the absence of bifidobacteria in these products makes the product ineffective (27). Some researches conducted on probiotics in Iran show the probiotic and technological potential of some strains. The main problem is the lack of *in vivo* tests to con-

firm their performance for human consumption (28, 29). The effects of probiotics on humans need to be investigated after their oral consumption, because the virulence may be falsely negative under *in vitro* conditions, but it changes under *in vivo* conditions and interaction with the host, which shows the importance of *in vivo* models and such simulations (30).

CONCLUSION

Further and complementary investigations are necessary to expand our findings in the field of probiotics. While there is promising evidence supporting their benefits for gut health, immune function, etc., more clinical trials are required to establish optimal strains, dosages, and treatment durations. Moreover, investigations and research should be continued on the potential interactions between different strains of probiotics, as well as their interactions with other medications or treatments. Continuous research across diverse disease contexts will contribute to a comprehensive understanding of probiotics. Insufficient knowledge and research in different stages of probiotic utilization, particularly within human communities where probiotic microorganisms interact with actual hosts, imposes limitations on their prescription. Therefore, it is imperative to conduct additional investigations and experiments to extensively explore the potential efficacy of probiotic microorganisms, particularly in *in vivo*. Due to the importance of probiotics in various aspects and public health, this commentary holds value for readers of this Journal.

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