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Probiotics: A Tool for Enhancing Calcium Absorption

Vijaysri, D[1*], Aishwarya, D[2] and Sai Srinivas, D[3]
[1]Division of Microbiology, ICAR-Indian Agricultural Research Institute, New Delhi, India-
110012
[2]Department of Dairy Engineering, Faculty of Dairy Technology Mohanpur, WBUAFS, Kolkata, West Bengal
[3]Department of Microbiology, School of Life Sciences, JSS Academy of higher education and
research, Mysore, Karnataka

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Abstract

Calcium is one of the essential nutrients required for the human body which plays a crucial role in various physiological processes, including bone health, muscle function, and nerve transmission. Adequate calcium absorption is vital for maintaining overall health. However, factors such as age, diet, higher phytic acids, higher pH, higher phosphorus, low vitamin D can affect calcium absorption and may lead to potential health issues. In recent years, research has increasingly focused on the probiotics and its role in enhancing calcium absorption. Probiotics are the live microorganisms that when administered in adequate amounts, confer health benefits on the host. These beneficial organisms are primarily associated with gut health but have also been linked to a range of other health benefits such as calcium absorption. Therefore, probiotics can be used as a promising tool for calcium absorption.

Introduction

Nutrients are necessary for the development and proper functioning of the body. Bio-availabilities of nutrients are of major concern rather than the supply of an adequate amount of nutrients through the diet (Dubey *et al.*, 2018). Probiotics are defined as “live microbes” that, when ingested in the right quantity, provide beneficial health function for the host (FAO/WHO, 2006). The era of probiotics began with Elie Metchnikoff at the beginning of 20th century who correlated the longevity of Bulgarians to their high consumption of fermented milk. He proposed that the acid producing bacteria in fermented milk products could avoid fouling in the large intestine and if consumed regularly lead to a longer, healthier life. Whereas, dietary

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prebiotics are non- digestible, selectively fermentable ingredients that results in specific changes in the composition and/or activity of the gastrointestinal microbiota, thus conferring benefits upon the host health (Gibson *et al*., 2010). These are known to increase helpful bacteria already present in the gut. Thus, reduces disease risk and improves general well-being.

Among many probiotic microorganisms, Lactic acid bacteria (LAB) is the most common group of organisms which are used as probiotics worldwide (Mathew *et al*., 2017). They constitute a primary component in fermentation starters, and some of them can also be found naturally in the microflora of gastrointestinal tract. LAB comprises of large and diverse group of Gram positive, non-spore forming, catalase negative bacteria which are considered as "generally recognized as safe" (GRAS) and can be safely used as probiotics (Schnurer and Magnusson, 2005). This comprises wide range of genera. They are usually present in a wide range of habitats like animals, fermented milk products and other food sources. These bacteria are commercially available in the form of dietary supplements (tablets, capsules, granules) and foods (curd, yoghurt, juices) (Milani *et al*., 2017). These organisms exhibit resistance to low pH and bile concentration and they also show inhibitory effect against other organisms by producing some organic acids and bacteriocins (Kailaspathy and Chin, 2000).

Potential probiotics and its characteristics (FAO/WHO, 2002).

1. Probiotics should be originated from humans or isolated from the same species as its intended host
2. It should be phenotypically and genotypically stable
3. It should be non-pathogenic
4. It should be capable to withstand the passage of gastrointestinal tract
5. It should be tolerant to bile and gastric acid
6. It must possess carbohydrate and protein utilization patterns
7. Should have Intestinal epithelial adhesion properties
8. Able to produce antimicrobial substances
9. It should be resistant to antibiotics
10. Ability to inhibit pathogens and spoilage organisms
11. On storage, large number of viable bacteria and should be capable to survive prolonged periods.

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12. Adherence to the mucosa of intestine is an important criterion for selecting probiotics since it is regarded as a fundamental requirement for colonization.

The ingestion of probiotics along with dietary regime neutralizes the stomach's acidity and enhances the survival rate of bacteria in the intestine. Probiotics provides many of essential nutrients, including proteins and calcium. Calcium is one of the most essential nutrients, about 99 % of calcium found in bone and teeth in the body and only 1 % is present in serum. In the adults who consumes calcium through food or supplements, the average absorption rate is approximately 30 %. The rate may vary widely because of multiple factors (Beto, 2015). It has been shown that adequate amount of calcium intake leads to reduced risk of fractures, osteoporosis and hypocalcaemia. But the bioavailability of calcium is inhibited by several factors like higher phytic acids, higher pH, higher phosphorus, low vitamin D (Dubey *et al.*, 2018).

The Probiotics shows significant role in improvement of calcium uptake and absorption. It increases the calcium bioavailability by different mechanisms and thus ensures the bone health and calcium level in the body. The probiotics produce short chain fatty acids, which increases the solubility of available calcium, simultaneously decreases the para-thyroid hormone level and minimizes the bone loss (Whisner *et al*., 2018). Cereal based diets are the richest source of calcium, but the available calcium is depressed by phytate. Probiotics produces an enzyme called phytases and it actively releases the depressed calcium and increase the availability of calcium at the site of absorption. Probiotics like *Lactobacillus* and *Bifidobacterium* increases the bioavailability of calcium in some foods with estrogenic activity *via* hydrolysis of glycoside bonds of estrogenic food in the intestines (Venken *et al*., 2008). Vitamin D plays an important role in regulating the intestinal metabolism and calcium absorption. Probiotics are associated with the synthesis of vitamins and increases the metabolism and absorption of available calcium. Some Probiotics like *Lactobacillus helveticus* produces the bioactive peptides like isoleucyl-prolyl-proline (IPP) and valyl-prolyl-proline (VPP) which may induce greater availability of Calcium (Martar *et al*., 1996).

It is known that oxidative stress stimulates osteoclast differentiation and leads to bone resorption. Probiotics like *Bifidobacterium longum* isolated from fermented broccoli can improve the periodontal antioxidant status by decreasing NF-kB gene expression and reduces the oxidative stress and the bone loss, ensuring the bone health. Probiotics leads to reduce

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intestinal inflammation and increase the bone mass density (BMD) and bone mineral concentration.

Hence an adequate intake of probiotic results in significant effect on bone health. Probiotics strengthen the bone and reduces the risk associated with bone loss and bone diseases *via* microbial production of metabolites or enzymes or synthesis of vitamins which are involved in calcium metabolism and are required for bone matrix formation.

References

Beto, J. A., 2015, The role of calcium in human aging. *Clin Nutr Res*., **4**(1): 1- 8.

Dubey, M. R. And Patel, V. P., 2018, Probiotics: A Promising Tool for Calcium Absorption. *Open Nutr. J*., **12**(1): 59-69.

FAO/WHO (2002), Guidelines for the evaluation of probiotics in food and health. Agricultural Organization of the United Nations and World Health Organization working group report.

FAO/WHO, 2002, Guidelines for the evaluation of probiotics in food and health. Agricultural Organization of the United Nations and World Health Organization working group report.

Food And Agriculture Organization (FAO); World Health Organization (WHO)., 2006, In: Joint FAO/WHO Working Group Report on Drafting Guidelines for the Evaluation of Probiotics in Food; Food and Agricultural Organization of the United Nations: London.

Gibson, G. R., Scott, K. P., Rastall, R. A., Tuohy, K. M., Hotchkiss, A., Dubert-Ferrandon, A., Gareau, M., Murphy, E.F., Saulnier, D. And Loh, G., 2010, Dietary prebiotics: Current status and new definition. *Food Sci. Technol. Bull. Funct. Foods.*, **7**: 1-19.

Kailasapathy, K. And Chin, J., 2000, Survival and therapeutic potential of probiotic organisms with reference to *Lactobacillus acidophilus* and *Bifidobacterium* spp. *Immunol. Cell Biol*., **78** (1): 80-88.

Matar, C., Amiot, J., Savoie, L. And Goulet, J., 1996, The effect of milk fermentation by *Lactobacillus helveticus* on the release of peptides during in vitro digestion. *J. Dairy Sci.*, **79**(6): 971-979.

Mathew, S., Vijay, S. And Potty, V. P., 2017, Assessment of Probiotic Potential of Lactic Acid Bacteria Isolated from Curd and its Application using Fruit Juice. *Int. J. Curr. Microbiol. App. Sci.*, **6** (1): 282-289.

Milani, C., Mangifesta, M., Mancabelli, L., Lugli, G. A., James, K. And Duranti, S., 2017, Unveiling Bifidobacteria biogeography across the mammalian branch of the tree of life. *J. Microb. Ecol.*, **11**: 2834-2847.

Schnurer, J. And Magnusson, J., 2005, Antifungal lactic acid bacteria as biopreservatives. *Trends Food Sci. Techol.*, **16** (1-3): 70-78.

Venken, K., Callewaert, F., Boonen, S. And Vanderschueren, D., 2008, Sex hormones, their receptors and bone health. *Osteoporos Int.*, **19**(11): 1517-1525.

Whisner, C. M. And Castillo, L. F., 2018, Prebiotics, bone and mineral metabolism. *Calcif. Tissue Int.*, **102**(4): 443-479.