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Editorial Open Access

Microbiological Connection to Our Food, Nutrition, Health, and Disease

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Editorial

With ever-increasing population, governments across the globe keep feeling the pressure of ensuring availability of food to their masses. Malnutrition has been plaguing a large part of the world population, particularly in the developing and under-developed world. Malnutrition also makes the victims more susceptible to different infections and physiological disorders. There are large scale social, economic, and political implications of failure of governments in tackling the problem of malnutrition. This problem is related to both quantity as well as quality of the food.

Microorganisms in the human gut are intimately associated with digestion and absorption of the food. The human gut microbiome has now been well demonstrated to have a strong connection to our health and disease. There are approximately 10^{14} microbial cells inside human gut, which weigh approximately 1 kg. These organisms provide a large array of benefits to their human host, such as protection from the allocthonous pathogens, synthesis of vitamins (e.g. vitamin K), aiding the host in breakdown of complex polysaccharides, etc. The gut microbiome is also able to communicate with the brain [1]. This communication across the gut-brain axis is a two-way process, wherein brain can send signals to the gut, and gut can also do the same to brain. Any imbalance in normal composition of the gut biota is likely to cause trouble to the host. This imbalance described as *dysbiosis*, can cause the host to suffer from conditions as mild as diarrhea to as serious as chronic irritable bowel syndrome (IBS), obesity, etc.

Increasing number of research papers are reporting connection of the gut biome to a variety of non-communicable diseases including diabetes, IBS, chronic constipation, Parkinson's disease (PD), etc. Scheperjans et al. [2] has reported that gut microbiota are related to Parkinson's disease and clinical phenotype. Abundance of Prevotellaceae in feces of PD patients was found by them to be reduced by 77.6%. The intestinal microbiota is now known to interact with the autonomic and central nervous system via diverse pathways including the enteric nervous system and vagal nerve.

Now, when several reports are indicating a strong link between the gut biota and health or disease, it is very clear that maintenance of a healthy gut biota is the key to good health. Composition of the gut biota is directly affected by what we eat, as that is what serves as the principal source of nutrition for these symbiotic organisms too. In this context the probiotics and the prebiotics assume a very important role. Consumption of the fermented food rich in probiotic strains (and their metabolites) may aid in maintenance of good health. However, the current array of microbial strains being used as probiotic strains is very limited, and largely comprises of the lactic acid bacteria (LAB) and *Bifidobacterium* spp. If in future specific probiotic strains can be developed with capacity to offer benefit in a specific disease condition, it will be a very useful breakthrough with potential widespread effect on the health of masses. With the number of births through cesarean section being increasing, more and more infants shall be born partially devoid of the normal biota, which otherwise they would have acquired from vaginal tract of their mothers. Thus, in future we shall have more children and adults requiring extragenous supply of health-promoting bacteria.

Prebiotics are the substances (mainly of plant origin) which are not digestible by the human host, but can be used by some of the gut bacteria, which are typically considered as 'good bacteria' (e.g. *Bifidobacterium*). Regular use of prebiotics may help in maintenance of a healthy gut biota. Consumption of pomegranate (*Punica granatum*) peel has been shown to modify gut microflora positively and helping reduce the intensity of inflammatory bowel disease [3]. Inulins and oligofructoses, present in a wide variety of plants are known to be effective prebiotics, as they are resistant to digestion by mammalian enzymes, but can be fermented by *Bifidobacterium* spp. and lactobacilli [4].

Vitamin B-12 deficiency is also one of those problems which can be managed with help of microorganisms. Human body does not synthesize cobalamin. As vegetarian diet is not a significant source of vitamin B-12, vegetarians are at an increased risk of its deficiency. Though vitamin B-12 supplements are available in the market in form of tablets and injections, in addition to being costly, they are part of the curative measures. We need to think of developing preventive measures against this vitamin deficiency. There are quite a few bacteria known to be capable of synthesizing vitamin B-12, however many of them being anaerobic, their laboratory handling and development of large scale fermentation processes using them is not so straightforward. If probiotic strains capable of vitamin B-12 synthesis can be developed for being incorporated in routine food items, their regular consumption can save a large portion of world population from vitamin B-12 deficiency.

There are many things which can be done to solve the problem of malnourishment, as well as for making the food more health-oriented. Effective use of probiotics and prebiotics for increasing the relative abundance of 'good bacteria' in the gut, is one of them. Ancient descriptions, such as those of *Panchgavya* in *Ayurved*, needs to be relooked in this context. However, any of these strategies will not create a great impact, if their use is limited as a curative/therapeutic measure. If full potential of these measures is to be reaped, then what is needed is that governments should come-up with an encompassing strategy for making the routine use of probiotics/prebiotics possible for the mass population. This can be achieved only if these prebiotics and probiotics are made part of our routine staple diet. Promotion of fermented foods with known health benefits at global level should be taken up. If microbiologically or otherwise produced vitamin B-12 can be used for routine fortification of our staple food (e.g. wheat flour), then the large population of vegetarians in countries like India can be

impacted positively towards a healthier future. As it has been done for iodine in salt, same needs to be done with vitamin A, vitamin B-12, etc. Some of the prebiotic substances can be tried as ingredients of our daily tea/curry powder spices. It is less likely that a healthy person with no apparent symptoms of any disease will go to the market specially for purchasing some probiotic/prebiotic food, and that is why it is necessary to make these beneficial agents part of our regular food. Even for probiotic strains, as they are not known to colonize the gut permanently, if their consumption is occasional, inclusion of them in some of our daily food-items needs to be taken up at international level. If the prebiotic/probiotic foods are continued to be sold as just another food-item and/or complementary therapeutic agent (e.g. those used for relief in diarrhea), and do not find routine use in our life, then their impact will remain limited only, despite their immense potential to benefit human health.

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