



Beneficial Microbiome

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Abstract

Microbiome (also called as Microbiota) is a group of trillions of different microbes having many thousands different types of species present in our body. Microbiome includes mainly bacteria but also has viruses, parasites and fungi. Microbiome is considered to be essential for the survival of the human body. Microbes are present almost throughout the body. However, these are dominant on the skin, nasal cavity, oral (buccal) cavity, reproductive tract (gonads), small and large (gut) intestine. Here, a brief discussion has been done on beneficial microbiome present on various parts of the body. Besides, a brief mention of probiotics and prebiotics has also been done.

Keywords: Microbiome; Microbiota; Skin microbiome; Buccal cavity microbiome; Reproductive tract microbiome; Gut microbiome; Probiotics; Prebiotics

Introduction

Microbiome is a group of trillions of different microbes present in our body which have many thousands different types of species. It is also called Microbiota. Microbiome is not consisted of only bacteria but also other lower organisms like viruses, parasites, fungi. The microbiome is much important for the healthy life and in fact for survival. So many different microbial species live in the body without troubling to each other (<https://www.hsph.harvard.edu/nutritionsource/microbiome/>). Although, microbes are present almost throughout the body including skin, nasal and buccal cavities, gonads but are more dominant in both small and large intestines.

All the microbes present in the body are not beneficial; some may be dangerous which cause harm to the body. The microbiome present in intestines is called 'Gut Microbiome' and it is beneficial. Much genetic diversity has been found in human microbiome and on comparison, it is found that no two human microbiomes are identical. It is also been observed that microbiome is also an important part of immunity and also affects the metabolism.

Den Besten et al. [1] showed that microbiome stimulates the immune system and also degrades the toxic food material. Besides, certain microbes within the microbiome synthesize certain vitamins and amino acids. It was mentioned that cyanocobalamin (Vitamin B12) is synthesized by microbes within the human body and is not synthesized by any plant or animal [2].

It has also been shown that microbiome also modulates drug interactions [3-5]. Microbiome is much beneficial for survival since it plays important roles for keeping daily routine functions smoothly. Some people have described symbiotic role of microbiome since humans require these microbiome for healthy living and to resist against colonization by exogenous pathogenic microbes and microbes require favorable environment on the human body to survive. The different microbes on or in the human body also adapt to the conditions/environment on these organs. Of course, there are chances of invasion of pathogenic microbes in immune compromised humans [6,7].

Skin microbiome

It has been found that *Bacillus subtilis* remains on human skin which is beneficial to human. It secretes a toxin named bacitracin which protects the skin from other microbes. It is shown that skin microbiome has role in telling the T cells to respond to pathogenic microbes [8].

Buccal cavity microbiome

It has been shown that *Streptococcus mutans* is present in buccal cavity. It releases bacteriocin to inhibit growth of harmful microbes. Actinomyces and *Lactobacillus* present in oral cavity produce acids which help in inhibition of growth of other harmful bacteria species [9,10].

Gut microbiome

Among the beneficial microbiomes, the most important is gut microbiome. It helps in digestion

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of the food and also has defense function against harmful microbes. If we talk of gut microbiome of infants, it depends on their delivery style. If delivered through vagina (normal mode of delivery), it has almost same microbiome as of mother's vagina which is enriched in *Lactobacillus* and *Prevotella*. Babies delivered via caesarian have dominance of mother's skin microbiome. In this case, gut microbiome is enriched in *Staphylococcus*, *Propionibacterium* and *Corynebacterium* [5,11]. Infants who survive on formula milk/food have difference in gut microbiome compared to those on breast fed. There are certain arrays of sugars found in mother's breast milk and these sugars are not degraded by the infant. These are the microbes present in gut microbiome which degrade these sugars. Some people raise the question that from where microbes come in the gut. It is considered that when baby is in the uterus of the mother, his gut is free from microbes. When baby passes through the birth canal at the time of delivery, it gets microbes from the mother. However, these microbes are much beneficial for survival after birth. On an average, babies after the age of 2.5 years to 3 years have similar microbiome as of adults. Depending on birth mode and/ or feed mode, gut microbiome may be dominant in *Firmicutes* or *Bacteroidetes* [4,12].

It has been considered that diet also contributes in deciding the composition of gut microbiome in addition to genes, surrounding atmosphere, medicines consumed. Persons consuming fiber enriched diet will have microbes in gut which secrete fiber hydrolyzing enzymes to digest fiber. On fermentation of dietary constituent, if acid is released, there will be lowering of gut pH resulting inhibition of harmful microbes like *Clostridium difficile*. On fermentation of fiber enriched diet, there is release of short chain fatty acids which help in stimulation of immune cell activity and also play role in maintaining blood glucose and cholesterol levels.

Recently, Scheiman et al. [13] carried out meta-omics analysis of elite athletes. They showed that gut microbiome has correlation with human health and diseases. They showed that elite athletes have a bacterium, *Veillonella atypical* and presence of this bacteria is linked with the exercise performance. There was an increase in the level of this bacteria in marathon runners. They inoculated mice with this bacteria and found that these inoculated mice had more exhaustive treadmill run time. It has been correlated that during exercise, there is formation of lactic acid due to limited oxygen level. This bacteria is capable of converting lactate into propionate. On giving propionate to mice by intrarectal instillation, they showed increased treadmill run time. They suggested that performance of athletes may be improved by *Veillonella atypical* by a natural microbiome encoded enzymatic process.

Reproductive tract (Gonads) microbiome

Another important beneficial microbiome is of reproductive tract. It is considered that healthy microbiome present in the reproductive tract plays an important role in successful reproduction. Microbiome present in reproductive tract plays an important role in gametogenesis, pregnancy and delivery of infants. It is also reported that composition and density of reproductive microbiome varies depending upon the age. Many vaginal diseases viz. bacterial vaginosis, sexually transmitted diseases, human immunodeficiency virus, urinary tract infection etc. are taken care of by the reproductive tract microbiome [14].

Various *Lactobacillus* sp. present in the microbiome on vagina are important since these produce lactic acid which decreases the pH in the vicinity and these bacteria also produce bacteriocidal and

bacteriostatic agents. The density of these bacteria changes depending upon the conditions. For example, during menstruation when there is increase of *Gardnerella vaginalis*, there is increase in density of *Lactobacilli*. The constitution of reproductive tract microbiome also varies in different ethnics, racial groups and geographical areas [5,15].

Probiotics

Nowadays, with awareness of beneficial microbiome/microbes, people take 'probiotics'. Probiotics word has been used to indicate live beneficial bacteria which people take orally. These are either in the form of food having natural microbiome or supplement pills having live bacteria. The best examples of food with natural microbiome are curd, yogurt, cheese and other dairy products [5]. It has been estimated that there is billions of dollars market worldwide of probiotics which is increasing day by day. It has been considered that probiotics are beneficial during stress period of the body. For example, probiotics may be helpful in reducing the severity of diarrhea. The probiotics also help in replacing normal gut microbiome after a sick person takes antibiotics. Although many healthy persons take probiotics thinking that these will be beneficial to him/her, however, these probiotics may not be as beneficial as in a patient on antibiotics (<https://www.hsph.harvard.edu/nutritionsource/microbiome/>).

Prebiotics

There is a term 'prebiotics'. These are the substances capable of feeding beneficial microbiome and these include indigestible carbohydrates and fibers viz. pectins, gums, resistant starches, fructosans etc. Some examples of foods enriched in prebiotics are Jerusalem artichokes, onions, garlic, asparagus, banana, seaweed, whole grains.

Conclusion

Although many researches are in progress on microbiome, there is still much scope of more researches in this field. The topic is directly related to human health.

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