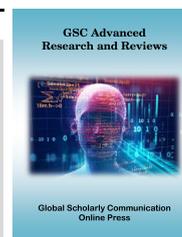


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(REVIEW ARTICLE)

## Gut bacteria and human body; a mini review

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### Abstract

Mammalian gastrointestinal tract is inhabited by microbiota right from the birth to old age. This microbial community is host specific and plays a major role in maintaining host physiology, nutritional status and stress response. Human body is inhabited by  $10^{14}$  microorganisms in gastrointestinal tract with higher number of gram-positive *Firmicutes* and the gram-negative *Bacteroidetes*. Major amount of gut flora are present in colon part where as stomach bear the smallest amount. Balance between body and the resident bacterial population is very important from health point and if disturbed, it can result into various kinds of disease. This review article will highlights the association of microbiota with the human body along the gastrointestinal tract starting from the mouth, esophagus, stomach, and intestines.

**Keywords:** Gut microbiota; *Firmicutes*; *Bacteroidetes*; Gastrointestinal tract

### 1. Introduction

The gut microbiota acts as ecosystem in maintain the homeostasis in host body right from the birth to old age [1-3]. Colonisation in gut of infants starts immediately after birth and its pattern depends mainly on milk feeding type (breast versus formula) and mode of delivery (birth canal versus caesarean section). This stage of life is very important as the pattern of permanent flora in adults depends significantly on colonization pattern at infant stage. Usually gut microbes are nonpathogenic, colonized from mouth to colon, and are mainly involved in regulating metabolism in host body as they are involved in many physiological processes like strengthening intestinal epithelium, immunity, harvesting energy and even giving protection against pathogens [4,5]. Human body inhabits by almost  $10^{14}$  microorganisms in gastrointestinal tract (GI tract) with the estimated ratio of 1:1 to human: bacterial cells [6]. The quantity and the composition of gut flora changes along the GI tract and strictly depend on the functions performed at the various parts in body [7-10]. Majority of gut flora consists of *Firmicutes* and *Bacteroidetes* which are gram-positive and the gram-negative bacteria respectively and constitutes about 90% of the gut phyla. However bacteria such as *Actinobacteria*, *Fusobacteria Verrucomicrobia*, *Proteobacteria*, and *Cyanobacteria* are present at subdominant levels [11]. Upper parts of the GI tract like mouth stomach and small intestine have low number of bacteria as compared with colon which consists of high number of bacteria [12].

#### 1.1. Mouth

Mouth is the major gateway of human body and consists of highly diverse microbiota with almost 600 bacterial species and serves as a primary digestive organ where breakdown of dietary carbohydrates and lipids takes place [13]. Diet and personal hygiene plays a very important role in maintain the normal flora in mouth [13-15]. As compared to other parts of the GI tract, mouth has easy access to pathogenic bacteria but it hardly catches infection due to presence of highly effective host-defense mechanisms [16, 17]. Salivary glands and epithelial cells in the mouth continuously secrete mucosa with antibacterial properties [18]. Food is chewed and mixed with saliva before entering to stomach.

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Saliva contains the microbial communities adhered to tooth, gingival crevices, and tongue dorsum [19]. Usually the oral bacteria present in saliva in planktonic state are not responsible for oral diseases but transmission of pathogenic bacteria within the mouth is mediated by saliva and can cause a number of oral infectious like tooth decay, periodontitis and tonsillitis [20,21]. Mutans *streptococci* stands for the primary etiologic agent for dental caries and tooth decay whereas *Porphyromonas gingivalis*, *Tannerella forsythia* and *Treponema denticola* infection leads to periodontitis [22, 23]. Microbes present in the saliva plays a significant role in host's health status. Microbes present in saliva are mixture of bacterial populations that exist at various sites in the oral cavity, although its community composition is most similar to the tongue microbiota [24-26]. Saliva plays a major role in maintaining the oral health by provide the primary nutrient's required for the development of a balanced microbiome [27, 28]. Salivary components like immunoglobulin A, lactoferrin, lactoperoxidase, lysozyme, statherin and histatins helps in maintaining the balanced microbes in mouth [29]. Oral health is mainly depend on symbiosis which depends on the complex equilibrium between resident species and if this equilibrium is disturbed it can result into disease or dysbiosis [30]. Many factors like dysfunction of salivary glands, poor oral hygiene, gingival inflammation, dietary habits and smoking can result in oral dysbiosis [31, 32].

### 1.2. Esophagus

The esophagus is approximately 25 cm long tube, responsible for transferring food from the pharynx to the stomach. Its internal mucosa is wet with saliva with pH 7 and mostly contain stratified squamous epithelial layer. As compared to other parts of gastrointestinal tract esophagus mucosa hosts a smaller population of microbes. Human esophagus flora is almost similar to what is present in mouth cavity [33]. Esophageal microbiome mainly constitute of bacteria and yease [34]. Usually the normal esophagous is dominated by *Streptococcus* spp in addition to low proportion of *Prevotella*, *Fusobacterium*, and *Veillonella* spp [35]. Heightening of some Gram-negative strains like *Veillonella*, *Prevotella*, *Haemophilus*, *Neisseria*, *Campylobacter*, and *Fusobacterium* in this region can results in gastroesophageal reflux disease and even in esophageal precancerous lesion. Overgrowth of *Campylobacter* species can also contribute towards the occurrence of adenocarcinoma [36].

### 1.3. Stomach

Normally the healthy stomach is sterile due to its pH less than 2 where most of the microbes cannot survive. Very few bacteria like *Streptococcus*, *Staphylococcus* and mainly acid-tolerant *lactobacilli* can be cultured from the normal stomach [37]. Also *helicobacter pylori* can colonizes in the gastric mucosa of humans. In some cases its infection can develop serious disease including duodenal ulceration and gastric cancer [38].

### 1.4. Intestine

The number and type of bacteria in small intestine vary with the region; the proximal part mainly has Gram-positive flora among which lactobacilli and *Enterococcus faecalis* predominate with around  $10^5$ -  $10^7$  bacteria per ml of fluid. The number of bacteria gets increased in digital part with around  $10^8$  bacteria per ml with some additional bacteria's including coliforms (*E. coli*) and bacteroides, in addition to *lactobacilli* and *enterococci*. When we move to large intestine also known as colon; its flora is qualitatively similar to feces. Colon has high number of bacteria as compared to small intestine and is almost  $10^{11}$  per ml of feces. Predominant species found in this region constitute of Coliforms, *enterococci*, *clostridia* and *lactobacilli* with very high number of anaerobic Bacteroides and anaerobic lactic acid bacteria in the genus *Bifidobacterium* [39]. The gut flora of intestines plays a very important role in protective and metabolic function of the body. Inhabitant flora act as central line of resistance to colonization by exogenous microbes and prevent intestinal mucosa from incoming pathogen. Adherent nonpathogenic bacteria are able to prevent the attachment and entry of pathogens into epithelial cells. Also they compete for available nutrients in ecological niches and thus maintain the collective microenvironment [40]. Some of the important vitamins such as vitamin K and some B vitamins like folate, B12, and biotin are synthesized by intestinal flora which include *Bacteroides*, *Eubacterium*, *Propionibacterium*, and *Fusobacterium* [41-43]. Colonic micro flora are also involves in fermentation of nondigestible carbohydrates like resistant starches, pectins, and cellulose in addition to some oligosaccharides that escape digestion and are metabolized to short-chain fatty acids as an end product in the process [44-46]. These sugars are mainly converted to acetate, propionate, and butyrate. All these fatty acids play a major role in stimulate epithelial cell proliferation and differentiation in the colon [44-48].

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## 2. Conclusion

Human body consists of two kinds of bacteria, beneficial and harmful. Healthy body holds balanced and useful bacteria dominate. A beneficial bacterium is able to produce some essential vitamins and organic acids in host body gut and thus

plays a major role in prevention of disease. These nonpathogenic gut microbes are involved in many physiological processes in body and are colonized right from mouth to colon to keep the body healthy.

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## Compliance with ethical standards

### *Disclosure of conflict of interest*

The authors declare that they have no competing interests

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