Abundance and distribution of mucosa-associated sulfate-reducing bacteria and methanogenic archaea in the healthy colon and in inflamed and non-inflamed tissues of IBD patients

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Stool samples have been used extensively for gut microbiota composition studies, but they do not adequately represent the mucosa-associated microbiota. An even greater challenge is to characterize low abundant microbial communities from colonic tissues such as hydrogenotrophic microbiota. Here, biopsies from healthy and inflammatory bowel disease (IBD) patients were used to examine the mucosa-associated sulfate-reducing bacteria (SRB) and methanogenic archaea (MA), which have been linked to chronic inflammation and intestinal homeostasis, respectively. The abundance of the two groups was quantified through qPCR targeting the functional genes dissimilatory sulfite reductase ($dsrA$) and methyl-coenzyme M reductase ($mcrA$). Sulfate-reducing bacteria were ubiquitously associated with the colonic mucosa in right colon, left colon or rectum of twenty-four healthy subjects. The abundance of SRB was similar among colonic regions ranging from $1.1 \times 10^3$ to $6.9 \times 10^{16}$ gene copies.g$^{-1}$. On the other hand, twenty of the twenty-four subjects harbored significant $mcrA$ gene copy numbers in at least one colonic region ranging from $1.1 \times 10^3$ to $1.5 \times 10^{11}$ gene copies.g$^{-1}$. The two functional genes were detected more often in rectum than right-colon and left-colon. These data indicate that there may not be a direct correlation between the presence of mucosal MA and detection of breath methane since detectable breath methane concentrations greater than 1 ppm have historically been detected in 30-60% of Caucasians, which comprised our subjects. Among these 24 subjects, 5 provided replicate biopsies less than 1 cm apart. Variable $dsrA$ and $mcrA$ quantities were detected for most of the replicates indicating the likelihood of microheterogeneity in mucosal hydrogenotrophs. Biopsies of inflamed and adjacent non-inflamed tissue from 3 Crohn’s disease and 2 ulcerative colitis patients were compared for $dsrA$ abundance. A greater abundance of $dsrA$ was detected in inflamed tissue (4 of 5 patients), consistent with the proinflammatory properties of hydrogen sulfide, the end product of sulfate respiration. Together the data confirm the prevalence of both SRB and MA in colonic mucosa of healthy subjects and are consistent with a possible influence of SRB on chronic inflammation.

Keywords: Sulfate-reducing bacteria, Methanogenic archaea, Crohn’s disease, Ulcerative colitis, Colonic biopsies