INTRODUCTION & AIM: Upon ingestion of dietary lipids, significant amounts of glycerol may reach the colonic microbiota intact. In an anaerobic environment glycerol is typically transformed into 1,3-propanediol with 3-hydroxypropanal (3-HPA) as intermediate. In solution, 3-HPA is part of the HPA-system, also known as reuterin. Reuterin may have significant health-modulating effects that range from a broad antimicrobial activity to (geno)toxicity as it can chemically bind biological molecules in the gastrointestinal tract. Only a few species are known to have the tools for this fermentation process. Although all of them are numerously present in the gastrointestinal tract, the glycerol metabolism has barely been studied in mixed cultures of the human colonic microbiota.

MATERIALS & METHODS: Fecal samples were obtained from 10 healthy volunteers. Upon homogenization, 10 g/L yeast extract was added, resulting in a final dilution of the inoculum of 1 to 15. All fecal samples were either incubated without and in the presence of 150 mM glycerol and samples were collected after 0h, 24h, 48h and 72h for quantitative analysis of SCFA, lactate, glycerol, HPA and 1,3-PDO. DNA was extracted from the samples at 0h and 72h and qualitative changes in the total bacterial community were investigated using PCR-DGGE. For integrated data analysis Principal Component Analysis (PCA) was performed on metabolic parameters, microbial community parameters and on the combination of both.

RESULTS & DISCUSSION: For all data sets, PCA resulted in a clear separation of the treated and the untreated incubations, demonstrating that the addition of 150 mM glycerol significantly altered the fecal microbial metabolism and community composition. Combined and metabolic PCA showed a decreased concentration of branched SCFA due to glycerol treatment, which is indicative of a more saccharolytic and thus more healthy metabolism. Furthermore, treated samples were grouped together according to their glycerol consumption. In 3 out of 10 treated samples all glycerol was consumed after 24h. This complete and fast glycerol consumption resulted in a significantly higher total SCFA concentration, originating in a higher absolute acetate production. Moreover, a remarkably higher 1,3-PDO production was found in these samples. The other samples were characterized by a slower glycerol consumption, resulting in an increased propionic acid and/or butyric acid concentration. While higher propionic acid levels increase satiety through stimulation of the hormone leptin and result in lower serum cholesterol by preventing de novo lipogenesis, higher butyric acid levels protect against the development of colorectal cancer. The colonic metabolism of glycerol could thus play a role in the occurrence of obesity, associated cardiovascular diseases and colon cancer. Microbial community PCA also demonstrated an effect of the glycerol treatment, by grouping all treated samples separated from the untreated samples. Interestingly, treated samples clustered close together while untreated samples were scattered on the plot indicating a directional effect of glycerol to certain bacterial species in the fecal microbial community. Although often overlooked, glycerol and its metabolism by the human colon bacteria could play an important role in the general health status of the host. Excessive consumption of glycerol through lipid rich diets may disrupt the normal glycerol metabolism in the colon and thus alter the aetiology of typical prosperity diseases, such as colon cancer and obesity.