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Spices and Gut Microbiome-First Links

Mini Review

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Mini Review

The intestinal microbiome is increasingly in focus of interest as a new therapeutic target [1].The mutualism between humans and microbes protects against disease and helps to adapt to different environmental conditions. Conversely, it is assumed that an imbalance in this relation (dysbiosis) contributes to the development of diseases such as diabetes mellitus, chronic inflammatory bowel diseases or autoimmune diseases. Conceptually, it is assumed that the immune processes triggered by the pathologically altered intestinal microbiome are essential for the development of the disease. The diversity of the microbiome is discussed as a marker for a healthy lifestyle. Modern lifestyle changes and diets can alter the composition and metabolic activity of the human microbiome [2,3]. Omic technologies allow us to better understand extrinsic factors affecting our microbiome. Thus, it could be shown that a change in diet has a significant reversible effect on microbial gene expression [4,5].

In this context, it seems likely that spices also alter physiological processes by influencing the gut microbiome. To date, however, there are only few scientific data on this. We would like to briefly summarise these data in this mini-review.

Curcuma longa (turmeric) and curcuma extracts

Curcuma longa (turmeric) and curcuma extracts are increasingly used for health purposes worldwide [6]. In addition to an antioxidant effect, curcuma is associated with anti-inflammatory, antimicrobial and antiproliferative effects. The likely active ingredient curcumin has a low bioavailability. After oral ingestion, 75% is excreted in the faeces. Even in high doses of up to 8g/day, no relevant plasma levels can be detected. This indicates a low metabolism in the gut and a probably high first-pass mechanism in the liver [7]. Interestingly, other natural substances, such as piperine, a component of black pepper, can improve bioavailability [8]. How this contributes to the biologic effects remains unclear.

Although its bioavailability is low, curcumin shows some marked clinical effects in humans. Curcumin has been studied in various clinical conditions (such as inflammatory or cardiovascular diseases) in more than 100 clinical studies; these, however, showed heterogeneous results [9].

The paradox between clinical efficacy and low bioavailability could be explained by an indirect effect, by modulation of the gut microbiome. Several animal studies have already shown that curcumin changes the microbiome towards more *bifidobacteria, lactobacilli* and butyrate-producing species [10,11]. However, human data are sparse. Peterson et al. examined the effect of curcuma longa in 30 healthy volunteers in an 8-week placebo-controlled study. Changes in the microbiome were individually variable, but showed an overall average increase of 69% in detected species [12]. Peron et al. recently showed that curcumin had a significant effect on urinary metabolites in healthy volunteers. The metabolome parameters in urine after a 28-day treatment showed a clear shift towards increased fatty acid synthesis and anti-inflammatory metabolites [13].

Although these data are still preliminary, they indicate that curcumin might alter the gut microbiome, which would at least partially explain its clinical effectiveness.

Capsaicin (chilli peppers)

Capsaicin is an active component of chilli peppers. It has been linked to analgesic, anti-inflammatory, antimicrobial, antiproliferative and cardioprotective properties. A smaller study in humans have shown that capsaicin can alter the ratio of *Firmicutes* to Bacteroides and increase the relative abundance of *Faecalibacterium prausnitzii* [14]. A lack of *Faecalibacterium prausnitzii* has been associated with the development of inflammatory bowel disease, diabetes and asthma.

Animal studies have demonstrated that capsaicin can increase Akkermansia muciniphila [15]. *Akkermansia muciniphila* has been implicated in a preventive role in obesity, diabetes and asthma. The gut microbiome-modulating effect of capsaicin has, however, also been attributed to its antimicrobial activity, as demonstrated in vitro [16].

Ginger, long and black pepper

In addition to publications on curcumin and capsaicin, there are also some data showing an influence of other herbs and spices on the human gut microbiome. Peterson et al. were able to show in 12 volunteers that ginger (*Zingiber officinale*), long pepper (*Piper longum*) or black pepper (Piper nigrum) can have a microbiome-modulating effect and that, in this very small group, they clearly led to intraindividual shifts in microbiome composition [17]. In a similar publication, the same group showed that liquorice (*Glycerrhiza glabra)*, slippery elm (*Ulmus rubra*) and the triphala, used in traditional Ayurvedic medicine, may have also microbiome-modulatory properties [18].

Summary

It is well known that lifestyle and diet can affect the composition of the microbiome. It is therefore reasonable to assume an influence of herbs and spices on the composition of the intestinal bacteria. Although overall, human data are sparse, there are at least some small studies on curcumin and capsaicin that indicate such a link. It will be exciting to see how future studies will reveal further effects of the spices we eat every day on our microbiota, and thus on our health and well-being.

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