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Biofunctionality of soya bean tempe

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Introduction: Diarrhoea is a major health problem worldwide, in adults but particularly during the weaning period of infants as well as of farm animals such as piglets.

Research indicated that tempe (fungal fermented soya bean) reduces the severity of E. coli induced diarrhoea in piglets (Kiers et al., 2003). This phenomenon can be explained by a decrease in adhesion of ETEC K88 to intestinal epithelial cells (Roubos-van den Hil et al., 2009). Nowadays research is performed to elucidate the mechanism of action and the chemical component(s) that are responsible for this anti-adhesion effect.

Materials and methods: Tempe was prepared at controlled laboratory scale. Soya beans were soaked overnight, cooked, cooled by evaporation of adhering water, inoculated with Rhizopus microsporus var. microsporus (LU 573) and incubated for 48, 72, 96 and 120 h at 30°C. Water soluble extracts were prepared and tested for their adherence to piglet brush border cells and Caco-2 human intestinal epithelial cells. Brush border cells were used to test get insight in the working mechanism. Furthermore, size exclusion and anion exchange chromatography were performed to partly purify the active component. Purified extracts were treated with enzymes for further characterization.

Results: Treatment of brush border cells with ETEC and tempe extracts resulted in an adhesion inhibition of more than 80%. Treatment of Caco-2 cells resulted in an inhibition of adhesion to about 50% for the tempe extracts compared to a control without added soya bean extract. Treatment of brush border cells with tempe pre-treated E. coli showed an adhesion inhibition even after a washing step of the tempe extract, which suggests an interaction between tempe and ETEC, that prevents brush border cells for ETEC adhesion.

With size exclusion chromatography the active part of tempe is found in the intermediate part of the chromatogram. This active fraction did not bind to an anion exchange column and was not broken down by protease enzymes, which suggests it to be of a carbohydrate nature. After hydrolysis the monossacharides composition of the active fraction contains mainly arabinose, galactose and mannose.

Conclusions:

1. Tempe extracts protect against the adhesion of ETEC K88 to pig intestinal brush borders and human Caco-2 intestinal epithelial cells.
2. The working mechanism may be explained by the adhesion of tempe to the E. coli cells.
3. Chemical treatments suggests that the active component is a carbohydrate.

References

Kiers, J.L., Meijer, J.C., Nout, M.J.R., Rombouts, F.M., Nabuurs, M.J.A., Van der Meulen, J., 2003, Effect of fermented soya beans on diarrhoea and feed efficiency in weaned piglets. Journal of Applied Microbiology 95, 545–552.

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