INFLUENCE OF INULIN ON GUT MICROFLORA AND MINERAL EXCRETION AMONG FORMULA-FED INFANTS

By

YAP KENG WAI

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Science in the Faculty of Food Science and Biotechnology, Universiti Putra Malaysia

January 2005

Specially dedicated to my parent, Mr. & Mrs Yap Khim, my sister, Keng Lai, my fiancé, Mr. Loh Zhi Ming
and last but not least to all my lecturers and friends….

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirements for the degree of Master of Science

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Chairman : Professor Suhaila Mohamed, Ph.D.

Faculty : Food Science and Biotechnology

Inulin, also known as fructooligosaccharide is increasingly used in human food preparations. *In vitro* they have been shown to selectively stimulate the growth of *Bifidobacterium* as well as mineral absorption. Hence, the present study was designed to investigate the effects of three different concentrations of inulin in 36 healthy formula-fed infants aged between 6 and 12 months. A complete randomised design was used to investigate the bifidogenic effect of inulin in enhancing mineral absorption, namely, calcium, iron, magnesium, zinc and copper. The formula-fed infants were grouped into three groups where they received 0.75 g/d, 1.00 g/d and 1.25g/d, while another group of infants acted as control. All the bifidobacteria faecal isolates were tested and characterised using biochemical test and API20, a genus level test kit. The balance method was opted for mineral balance study. Total blood cholesterol levels were determined to investigate the correlation between inulin intake and total cholesterol level in healthy infants. All the three concentrations of inulin studied were found to

significantly ($P < 0.05$) promote *Bifidobacterium* growth by inhibiting potential pathogenic microorganisms. With 1.25 g/d of inulin, a significant ($P < 0.05$) decline in Gram-positive cocci and coliform counts and a significant ($P < 0.05$) increase in *Bifidobacterium* count were observed. The increase in inulin consumption also exhibited a greater significant ($P < 0.05$) difference in pH value. Higher production of short-chain fatty acids as a result of colonic fermentation was observed and therefore, contributing to the reduction of colonic pH. The inulin supplementation has significantly ($P < 0.05$) improved the absorption of Fe and Mg while no significant ($P > 0.05$) improvement of the absorption of calcium, copper and zinc were observed. The total cholesterol level was not affected by the three levels of inulin supplementation.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

KESAN PENAMBAHAN INULIN DALAM PEMAKANAN BAYI KE ATAS MIKROFLORA USUS DAN PENYINGKIRAN MINERAL DIKALANGAN BAYI YANG MEMINUM SUSU FORMULA

Oleh

YAP KENG WAI

Januari 2005

Pengerusi: Professor Suhaila Mohamed, Ph.D.

Fakulti: Sains Makanan dan Bioteknologi

Inulin atau dikenali dengan frukto-oligosakarida kini digunakan secara meluas dalam penyediaan makanan manusia. Secara *in vitro*, ianya digunakan untuk menggiatkan peningkatan spesis *Bifidobakterium* dan penyerapan mineral secara terpilih. Maka, kajian ini direkabentuk untuk mengkaji kesan 3 dos inulin yang berlainan terhadap microflora usus dan penyerapan mineral dalam 36 bayi berumur dalam lingkungan 6-12 bulan. Rekabentuk eksperimen secara rawak lengkap telah dipilih untuk mengkaji kesan bifidogenik inulin dalam meningkatkan penyerapan kalsium, zat besi, magnesium, zink dan kuprum. Subjek bayi yang terlibat dibahagikan kepada tiga kumpulan di mana mereka diberi dos inulin sebanyak 0.75g/hari, 1.00g/hari dan 1.25g/hari bersama sekumpulan bayi yang lain bertindak sebagai kawalan. Kesemua bifidobakteria yang dipencilkan diuji dan dicirikan menggunakan ujian biokimia dan peralatan ujian AP120 A sehingga peringkat genus. Kaedah pembelajaran nutrisi secara klasik - kaedah yang seimbang dipilih untuk pengkajian keseimbangan mineral. Jumlah kolestrol darah

diambil daripada kajian terkini untuk menyiasat kesan pengambilan inulin ke atas jumlah tahap kolestrol bagi bayi sihat. Kesemua ketiga-tiga tahap inulin yang dikaji adalah untuk menggalakkan pertumbuhan *Bifidobakterium* dengan pengurangan potensi mikroorganisma patogenik seperti jumlah bakteria anaerobik dan klostridia secara signifikasi ($P < 0.05$). Semasa pemakanan inulin 1.25g/hari terdapat pengurangan dalam gram positif kokki dan kolifom secara signifikasi ($P < 0.05$). Peningkatan penggunaan inulin juga mempamerkan perbezaan signifikasi yang lebih besar ($P < 0.05$) bagi nilai pH. Peningkatan yang lebih tinggi dalam pengeluaran asid rangkaian pendek daripada fermentasi kolon mungkin sebab utama pH kolon mempamerkan perbezaan signifikasi ($P < 0.05$) dengan peningkatan penggunaan inulin. Peningkatan penyerapan ferum dan magnesium secara signifikasi ($P < 0.05$) juga diperolehi manakala tiada peningkatan ketara pada penyerapan kalsium, kuprum dan zink. Tiada pengurangan kolesterol jumlah secara signifikasi ($P < 0.05$) diperolehi.

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To all the parents that had put their most precious trust in me by participated in the research; I would like to express my deepest appreciation. Without your participation, I would not have completed the research successfully. Thank you so much!

I certify that an Examination Committee met on **12 January 2005** to conduct the final examination of **YAP KENG WAI** on her **Master Science Degree of Food Microbiology & Food Safety** thesis entitled "**INFLUENCE OF INULIN ON GUT MICROFLORA AND MINERAL EXCRETION AMONG FORMULA-FED INFANTS"** in accordance with Universiti Putra Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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This thesis submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of Master of Science. The members of the Supervisory Committee are as follows:

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DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

_____

YAP KENG WAI

Date:

TABLE OF CONTENTS