行政院國家科學委員會專題研究計畫　成果報告

蒟蒻纖維補充劑對人體腸道生理及生態調節作用之探討

計畫類別：個別型計畫
計畫編號：NSC93-2320-B-040-043-
執行期間：93 年 08 月 01 日至 94 年 07 月 31 日
執行單位：中山醫學大學營養學系

計畫主持人：陳曉鈴
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計畫參與人員：劉燕居　劉淑媛　吳文慈

報告類型：精簡報告

處理方式：本計畫涉及專利或其他智慧財產權，2 年後可公開查詢

中　華　民　國 94 年 9 月 22 日

行政院國家科學委員會補助專題研究計畫成果報告

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計畫類別：☑個別型計畫　　□整合型計畫
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計畫主持人：陳曉鈴

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執行單位：中山醫學大學

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一、中文摘要

目的:本實驗探討蒟蒻纖維補充劑對便秘成人排便習慣及腸道生態之調節作用。
方法:我們進行單盲安慰劑控制飲食(高脂, 提供 35%能量及低纖,約 5 g 纖維/1000 kcal 能量)之人體實驗，基礎期、介入適應期、介入期(4.5 g/d 蒟蒻精粉)各為 21 天、7 天及 21 天,參試者每天紀錄腸道生理現象及糞便重量，基礎期前及每時期之最後一天收集空腹血液樣品之外，亦於基礎期前及每時期之最後 7 天收集糞便樣品。我們分析腸道生理及排便特性包括排便頻率、排便容易度、脹氣等、糞便特性如糞便重、濕份、pH、糞便細菌及未消化組成份重量及糞便短鏈脂肪酸濃度，以螢光原位雜交技術分析糞便中菌相消長情形。
結果: 參試者在服用蒟蒻纖維補充劑 3 週後排便次數及容易度及糞便乾重顯著增加。蒟蒻纖維補充劑使糞便中 lactobacilli 濃度增加、每日糞便中 bifidobacteria, lactobacilli 及總菌數上升。蒟蒻纖維增加大腸發酵產物短鏈脂肪酸並有效降低糞便酸鹼值。
關鍵詞： 蒟蒻、排便特性、菌相、腸道生態、便秘成人

Abstract

Objectives: This study was designed to examine effects of konjac glucomannan (KGM) supplement on the bowel habit in 7 constipated subjects. In addition, this study explored mechanisms by which KGM exhibited the laxative effect.

Methods: The placebo-controlled, diet-controlled, linear study consisted of a 21-d control period, a 7-d adaptation period, and a 21-d KGM period. The gastrointestinal response was monitored daily. Stools were individually collected on days 15-21 of control and KGM periods for analyses of the fecal components, microflora and short chain fatty acid contents.

Results: Consuming KGM supplement for 3 wk significantly enhanced the defecation frequency, easiness of bowel movement and the feeling of relief as compared to the 3rd wk of control period. This fiber supplement significantly increased the dry stool weight (g/d) by ~12.7%. The increased fecal mass was mainly contributed by the increase in the fecal soluble material. However, the stool wet weight and moisture ratio (%) did not differ between the control and KGM periods. KGM supplement modulated the microflora by promoting the fecal concentrations (log counts/g wet feces) of lactobacilli, and the daily outputs (log counts/d) of bifidobacteria, lactobacilli and total bacteria. KGM supplement resulted in greater fermentation as shown in greater fecal acetate, propionate and *i*-butyrate concentrations and lowered fecal pH.
Keywords: glucomannan, bowel movement, microflora, short chain fatty acid, constipated

二、緣由與目的

緣由: 至今無人探討蒟蒻腸道功能及預防致癌因子產生之機制。根據前人及本實驗室研究結果推論，蒟蒻雖為水溶性纖維卻有促進正常動物及人體之腸道蠕動及排便容易度之作用，因此極有可能使慣性便秘者之腸道功能正常化。此外，高脂、高肉類及低纖(蔬菜)飲食型態已被證實導致健康成人糞便中基因毒性物質增加 [1]，補充蒟蒻可能影響膽酸代謝及腸道基因毒性，但至今無人進行相關研究。慣性便秘成人

較正常者血液內二級膽酸 deoxycholic acid 濃度及總量(pool)上升[2]，補充蒟蒻可能可能藉由調節菌相或使腸道運作正常化而降低腸道基因毒性，但至今也無人進行相關研究。

目的:

本提案欲釐清：

一、蒟蒻補充劑對慣性便秘者之腸道生理效應及其機制；二、蒟蒻補充劑對慣性便秘者之大腸生態環境，包括菌相、短鏈脂肪酸、膽酸、酵素等之影響；

結果

如下頁

討論

與控制期之第 3 週比較，蒟蒻補充劑提高排便次數及容易度及糞便乾重。糞便濕重或含水比例在蒟蒻期無顯著增加，因此蒟蒻纖維補充劑之軟便作用可能是與腸道中有益菌增加有關。蒟蒻纖維亦增加大腸發酵產物短鏈脂肪酸濃度並有效降低糞便酸鹼值。因此，於低纖維飲食中補充蒟蒻纖維有益促進腸道生態。

計畫成果自評

本研究進度符合預期。研究內容根據評審委員之建議刪除抗氧化項目，使研究更深入完整。目前主持人正準備將此研究結果發表。

參考文獻

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2. Veysey MJ, Thomas LA, Mallet AI, et al;: Colonic transit influences deoxycholic acid kinetics. *Gastroenterology* 2001;121:812-22.

Table 1. Basic characteristics of constipated subjects before entering this study[1]

Characteristics	
No. (gender)	7 (female)
Age (yr)	45.9 ± 2.7
Weight	55.0 ± 1.0
Body mass index	22.9 ± 0.5
Duration of constipation (yr)	15.6 ± 7.6
Number of bowel movement per week	2.6 ± 0.1
Stool consistency[2]	1.6 ± 0.2

[1]Data were expressed as means ± SEM (n=7). Data in the parenthesis indicates the range.

[2] The rating scale from 1 to 4 is denoted as: 1 (pellets), 2 (hard), 3 (soft), 4 (loose), 5 (liquid).

Table 2. Large-bowel Response to Ingestion of Konjac Glucomannan (KGM) in Constipated Subjects[1]

	Control	KGM		
	Week 3	Week 1	Week 2	Week 3
Defecation (no./wk)	4.1 ± 0.6	4.3 ± 0.6	5.1 ± 0.5†	5.3 ± 0.6*,†
Easiness to pass bowel movement[2]	3.0 ± 0.2	2.9 ± 0.2	2.8 ± 0.2	2.8 ± 0.1*,†
Feeling complete relief[3]	3.5 ± 0.1	3.3 ± 0.2	3.0 ± 0.1†	2.9 ± 0.2*,†
Abdominal cramping[4]	0.3 ± 0.1	0.2 ± 0.1	0.4 ± 0.2	0.3 ± 0.1
Borborygmi[4]	0.4 ± 0.2	0.3 ± 0.1	0.3 ± 0.2	0.2 ± 0.1*,†
Bloating[4]	0.4 ± 0.2	0.3 ± 0.2	0.4 ± 0.3	0.3 ± 0.2
Flatulence[4]	2.2 ± 0.2	2.1 ± 0.2	2.2 ± 0.2	2.4 ± 0.3*,†
Stool consistency[5]	2.2 ± 0.2	2.4 ± 0.2	2.3 ± 0.2	2.4 ± 0.2

[1]Data were expressed as means ± SEM (n=7). The effect of treatment duration was analyzed using repeated measures. The difference between control period (week 3) and each time point of KGM period were analyzed using Wilcoxon's matched pairs test. $p < 0.05$ is considered statistically significant. * and † denotes for significant effect of duration and treatment, respectively.

[2]The rating scale from 1 to 4 is denoted as: 1 (easy), 2 (slightly difficult), 3 (difficult), 4 (extremely difficult).

[3]The rating scale from 1 to 4 is denoted as: 1 (agree extremely), 2 (agree), 3 (disagree), 4 (extremely disagree).

[4]The rating scale from 0 to 4 is denoted as: 0 (no symptom), 1 (very slight symptom), 2 (slight symptom), 3 (severe symptom), 4 (very severe symptom).

[5]The rating scale from 1 to 4 is denoted as: 1 (pellets), 2 (hard), 3 (soft), 4 (loose), 5 (liquid).

Table 3. The weights and moisture contents of stools collected from constipated subjects on days 16-21 of control and experimental period[1]

	Control	KGM
Wet wt/d (g)	108.3 ± 27.9	117.2 ± 22.8
Dry wt/d (g)	29.1 ± 9.1	32.8 ± 8.4*
Fractions		
Plant	5.0 ± 1.3	5.1 ± 0.9
Bacterial	13.5 ± 5.0	14.6 ± 4.8
Soluble	7.6 ± 1.9	10.0 ± 1.5*
	74.6 ± 2.6	73.2 ± 2.5

[1]Data were expressed as mean ± SEM (n=7).

*$p < 0.05$ as analyzed using paired *t* test between the control and experimental periods.

Table 4. Fecal microflora of constipated subjects on days 15-21 of control and KGM period[1]

	Control	KGM
	log counts/g wet feces	
Bifidobacteria	9.4 ± 0.1	9.6 ± 0.1
Lactobacilli	8.8 ± 0.1	9.1 ± 0.1*
Bacteroides spp.	8.9 ± 0.1	8.9 ± 0.1
Clostridia	9.5 ± 0.1	9.4 ± 0.1
Total	10.3 ± 0.1	10.3 ± 0.1
	log counts/d wet feces	
Bifidobacteria	11.3 ± 0.1	11.6 ± 0.2*
Lactobacilli	10.8 ± 0.1	11.1 ± 0.2*
Bacteroides spp.	10.8 ± 0.1	10.9 ± 0.2
Clostridia	11.5 ± 0.2	11.4 ± 0.1
Total	12.2 ± 0.1	12.4 ± 0.1*
	% of total bacteria	
Bifidobacteria	12.6 ± 1.9	18.1 ± 2.5*
Lactobacilli	3.6 ± 0.5	5.9 ± 1.1*
Bacteroides spp.	4.4 ± 1.0	4.4 ± 1.1
Clostridia	17.9 ± 2.3	12.4 ± 2.0*

[1]Data are expressed as means ± SEM (n=7).

*$P < 0.05$ as analyzed using paired *t* test between the control and KGM periods.

Table 5. Fecal pH and Short Chain Fatty Acids (SCFA) on Days 15-21 of the Control and KGM Periods[1]

	Control	KGM
pH	7.1 ± 0.2	6.7 ± 0.1 *
SCFA Concentration (μmol/ g wet feces)		
Acetate	46.8 ± 24.8	68.5 ± 28.0*
Propionate	20.2 ± 10.1	40.8 ± 15.3*
i-Butyrate	1.6 ± 0.4	2.4 ± 0.5*
n-Butyrate	15.4 ± 7.9	19.8 ± 6.9
Total	83.9 ± 43.1	131.5 ± 49.9*
Daily Excretion (mmol/ d)		
Acetate	6.3 ± 3.4	8.2 ± 3.8*
Propionate	2.7 ± 1.4	4.5 ± 1.8*
i-Butyrate	0.2 ± 0.1	0.3 ± 0.1*
n-Butyrate	2.1 ± 1.1	2.3 ± 0.9
Total	11.3 ± 5.9	15.3 ± 6.6
	%	
Acetate	53.9 ± 2.1	50.9 ± 2.0
Propionate	25.3 ± 2.0	30.2 ± 1.9*
i-Butyrate	3.2 ± 0.5	2.8 ± 0.6
n-Butyrate	17.6 ± 0.8	16.2 ± 1.1

[1] Data were expressed as mean ± SEM (n=7).

* $p<0.05$ as analyzed with paired *t* test between the control and experiment periods.

Table 6. Daily dietary intakes of subjects during the Control and KGM periods[1]

	Control	KGM
Energy (kcal)	1796.1 ± 13.8	1814.6 ± 41.7
Carbohydrate (g)	227.1 ± 3.3	230.9 ± 7.5
Protein (g)	66.8 ± 1.2	65.8 ± 3.0
Fat (g)	69.4 ± 1.6	70.7 ± 2.4
Dietary fiber[2] (g)	11.0 ± 0.1	11.5 ± 0.5
(g/Mcal)	6.1 ± 0.1	6.4 ± 0.2

[1] Data were the average of three consecutive days and were expressed as mean ± SEM (n=7).

[2] The dietary fiber provided by the KGM supplement was not included.