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The Effect of Probiotic on Constipation in Rats

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－Abstract－

Background : Constipation is one of the most common disorders in Korea and Western countries. It may be related with life style, diet, physical activity, age, stress and gender, and particularly premenopausal women experience constipation more often than men due to the significant prolongation of the mean colonic transit in women. The aim of this study was to evaluate the effect of a probiotic on constipation in loperamide-induced constipated rats.

Materials and Methods : The rats were divided into 3 groups. Constipation was induced by administration of loperamide for 5 days, and the excreted amount as well as the number of feces was observed. Lactic acid bacteria as a probiotic were administered orally every day for 5 days.

Results : The results showed that loperamide administration induced severe experimental constipation in rats. The amount of feces was decreased and the number of pellets was increased by loperamide. The water content in the feces as a parameter of constipation was also decreased by loperamide. On the other hand, the dry weights of feces were not significantly different among the groups. It represents that the amount of food consumption might have been similar among the groups, and constipation was caused by delayed intestinal movement.

Conclusion : Probiotic administration for 5 days in rats partly alleviated or prevented the constipation induced by loperamide.

Key Words: Probiotics, Constipation, Loperamide, Rat

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Introduction

Constipation is one of the most common gastrointestinal complaints in the world.[1] More than 15% of Koreans have constipation and use laxative.[2] Women most often report suffering from constipation in Korea.[3] Pregnant women may have constipation, and it is a common problem following childbirth or surgery.

Constipation is a symptom, not a disease, and it is defined as having a bowel movement fewer than three times per week. It means different things to different people, and it simply means infrequent stools or hard stools, difficulty passing stools (straining) or a sense of incomplete emptying after a bowel movement.[4-8] The cause of each of these "types" of constipation is probably different.

Almost all people experience constipation at some point in their life, and a poor life style typically is the major cause. However, decreased bowel movements or a delayed transit time in the colon causes constipation.

Probiotics are dietary supplements containing potentially beneficial bacteria or yeast, with lactic acid bacteria (LAB) as the most common microbes used, and they have also been defined as live microorganisms administered in adequate amounts and this confers a beneficial health effect on the host.[9] LAB have been used in the food industry for many years because they are able to convert sugars (including lactose) and other carbohydrates into lactic acid.

Lactobacillus as probiotic bacteria is known to be beneficial for health, including increasing the food digestibility and the bioavailability of vitamins and minerals, lactose utilization, control of gastrointestinal infection, reduction of liver catabolic products, cancer suppression, reduction of the serum cholesterol level and immune stimulation, and reduction of blood pressure.[10] Some strains of LAB were recently reported to improve constipation in humans as assessed by a double-blind, randomized trial.[11] But no such studies have been done in rats as assessed by intestinal motility measurement.

Therefore this study was conducted to validate the effect of probiotic LAB on constipation in rats, as assessed by the direct measurement of the intestinal motility.

Methods and Materials

Experimental Animals and Diets

Specific pathogen-free male Sprague Dawley rats (approximately 5 weeks old) were purchased from Samtako, Inc. (Osan, Korea). Three animals were housed together in a cage and fed with tap water and rat chow diet (Nestlé Purina PetCare Korea, Ltd., Seoul, Korea). The Sprague Dawley rats (n=27) were divided into 3 groups for examining the effects of a probiotic on the gastrointestinal function and constipation.

Groups and Development of Constipation

The rats were randomly divided into 3 groups. Constipation was induced by administration of 0.15 mg of loperamide/100 g of body weight twice a day for 5 days, and the excreted amount as well as the number of feces was observed.

Lactic acid bacteria (Probio-Tec LA-5, Christian Hansen, Denmark) as a probiotic was administered orally at 1×10^6 CFU in 1 ml of distilled water daily, while loperamide was administrated for 5 days, and the control rats were administered 1 ml water only.

Examination of intestinal movement

To test the effect of probiotic on gastrointestinal function, the animals were starved for 1 day and then directly administered 10% barium sulfate solution into the stomach as much as 1 mL/100 g of body weight. After 30 min, rats were anesthetized with urethane and sacrificed by blood sampling via the abdominal aorta, and then the intestine was separately dissected. The distance the barium sulfate moved in the intestinal tract was measured.

Statistical analysis

Values are expressed as means±SEs. One-way analysis of variance (ANOVA) was used for multiple comparisons. When ANOVA showed significant differences, post-hoc analysis was performed with the Newman-Keuls multiple range test. SPSS for windows was used for all the analysis.

Results

1. Effect on the feces content

The feces content in rats with constipation induced by loperamide was decreased by 53% of that of the normal rats. Probiotic administration recovered the feces content to 84% of the normal level (Fig. 1).

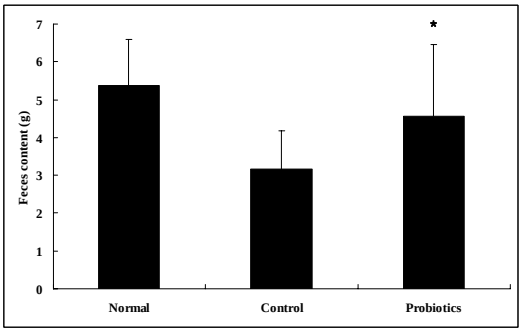

Fig. 1. Effect of probiotic on feces content (g) in loperamide-induced constipated rats *p< 0.05 vs. control.

2. Effect on pellet number

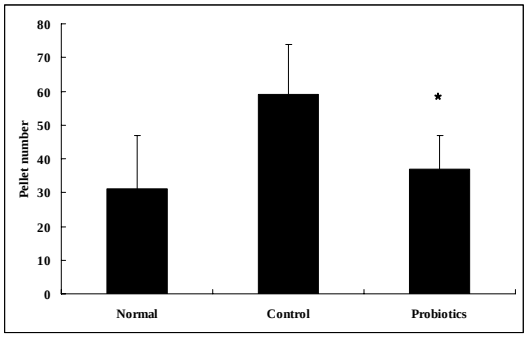

Fig. 2. Effect of probiotic on pellet number of feces in loperamide-induced constipated rats *p<0.01 vs. control.

The number of feces pellets was 31±16 a day for the normal rats and this was increased by loperamide administration to 59±15. Probiotic administration recovered the pellet number to 37±10 (Fig. 2).

3. Effect on gastrointestinal movement

The length (cm) of barium transfer in the normal rats was 75.2±6.3, and this was decreased by loperamide administration to 45.2±3.5. Probiotic administration recovered the transfer length to 65.3±3.7 (87% of normal) (Fig. 3).

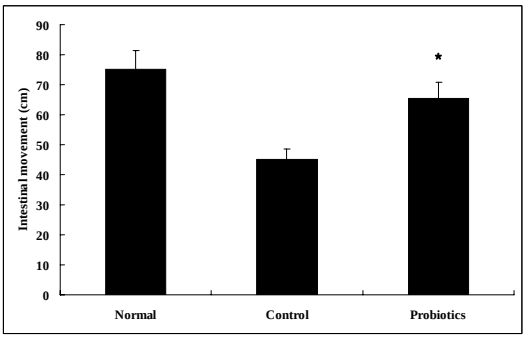

Fig. 3. Effect of probiotic on gastrointestinal movement in loperamide-induced constipated rats *p<0.01 vs. control.

4. Effect on the water content of the feces

The water content (g) of the feces of the normal rats was 1.9±0.14, and this was decreased by loperamide administration to 0.08±0.048. Probiotic administration recovered it to 1.4±0.12 (74% of normal) (Fig. 4).

5. Effect on the dry weight of feces

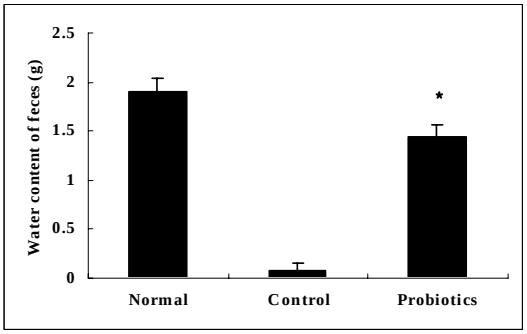

Fig. 4. Effect of probiotic on pellet number of feces in loperamide-induced constipated rats *p<0.01 vs. control.

The dry weight (g) of feces among the groups were not significantly different (3.48± 0.25, 3.09±0.18 and 3.13±0.19 in the normal, control and probiotic diet rats, respectively) (Fig. 5).

Discussion

Constipation is one of the most common disorders in Western countries and it is known that dietary factors such as a low fiber diet and low caloric intake are associated with this condition. Constipation is a very common clinical problem[12] that may be associated with slow intestinal movement.[13] Constipation may be related with life style, diet, physical activity, stress and gender, and premenopausal women particularly experience constipation more often than men[14, 15] with significant prolongation of the mean colonic transit in women.[16, 17]

The aim of this study was to evaluate the effects of a probiotic on intestinal movement

and constipation in loperamide-induced constipated rats.

The results showed that loperamide administration induced severe experimental constipation in rats. The feces content was decreased and the pellet number was increased by loperamide. The water content in feces as a constipation parameter was also decreased by loperamide. On the other hand, the dry weight of feces was not significantly different among the groups. This represents that the amount of food consumption might have been similar among the groups, and constipation was caused by delayed intestinal movement. Probiotic administration for 5 days partially recovered or prevented constipation in the loperamide-induced constipated rats.

These results are similar to those of some previous reports[18-20] and probiotics are now being proposed for the treatment of childhood or adulthood chronic constipation, and for improving constipation when eating a hypocaloric diet for the treatment of obesity.

In conclusion, the results suggested that probiotics can prevent or treat constipation via normalizing the bowel movement in loperamide-induced constipated rats.

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한글초록

변비는 우리나라나 서구국가에서 가장 흔한 질환중의 하나로서 생활 습관, 식이, 육체적 활동, 스트레스등과 밀접한 관련이 있다고 한다. 그리고 가임기의 여성에서 남성보다 빈도가 높으며 그 이유는 여성호르몬에 의한 대장운동성 저하때문이라고 한다. 본 연구는 로페라미드 투여에 의한 변비 쥐에서 프로바이오틱스가 장 운동과 변비에 미치는 영향을 알아보기 위하여 시행되었다. 로페라미드 투여는 쥐에서 변량은 감소시킨 대신에 변 pellet수는 증가시켰다. 변의 수분함량은 로페라미드 투여에 의하여 감소하였으나 건조 변량은 실험군간의 유의한 차이는 없었다. 따라서 로페라미드는 장 운동 감소에 의하여 변비를 유발하는 것으로 생각되었다. 프로바이오틱스의 투여는 로페라미드에 의하여 발생한 장 운동 저하와 변비를 완화시켜 주는 것으로 나타났다. 이상의 결과로 미루어 보아 프로바이오틱은 로페라미드에 의한 장 운동 감소 및 변비발생을 예방 또는 치료해 줄 수 있는 것으로 생각되었다.

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