The Effects of Tea Catechins on Fecal Conditions of Elderly Residents in a Long-Term Care Facility*

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Summary This study was carried out to evaluate the effects of tea catechins on fecal contents and metabolites of elderly people who were on a diet of solid food. The subjects were 35 residents in a long-term care facility who were all on the same diet, consisting of rice gruel and minced food. Tea catechins (300 mg), which were divided into 3 doses a day, were a meal supplement every day for 6 weeks. Fecal specimens were collected by the nursing staff, and their moisture content, pH, ammonia, sulfide, and oxidation-reduction potential (ORP) were determined before, during, and after the administration of tea catechins. In a comparison of values before the administration, all these fecal parameters decreased significantly during the tea catechin administration. After termination of the administration, these data tended to return toward the levels before administration. The reduction of such fecal parameters as moisture, pH, ammonia, sulfide, and ORP by tea catechin administration indicated very favorable improvements of the subjects' bowel conditions.

Key Words catechins, tea, tea polyphenols, fecal conditions

Recent studies have revealed a variety of biological activities of tea polyphenols, especially tea catechins, which comprise about 15% (dry weight) of "green tea" and are responsible for the tea's pungency (1). They are known to have a variety of physiological actions such as antioxidative (2), antimutagenic (3), hypolipidemic (4), hypotensive (5), hypoglycemic (6), and antiviral (7).

In our previous report (8), the administration of tea catechins equivalent to 5

* Effects of Tea Polyphenols on Fecal Conditions, Part 2.
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to 6 cups of green tea per day for 15 elderly inpatients bedridden with enteral feeding showed a favorable change of fecal flora and fecal metabolites that brought about the reduction of fecal malodors.

In this report, we further studied the effects of tea catechins with a larger number of elderly inpatients on a diet of solid food in a long-term care facility. Catechins were administered for a longer period than in the previous study and such parameters of feces—moisture contents, pH, ammonia, sulfide, and oxidation-reduction potential (ORP)—were monitored.

Experimental

Subjects and diets. The subjects were 35 residents in the Garden of the Cross Nursing Home, Shizuoka Prefecture, Japan: 31 females and 4 males from 66 y to 98 y of age (average 85.4). Almost all had some kind of illness, such as hypertension, cerebral stroke, and senile dementia, and many were bedridden. None had complications of the gastrointestinal tract or endocrine organs, and none were receiving antibiotics. Those on medication continued their treatment. The subjects all received the same daily diet of rice gruel and minced food prepared by the nutritional department of the Garden of the Cross Nursing Home. Daily meals contained, on average during the test period, 38.7 g of proteins, 21.1 g of lipids, 191 g of carbohydrates, and integrated minerals and vitamins. The calculated number of calories was approximately 1,110 kcal a day.

This study protocol was approved by the Ethics Committees of the Garden of the Cross Nursing Home, and informed consent was obtained from each subject.

Tea catechins. The tea catechin mixture used in this study was Polyphenon 60R, provided by Mitsui Norin, Japan, which contained 62% catechins, including (-)-epicatechin (6.5%), (-)-epigallocatechin (18.5%), (-)-epicatechin gallate (7.0%), and (-)-epigallocatechin gallate (30.5%). All patients received 300 mg of tea catechins, i.e., 484 mg of Polyphenon 60R, which was divided into 3 doses a day: Two tablets containing 50 mg of tea catechins (about 81 mg of Polyphenon 60R) were taken after each meal. When a subject was unable to swallow the tablets, Polyphenon 60R powder of the same dosage was administered. This administration was continued for 6 weeks.

Fecal specimens. More than 10 g of fresh specimens were collected by the nursing staff immediately or within 2 h after being voided. After the sensory check, specimens were frozen and kept for later analysis. Specimens were collected, as shown in Fig. 1, on day 0 (before administration, period O), days 9 to 11 of administration (period I), days 23 to 25 during administration (period II), days 37 to 39 during administration (period III), and days 16 to 18 of postadministration (period IV). When the specimens were not voided on the intended day, pure glycerin enema was used to initiate bowel movement. Changes in the odor of feces were monitored by a sensory check and recorded by a care-giving member of the staff in each period when specimens were collected. This study was conducted from June 3 to Aug 7, 1996. Tea catechins were given from June 9 to July 20.
Effects of Tea Polyphenols on Fecal Conditions

Fig. 1. Experimental protocol. Subjects; 35 residents (31 females and 4 males). Tea catechin administration: 300 mg/d. Sampling of fecal specimens: more than 10 g. Measurements: fecal properties (moisture content, pH, and oxidation-reduction potential) and fecal metabolic products (ammonia and sulfide).

Measurements. The pH values were determined by inserting a flat glass electrode (Horiba, Kyoto) directly into the feces. Fecal moisture content was measured by moisture meter FD-240 (Kett Electric Laboratory, Tokyo) in approximately 1 g samples. Ammonia was measured by a potentiometer F-24 with an ammonia gas sensing electrode 5002A-10C (Horiba) after suspending 0.5 g of feces in 48.5 mL of distilled water, then mixing thoroughly with 1 mL of 1 M NaOH (9). Sulfide was measured by a potentiometer F-24 with a sulfide electrode 8003-10C (Horiba), after suspending 0.5 g of feces in 44.5 mL of distilled water and mixing it thoroughly with 5 mL of S-DIMAB (NaOH 40 g, L-ascorbic acid 10 g, sodium ethylenediamine tetra acetate 9.3 g, and glycerin 500 mL to fill up to 1 L with distilled water) (10). The ORP values were determined by a potentiometer F-24 with an ORP electrode 6861-10C (Horiba), after suspending 0.5 g of feces in 49.5 mL of distilled water.

Statistical analysis of data. Data were analyzed by multiple paired comparisons by using a Student’s t-test. Day 0 (before administration, period O) was taken as the standard point with which paired calculations with period I, period II, and period III of administration, and days 16 to 18 after administration (period IV), were made. The statistical probability of \( p < 0.05 \) was considered significant. To avoid committing a Type I error (e.g., rejecting the null hypothesis when it is true), data were analyzed by means of a two-way analysis of variance (ANOVA), using patient and time point as the factors. A Student’s t-test and a two-way ANOVA were used to analyze all these measurements.

Results

The changes of fecal parameters are shown in Fig. 2.

Fecal properties (fecal moisture contents, pH values and ORP). In a comparison of values before administration with those during tea catechin adminis-
Fig. 2. Effect of tea catechin administration on fecal pH, water content, oxidation-reduction potential (ORP), ammonia, and sulfide. All values are expressed as means±SD. Data were analyzed by multiple paired comparisons using Student’s t-test: * p<0.05; ** p<0.01; *** p<0.001 from the values of day 0 (before administration).

Fecal metabolic products. Fecal concentrations of ammonia decreased significantly in period I (p<0.05), period II (p<0.01), and period III (p<0.001). Fecal concentrations of sulfide decreased significantly in period I (p<0.001), period II (p<0.001), and period III (p<0.001). On days 16 to 18 of postadministration (period IV), all the above data showed a tendency to return toward the levels of period O (before administration).

**Discussion**

Tea catechins, which are extracted from green tea (Camellia sinensis L.), have potent antibacterial activity (4, 11). They are bactericidal against foodborne pathogenic bacteria, such as Staphylococcus aureus, Clostridium perfringens, Bacillus cereus, Vibrio parahaemolyticus and other Vibrio species, Aeromonas sobria, and Plesiomonas shigelloides, but not, curiously, against bifidobacteria and lactobacilli. Diker et al reported that extracts of tea catechins showed an antibacterial effect against Campylobacter coli and C. jejuni (12). In an in vitro study, Ahn et al reported that tea catechins have notable effects on intestinal floral bacteria;
Effects of Tea Polyphenols on Fecal Conditions

a growth-inhibitory activity against a variety of putrefactive bacteria such as Clostridium difficile and C. perfringens, and a growth-promoting activity on some bifidobacteria and lactobacilli (13, 14). The same effects were shown by analyses of animal feces. Terada et al observed that tea catechins selectively enhance the growth of lactobacilli and reduce Bacteroidaceae in the intestines of chicks, and that they also have a deodorizing effect on chicken caecal contents (15). Hara et al obtained the same results on the freshly voided feces of pigs (16).

In our previous study with humans (8), 300 mg of tea catechins a day for 3 weeks revealed statistically significant improvement of the intestinal flora and fecal odorous metabolites. The levels of bifidobacteria and lactobacilli, both of which profusely produce lactic acid, increased significantly, and decreases in numbers of so-called putrefactive bacteria such as Bacteroidaceae, Enterobacteriaceae, and clostridia were noted. Thus the reduction of fecal ammonia and other putrefactive products was thought to have derived from the suppression of these bacteria (17, 18), and the decrease of fecal pH was considered to have derived mainly from an increase of the levels of the lactic acid forming bacteria, though the production of acids by such intestinal bacteria as Bacteroidaceae, Enterobacteriaceae, and clostridia should also be taken into account (15, 16). In our previous study, a significant decrease of such malodorous compounds as indole, skatol, ethylphenol, cresol, and phenol were determined (8). Although subjects in the previous study were all receiving liquid alimentation, the patients in this study were eating solid food. It is noteworthy that when tea catechins were administered to inpatients on a diet that was close to ordinary, the same tendency of fecal parameters was obtained as with tube-fed people. Okubo et al showed that tea catechins (1,200 mg per d for 4 weeks, 8 volunteers) administered to healthy adults decreased the counts of clostridia and their frequency of occurrence (the amount of tea catechins administered was about 4 times that of the present study) (19). They reported that the total volatile acids, including acetic acid, increased significantly, and this increase was paralleled with an increase in bifidobacteria. The same improvements were reported by administrations of a cereal fiber and several oligo-saccharides, such as lactosucrose (20, 21). It is a known fact that low pH will help to improve intestinal conditions and reduce the formation of ammonia and putrefactive compounds (22). Although not specifically detailed here, it was noteworthy that a lessening of fecal odor was observed in at least 16 cases of the 35 subjects during tea catechin administration. A lessening of fecal odor will contribute to making conditions in nursing homes more comfortable. Fecal moisture content decreased significantly in period III. This may suggest that tea catechins are effective in improving the stools of elderly people from a watery to a more solid condition. Fecal ORP decreased significantly in all periods in I, II, and III, which is quoted to show favorable conditions against the pathogenic infection of intestine (23).

No untoward effects resulting from catechin intake by humans have ever been reported. Six hundred milligrams to 900 mg of catechins per day have been administered to hundreds of carriers of Helicobacter pylori or to carriers of Hepatitis
C virus in several clinical institutions for years without any ill side effects. Various epidemiological studies endorse that the consumption of 1,000 mg of tea catechins a day will prevent cardiovascular or neoplastic degeneration of the body (24). From this study, it is inferred that tea catechin administration may work favorably to improve elderly inpatient fecal conditions and to reduce fecal odors. Eventually, studies extended to the general public may be warranted.

This study was conducted in the health care center—The Garden of the Cross Nursing Home, Shizuoka Prefecture, Japan—in collaboration with the staff there. We thank the volunteers and nurses for their dedicated cooperation.

REFERENCES


