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ORIGINAL ARTICLE

Case Control Study

Influence of dietary isoflavone intake on gastrointestinal symptoms in ulcerative colitis individuals in remission

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Abstract

AIM

To analyse the association between isoflavone intake and ulcerative colitis motility symptoms in individuals in remission.

METHODS

Cross-sectional study was conducted in a group of ulcerative colitis remission individuals, in sub-groups characterised by various intestinal motility and functioning characteristics (abdominal pain, flatulence, constipations, tenesmus). Total of 56 individuals with ulcerative colitis in remission (19 males and 37 females) were recruited for the study. Assessment of diet was based on self-reported data from each patient's dietary

records taken over a period of three typical, random days (2 weekdays and 1 d of the weekend). The daily isoflavone intake (daidzein, genistein, glycitein and total isoflavones) and daily isoflavone intake per 1000 kcal of diet were assessed.

RESULTS

No correlations between isoflavone intake levels and number of bowel movements per day were observed both in the case of intake and intake per 1000 kcal of diet. In the group of individuals declaring lack of abdominal pain, the higher intakes of daidzein (P = 0.0075), daidzein per 1000 kcal of diet (P = 0.0358) and total isoflavone (P = 0.0358) were stated, than in the group of individuals declaring abdominal pain. In the group of individuals declaring lack of constipations, the lower intakes of glycitein (P = 0.0213) and glycitein per 1000 kcal of diet (P = 0.0213) were stated, than in the group of individuals declaring presence of constipations. No differences were observed in isoflavone intake between groups of ulcerative colitis individuals declaring lack of flatulence and declaring presence of flatulence, as well as between groups declaring lack of tenesmus and declaring presence of tenesmus.

CONCLUSION

The moderate dietary isoflavone intake may be beneficial for individuals with ulcerative colitis in remission, however, before including it into recommendations, further prospective studies are needed.

Key words: Abdominal pain; Constipations ulcerative colitis; Daidzein; Genistein; Glycitein; Isoflavone

Core tip: Studies assessing influence of isoflavones on inflammatory bowel disease are contradictory. In presented study a higher daidzein, glycitein and total isoflavones intake in ulcerative colitis individuals in remission were associated with lack of abdominal pain and declared constipations. The effect of isoflavone may be dose-dependent, as in conducted study, an isoflavone intake was over 10 times lower, that in Japanese study, in which it was indicated, that isoflavone intake may be associated with increased risk of the disease. It may be stated, that in European countries, due to lower intake than in Asian ones, beneficial isoflavone effect may be observed.

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INTRODUCTION

In spite of the fact, that nutritional support and therapy in inflammatory bowel diseases guidelines is indicated, as an element of the high-quality clinical care[1], the diet therapy is applied by only 10% of patients with inflammatory bowel disease[2]. It is associated with the fact, that there is little evidence, indicating, that diet plays the proven role in etiology[3] or may change the natural course of ulcerative colitis or Crohn's disease[4].

Although evidence-based dietary guidelines in inflammatory bowel diseases are lacking[4], there are number of studies indicating potential influence of nutrition and suggesting dietary modifications in prevention[5-7] or therapy of inflammatory bowel diseases[8,9]. Among other nutrients, isoflavones are indicated as characterized by potential influence on inflammatory bowel disease, but the conclusions seem to be contradictory, as the effects of isoflavones on development and course of the disease may differ. The first study proving the association between dietary isoflavone intake and ulcerative colitis development, indicated, that isoflavone intake may be associated with an increased risk of the disease[10]. However, a number of animal-model studies indicated, that isoflavone intake may prevent exacerbations by inhibiting the colitis[11-13].

Due to the fact, that in the group of inflammatory bowel disease individuals, isoflavone supplementation is not indicated as recommended[14], in the mentioned group isoflavone intake depends on the diet. Although the main sources of isoflavone in western diets are soy products[15], also other foods may deliver a certain amount of isoflavone[16]. In the case of inflammatory bowel disease individuals, all the sources of isoflavone are important, as the soy products intake in some individuals may be limited[4]. Especially for individuals with ulcerative colitis or colon-affecting Crohn's disease, the choice of products may be essential, as it may influence the motility symptoms[17]. Such symptoms, being affected by the disease even during remission, due to the course of the disease and psychological factors[18] are for patients especially important, as they may influence directly their quality of life.

The aim of the study was to analyse the association between isoflavone intake (daidzein, genistein, glycitein and total isoflavones) and ulcerative colitis motility symptoms (number of bowel movements, abdominal pain, flatulence, constipations, tenesmus) in individuals in remission.

MATERIALS AND METHODS

Study design

The study was conducted at the Dietetic Outpatient Clinic of the Department of Dietetics, Warsaw University of Life Sciences (WULS-SGGW). The study was carried out according to the guidelines laid down

in the Declaration of Helsinki and all the procedures involving human subjects were approved by the Bioethical Commission of the Central Clinical Hospital of the Ministry of Interior in Warsaw and the Bioethical Commission of the National Food and Nutrition Institute.

The study's hypothesis was that isoflavone intake may influence gastrointestinal motility symptoms of ulcerative colitis. The three-days dietary records of remission ulcerative colitis individuals were collected and analysed. The intestinal motility and functioning were assessed on the basis of the self-reported data (questionnaire regarding number of bowel movements, abdominal pain, flatulence, constipations, tenesmus).

Study participants

The study was carried out on male and female individuals with ulcerative colitis in remission, recruited and monitored at the Warsaw Gastroenterology Outpatient Clinics: Gastroenterology Outpatient Clinic in Maria Skłodowska-Curie Memorial Cancer Center and Institute of Oncology, Gastroenterology Outpatient Clinic in Central Clinical Hospital of the Ministry of Interior in Warsaw and Gastroenterology Outpatient Clinic in Public Central Teaching Hospital in Warsaw.

Total number of 56 remission ulcerative colitis individuals (19 males and 37 females), age 18-80 years, was recruited for the study. Inclusion criteria were described in the previous publication[19]. All of the participants provided written consent to participate in the study.

Analysis of intestinal motility and functioning

All the participants with ulcerative colitis in remission were interviewed and asked about the presence of abdominal pain, flatulence, constipations, tenesmus and frequency of bowel movements. The presence of abdominal pain, flatulence, constipations and tenesmus were subjectively assessed by patients. They were asked to compare the current frequency and intensity of the symptoms with those before the diagnosis of ulcerative colitis. A lack of abdominal pain, flatulence, constipations, tenesmus during remission or no increase in frequency or intensity of symptoms compared to those observed before the ulcerative colitis diagnosis were interpreted as a lack of the above-mentioned symptoms.

Analysis of diet

Assessment of the diets was based on the self-reported data from dietary records conducted in three typical random days (2 weekdays and 1 weekend day). The dietary record was conducted on the basis of widely accepted and applied rules, the same as in the case of previously published analysis assessing the retinoid intake in the ulcerative colitis individuals[19]. To provide the reliable estimates of food intake, participants were instructed about the principles of conducting dietary record, as well as about the necessity of accurate and scrupulous recording of all consumed food products and beverages. The serving sizes were verified using the Polish Atlas of Food Products and Dishes Portion Sizes[20]. The serving sizes, recipes and number of glasses of beverages drunk daily were verified during personal interview.

The energy values of diets (kcal) were analysed using the Polish dietician software (National Food and Nutrition Institute, version 2.0) and the Polish base of the nutritional value of the products[21].

Isoflavone intake: daidzein (μg), genistein (μg), glycitein (μg) and total isoflavones (μg) were assessed using the National Nutrient Database for Standard Reference of the United States Department of Agriculture[16], due to the lack of Polish database. The obtained average intake levels of the analyzed nutrients (mean values from three recorded days) were presented and were recalculated per 1000 kcal of diet (μg/1000 kcal) in order to analyze also the nutrient density of the diets.

Individuals affected and unaffected by detailed ulcerative colitis symptoms were treated as groups and isoflavone intake was compared between them. The analysis of correlation between daily number of bowel movements and isoflavone intake was also conducted.

Statistical analysis

The obtained data are presented as mean ± SD values with minimum, maximum and median values indicated. The distributions of the analysed factors were verified using Shapiro-Wilk test. The correlations between analysed factors were verified using Spearman rank correlation coefficient (applied due to nonparametric distribution). The differences between groups were analysed using *U* Mann-Whitney test (applied due to nonparametric distribution). The level of significance $P \leqslant 0.05$ was accepted. The statistical analysis was carried out using Statistica software version 8.0 (StatSoft Inc., Tulsa, OK, United States).

RESULTS

The analysis of correlation between isoflavone intake levels and number of bowel movements per day is presented in Table 1. No correlations were observed both in the case of intake and intake per 1000 kcal of diet.

The isoflavone intake levels in groups of ulcerative colitis individuals declaring lack of abdominal pain and declaring presence of abdominal pain is presented in Table 2. In the group of individuals declaring lack of abdominal pain, the higher intakes of daidzein ($P = 0.0075$), daidzein per 1000 kcal of diet ($P = 0.0358$) and total isoflavone ($P = 0.0358$) were stated, than in the group of individuals declaring abdominal pain.

The isoflavone intake levels in groups of ulcerative colitis individuals declaring lack of flatulence and

Table 1 Analysis of correlation between isoflavone intakes and number of bowel movements per day declared in group of ulcerative colitis individuals (analysis conducted using Spearman rank correlation coefficient)

	P value	R
Intake		
Daidzein (mg)	0.0889	-0.2509
Genistein (mg)	0.2942	0.1543
Glycitein (mg)	0.1889	0.1946
Total isoflavones (mg)	0.8987	0.0191
Intake per 1000 kcal		
Daidzein (mg/1000 kcal)	0.0992	-0.2434
Genistein (mg/1000 kcal)	0.2762	0.1621
Glycitein (mg/1000 kcal)	0.1899	0.1946
Total isoflavones (mg/1000 kcal)	0.9881	-0.0022

declaring presence of flatulence is presented in Table 3. No differences were observed in isoflavone intake between groups.

The isoflavone intake levels in groups of ulcerative colitis individuals declaring lack of constipations and declaring presence of constipations is presented in Table 4. In the group of individuals declaring lack of constipations, the lower intakes of glycitein (P = 0.0213) and glycitein per 1000 kcal of diet (P = 0.0213) were stated, than in the group of individuals declaring presence of constipations.

The isoflavone intake levels in groups of ulcerative colitis individuals declaring lack of tenesmus and declaring presence of tenesmus is presented in Table 5. No differences were observed in isoflavone intake between groups.

DISCUSSION

In the study of Magee *et al*[8], legumes were indicated among beneficial food products, contributing to better results in the sigmoidoscopy screening in ulcerative colitis individuals. It was observed, that while consumed in typical amount of 120 g per week, legumes may contribute to lower clinical activity of the ulcerative colitis, so they were stated to be an element of potentially therapeutic diet for such patients[8]. The indicated role of legumes is in agreement with the report of World Cancer Research Fund and American Institute for Cancer Research[22], stating, that legumes are beneficial factor preventing colon cancer. It may be of a great value especially for ulcerative colitis patients, as the risk of colon cancer is for them higher than for individuals with no inflammatory bowel diseases diagnosed[23].

The observations of Magee *et al*[8] are in the contrast with the general belief, that a specific carbohydrate diet, described by Haas and Haas[24], including restriction of legumes such as soybeans, or chickpeas, may be beneficial for ulcerative colitis patients[4]. However, the food products are the complex source of various nutrients, so in spite of the fact, that simple carbohydrates limitation may force ulcerative colitis patients to avoid *inter alia* legume intake, such products may also be considered as a source of health-promoting components for them. Magee *et al*[8] were trying to explain the associations that they observed, but in spite of the fact that for legumes they indicated some potential reasons of proved association (high content of thiamin, resistant starch, prebiotics), they were not able to definitely conclude about the causes of mentioned relation.

Since the study of Magee *et al*[8] was published, more insight into the role of legumes and their composition was gained. In spite of the fact, that in the meta-analysis of Yan *et al*[25] positive influence of soy intake on the colorectal cancer risk reduction was stated for women, but not for men, the other meta-analysis seem to be more promising. In the meta-analysis of Wang *et al*[26], among beneficial nutrients from legumes, that may reduce the risk of colon cancer, isoflavone was indicated. Also in the systematic review and meta-analysis of Yu *et al*[27], the soy isoflavone intake was stated to be associated with reduced colorectal cancer risk, that was observed while studied both in Asian populations and in case-control studies.

Among the fears experienced by inflammatory bowel disease patients, except these associated with complications of the disease, mainly with cancer risk, are also the fears and discomforts associated with the symptoms of the disease (uncertainty of the disease course, fear of feeling fatigue, body image concern, discomfort of feeling dirty)[28]. As a result, the quality of life of ulcerative colitis individuals is often decreased[29], so all the actions, that would be able to reduce their symptoms are of a great value.

The presented study revealed, that the higher isoflavone intake may contribute to lower abdominal pain incidence, but simultaneously, to higher constipations incidence. However, as the presence of constipations was subjectively assessed by patients and reported by them, also misunderstanding of the term must be taken into account, as it is well-known, that there exists a disparity between self-reported and definitions-based constipations frequency[30]. Moreover, in spite of the fact, that in general population, the constipations incidence is a negative symptom, decreasing quality of life[31], in the case of ulcerative colitis individuals situation may be different. As, even in remission, a number of ulcerative colitis patients experience abdominal pain and diarrhea[32], they may perceive decreased stool frequency as a positive symptom. As a consequence, the fact that ulcerative colitis individual declared constipations should be rather interpreted as decreased frequency of bowel movements, that may be even positively perceived by patient. However, it must be also indicated, that in the case of the analysis of correlation between isoflavone intake and number of bowel movements per day, no significance was stated.

Table 2 Isoflavone intake levels in groups of ulcerative colitis individuals declaring lack of abdominal pain and declaring presence of abdominal pain (comparison conducted using *U* Mann-Whitney test)

	Individuals declaring lack of abdominal pain (n = 29)		Individuals declaring abdominal pain (n = 27)		*P* value
	Mean ± SD	Median (min-max)	Mean ± SD	Median (min-max)	
Intake					
Daidzein (μg)	168.3 ± 112.5	176.7 (4.3-476.7)	119.1 ± 187.2	68.0[1] (3.3-977.7)	0.0075
Genistein (μg)	177.9 ± 127.6	156.7 (5.3-444.0)	177.1 ± 287.0	125.3[1] (2.3-1428.3)	0.1356
Glycitein (μg)	0.5 ± 2.6	0.0[1] (0.0-14.0)	3.4 ± 12.3	0.0[1] (0.0-56.0)	0.2706
Total isoflavones (μg)	346.6 ± 185.2	333.3 (7.7-770.7)	299.6 ± 362.2	177.3[1] (18.0-1574.0)	0.0358
Intake per 1000 kcal					
Daidzein (μg/1000 kcal)	94.6 ± 86.1	69.9[1] (1.3-347.7)	60.4 ± 79.1	46.2[1] (2.1-392.7)	0.0358
Genistein (μg/1000 kcal)	88.3 ± 69.6	86.2[1] (1.6-279.5)	100.4 ± 161.4	57.4[1] (1.4-759.2)	0.2378
Glycitein (μg/1000 kcal)	0.3 ± 1.5	0.0[1] (0.0-8.0)	2.1 ± 7.8	0.0[1] (0.0-37.4)	0.2706
Total isoflavones (μg/1000 kcal)	183.1 ± 130.9	137.2 (8.3-517.2)	162.9 ± 193.5	119.7[1] (8.6-836.7)	0.1400

[1]Nonparametric distribution (verified using the Shapiro-Wilk test; $P < 0.05$).

Table 3 Isoflavone intake levels in groups of ulcerative colitis individuals declaring lack of flatulence and declaring presence of flatulence (comparison conducted using *U* Mann-Whitney test)

	Individuals declaring lack of flatulence (n = 46)		Individuals declaring flatulence (n = 10)		*P* value
	Mean ± SD	Median (min-max)	Mean ± SD	Median (min-max)	
Intake					
Daidzein (μg)	147.4 ± 165.6	115.0[1] (3.3-977.7)	131.4 ± 843	109.8 (19.0-278.0)	0.7727
Genistein (μg)	187.6 ± 225.4	140.0[1] (2.3-1428.3)	131.1 ± 177.6	78.3[1] (7.3-586.7)	0.2186
Glycitein (μg)	2.2 ± 9.7	0.0[1] (0.0-56.0)	0.4 ± 1.3	0.0[1] (0.0-4.0)	0.7738
Total isoflavones (μg)	337.2 ± 293.4	302.5[1] (18.0-1574.0)	262.9 ± 232.2	220.8[1] (37.3-833.0)	0.4162
Intake per 1000 kcal					
Daidzein (μg/1000 kcal)	78.9 ± 89.1	53.9[1] (1.3-392.7)	74.3 ± 56.6	60.8 (12.1-56.6)	0.6455
Genistein (μg/1000 kcal)	97.3 ± 121.5	68.1[1] (1.4-759.2)	79.4 ± 128.7	32.3[1] (3.6-426.6)	0.2268
Glycitein (μg/1000 kcal)	1.4 ± 6.1	0.0[1] (0.0-37.4)	0.3 ± 0.9	0.0[1] (0.0-2.9)	0.7738
Total isoflavones (μg /1000 kcal)	177.6 ± 162.9	133.5[1] (8.3-836.7)	154.0 ± 170.0	133.9[1] (21.7-605.7)	0.5854

[1]Nonparametric distribution (verified using the Shapiro-Wilk test; $P < 0.05$).

Table 4 Isoflavone intake levels in groups of ulcerative colitis individuals declaring lack of constipations and declaring presence of constipations (comparison conducted using *U* Mann-Whitney test)

	Individuals declaring lack of constipations (n = 49)		Individuals declaring constipations (n = 7)		*P* value
	Mean ± SD	Median (min-max)	Mean ± SD	Median (min-max)	
Intake					
Daidzein (μg)	147.0 ± 158.0	117.7[1] (3.3-977.7)	127.0 ± 128.6	73.0 (11.3-353.0)	0.6827
Genistein (μg)	183.6 ± 219.9	137.0[1] (2.3-1428.3)	134.9 ± 208.8	67.0[1] (6.7-586.7)	0.1891
Glycitein (μg)	1.0 ± 5.1	0.0[1] (0.0-33.3)	8.6 ± 21.0	0.0[1] (0.0-56.0)	0.0213
Total isoflavones (μg)	331.6 ± 282.8	262.7[1] (27.7-1574.0)	270.5 ± 300.4	123.7 (18.0-833.0)	0.3339
Intake per 1000 kcal					
Daidzein (μg/1000 kcal)	146.8 ± 161.0	117.7[1] (3.3-977.7)	101.1 ± 124.2	46.2 (5.4-347.7)	0.9802
Genistein (μg/1000 kcal)	183.3 ± 224.2	137.0[1] (2.3-1428.3)	97.6 ± 152.0	37.1[1] (3.2-426.6)	0.4279
Glycitein (μg/1000 kcal)	1.0 ± 5.2	0.0[1] (0.0-33.3)	5.7 ± 6.7	0.0[1] (0.0-37.4)	0.0213
Total isoflavones (μg/1000 kcal)	331.1 ± 287.9	262.7[1] (27.7-1574.0)	204.5 ± 236.1	68.4 (8.6-605.7)	0.7102

[1]Nonparametric distribution (verified using the Shapiro-Wilk test; $P < 0.05$).

Taking into account the possible positive interpretation of constipations reported by ulcerative colitis patients, the results of the presented study may be treated as a confirmation of the results of animal-model studies assessing the influence of isoflavone intake on the course of ulcerative colitis. Due to the fact, that no similar studies were conducted in the groups of ulcerative colitis patients, the conducted study must be treated as a significant contribution.

In the animal-based studies, it was stated, that isoflavone intake may diminish the secretion or overexpression of tumor necrosis factor-α[11,13,33], interleukin (IL)-1β[11], IL-6[12], IL-12p40[12], interferon-γ[11,12], cyclooxygenase-2[34] and inducible nitric oxide synthase[13,35]. In animal model, while disease activity index (including *inter alia* body weight loss, diarrhea,

Table 5 Isoflavone intake levels in groups of ulcerative colitis individuals declaring lack of tenesmus and declaring presence of tenesmus (comparison conducted using *U* Mann-Whitney test)

	Individuals declaring lack of constipations (n = 47)		Individuals declaring constipations (n = 9)		*P* value
	Mean ± SD	Median (min-max)	Mean ± SD	Median (min-max)	
Intake					
Daidzein (μg)	124.5 ± 107.8	101.0[1] (3.3-476.7)	249.4 ± 284.4	205.7[1] (5.3-977.7)	0.0818
Genistein (μg)	190.4 ± 233.0	138.0[1] (2.3-1428.3)	110.0 ± 79.7	126.0 (7.3-253.7)	0.3662
Glycitein (μg)	2.3 ± 9.6	0.0[1] (0.0-56.0)	0.0 ± 0.0	0.0[1] (0.0-0.0)	0.3819
Total isoflavones (μg)	317.2 ± 280.2	302.3[1] (18.0-1574.0)	359.4 ± 311.7	242.3[1] (139.3-1137.7)	0.7379
Intake per 1000 kcal					
Daidzein (μg/1000 kcal)	70.6 ± 76.7	48.1[1] (1.3-347.7)	117.2 ± 111.6	95.1[1] (4.5-392.7)	0.0943
Genistein (μg/1000 kcal)	101.4 ± 130.7	69.1[1] (1.4-759.2)	55.7 ± 42.5	46.5 (3.6-117.4)	0.3722
Glycitein (μg/1000 kcal)	1.4 ± 6.1	0.0[1] (0.0-37.4)	0.0 ± 0.0	0.0[1] (0.0-0.0)	0.3819
Total isoflavones (μg/1000 kcal)	173.4 ± 171.7	131.2[1] (8.3-836.7)	173.0 ± 113.5	140.9[1] (73.4-456.9)	0.5770

[1]Nonparametric distribution (verified using the Shapiro-Wilk test; $P < 0.05$).

gross bleeding) of colitis was assessed, isoflavone intake was also stated to be beneficial[13]. As a result, isoflavone was indicated among natural compounds positively influencing cytokines in inflammatory bowel diseases[36]. Especially in the context of presented own results indicating influence on subjectively perceived symptoms such as abdominal pain or stool frequency, the potential role of isoflavone intake must be confirmed.

Taking into account previously mentioned human study of Ohfuji *et al*[10] indicating opposite effect of isoflavone in ulcerative colitis development, the effect of dose must be considered. In the mentioned study, the total isoflavones intake was 13.6 mg/1000 kcal in the study group and 11.1 mg/1000 kcal in the control group[10], while in own study it was not higher than 0.836 mg/1000 kcal. It must be mentioned, that the study of Ohfuji *et al*[10] was conducted in Japan and the stated isoflavone intake was similar as in the case of other Japanese studies[37]. In European countries, isoflavone intake is significantly lower than in Asian ones[38], while in Japan it is even higher than in other Asian countries[39].

The possible explanation of the isoflavone influence and observed contradictory results may arise from the fact, that isoflavone impact may depend on the microbiota[40]. In the study of Bowey *et al*[40], it was proven that colonization of germ-free rats with a human faecal microbiota resulted in specific conversion of dietary daidzein into equol, being its metabolite decreasing level of anti-inflamatory IL-10 and causing weight loss[41]. As an equol is produced after isoflavone intake by only 25%-30% of adults in Western countries[42], it should be stated that the effect of isoflavone intake depends not only on the dose, but also on the intestinal microbiota[43].

Not only the influence of microbiota on the course of ulcerative colitis was indicated by other authors, but also it was stated, that ulcerative colitis individuals are often characterized by different microbiota than healthy ones, as they have *inter alia* higher content of fecal microbiota[44]. Taking it into account, in the context of presented studies, excessive isoflavone intake, such as observed in Asian populations, may be confirmed for ulcerative colitis patients as not recommended. However, the isoflavone intake in own study was lower than in Asian populations, being on the level typical for Western ones. The observed beneficial effect may be explained as dependent on the lower dietary isoflavone intake and caused by positive anti-inflammatory effect confirmed in a number of animal-based studies. However, before including it into recommendations, further prospective studies are needed to expand the sample size and to confirm stated association.

In conclusion, higher daidzein and total isoflavone intakes in individuals with ulcerative colitis in remission were associated with lower incidence of abdominal pain. Higher glycitein intake in individuals with ulcerative colitis in remission was associated with higher constipations incidence declared by them, which may be interpreted as decreased frequency of bowel movements. The moderate dietary isoflavone intake may be beneficial for individuals with ulcerative colitis in remission, however, before including it into recommendations, further prospective studies are needed to confirm.

COMMENTS

Background

Among other nutrients, isoflavones are indicated as characterized by potential influence on inflammatory bowel disease, but the conclusions seem to be contradictory, as the effects of isoflavones on development and course of the disease may differ.

Research frontiers

In presented study a higher daidzein, glycitein and total isoflavones intake in ulcerative colitis individuals in remission were associated with lack of abdominal pain and declared constipations. The study of association between single isoflavones intake and a specific gastrointestinal symptoms is a novel approach.

Innovations and breakthroughs

The moderate dietary isoflavone intake may be beneficial for individuals with

ulcerative colitis in remission.

Applications

The observed beneficial effect may be explained as dependent on the lower dietary isoflavone intake in typical Western populations, than in Asian ones, and may be caused by positive anti-inflammatory effect confirmed in a number of animal-based studies. However, before including it into recommendations, further prospective studies are needed.

Peer-review

It is interesting to reveal that the higher isoflavone intake may contribute to lower abdominal pain incidence, but to higher constipations incidence in this study.

REFERENCES

1 **Mowat C**, Cole A, Windsor A, Ahmad T, Arnott I, Driscoll R, Mitton S, Orchard T, Rutter M, Younge L, Lees C, Ho GT, Satsangi J, Bloom S; IBD Section of the British Society of Gastroenterology. Guidelines for the management of inflammatory bowel disease in adults. *Gut* 2011; **60**: 571-607 [PMID: 21464096 DOI: 10.1136/gut.2010.224154]

2 **Cassinotti A**, Keshav S, Ardizzone S, Mortensen N, Sampietro G, Fociani P, Duca P, George B, Lazzaroni M, Manes G, Warren B, Foschi D, Vago G, Porro GB, Travis S. IBD care in Europe: A comparative audit of the inpatient management of Crohn's disease and ulcerative colitis using the national UK IBD audit tool. *J Crohns Colitis* 2009; **3**: 291-301 [PMID: 21172290 DOI: 10.1016/j.crohns.2009.08.002]

3 **Carter MJ**, Lobo AJ, Travis SP; IBD Section, British Society of Gastroenterology. Guidelines for the management of inflammatory bowel disease in adults. *Gut* 2004; **53** Suppl 5: V1-V16 [PMID: 15306569 DOI: 10.1136/gut.2004.043372]

4 **Hou JK**, Lee D, Lewis J. Diet and inflammatory bowel disease: review of patient-targeted recommendations. *Clin Gastroenterol Hepatol* 2014; **12**: 1592-1600 [PMID: 24107394 DOI: 10.1016/j.cgh.2013.09.063]

5 **Reif S**, Klein I, Lubin F, Farbstein M, Hallak A, Gilat T. Pre-illness dietary factors in inflammatory bowel disease. *Gut* 1997; **40**: 754-760 [PMID: 9245929]

6 **Russel MG**, Engels LG, Muris JW, Limonard CB, Volovics A, Brummer RJ, Stockbrügger RW. Modern life' in the epidemiology of inflammatory bowel disease: a case-control study with special emphasis on nutritional factors. *Eur J Gastroenterol Hepatol* 1998; **10**: 243-249 [PMID: 9585029]

7 **Sakamoto N**, Kono S, Wakai K, Fukuda Y, Satomi M, Shimoyama T, Inaba Y, Miyake Y, Sasaki S, Okamoto K, Kobashi G, Washio M, Yokoyama T, Date C, Tanaka H; Epidemiology Group of the Research Committee on Inflammatory Bowel Disease in Japan. Dietary risk factors for inflammatory bowel disease: a multicenter case-control study in Japan. *Inflamm Bowel Dis* 2005; **11**: 154-163 [PMID: 15677909]

8 **Magee EA**, Edmond LM, Tasker SM, Kong SC, Curno R, Cummings JH. Associations between diet and disease activity in ulcerative colitis patients using a novel method of data analysis. *Nutr J* 2005; **4**: 7 [PMID: 15705205 DOI: 10.1186/1475-2891-4-7]

9 **Uchiyama K**, Nakamura M, Odahara S, Koido S, Katahira K, Shiraishi H, Ohkusa T, Fujise K, Tajiri H. N-3 polyunsaturated fatty acid diet therapy for patients with inflammatory bowel disease. *Inflamm Bowel Dis* 2010; **16**: 1696-1707 [PMID: 20222122 DOI: 10.1002/ibd.21251]

10 **Ohfuji S**, Fukushima W, Watanabe K, Sasaki S, Yamagami H, Nagahori M, Watanabe M, Hirota Y; Japanese Case-Control Study Group for Ulcerative Colitis. Pre-illness isoflavone consumption and disease risk of ulcerative colitis: a multicenter case-control study in Japan. *PLoS One* 2014; **9**: e110270 [PMID: 25314032 DOI: 10.1371/journal.pone.0110270]

11 **Ko JK**, Chik CW. The protective action of radix Astragalus membranaceus against hapten-induced colitis through modulation of cytokines. *Cytokine* 2009; **47**: 85-90 [PMID: 19539495 DOI: 10.1016/j.cyto.2009.05.014]

12 **Morimoto M**, Watanabe T, Yamori M, Takebe M, Wakatsuki Y. Isoflavones regulate innate immunity and inhibit experimental colitis. *J Gastroenterol Hepatol* 2009; **24**: 1123-1129 [PMID: 19220665 DOI: 10.1111/j.1440-1746.2008.05714.x]

13 **Park DK**, Park HJ. Ethanol extract of Cordyceps militaris grown on germinated soybeans attenuates dextran-sodium-sulfate- (DSS-) induced colitis by suppressing the expression of matrix metalloproteinases and inflammatory mediators. *Biomed Res Int* 2013; **2013**: 102918 [PMID: 23841050 DOI: 10.1155/2013/102918]

14 **Dignass A**, Lindsay JO, Sturm A, Windsor A, Colombel JF, Allez M, D'Haens G, D'Hoore A, Mantzaris G, Novacek G, Oresland T, Reinisch W, Sans M, Stange E, Vermeire S, Travis S, Van Assche G. Second European evidence-based consensus on the diagnosis and management of ulcerative colitis part 2: current management. *J Crohns Colitis* 2012; **6**: 991-1030 [PMID: 23040451 DOI: 10.1016/j.crohns.2012.09.002]

15 **Kirk P**, Patterson RE, Lampe J. Development of a soy food frequency questionnaire to estimate isoflavone consumption in US adults. *J Am Diet Assoc* 1999; **99**: 558-563 [PMID: 10333777 DOI: 10.1016/S0002-8223(99)00139-X]

16 **USDA**. USDA Database for the Isoflavone Content of Selected Foods, Release 2.0. Available from: URL: https://www.ars.usda.gov/northeast-area/beltsville-md/beltsville-human-nutrition-research-center/nutrient-data-laboratory/docs/usda-database-for-the-isoflavone-content-of-selected-foods-release-20/

17 **Olendzki BC**, Silverstein TD, Persuitte GM, Ma Y, Baldwin KR, Cave D. An anti-inflammatory diet as treatment for inflammatory bowel disease: a case series report. *Nutr J* 2014; **13**: 5 [PMID: 24428901 DOI: 10.1186/1475-2891-13-5]

18 **Simrén M**, Axelsson J, Gillberg R, Abrahamsson H, Svedlund J, Björnsson ES. Quality of life in inflammatory bowel disease in remission: the impact of IBS-like symptoms and associated psychological factors. *Am J Gastroenterol* 2002; **97**: 389-396 [PMID: 11866278 DOI: 10.1111/j.1572-0241.2002.05475.x]

19 **Głąbska D**, Guzek D, Zakrzewska P, Włodarek D, Lech G. Lycopene, Lutein and Zeaxanthin May Reduce Faecal Blood, Mucus and Pus but not Abdominal Pain in Individuals with Ulcerative Colitis. *Nutrients* 2016; **8**: pii: E613 [PMID: 27706028 DOI: 10.3390/nu8100613]

20 **Szponar L**, Wolnicka K, Rychlik E. Atlas of Food Products and Dishes Portion Sizes; IŻŻ: Warsaw, Poland, 2000

21 **Kunachowicz H**, Nadolna J, Iwanow K, Przygoda B. Food Composition Tables; PZWL: Warsaw, Poland, 2005

22 **World Cancer Research Fund/American Institute for Cancer Research**. Food, Nutrition, Physical Activity, and the Prevention of Cancer: a Global Perspective. Washington DC: AICR, 2007

23 **Eaden JA**, Abrams KR, Mayberry JF. The risk of colorectal cancer in ulcerative colitis: a meta-analysis. *Gut* 2001; **48**: 526-535 [PMID: 11247898]

24 **Haas SV**, Haas MP. The treatment of celiac disease with the specific carbohydrate diet; report on 191 additional cases. *Am J Gastroenterol* 1955; **23**: 344-360 [PMID: 14361377]

25 **Yan L**, Spitznagel EL, Bosland MC. Soy consumption and colorectal cancer risk in humans: a meta-analysis. *Cancer Epidemiol Biomarkers Prev* 2010; **19**: 148-158 [PMID: 20056634 DOI: 10.1158/1055-9965.EPI-09-0856]

26 **Wang Y**, Wang Z, Fu L, Chen Y, Fang J. Legume consumption and colorectal adenoma risk: a meta-analysis of observational studies. *PLoS One* 2013; **8**: e67335 [PMID: 23826270 DOI: 10.1371/journal.pone.0067335]

27 **Yu Y**, Jing X, Li H, Zhao X, Wang D. Soy isoflavone consumption and colorectal cancer risk: a systematic review and meta-analysis. *Sci Rep* 2016; **6**: 25939 [PMID: 27170217 DOI: 10.1038/srep25939]

28 **Casati J**, Toner BB. Psychosocial aspects of inflammatory bowel disease. *Biomed Pharmacother* 2000; **54**: 388-393 [PMID: 10989978 DOI: 10.1016/S0753-3322(01)80006-8]

29 **Irvine EJ**. Quality of life of patients with ulcerative colitis: past, present, and future. *Inflamm Bowel Dis* 2008; **14**: 554-565 [PMID: 17973299 DOI: 10.1002/ibd.20301]

30 **Leung L**, Riutta T, Kotecha J, Rosser W. Chronic constipation: an evidence-based review. *J Am Board Fam Med* 2011; **24**: 436-451 [PMID: 21737769 DOI: 10.3122/jabfm.2011.04.100272]

31 **Belsey J**, Greenfield S, Candy D, Geraint M. Systematic review: impact of constipation on quality of life in adults and children. *Aliment Pharmacol Ther* 2010; **31**: 938-949 [PMID: 20180788 DOI: 10.1111/j.1365-2036.2010.04273.x]

32 **Long MD**, Drossman DA. Inflammatory bowel disease, irritable bowel syndrome, or what?: A challenge to the functional-organic dichotomy. *Am J Gastroenterol* 2010; **105**: 1796-1798 [PMID: 20686466 DOI: 10.1038/ajg.2010.162]

33 **Jiang H**, Przybyszewski J, Mitra D, Becker C, Brehm-Stecher B, Tentinger A, MacDonald RS. Soy protein diet, but not Lactobacillus rhamnosus GG, decreases mucin-1, trefoil factor-3, and tumor necrosis factor-α in colon of dextran sodium sulfate-treated C57BL/6 mice. *J Nutr* 2011; **141**: 1239-1246 [PMID: 21593350 DOI: 10.3945/jn.110.137414]

34 **Seibel J**, Molzberger AF, Hertrampf T, Laudenbach-Leschowski U, Diel P. Oral treatment with genistein reduces the expression of molecular and biochemical markers of inflammation in a rat model of chronic TNBS-induced colitis. *Eur J Nutr* 2009; **48**: 213-220 [PMID: 19234664 DOI: 10.1007/s00394-009-0004-3]

35 **González-Mauraza H**, Martín-Cordero C, Alarcón-de-la-Lastra C, Rosillo MA, León-González AJ, Sánchez-Hidalgo M. Anti-inflammatory effects of Retama monosperma in acute ulcerative colitis in rats. *J Physiol Biochem* 2014; **70**: 163-172 [PMID: 24057513 DOI: 10.1007/s13105-013-0290-3]

36 **Hur SJ**, Kang SH, Jung HS, Kim SC, Jeon HS, Kim IH, Lee JD. Review of natural products actions on cytokines in inflammatory bowel disease. *Nutr Res* 2012; **32**: 801-816 [PMID: 23176791 DOI: 10.1016/j.nutres.2012.09.013]

37 **Akhter M**, Iwasaki M, Yamaji T, Sasazuki S, Tsugane S. Dietary isoflavone and the risk of colorectal adenoma: a case-control study in Japan. *Br J Cancer* 2009; **100**: 1812-1816 [PMID: 19417743 DOI: 10.1038/sj.bjc.6605088]

38 **van Erp-Baart MA**, Brants HA, Kiely M, Mulligan A, Turrini A, Sermoneta C, Kilkkinen A, Valsta LM. Isoflavone intake in four different European countries: the VENUS approach. *Br J Nutr* 2003; **89** Suppl 1: S25-S30 [PMID: 12725653 DOI: 10.1079/BJN2002793]

39 **Messina M**, Nagata C, Wu AH. Estimated Asian adult soy protein and isoflavone intakes. *Nutr Cancer* 2006; **55**: 1-12 [PMID: 16965235 DOI: 10.1207/s15327914nc5501_1]

40 **Bowey E**, Adlercreutz H, Rowland I. Metabolism of isoflavones and lignans by the gut microflora: a study in germ-free and human flora associated rats. *Food Chem Toxicol* 2003; **41**: 631-636 [PMID: 12659715]

41 **Sakai T**, Furoku S, Nakamoto M, Shuto E, Hosaka T, Nishioka Y, Sone S. Soy isoflavone equol perpetuates dextran sulfate sodium-induced acute colitis in mice. *Biosci Biotechnol Biochem* 2011; **75**: 593-595 [PMID: 21389602 DOI: 10.1271/bbb.100710]

42 **Setchell KD**, Clerici C. Equol: history, chemistry, and formation. *J Nutr* 2010; **140**: 1355S-1362S [PMID: 20519412 DOI: 10.3945/jn.109.119776]

43 **Bosscher D**, Breynaert A, Pieters L, Hermans N. Food-based strategies to modulate the composition of the intestinal microbiota and their associated health effects. *J Physiol Pharmacol* 2009; **60** Suppl 6: 5-11 [PMID: 20224145]

44 **Ohkusa T**, Koido S. Intestinal microbiota and ulcerative colitis. *J Infect Chemother* 2015; **21**: 761-768 [PMID: 26346678 DOI: 10.1016/j.jiac.2015.07.010]

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