

Daily Consumption of Dried Plum by Postmenopausal Women Does Not Cause Undesirable Changes in Bowel Function

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ABSTRACT

Objective: To determine the effect of daily consumption of 100 g of dried plum (*Prunus domestica* L.) on the bowel habits of postmenopausal women.

Method: Fifty-eight postmenopausal women not on hormone replacement therapy and free of any gastrointestinal problems or eating disorders were randomly assigned to receive either 100 g of dried plum or 75 g of dried apples daily for 3 months. During the first week of treatment and each month thereafter, the participants were asked to fill out a validated questionnaire regarding their weekly bowel habits. The parameters used to assess bowel habits included

stool frequency, estimated fecal bulk, consistency of stool, strain and pain during bowel movement, and feeling of constipation.

Results: In both treatment regimens, there were no significant differences between the 4 different time points for any of the parameters used to assess bowel function.

Conclusion: Many postmenopausal women can take advantage of all the health benefits that accompany prune consumption, such as improving blood lipid profile and reducing bone loss, without negative gastrointestinal side effects.

INTRODUCTION

Dried plums and dried plum juice are commonly used for the relief of constipation, but the general public is less

Table 1. Macronutrient and Fiber Contents of the Dried Plum and Dried Apple Regimens

	Dried apple (75 g)	Dried plum (100 g)
Energy (kcal)	259	239
Fat (g)	0.43	0.52
Carbohydrate (g)	70.2	62.7
Protein (g)	0.99	2.61
Fiber (g)		
Total	6.52	7.10
Soluble	1.34	2.98
Insoluble	5.19	4.12

Values were obtained using Food Processor version 7.5 (ESHA Research, Salem, Ore)

familiar with the other health benefits of this fruit. Its fiber composition (Table 1), which plays a role in laxation, may also provide other benefits such as improved glucose tolerance^{1,2} and lipid metabolism.^{3,4} The phenolic compounds found in dried plum, chlorogenic acid in particular,⁵ may be involved in the improved glucose metabolism observed with dried plum consumption.¹ Furthermore, chlorogenic acid has been found to stimulate the immune function against certain tumor cell lines⁶ and to exhibit antiviral activity *in vitro*.⁷

Dried plums have also been identified as having the highest antioxidant activity among the commonly consumed plant foods in the US.⁸ This antioxidant property of dried plum can potentially play a role in the prevention of disorders such as cardiovascular disease, cancer, and bone loss. For instance, dried plum have been recently shown to be effective in both preventing⁹ and reversing¹⁰ ovarian hormone deficiency-associated bone loss in a rat model of osteoporosis, as well as positively influencing the indices of bone metabolism in postmenopausal women.¹¹ Also, the cholesterol lowering properties of dried plum in humans and animals have been demonstrated.^{3,12,13}

Unfortunately, many people may not take advantage of the potential health benefits of dried plum based on the perception that they cause diarrhea and bloating. Clinical trials documenting the actual effect of dried plum on the bowel habits of people without constipation are lacking. Therefore, we hypothesized that the gradual incorporation of 100 g of dried plum into the daily diet of healthy postmenopausal women would not cause significant changes in self-reported bowel habits including frequency of defecation, fecal bulk, and stool consistency.

METHODS

Subjects

This study was part of a study in which 58 healthy postmenopausal women were recruited for evaluating the effects of dried plum on bone biomarkers.¹¹ The exclusion criteria were history of gastrointestinal disorders, cancer, diabetes, hypo- or hyperthyroidism, liver or kidney disease, heavy smoking (more than 20 cigarettes per day), pelvic inflammatory disease, or endometrial polyps. All participants signed a consent form after receiving written and oral descriptions of the study. Complete medical and diet histories were obtained before initiating the treatments. The study protocol was approved by the Institutional Review Board at Oklahoma State University.

Study Design

Subjects were randomly assigned to receive either 100 g of dried plum (approximately 10 to 12 individual dried plum) or 75 g of dried apples, which were to be consumed daily for 3 months. The amount of dried plum was based on previous findings in which consumption of 100 g of dried plum daily resulted in improved lipid profiles of mildly hypercholesterolemic men.³ The amount of dried apples was chosen to provide comparable amounts of calories, carbohy-

Table 2. Subject Characteristics

	Dried apple			Dried plum		
	Baseline	Final	<i>P</i>	Baseline	Final	<i>P</i>
Age (y)	55 ± 1.2	-		53.6 ± 1.6	-	
Weight (lb)	163.9 ± 7.6	164.9 ± 7.6	0.40	171.6 ± 8.0	172.9 ± 8.0	0.32
BMI (kg/m ²)	28.3 ± 1.3	28.5 ± 1.3	0.40	28.9 ± 1.3	29.1 ± 1.3	0.31

BMI, body mass index. Values are least square mean ± SE; n = 20 and 18 for dried apple and dried plum regimens, respectively.

drates, fat, and fiber as assessed using food analysis software (Food Processor version 7.50, ESHA Research, Salem, Ore). The calculated values for the macronutrient composition and fiber contents of the dried fruit regimens are presented in Table 1. The dried fruits were distributed to the subjects monthly, and at the end of each of the 3 months. Study participants were asked to return any unused fruit along with a self-recorded intake log to enable the investigators to monitor the intake of dried fruits. The participants were advised to make appropriate adjustments in their daily food consumption to account for the additional energy provided by the dried fruits. Subjects were instructed to gradually increase their intake of the study foods over the first week of treatment to avoid any gastrointestinal problems related to the rapid increase in dietary fiber. Subjects were asked to maintain similar dietary and physical activity patterns throughout the study.

Dietary Assessment and Anthropometric Measurements

A 7-day food frequency questionnaire was obtained, via interview, at the beginning and the end of the study. Nutrient analysis was performed using Food Processor version 7.5 (ESHA Research, Salem, Ore). Height was measured at the beginning of the study and weight was determined at the beginning of the study and thereafter on a monthly basis. Height and weight were used to calculate body mass index (BMI).

Bowel Habit Assessment

Each study participant completed a seven-day validated bowel movement questionnaire¹⁴ at the beginning of the study and every month thereafter for a period of 3 months. During each 7-day period, participants answered a series of questions pertaining to each bowel movement. The bowel habit diary used a 7-point scale and included stool consistency (very soft to very hard), straining during bowel movement (none to extreme), pain during bowel movement (none to extreme), and feeling of constipation after bowel movement (not constipated to very constipated). The amount of stool was estimated by comparing the amount produced to a cup, ie, less than 1/4, 1/2, and 1 cup.

Statistical Analyses

Statistical analyses were performed using SAS (version 8.2, SAS Institute, Cary, NC). Data for the anthropometric measurements were assessed using analysis of variance (ANOVA) and bowel movement questionnaires were assessed as repeated measures. Data are reported as least square means ± SE and *P*<0.05 was regarded as significant.

RESULTS

Twenty women were unable to complete the study; the reasons for attrition included: medical conditions that prevented continued inclusion in the study (4 women), noncompliance with study protocol (9 women), time constraints (1 woman), personal reasons (1 woman),

Table 3. Daily Energy and Nutrient Intake Calculated from 7-Day Food Frequency Questionnaires Before and 3 Months After Treatment

	Dried apple		Dried plum	
	Baseline	Final	Baseline	Final
Total energy (Kcal)	1742 ± 422	1785 ± 498	1673 ± 493	1989 ± 493
Macronutrients (g)				
Protein	73.8 ± 20.7	64.7 ± 18.1	62.5 ± 1.4	71.7 ± 20.9
Carbohydrate	239 ± 69	252 ± 68	204 ± 47	279 ± 62
Total fat	56.9 ± 18.4	62.0 ± 28.4	59.9 ± 20.5	70.1 ± 31.6
SFA*	19.4 ± 6.8	20 ± 9.8	21.5 ± 8.2	23.8 ± 9.6
PFA†	10.1 ± 3.9	10.8 ± 5.2	10.5 ± 4.6	13.0 ± 8.8
Fiber (g)				
Total	19.2 ± 6.8	24 ± 7.3	19.3 ± 6.0	26.9 ± 8.7
Soluble	4.8 ± 2.1	5.00 ± 1.6	5.4 ± 2.3	8.1 ± 2.8
Insoluble	9.7 ± 4.3	12.8 ± 2.9	9.8 ± 3.8	13.5 ± 5.5
Water (mL)	3118 ± 1012	2760 ± 848	3040 ± 839	3224 ± 863

Values are least square mean ± SE; n = 20 and 18 for dried apple and dried plum regimens, respectively. There were no significant differences between baseline and final values within each treatment group or between the treatment groups. *SFA, saturated fatty acids; †PFA, polyunsaturated fatty acids.

and gastrointestinal complaints (5 women). Those women remaining in the study adhered to their regimens, as indicated by the self-recorded intake log.

Subject characteristics of the 38 women who completed the study are presented in Table 2. There were no significant differences in age, weight, or body mass index (BMI) between the 2 groups either at baseline or at the termination of the study.

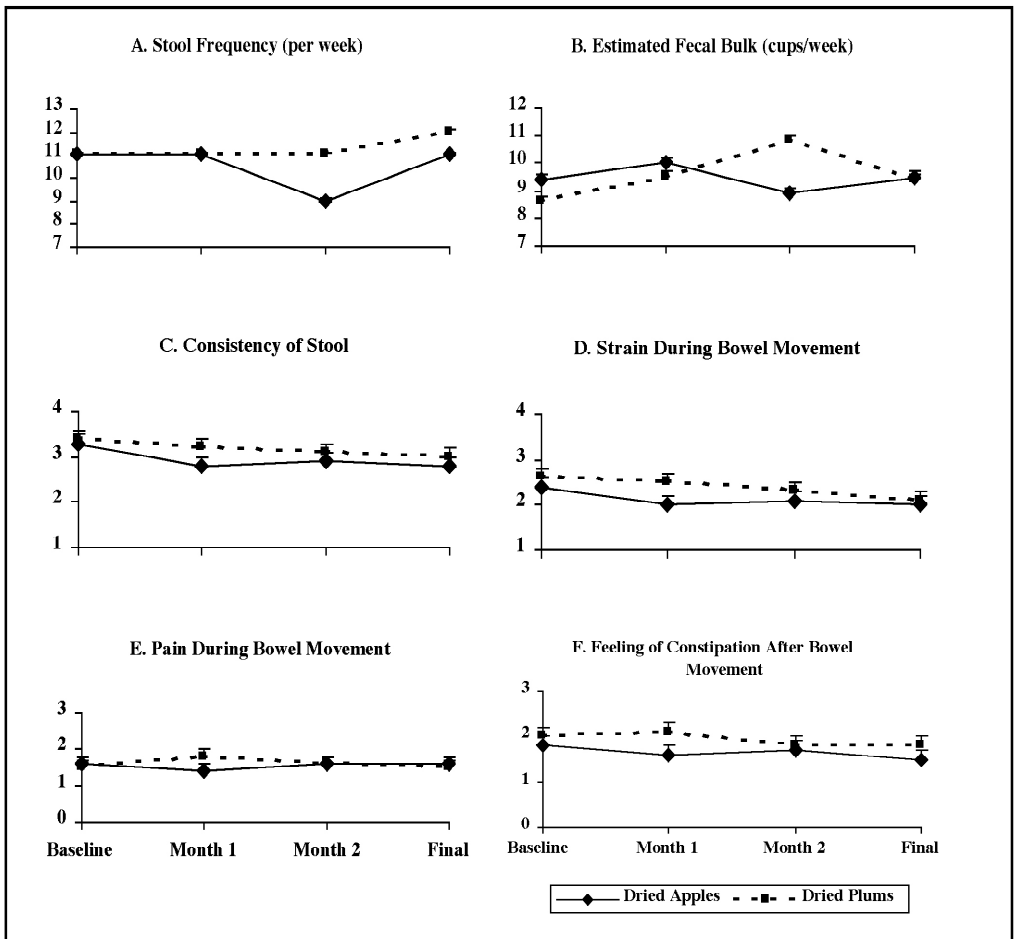
Analysis of the 7-day food frequency questionnaires revealed no significant difference between participants' baseline and corresponding final energy intake in either of the 2 treatment groups (Table 3). Although the subjects consuming the dried plum increased their consumption of total energy, protein, and carbohydrate compared to their baseline intakes, these increases were not significant and they did not result in weight gain. There were also no differences in macronutrient intake between the 2 groups.

The mean responses for the bowel movement questionnaires from baseline and the successive 3 months revealed no

significant differences in the bowel habits of the subjects during the different time points nor were there any differences between the 2 treatment groups at any given time point (Fig. 1A-1F).

DISCUSSION

Although numerous health benefits have been attributed to the consumption of dried plum^{1-4,9,11} many people may be unwilling to consume this fruit routinely due to the perception that dried plum increase bowel movements. In contrast, the findings of this study indicate that the intake of 100 g of dried plum daily by postmenopausal women with no reported bowel problems does not cause unfavorable changes in bowel habits. Similar to our findings, a study by Tinker et al³ reported no gastrointestinal disturbances, including diarrhea or loose stool, by men consuming 100 g of dried plum daily for 4 weeks. However, in that study actual fecal dry and wet weights significantly increased at the end of the treatment period. This could also be the case in the present study but fecal dry and wet weights were not assessed.



Figures 1A to 1F. For each graph, values are least square mean \pm SE; $n = 20$ and 18 for dried apple and dried plum regimens, respectively. Figures 1A through 1F reflect the effects of dried plum and dried apples for 3 months on bowel movement habits. Figures 1A and 1B represent number of bowel movements and amount of stool produced per week, respectively. Figures 1C through 1F are based on a scale of 1 to 7. Figure 1C, 1 being very soft and 7 being very hard; Figure 1D, 1 being none and 7 being extreme straining; Figure 1E, 1 being none and 7 being extreme pain during bowel movement; and Figure 1F, 1 being not constipated and 7 being very constipated. No statistically different responses were observed between time points within each treatment or between treatment group.

Many factors affect bowel function,¹⁵ one of those factors being fiber intake. Haack et al¹⁶ reported an increase in dietary fiber from 16 g to 30 g a day, from a variety of food sources, increased frequency of defecation. It has also been reported that dietary fiber increases fecal bulk by 3 to 6 g for each additional gram of fiber consumed.¹⁷ In our study, fiber intake prior to initiation of the study was 19 g/day, which is above

the estimated 14 g/day typically consumed by Americans.¹⁸ According to the final food frequency questionnaire, study participants receiving the dried plum and the dried apples increased their fiber consumption by 7 and 5 g/day, respectively. The final fiber intake of 26 g/day for the prune and 24 g/day for the dried apple regimens, are approximately the same level as the adequate intake (AI) of 14g/1000 calories recommended

by the Food and Nutrition Board.¹⁹ At the end our study, the women on the prune regimen consumed 1989 ± 493 calories per day and the women on the dried apple regimen consumed 1785 ± 498 calories per day (Table 3), that translates into fiber intakes of 28 and 25 g, respectively. In our study, increasing fiber intake by 45 to 63% may have resulted in changes in fecal bulk that were undetectable with the subjective measures utilized.

The effect of dried plum on bowel habits appears to be mild. Dried plum contains approximately 6 g of fiber per 100 g, consisting of both soluble and insoluble fibers. In general, insoluble fiber is only slightly fermentable and has a marked laxative and intestinal regulatory effect.²⁰ The amount of insoluble fibers contained in the dried apples and the dried plum were similar (Table 1); these comparable amounts of insoluble fibers in the study groups could explain the minimal differences noticed in bowel movements between the groups. Although no statistically significant differences were noted in either treatment group, it is believed that the soluble and insoluble fibers of the dried apples or dried plum work together to modestly improve intestinal motility.²

CONCLUSION

Dried plum is a rich source of fiber and antioxidants that appear to provide a variety of health benefits related to cardiovascular disease, tumorigenesis, and osteoporosis. While many people may have avoided consuming dried plum due to alleged gastrointestinal distress, the findings of this study suggest that postmenopausal women can easily incorporate up to 100 g of dried plum (approximately 10 to 12 small dried plum) into their daily diet without significant changes in their bowel habits.

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