Consumption of prunes as a source of dietary fiber in men with mild hypercholesterolemia[1-3]

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ABSTRACT Forty-one free-living adult men with mild hypercholesterolemia (5.2–7.5 mmol/L) voluntarily participated in an 8-wk crossover study designed to determine the effect of prunes as a source of fiber on plasma cholesterol and on fecal output and bile acid concentration. During the prune period, subjects supplemented their usual diets with 12 prunes (100 g; 6 g dietary fiber) daily. Plasma low-density-lipoprotein cholesterol was significantly lower after the prune period (3.9 mmol/L) than after the grape-juice-control period (4.1 mmol/L). Fecal bile acid concentration of lithocholic acid was significantly lower after the prune period (0.95 mg bile acid/g dry wt stool) than after the grape-juice-control period (1.20 mg bile acid/g dry wt stool). Both fecal wet and dry weights were ~20% higher after the prune period than after the grape-juice-control period. Total bile acids (mg/72 h) did not significantly differ between experimental periods. *Am J Clin Nutr* 1991;53:1259–65.

KEY WORDS Prune, dietary fiber, pectin, cholesterol, hypercholesterolemia, bile acids, human

Introduction

Adults with plasma cholesterol concentrations > 5.2 mmol/L may be at risk for developing coronary heart disease (1–3). Plasma cholesterol concentrations of 5.2–6.2 mmol/L were classified in the National Cholesterol Education Program (NCEP) as borderline high in relation to cardiovascular disease risk and concentrations ≥ 6.2 mmol/L were classified as high (4). The Expert Panel of the NCEP has identified dietary modification as the treatment of choice for decreasing plasma cholesterol in people at risk for cardiovascular disease. Suggested dietary modifications include lowering the fat, saturated fatty acid, and cholesterol content of the diet and increasing dietary fiber intake.

Pectin, a type of soluble dietary fiber, was shown to decrease plasma cholesterol concentrations in hypercholesterolemic humans (5–11). Although different amounts of pectin were used in these studies, ranging from 9 to 50 g/d, most investigators have used daily doses of 15 g pectin (6–10). These studies have incorporated purified pectin rather than pectin-containing foods. Another strategy has been to feed subjects dietary fiber that has been isolated from food sources. For example, Jenkins et al (12) used ~20 g fiber isolated from carrot, cabbage, or apple. Cerda et al (13) fed subjects 15 g pectin isolated from grapefruit.

The logical progression is to test the efficacy of pectin-containing foods for lowering blood cholesterol concentrations. Relatively few studies have been conducted wherein pectin-containing foods were added to the diets of human subjects. Stasse-Wolthuis et al (11) modified experimental diets to include a variety of vegetables (400 g/d) and fresh apple (600 g/d, equivalent to 3 or 4 medium-sized apples) and estimated these modifications to represent a daily addition of 8 g pectin. When these diets were fed to nonhypercholesterolemic subjects, plasma cholesterol significantly decreased. Robertson et al (14) demonstrated a reduction in plasma cholesterol concentrations in hypercholesterolemic subjects when 200 g fresh carrot daily (equivalent to four or five small carrots; estimated dietary fiber content 6 g) supplemented the experimental diets. Sablé-Amplis et al (15) fed hypercholesterolemic subjects diets supplemented with 350–400 g apple daily (equivalent to two or three medium-sized apples; estimated dietary fiber content 8 g) and reported a decrease in plasma cholesterol concentrations.

The purpose of our experiment was to test the hypothesis that prunes as a source of fiber can lower plasma cholesterol in men with mild to moderate hypercholesterolemia (5.2–7.5 mmol cholesterol/L). Prunes were chosen because they represent a potentially significant source of total dietary fiber, containing 6–7 g dietary fiber/100 g prunes (16), of which ~60% is pectin (JM Labavitch, unpublished observations, 1988).

Further, we tested the hypothesis that fecal bile acid excretion is increased in response to the ingestion of prunes as a source of fiber, and that this may help explain the cholesterol lowering effect of fiber. Dietary fiber has been shown to adsorb bile acids in vitro (17–21) and in vivo (22). Increased bile acid excretion and decreased plasma cholesterol in response to dietary fiber supplementation from pectin has been demonstrated (6, 9). However, the relationship between fecal bile acid excretion and plasma cholesterol reduction remains unclear. Stasse-Wolthuis et al (11) demonstrated a decreased plasma cholesterol after pec-

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tin ingestion, yet fecal bile acid excretion did not change over the experimental periods.

Subjects and methods

Subjects

The study was conducted according to a protocol approved by the Human Subjects Research Review Committee of the University of California, Davis (HSRC Log No 88-214). All subjects signed an informed consent form before the study began.

Subjects were recruited from the general population within a 160-km geographic radius of the study site. Criteria for participation included the following: *1*) adult male, *2*) fasting plasma cholesterol concentration between 5.2 and 7.5 mmol/L, and *3*) fasting plasma triglyceride < 2.3 mmol/L. To maintain homogeneity within the study population, volunteers were also screened for absence of known lipid metabolism disorders, diabetes, or gastrointestinal disorders. The following medications precluded participation: cholesterol-lowering drugs, excessive vitamin C (> 250 mg/d), or excessive vitamin E (> 10 mg α-tocopherol/d).

Forty-one free-living men met the above criteria and voluntarily participated in the study. All subjects starting the study completed the study. Subjects were aged 29–79 y (46.5 ± 12.4, $\bar{x}$ ± SD). Body mass index (BMI; in kg/m^2) ranged from 19.6 to 28.9 (24.9 ± 2.2). Two subjects smoked tobacco, 6 subjects had a history of cardiovascular disease or cardiovascular surgery, and 25 subjects stated that they had made past dietary changes, such as lowering their fat or sodium intake. However, all subjects stated that no dietary changes had been made within the 6 mo before entering the study.

Baseline nutrient intakes of energy, carbohydrate, protein, fat, alcohol, dietary cholesterol, and dietary fiber were estimated from self-reported food records collected every other day for 2 wk before the start of the experiment. These nutrient-intake values are listed in **Table 1.**

Experimental design

The experiment was designed as an 8-wk crossover study with each subject acting as his own control. The 8 wk were split into two experimental diet periods, each lasting 4 wk. Subjects were randomly assigned a diet sequence, starting with either a grape-juice-control supplement (GJ control) or a prune supplement. Subjects lived at home during both experimental periods. Because of the nature of the dietary supplements, it was not feasible to conduct the study in a double-blind manner. However, subjects were not informed of their plasma lipid values during the study and all samples were coded to prevent the individuals conducting the analyses from knowing the experimental period or subject associated with a sample.

Diets

During the 4 wk GJ-control period, subjects consumed their usual diet with a supplement of 360 mL grape juice/d. Grape juice was selected as a control because it is a negligible fiber source yet is similar to prunes in providing simple carbohydrates. During the 4-wk prune period, 12 prunes (~100 g/d) replaced the grape juice. The prunes used in this study had 6 g total dietary fiber per 100 g prunes, as analyzed by the Prosky method (Sigma Total Dietary Fiber Assay Kit, Sigma Technical Bulletin TDFAB-1, 9-85, Sigma Chemical Company, St Louis) (23). The pectin content of the prunes was 55–60% of the total dietary fiber (JM Labavitch, unpublished observation, 1988). Each supplement provided ~1004 kJ/d (24).

Before the start of the study, subjects were instructed to maintain a consistent food intake and activity pattern during the study. Instruction was provided on keeping food records and subjects were given food scales to facilitate the process.

Sample and data collection

Subjects kept food records every other day during the entire study period and were interviewed weekly by a registered dietitian. During the interview, food records were reviewed for completeness and the dietary supplements for the next week were distributed.

Fasting (12-h overnight) blood samples, 10 mL each, were collected by venipuncture three times during the 8-wk study: week 0 (baseline), week 4 (crossover), and week 8 (conclusion). The blood samples were collected into EDTA-containing evacuated tubes (final concentration 1 g EDTA/L blood) and plasma was separated by centrifugation at 1200 × *g* for 20 min at 4 °C.

Fecal samples, 72-h collections each, were taken three times during the study at times coinciding with the blood samples. The fecal samples were collected in plastic bags and immediately frozen at 0 °C.

TABLE 1
Daily nutrient intake*

				Probability values	
	Baseline	GJ control	Prune	Baseline vs GJ control	Prune vs GJ control
Energy (kJ)	10 552 ± 339	10 761 ± 63	10 791 ± 297	0.41	0.88
Carbohydrate (% of energy)	47 ± 1	51 ± 1	51 ± 1	0.0001	0.90
Protein (% of energy)	16 ± 1	15 ± 1	14 ± 1	0.03	0.31
Fat (% of energy)	33 ± 1	30 ± 1	30 ± 1	0.0001	0.90
Alcohol (% of energy)	4 ± 1	4 ± 1	5 ± 1	0.85	0.03
Cholesterol (mg)	276 ± 15	255 ± 12	277 ± 16	0.11	0.12
Dietary fiber (g)	21 ± 1	18 ± 1	24 ± 2	0.005	0.0001

* $\bar{x}$ ± SEM; n = 41. GJ, grape juice.

Sample and data analysis

Food records were analyzed for energy, carbohydrate, protein, fat, alcohol, dietary cholesterol, and dietary fiber (*Nutritionist III*, N-Squared Computing, Silverton, OR). The database record for prunes was modified to be 6 g total dietary fiber/100 g prunes. The dietary fiber data for other food items were updated according to the US Department of Agriculture Provisional Table on the Dietary Fiber Content of Selected Foods (16).

Fresh plasma was used to quantitate total cholesterol (TC) (25, 26), high-density-lipoprotein cholesterol (HDL-C) (27–29) and total triglycerides (TGs) (30). The lipid analyses were performed in the University of California, Davis, Lipid Assay Laboratory, which is standardized by participation in the Centers for Disease Control National Heart, Lung and Blood Institute lipid standardization program (LSP-206). HDL-particle size distribution was determined by gradient-gel electrophoresis (31) on the HDL plasma subfraction obtained by sequential density ultracentrifugation (32). Low-density-lipoprotein cholesterol (LDL-C) was estimated by using this equation (33):

$$\text{LDL-C} = [(\text{C}) - (\text{HDL-C}) - (0.2 \times \text{TG})]$$

Fecal samples were analyzed for wet weight, dry weight, and bile acids. Each 72-h sample was thoroughly mixed with an equal weight of water in a paint-can shaker or blender, and a sample of each mixture was lyophilized and then weighed. Bile acids were extracted from samples of lyophilized samples by refluxing in organic solvents and partially purified by using C_{18} solid-phase-extraction cartridges (Sep-Pak, Waters Associates, Milford, MA) (34). This procedure has been shown to recover > 90% of fecal bile acids.

Individual bile acids were quantified by high-performance-liquid chromatography, as previously described (35). Individual bile acids in the samples were identified by comparison with retention times of known bile acid standards. Sulfated bile acids are not determined by this procedure because they do not have a 3α-hydroxyl group to react with the enzyme. Cholic acid, chenodeoxycholic acid, deoxycholic acid, and lithocholic acid were obtained from Sigma Chemical Co. Ursodeoxycholic acid, glycocholic acid, taurocholic acid, glycodeoxycholic acid, and taurodeoxycholic acid were from Calbiochem (San Diego). 3α-hydroxy-12-keto-5β-cholanic acid and 3α-hydroxy-7-keto-5β-cholanic acid were from Steraloids (Wilton, NH).

Statistical analyses

Treatment differences were evaluated by a repeated-measures analysis of variance (ANOVA), grouped by diet sequence. The baseline and prune periods were compared with the GJ-control period by using planned *F* tests (36). The comparison between the GJ-control and baseline values provides an indication of differences due to participation in the study, whereas differences between the GJ-control and prune periods provide an indication of differences due to the fiber supplement within the experimental design. The repeated-measures analyses for treatment differences were performed with *SAS* statistical computer software (37).

The overall linear relationships between dietary fiber intake and plasma lipids or fecal bile acid excretion were evaluated by repeated-measures ANOVA with one covariate, dietary fiber intake, changing across the repeated measures (36). Because of the repeated-measures design of the study, covariate analyses rather than regression analyses were used to analyze the linear relationships. The covariate analyses were not used in the classic manner for statistical control of confounding environmental factors. The covariate analyses were performed with BMDP statistical computer software (38).

Results

Nutrient intake

Between the baseline and GJ-control values, the only dietary variables that differed were the percent energy from carbohydrate and fat, and grams of dietary fiber. Participation in the study resulted in a slight increase in percent energy from carbohydrate and a slight decrease in percent energy from fat. During the GJ-control period, dietary fiber intake was slightly lower than within the baseline period (Table 1).

However, during the two experimental periods, GJ control and prune, the subjects maintained a consistent nutrient intake of total energy, percent energy from carbohydrate, protein, fat, and dietary cholesterol. Alcohol intake increased from 4% to 5% of energy intake during the prune period compared with the GJ-control period. Dietary fiber significantly increased from 18 to 24 g/d ($P = 0.0001$) during the prune period compared with the GJ-control period, as was expected (Table 1). No interactions between diet sequence and dietary treatment were detected for the nutrient intakes.

Plasma lipids

Plasma lipid data are summarized in **Table 2.** LDL-C was significantly higher after the GJ control than after baseline ($P = 0.01$) and significantly lower after the prune period than after the GJ-control period ($P = 0.02$). No statistically significant differences in TC, HDL-C, or TG occurred between baseline values and those obtained during the GJ-control, or between GJ-control and prune periods. However, a trend ($P = 0.073$) was observed for plasma TC to be lower after the prune period than after the GJ-control period. HDL_2 and HDL_3 particle size distribution did not differ between experimental periods. No interactions between diet sequence and dietary treatment were detected for the plasma lipids.

Relationship between dietary fiber intake and plasma lipids

The overall relationship between changes in dietary fiber intake and changes in plasma lipid concentrations were analyzed within the baseline, GJ-control, and prune periods by using covariate analyses. An overall trend was observed between changes in dietary fiber intake and changes in plasma TC and LDL-C. For each 1.0-g increase in daily dietary fiber intake, plasma TC decreased by 0.016 mmol/L ($P = 0.068$). For each 1.0-g increase in daily dietary fiber intake, plasma LDL-C decreased by 0.013 mmol/L ($P = 0.16$). No statistically estimable relationships were observed between changes in daily dietary fiber intake and changes in HDL-C or TG.

Fecal excretion

No overall effect from being in the study was noted on the fecal weights. Between the baseline and GJ-control periods, neither fecal wet weight, dry weight, nor percent water differed.

Fecal wet and dry weights were higher after the prune period than after the GJ-control period, whereas percent water in the stool remained the same during the study (**Table 3**). Increased

TABLE 2
Plasma lipids*

				Probability values	
	Baseline	GJ control	Prune	Baseline vs GJ control	Prune vs GJ control
Total cholesterol (mmol/L) [n = 41]	5.84 ± 0.09	5.96 ± 0.11	5.84 ± 0.09	0.10	0.07
LDL-C (mmol/L) [n = 41]	3.89 ± 0.08	4.09 ± 0.10	3.92 ± 0.09	0.01	0.02
HDL-C (mmol/L) [n = 41]	1.30 ± 0.05	1.27 ± 0.04	1.26 ± 0.05	0.93	0.46
HDL_2 (% HDL) [n = 35]†	55 ± 1.6	55 ± 1.7	56 ± 1.6	0.61	0.33
HDL_3 (% HDL) [n = 35]†	45 ± 1.6	45 ± 1.6	44 ± 1.6	0.93	0.51
Triglyceride (mmol/L) [n = 41]	1.35 ± 0.07	1.31 ± 0.08	1.44 ± 0.11	0.55	0.08

* $\bar{x}$ ± SEM. LDL-C, low-density lipoprotein cholesterol; HDL-C, high-density lipoprotein cholesterol.
† Distribution of HDL particle size based on gradient-gel electrophoresis (31); six samples unmeasurable.

fecal weight in response to ingestion of the prunes indicates general subject compliance with the study protocol. Interactions between diet sequence and dietary treatment were not statistically significant for the fecal samples.

Individual effects on bowel habits varied widely during the study. Five to ten percent of the study population experienced softer stools or increased stool frequency or flatulence at some time during the study. These responses did not occur consistently or more frequently in any one subject or study period than others.

Fecal bile acids

Total bile acid excretion data are summarized in **Table 4.** The excretion of total bile acids, expressed as the total or individual bile acids, collected during the 72-h fecal collection period did not differ between the baseline and GJ-control periods, nor between the prune and GJ-control periods. No interactions between diet sequence and dietary treatment were detected for the bile acids.

The concentration (mg bile acid/g dry wt stool) of the total bile acids, primary bile acids, secondary bile acids, or individual bile acids did not differ between the baseline and GJ-control periods (**Figs 1 and 2**).

Between the GJ-control and prune periods, the concentration (mg bile acid/g dry wt stool) of the total bile acids and primary bile acids did not differ. However, concentration of secondary fecal bile acids was lower after the GJ-control period than after the prune period (P = 0.024) (Fig 1). The concentration of lithocholic acid was significantly lower (P = 0.015) and deoxycholic acid tended to be lower (P = 0.067) after the prune period than after the GJ-control period (Fig 2). No differences in cholic or chenodeoxycholic acid concentrations were observed. No interactions between diet sequence and dietary treatment were detected for the bile acid concentrations.

No linear relationships were statistically estimable between wet and dry fecal weights and plasma TC or LDL-C concentrations, or between fiber intakes and concentration of total bile acids, primary bile acids, secondary bile acids, or the individual bile acids (cholic acid, chenodeoxycholic acid, deoxycholic acid, or lithocholic acid) when covariate analyses were used.

Discussion

During the 8-wk study period, the subjects modified their baseline diets to incorporate the carbohydrate-derived energy from either the prune or grape-juice supplement. The percent of energy from carbohydrate significantly increased, protein decreased slightly, and fat significantly decreased. Energy displacement is unavoidable when high-fiber foods are used rather than

TABLE 3
Fecal excretion*

				Probability values	
	Baseline	GJ control	Prune	Baseline vs GJ control	Prune vs GJ control
Fecal wet wt (g/72 h)	550 ± 42.7	514 ± 34.0	628 ± 43.9	0.39	0.001
Fecal dry wt (g/72 h)	123 ± 7.1	120 ± 7.8	140 ± 9.0	0.64	0.006
Water (%)	76 ± 1.0	76 ± 0.7	77 ± 1.1	0.61	0.56

* $\bar{x}$ ± SEM; n = 41.

TABLE 4
Total fecal excretion of bile acids*

	Baseline	GJ control	Prune	Probability values: Baseline vs GJ control	Probability values: Prune vs GJ control
Total bile acids (mg/72 h)†	519 ± 51.6	501 ± 53.7	518 ± 67.3	0.83	0.80
Primary bile acids (mg/72 h)‡	76 ± 19.8	80 ± 18.8	111 ± 51.0	0.73	0.40
Cholic acid (mg/72 h)	43 ± 11.8	50 ± 11.6	68 ± 30.1	0.98	0.29
Chenodeoxycholic acid (mg/72 h)	33 ± 8.4	30 ± 7.8	43 ± 21.2	0.50	0.42
Secondary bile acids (mg/72 h)§	387 ± 39.1	383 ± 46.0	338 ± 36.9	0.73	0.40
Deoxycholic acid (mg/72 h)	244 ± 28.5	239 ± 33.2	213 ± 28.2	0.96	0.38
Lithocholic acid (mg/72 h)	145 ± 14.5	144 ± 20.0	125 ± 11.3	0.99	0.29

* $\bar{x}$ ± SEM; n = 39 (two samples not measurable).
† Total bile acids equal the sum of cholic, chenodeoxycholic, deoxycholic, lithocholic, ursodeoxycholic, 3α-hydroxy-7-keto-5β-cholanic, glycocholic, 3α-hydroxy-12-keto-5β-cholanic, taurocholic, glycodeoxycholic, and taurodeoxycholic acids.
‡ Primary bile acids equal the sum of cholic and chenodeoxycholic acids.
§ Secondary bile acids equal the sum of deoxycholic and lithocholic acids.

isolated sources of fiber, although the particular nutrients displaced may vary. Stasse-Wolthuis et al (11) reported no change in carbohydrate or protein intakes, an increase in fat intake, and a decrease in alcohol intake when comparing the usual diets with experimental diets of subjects participating in a study investigating the effects of high-fiber diets on serum lipids.

To see the effect in our study of prunes as a source of dietary fiber on plasma cholesterol concentrations and fecal bile acid excretion, we compared the results from the prune period with those from the GJ-control period rather than with those from the baseline period. This comparison assumes that the displacement of certain foods by either the grape-juice or prune supplement was consistent during the entire 8-wk study period and that the increase in dietary fiber intake was from the prunes. This assumption is supported by the observation that the percent of energy from carbohydrate, protein, and fat was consistent during the 8-wk study period. On the basis of the dietary pattern observed, differences between the GJ-control and baseline periods were used to illustrate changes that occurred as a result of participation in the study, whereas differences between the prune and GJ control were used to interpret changes due to adding fiber within the experimental design.

LDL-C was slightly higher as a result of participation in the study (GJ control vs baseline) but was significantly lower at the end of the prune period than at the end of the GJ-control period. The observed decrease in LDL-C parallels the decrease in TC and is consistent with results reported in other studies (7, 8, 12, 13). Plasma HDL-C did not change between the experimental periods.

In our study, plasma TC tended to be lower at the end of the prune period than at the end of the GJ-control period (P = 0.07), although the decrease was not statistically significant at the 5% level. We believe that the 6 g increase in dietary fiber from the 100-g prune supplement may have been insufficient to clearly demonstrate differences in plasma TC. Delbarre et al (39) also demonstrated a trend, though not statistically significant, for plasma TC to decrease in response to feeding 6 g pectin/d to hypercholesterolemic subjects. However, we do not propose feeding a greater amount of prunes to increase the fiber dose. At the present feeding level, the prune supplement represents a 9% caloric displacement; a further increase might displace sources of other nutrients.

We used covariate regression analysis on the repeated measures to investigate the relationship between the level of dietary fiber intake and plasma lipid response. Because our study was designed to have the subjects consume their usual diets with minor changes, total dietary fiber intakes varied between subjects

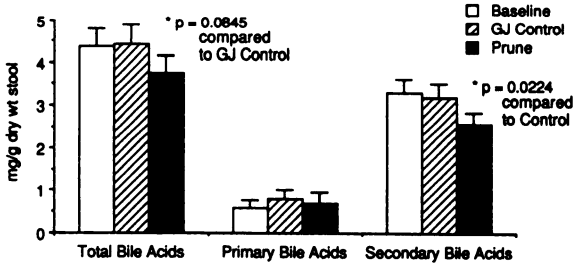

FIG 1. Fecal bile acid concentration (mg/g dry wt stool): total, primary, and secondary bile acids. $\bar{x}$ ± SEM (n = 39).

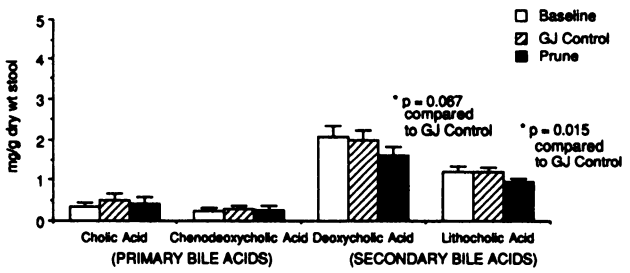

FIG 2. Fecal concentration (mg/g dry wt stool) of cholic acid, chenodeoxycholic acid, deoxycholic acid, and lithocholic acid. $\bar{x}$ ± SEM (n = 39).

(baseline range: 8–54 g fiber/d). Overall, the results of the covariate analyses suggest that within our study population, the greater the increase in dietary fiber intake between experimental periods the greater the decrease in plasma TC and LDL-C concentrations. Consequently, the contribution of fiber from prunes may be important in an overall diet modification to increase fiber.

Kies (40) suggested that the cholesterol-lowering effects of dietary fiber in normolipemic individuals was related to changes in fecal weight. These data were pooled from several studies and the fiber sources included psyllium seed, wheat bran, rice bran, or corn bran fed in amounts equivalent to 16 g dietary fiber/d. Responders had significantly greater stool volumes and decreased intestinal transit times after fiber ingestion. In the present study, no linear relationship was observed by covariate regression analysis with plasma TC and LDL-C as the dependent variables and fecal wet or dry weights as the covariates. Jenkins et al (12) observed a similar lack of association between hypocholesterolemic and fecal-bulking effects of dietary fiber.

Excretion of bile acids over a 72-h period did not differ between the prune and the GJ-control periods. Thus, an increased excretion of total bile acids was not associated with the changes in plasma cholesterol. Kay and Truswell (41) observed an increase in total fecal bile acid excretion; however, in their study, 15 g of isolated pectin was fed to nine adults who consumed all their meals in a metabolic kitchen. In a study with rats, Vahouny et al (42) reported no difference in the amount of fecal bile acids excreted after feeding pectin. It is interesting that in our study there was a slight tendency for the fecal excretion of primary bile acids to increase and secondary bile acids to decrease after the prune period. A purported mechanism is that dietary fiber alters the colonic milieu and may inhibit the conversion of primary bile acids to secondary bile acids.

The concentration of fecal bile acids was lower after the prune period than after the GJ-control period. This result is explainable given that the fecal weights increased and total fecal bile acid excretion did not change. Specifically, the bile acid concentration of the secondary bile acids (deoxycholic + lithocholic) decreased, with the decrease being greater for lithocholic acid than for deoxycholic acid. A high concentration of secondary bile acids has been associated with an increased risk of colon cancer (43).

Studies have been conducted on the specific laxative effect of prunes (44–46; EM Mrak, unpublished observations, 1931) and some diet manuals recommend prune juice or other fruit juices for a laxative effect associated with an increased water content in the stool (48). In the present study, both fecal wet and dry weights increased in response to prunes compared with the GJ control. The percent water in the stool, which was in the normal range throughout the study, remained the same at each fecal collection time point. No subjects reported diarrhea or runny stools after eating 12 prunes/d. No subject discontinued the study because of a problem with consuming either supplement. The laxative substance, dihydroxyphenylisatin, reported in the studies by Baum et al (44) has not been reported elsewhere, nor have any other laxative substances unique to prunes been reported (45, 46; EM Mrak, unpublished observations, 1931). Our results suggest that the fecal-bulking effect of prunes is most likely due to its contribution of fiber to the diet.

The addition of 12 prunes/d significantly increased the average dietary fiber intake of the subjects participating in this study. Thus, prunes complement other high-fiber foods and are a useful addition to the diets of individuals whose goal it is to consume a high-fiber diet. Careful menu planning incorporating high-fiber foods, rather than isolated fiber supplements, can lead to positive changes in eating habits. Individual therapeutic needs should be considered whenever dietary modifications are suggested.

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