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The Effect of Acacia Gum and a Water-Soluble Dietary Fiber Mixture on Blood Lipids in Humans

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Water-soluble dietary fibers (WSDF) are generally thought to lower cholesterol. This study compared the cholesterol-lowering effects of a medium viscosity WSDF mixture (psyllium, pectin, guar gum and locust bean gum) with an equal amount of WSDF from acacia gum, which has a lower viscosity. Hypercholesterolemic males (n = 13) and females (n = 16) were randomly assigned to one of two WSDF treatments provided in a low-calorie powder form for mixing into beverages (<4 kcal/serving). Subjects were instructed to mix powders into their usual beverages and to consume them three times daily (5 g WSDF/serving) for 4 weeks while consuming their typical fat-modified diets. Exercise and body weights were also held constant. The WSDF mixture yielded a 10% decrease in plasma total cholesterol (from 251 ± 20 to 225 ± 19 mg/dL; $p < 0.01$), and a 14% reduction in low-density lipoprotein cholesterol (from 167 ± 14 to 144 ± 14 mg/dL; $p < 0.001$). No significant changes in plasma high-density lipoprotein cholesterol, very-low-density lipoprotein cholesterol or triglycerides were observed. In contrast, the acacia gum-treated group showed no change in any plasma lipid parameters. The WSDF treatments did not produce significant changes in mean dietary intakes within or between treatment groups. These data support previous findings that a diet rich in select WSDF can be a useful cholesterol-lowering adjunct to a fat-modified diet, but that caution should be exercised in ascribing cholesterol-lowering efficacy to dietary fibers based solely on their WSDF classification. Finally, WSDF viscosity is a potential cholesterol-lowering factor to be explored further.

Abbreviations: HDL-C = high-density lipoprotein cholesterol, LDL-C = low-density lipoprotein cholesterol, NCEP = National Cholesterol Education Program, TC = total cholesterol, TG = triglycerides, VLDL-C = very-low-density lipoprotein cholesterol, WSDF = water-soluble dietary fiber

INTRODUCTION

Elevated plasma total cholesterol (TC) and low-density lipoprotein cholesterol (LDL-C) are major coronary heart disease risk factors [1], the modification of which in asymptomatic hypercholesterolemic men, has resulted in a lower incidence of fatal and nonfatal cardiac events [2].

According to National Cholesterol Education Program (NCEP) criteria, approximately 60 million adult Americans are candidates for medical advice and intervention for high blood cholesterol levels [3]. The starting-point for treatment of hypercholesterolemia is dietary management, with the general aim to lower plasma TC and LDL-C concentrations by reducing the intake of total fats, saturated fatty acids and cholesterol, and to promote weight loss in individuals who are overweight [4]. A nutritionally adequate diet containing a variety of foods is recommended. NCEP guidelines also acknowledge that water-soluble dietary fiber (WSDF) sources such as pectins, certain gums, psyllium and β-glucan, have been reported to lower plasma TC levels by 5–15%, but they offer no specific recommendations for dietary fiber with regard to types or amounts. In fact, we are aware of only a few published studies which compare the cholesterol-lowering efficacy of

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various types, forms, and/or combinations of WSDF [5–11]. In addition, there is some debate whether diets rich in fiber lower blood cholesterol levels independently, or act through some other means such as displacement of total fat and saturated fat in the diet [12,13].

The objective of the present study was to explore the cholesterol-lowering efficacy of two different WSDF preparations: one featuring a beverage with acacia gum as the sole source of WSDF, and the other a beverage composed of WSDF from psyllium, pectin, guar gum and locust bean gum. Both treatments were specifically designed to have minimal impact on typical food choices, energy consumption and macronutrient intake.

METHODS

Subjects

Thirty volunteers (13 males and 17 females, age range 39–70 years, 83–122% ideal body weight from 1983 Metropolitan Life Insurance Tables), with fasting blood glucose levels from 81 to 122 mg/dL were recruited through newspaper advertisements and agreed to participate in the study (Table 1). Subjects were free of plasma cholesterol-lowering medications, had stable dietary patterns for at least 3 months prior to entering the study, had no history of dietary fiber supplement use, and were free of gastrointestinal diseases that might influence lipoprotein metabolism. Two of the subjects were smokers and none consumed more than two alcoholic drinks/day (drink = 4 oz wine or 12 oz beer). One subject dropped out of the study prior to completion for reasons unrelated to the study itself. Her data were excluded from Table 1 and the final analyses.

Study Design and Parameters Measured

The study design and protocol were approved by the Health Research and Studies Center's Review Committee on the use of human subjects in research, and all subjects provided written informed consent.

The study involved hypercholesterolemic subjects consuming self-selected diets which were supplemented with either a WSDF mixture or acacia gum in a double-blind, parallel, 4-week comparison. The supplementation period was preceded by 1 week of baseline measures. During the baseline week and final week of treatment, subjects completed 4-day weighed food records, had their body weights measured, and provided duplicate fasting blood samples. Blood samples were collected on days 1 and 7 of the baseline week, day 28 after 3 weeks of treatment and day 35 after 4 weeks of treatment.

Subjects were given food scales and measuring cups and spoons, and were instructed on their use in measuring food intake. Subjects were instructed to maintain their typical dietary, medication and exercise patterns throughout the study period. Subjects also completed daily logs where they noted taking the WSDF treatments and any side-effects.

Subjects were randomized to WSDF treatments based on day 1 baseline TC values. Values were ranked from highest to lowest and the corresponding subjects were randomly assigned to one of the two treatment groups within blocks of four subjects.

Subjects were instructed to mix the WSDF treatments with their typical meal beverages, and to consume them with meals three times daily during the 1 month of supplementation.

Table 1. Description of Subjects (Mean ± SD [range])

Parameter	WSDF mixture	Acacia gum
Gender (no. M/F)	6/9	7/7
Age (years)	52 ± 9 [40–69]	56 ± 9 [39–69]
% ideal body weight	103 ± 11 [83–122]	103 ± 8 [90–117]
Blood glucose (mg/dL)	97 ± 7 [81–110]	98 ± 9 [88–122]

WSDF Treatments

Treatments consisted of two different WSDF powders (Table 2), each providing 5 g WSDF and <4 kcal/serving (<1 g maltodextrin/serving of beverage when mixed in water). One treatment provided WSDF from acacia gum (Acacia senegal), which is referred to in the text and tables as acacia gum, and which produced a comparatively low viscosity beverage when mixed with water, juices or other appropriate beverages. Acacia gum was selected as a treatment because of its low viscosity and greater palatability when mixed into liquids. The other treatment consisted of a mixture of WSDF sources: psyllium (Plantago psyllium),

Table 2. WSDF Treatments: Composition and Viscosity

Treatment	WSDF mixture	Acacia gum
Calories/serving	<4	<4
Carbohydrates/serving (g) (maltodextrin)	0.75	0.65
WSDF sources (g WSDF/serving)		
Psyllium	2.1	—
Pectin	1.3	—
Guar gum	1.1	—
Locust bean gum	0.5	—
Acacia gum	—	5.0
Total servings/day	3	3
Total WSDF/day (g)	15	15
Viscosity (cps)		
4 minutes	142	6
6 minutes	205	6
10 minutes	315	6
30 minutes	685	5

pectin (high methoxyl type from apple), guar gum (Cyamopsis tetragonolobus), and locust bean gum (Ceratomia silica L.), and is referred to as WSDF mixture in the text and tables. The WSDF mixture yielded a comparatively higher viscosity beverage when mixed into appropriate liquids. A mixture of WSDF sources was chosen in an effort to abide by standards for appropriate levels of these dietary fiber sources in foods [18,19], and to produce a beverage of acceptable viscosity. The 15 g/day WSDF dose was selected based on a previous dose-response study where the same mixture of WSDF, administered in conjunction with 17 g/serving of fructose, produced significant cholesterol lowering [11].

Viscosity was measured with a Brookfield Viscosimeter (Model LVTDV, Brookfield Instrument Co, Stoughton, MA) on treatments that were mixed into 280 ml distilled water at 21°C. Viscosity readings were taken every 2 minutes for 30 minutes. Data are reported at 4, 6, 10 and 30 minutes (Table 2). Treatments were packaged identically and labeled with a four-digit random number code to ensure double-blinding.

Laboratory Analyses

Blood samples were drawn after 12-hour fasts for analysis of plasma lipids. Two 10 ml blood samples were drawn from the antecubital vein of subjects into vacutainer tubes containing 15 mg EDTA. Each sample was centrifuged and refrigerated. The specimens were shipped by overnight air carrier under refrigeration to Pacific Biometrics, Inc, Seattle, WA; all samples were analyzed on the day following blood sampling.

High-density lipoprotein cholesterol (HDL-C) was separated from the plasma by precipitation using dextran sulfate and magnesium chloride [14]. TC in the remaining plasma and in the separated HDL-C fraction was measured by an enzymatic procedure [15] on a Spectrum bichromatic analyzer (Abbott Laboratories, North Chicago, IL). Plasma triglycerides (TG) corrected for the glycerol blank were analyzed by a hydrogen peroxide-producing enzymatic procedure [16] on the Spectrum analyzer. These analytical procedures were standardized and met the performance requirements of the Lipoprotein Standardization Program of the Centers for Disease Control, Atlanta, GA, and are traceable to the National Reference System for Cholesterol. Very-low-density lipoprotein cholesterol (VLDL-C) and LDL-C were calculated as described by Friedewald et al [17]. The long-term interassay coefficient of variation during the study was 1–2% for TC and <2.5% for HDL-C at all concentrations measured. Intra-assay coefficient of variation was <1.5% for both TC and HDL-C.

Statistical Methods

Baseline values for age, percent of ideal body weight, fasting blood glucose, and plasma TC and TG were compared between treatment groups using a one-way analysis of variance procedure.

Four-day weighed food records completed during week 1 (baseline) and at the end of 4 weeks of supplementation were analyzed using the nutrition software package Nutritionist III (version 5.0, N-Squared Computing, Salem, OR). Dietary values determined from baseline were averaged and subtracted from those averages obtained during the end of treatment for each subject. In addition, body weights measured at baseline were subtracted from those obtained at the end of treatment for each subject. Average differences in dietary parameters and body weights were analyzed using one-way analysis of variance comparing the two treatment groups. Within each treatment group the resultant change in dietary values and body weights from baseline to end of treatment was tested against the null hypothesis of no change.

Plasma lipid values obtained on days 1 and 7 were averaged for each subject and designated as baseline values. Final lipid values were designated as the average of those obtained on days 28 and 35 during the third and fourth weeks of treatment. Differences between baseline and final lipid values were calculated for each subject. A two-way analysis of variance was performed on these changes with treatment and gender as the factors tested. The interaction of gender and treatment was also tested. All tests of significance were conducted at the 0.05 level of significance.

RESULTS

Treatment Groups

No significant differences between the two treatment groups at baseline were noted in terms of age, percentage of ideal body weight, fasting blood glucose concentrations (Table 1), and plasma lipids (Table 3).

Compliance and Side Effects

Subjects were instructed to consume WSDF treatments with their typical meal beverages, and treatments were taken most commonly with juices and diluted juices, followed by plain water, and then milk. According to daily logs, 51 acacia gum servings were missed out of a possible 1176 servings (4.3%), and 46 WSDF mixture servings out of a possible 1260 servings (3.6%) over the course of the study.

Minor gastrointestinal disturbances (e.g., gas, bloating and loose stools) were common during the first week of treatments and tended to subside over the course of the

Table 3. Plasma Lipid Concentrations (mg/dL; Mean ± SD) in Response to WSDF Treatments

Plasma lipid	WSDF mixture		Acacia gum	
	Baseline	Final	Baseline	Final
TC	251 ± 20	225 ± 19	245 ± 23	244 ± 37
Change		−25 ± 14		0 ± 25
% change from baseline		−10*		0
LDL-C	167 ± 14	144 ± 14	160 ± 21	163 ± 21
Change		−24 ± 13		+3 ± 19
% change from baseline		−14**		+2
HDL-C	60 ± 19	57 ± 17	59 ± 14	55 ± 13
Change		−2 ± 3		−4 ± 7
% change from baseline		−4		−7
VLDL-C	23 ± 7	24 ± 10	25 ± 10	26 ± 17
Change		+1 ± 6		0 ± 12
% change from baseline		+3		0
TG	116 ± 39	119 ± 52	126 ± 50	129 ± 85
Change		+3 ± 29		+2 ± 61
% change from baseline		+3		+2

* Differs from baseline at $p < 0.01$.
** Differs from baseline at $p < 0.001$.
TC = total cholesterol; LDL-C = low-density lipoprotein cholesterol; HDL-C = high-density lipoprotein cholesterol; VLDL-C = very-low-density lipoprotein cholesterol; TG = triglycerides.

study. During the first week of treatments, 6 in the acacia gum group reported experiencing mild gas and bloating, 2 reported loose stools, and 6 reported no side-effects. During the same time period, 7 in the WSDF mixture group reported mild gas and bloating, 1 experienced severe gas, bloating and cramps, and 7 reported no side effects. During the second week of treatments, 1 subject in the acacia gum group and 2 in the WSDF mixture group reported experiencing mild gas. A third person in the WSDF mixture group reported severe gas and bloating in the second week. No side effects were reported for either group during the last 2 weeks of treatment.

Dietary Analyses and Body Weights

Dietary intakes for the two treatment groups at baseline and the end of the study are presented in Table 4. The two treatment groups did not differ at baseline in terms of energy, fat, protein, or carbohydrate consumption, percentage of energy derived from fat, protein or carbohydrate, intake of saturated and polyunsaturated fat, cholesterol and dietary fiber, nor servings from milk, vegetable, fruit, bread, meat and fat food groups. In addition, there were no significant changes in these dietary measures within or between treatment groups during the course of the study. No significant changes in mean body weights were noted within or between treatment groups during the study period.

Plasma Lipids

Changes in plasma lipid parameters are shown in Table 3. The 4-week period of supplementation with the WSDF mixture produced a 10% decrease in mean plasma TC ($p < 0.01$), and a 14% decrease in mean plasma LDL-C ($p < 0.001$). Mean plasma HDL-C, VLDL-C and TG concentrations were unchanged. Administration of acacia gum yielded no statistically significant effects on plasma lipid parameters. Finally, the interaction of treatment and gender was not found to be statistically significant.

DISCUSSION

At baseline, the two groups appeared to be homogeneous with respect to health status, mean dietary intakes and potential receptivity to a WSDF-approach to lowering cholesterol based on similarity in age, percentage ideal body weight, and fasting blood glucose and plasma lipid concentrations. Thus, the randomization appeared to be effective.

According to daily logs, treatment compliance was excellent in both groups (>95%), indicating that WSDF at a level of 15 g/day in free-living subjects was successfully incorporated into their diets during the course of the study. The side effects of treatments (e.g., gas, bloating and loose stools) appeared to be transient in that none were reported during the final 2 weeks of treatment.

Analyses of the baseline and end-of-treatment 4-day weighed food records indicated that dietary intakes of the treatment groups were, on average, largely consistent with the NCEP Step-One diet [4] to the extent that total energy from fat averaged 30% or less, intake of saturated fat represented less than one-third of the total fat intake, and cholesterol intake averaged <300 mg/day. Analyses of the

Table 4. Summary of Mean Daily Dietary Intakes and Body Weights at Baseline and End of Study (Mean ± SD)

Parameter	WSDF mixture		Acacia gum	
	Baseline	Final	Baseline	Final
Energy (kcal)	1863 ± 432	1888 ± 567	2042 ± 713	1965 ± 632
Total fat (g) (% of energy)	56 ± 21	61 ± 31	69 ± 33	64 ± 23
	(27 ± 9)	(29 ± 11)	(30 ± 8)	(29 ± 7)
Saturated fat (g)	16 ± 8	18 ± 11	20 ± 14	18 ± 9
Polyunsaturated fat (g)	10 ± 3	12 ± 8	15 ± 7	13 ± 6
Protein (g) (% of energy)	80 ± 16	78 ± 21	86 ± 30	90 ± 35
	(17 ± 3)	(17 ± 4)	(17 ± 3)	(18 ± 3)
Carbohydrate (g) (% of energy)	242 ± 90	242 ± 105	257 ± 97	252 ± 94
	(50 ± 10)	(51 ± 12)	(50 ± 10)	(51 ± 10)
Cholesterol (mg)	179 ± 96	192 ± 98	233 ± 147	190 ± 23
Dietary fiber (g)	19 ± 7	19 ± 10	22 ± 9	22 ± 7
Food group servings/day				
Milk	0.8 ± 0.8	0.5 ± 0.5	0.8 ± 0.7	0.7 ± 0.6
Vegetables	2.5 ± 1.9	2.2 ± 1.5	2.1 ± 0.9	2.1 ± 1.3
Fruit	3.2 ± 2.1	3.5 ± 3.3	3.5 ± 1.9	3.8 ± 2.5
Bread	9.5 ± 4.5	9.6 ± 4.7	10.2 ± 4.8	10.3 ± 4.9
Meat	5.8 ± 2.3	5.7 ± 2.2	6.2 ± 3.3	7.0 ± 3.8
Fat	8.3 ± 3.5	9.5 ± 5.3	11.1 ± 5.0	9.6 ± 3.4
Body weight (kg)	70 ± 11	70 ± 11	71 ± 11	71 ± 10

Note: Dietary fiber values in the table do not include the 15 g/day of WSDF from treatments.

diet records also indicated that the WSDF treatments had no statistically significant impact on subjects' typical diets as measured by energy and macronutrient intake, percentage of energy consumed from macronutrients, intake of saturated fat, polyunsaturated fat, dietary fiber and cholesterol, and servings of food groups. Also, there was no significant change in mean body weights during the course of the study. Therefore, with medications and exercise habits also held constant, changes in plasma lipid parameters can be reasonably attributed to the WSDF treatments.

The observed mean 10 and 14% declines in plasma TC and LDL-C, respectively, in the WSDF mixture group are consistent with results from previous studies [11], where psyllium, pectin, guar gum and locust bean gum have been administered individually at levels comparable to the 15 g/day dose of WSDF administered in this study, and for similar lengths of time. The finding that plasma HDL-C, VLDL-C and TG were unchanged is also largely consistent with this earlier work. The drawback to these previous studies, however, is that most failed to control the diet or measure dietary intake in response to WSDF fiber treatments. Hence, it is possible that the lipid-lowering effects observed were due to changes in diet, perhaps brought about by the addition of dietary fiber, but not necessarily directly related to dietary fiber. One theory postulated is that dietary fiber acts indirectly to lower blood cholesterol through replacement of dietary saturated fat and cholesterol [12,13,20].

A few studies have examined the adjunct role of WSDF in reducing blood cholesterol levels in subjects consuming a fat-modified diet and whose dietary intakes and body weights remained constant (Table 5). Van Horn et al [21] isocalorically substituted 56 g/day oatmeal in place of other carbohydrate foods for 8 weeks in normocholesterolemic subjects, and observed a significantly greater decline in TC in the oatmeal-substituted group in comparison to controls (3.1 vs 1.3%).

Bell et al [22] administered 10.2 g/day psyllium for 8 weeks to hypercholesterolemic patients and achieved a 4.2% reduction in TC and 7.7% reduction in LDL-C over that of diet alone, while the control group was unchanged.

Levin et al [23] administered 10.2 g/day psyllium for 16 weeks to hypercholesterolemic subjects and produced a 5.6% reduction in TC and a 8.6% reduction in LDL-C beyond that of diet alone. The control group showed no significant changes.

Neal and Balm [24] administered 20.4 g/day psyllium for 3 months to hypercholesterolemic patients and observed a decrease of 7.1% in TC and 8.6% in LDL-C beyond that of diet alone. Controls showed a 1.6% decline in TC and 3.5% decline in LDL-C.

Finally, Anderson et al [25] administered 10.2 g/day psyllium for 8 weeks to hypercholesterolemic subjects and produced an 8.2% decline in TC and a 13.4% decline in LDL-C beyond that of diet alone. The control group experienced a 3.9% decline in TC and a 4.6% decline in LDL-C. Thus, in each of the five studies cited [21–25], the addition of WSDF to a fat-modified diet yielded a significant reduction in TC, principally the LDL-C subfraction, beyond that achieved by diet alone. These results are comparable to those observed in the current study with the WSDF mixture.

Table 5. Summary of Studies of the Cholesterol-Lowering Effects of WSDF as an Adjunct to Fat-Modified Diets Where Diets and Body Weights Have Remained Constant

Author	n	Diet/design	WSDF type	B-TC* (mg/dL)	% change	
					TC	LDL-C
Van Horn [21]	236	Step-One 4-wk lead-in 8-wk treatment	Oatmeal 56 g/day	193	−3.1	NR
Bell [22]	75	Step-One 12-wk lead-in 8 wk treatment	Psyllium 10.2 g/day	228	−4.2	−7.7
Levin [23]	58	Step-One 8-wk lead-in 12-wk treatment	Psyllium 10.2 g/day	237	−5.6	−8.6
Neal [24]	59	Step-One 2-mo lead-in 3-mo treatment	Psyllium 20.4 g/day	282	−7.1	−8.6
Anderson [25]	52	Step-One 8-wk lead-in 8-wk treatment	Psyllium 10.2 g/day	247	−8.2	−13.4
Jensen**	15	Step-One 4-wk treatment	WSDF mix 15 g/day WSDF	251	−10	−14

* B-TC refers to baseline plasma total cholesterol concentrations (after the dietary lead-in period).
** Current study.

The fact that acacia gum had no effect on plasma lipids is consistent with our previous work where acacia gum has been fed in beverage form in combination with fructose as a sweetener [11]. However, these data conflict with earlier studies with acacia gum where cholesterol-lowering was observed. Ross et al [26] fed five men 25 g acacia gum in beverage form once daily for 3 weeks and observed a 6.3% decline in TC concentration. Sharma [27] administered a total of 30 g acacia gum in the form of a lentil soup dish twice daily for 30 days to a total of 7 subjects (males and females), which produced a 10.4% decline in TC concentration. In both of these studies, larger amounts of acacia gum were administered in fewer divided doses than in the current study, which could account for the discrepancy in results. It should also be noted that neither study included a control group, nor controlled or monitored the diet of subjects. It is possible that such large intakes of acacia gum led to other changes in the diet that may have impacted blood cholesterol levels. It is also possible that different forms of acacia gum have different hypocholesterolemic properties, perhaps related to the acacia tree species, growing conditions and/or processing of the acacia gum source. Nonetheless, our results suggest that WSDF sources should not be assumed to be hypocholesterolemic simply because they are classified as WSDF.

A difference between acacia gum and other WSDF sources, which have consistently demonstrated cholesterol-lowering properties, is the component carbohydrates and their polymeric structures [28]. Acacia gum, for example, is a tree exudate composed mainly of D-galactose, L-arabinose, L-rhamnose and D-glucuronic acid. Guar gum and locust bean gum are bean gums composed primarily of D-galactose and D-mannose. Psyllium seed husk is a grain composed of L-arabinose, D-xylose, and D-galacturonic acid, while high methoxyl apple pectin is primarily composed of D-galacturonic acid, D-galactose and D-arabinose. These constituent carbohydrates and their corresponding polymeric structures influence many of the chemical-physical properties of dietary fibers, some of which may contribute to cholesterol-lowering efficacy, e.g., water-holding capacity and gel formation, microbial degradation, and adsorption of organic molecules [29]. Indeed, while the mechanisms by which certain WSDF lower plasma cholesterol are unknown, proposed mechanisms [30] include: 1) a binding of WSDF with bile acids, other lipids, or both, which may interfere with micelle formation in the proximal small intestine, leading to alterations in the quantity of cholesterol or fatty acids absorbed; 2) an increase in fecal absorption of bile acids that may affect hepatic cholesterol synthesis; and 3) fermentation of WSDF by colonic bacteria, whereupon formed short-chain fatty acids may be absorbed into the portal vein and ultimately impair hepatic cholesterol synthesis.

The high water-holding capacity of certain WSDF results in the formation of a gel-matrix that can be measured as viscosity. In the current study, the acacia gum treatment mixed in water produced a substantially lower viscosity in comparison to the WSDF mixture, and failed to elicit a significant hypocholesterolemic response. An apparent association of viscosity to cholesterol-lowering response has also been observed by others. Jenkins et al [31] found that viscous guar gum reduced serum insulin concentrations after a glucose load as compared to nonviscous guar, and postulated that the hypocholesterolemic activity of viscous fiber sources might be due, in part, to lowering of mean 24-hour insulin concentrations and hence decreased hepatic cholesterol synthesis. Superko et al [9] observed a greater cholesterol-lowering effect with a high viscosity guar beverage as compared to a medium viscosity guar beverage. Based on their work with everted jejunal sacs of rats, Blackburn, Gee, and colleagues [32,33] have proposed that viscous WSDF (guar gum) might be interfering with the absorption of lipids by altering the viscosity of the lumen fluid adjacent to the intestinal mucosal surface. In a more recent follow-up study using the same animal model, Lund et al [34] demonstrated that oat gum reduced the rate of uptake of D-galactose and progressively inhibited uptake of cholesterol with increasing concentrations of oat gum. Thus, the potential relationship of WSDF viscosity to cholesterol-lowering efficacy should be explored further.

CONCLUSION

This research adds to the pool of data indicating that certain WSDF, administered as an adjunct to a fat-modified diet, can elicit further decreases in TC and LDL-C concentrations beyond those achieved by diet alone.

Recent estimates of dietary fiber intakes in the United States indicate that adult Americans consume approximately 7–14 g daily depending on age, gender and race [35], an intake which is thought to be low [36]. Of the total estimated dietary fiber intake, only about 14% is from WSDF-rich sources such as legumes [37], suggesting that Americans may not be fully utilizing the potential cholesterol-lowering benefits of a diet rich in WSDF. Consequently, in addition to the dietary recommendations put forth by the NCEP for managing elevated blood cholesterol levels, consideration should be given to specifying the amounts and types of dietary fiber that can reasonably be expected to offer cholesterol-lowering efficacy as an adjunct to fat-modified diets. In order to develop such recommendations, comparative cholesterol-lowering and dose-response studies of various dietary fiber sources are needed, as well as long-term studies to clearly establish the potential public health benefits of lowering cholesterol through a diet rich in WSDF.

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