EFFECT OF WHEAT BRAN CONSUMPTION ON SERUM LIPID PROFILE OF HYPERCHOLESTEROLEMIA PATIENTS RESIDENCE IN HOLLY MAKAH

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ABSTRACT

Background: *Hypercholesterolemia is a metabolic disorder resembling a major risk factor for cardiovascular diseases. It is associated with hypertension, atherosclerosis, diabetes and hypertriglyceredemias. Therefore, it is not surprising that hypercholesterolemia subjects have more susceptibility to sudden death. Dietary intervention is the first-line approach. Increasing dietary fiber has been discussed recommended as a safe and practical approach for cholesterol reduction (Truswell, 2000).*

Objective: *This study was performed to quantify the cholesterol-lowering effect of wheat bran as dietary fibers in hypercholesteremia patients.*

Design: *a study design was conducted and used to test the effect of wheat bran consumption on serum lipid profile. Independent variables were the type and the amount of insoluble fiber, initial cholesterol concentration, and other important study characteristics.*

Results: *Insoluble fiber was associated with slight but significant decreases in serum total cholesterol, low density lipoprotein (LDL), triglycerides and total serum cholesterol, (149.67±39.62 to121.89±44.38), (157.89±49.19 to156.67±68.13) and (214.11±43.052 to 193.89 ±42.30) respectively. LDL/HDL and total cholesterol/HDL ratios had been decreased significantly after wheat bran consumption (3.76±1.35 to 3.17±1.62) and (4.85±2.05 to 4.71 ±1.78) respectively. Serum levels of high density lipoprotein (HDL) were elevated in respondents following wheat bran consumption for one month (42.45±12.47 to 43.22±13.69).*

Conclusions: *wheat bran as dietary fibers can decrease serum levels of total and LDL cholesterol. The positive effect of wheat bran consumption on lipid profile was little within the practical range of intake. Increasing insoluble fiber as dietary therapy can lower blood cholesterol level in patients suffering from hypercholesterolemia.*

Keywords: Hypercholesterolemia, wheat bran, serum, cholesterol

INTRODUCTION

Cholesterol is lipid or lipid-like alcohol with a unique structure present in most cell membranes of animals with varying amounts. Cholesterol is insoluble in the blood and has to be transported within the cells by lipoprotein carriers.

Low-density Lipoprotein (LDL) and very low-density lipoprotein (VLDL) are known as the "bad" cholesterols while high-density Lipoprotein (HDL) is known as "good" cholesterol.

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Generally, the human liver makes about 80% of cholesterol for the body and only 20% comes from daily diet (Freeman and Junge 2005 and Vyroubal et al., 2008).

Normal range of cholesterol levels are up to 200 mg/dL. Normal triglyceride levels are up to 150 mg/dL, HDL (good cholesterol) is considered normal at 40mg/dL whereas LDL (bad cholesterol) should be less than 100 mg/dL to be at a desirable range (Borghi et al., 2004).

Hypercholesterolemia is a condition when there is an extremely high level of cholesterol in the body which reflects high concentration of LDL and low concentration of HDL (Stevens et al., 2009).

Fibers are proved to play essential role in lowering serum cholesterol. Generally, there were many types of fibers. In the 1970s, dietary fiber is defined as remnants of plant cells that are resistant to digestion by human enzymes. This definition includes a component of some plant cell walls called lignin, as well as indigestible carbohydrates found in plants (Lupton and Turner 2000). Dietary fiber means that fraction of the edible parts of plants or their extracts, or synthetic analogues, that are resistant to the digestion and absorption in the small intestine, usually with complete or partial fermentation in the large intestine. Dietary fiber includes polysaccharides, oligosaccharides and lignins, and promotes beneficial physiological effects like laxation, reduction in blood cholesterol, and modulation of blood glucose (Baghurst et al., 1996).

Dietary fibers can be generally classified into two main categories insoluble and soluble dietary fiber according to their solubility in water. Each category has different physiological effects. In terms of health benefits, both fibers complement each other and a 70–50 insoluble and 30–50 soluble dietary fiber is considered a well-balanced proportion. In fruits, the ratio between soluble and insoluble dietary fiber fractions is more balanced compared to cereals. The insoluble part is related to both water absorption and intestinal regulation, whereas the soluble fraction is associated with the reduction of cholesterol in blood and the decrease of glucose absorption by the small intestine. (Ajila and Prasada, 2013).

Dietary fiber intake provides many health benefits. However, average fiber intakes for US children and adults are less than half of the recommended levels. Individuals with high intakes of dietary fiber appear to be at significantly lower risk for developing coronary heart disease, stroke, hypertension, diabetes, obesity, and certain gastrointestinal diseases. Increasing fiber intake lowers blood pressure and serum cholesterol levels. Increased intake of soluble fiber improves glycemia and insulin sensitivity in non-diabetic and diabetic individuals. Fiber supplementation in obese individuals significantly enhances weight loss. Increased fiber intake benefits a number of gastrointestinal disorders including the following: gastroesophageal reflux disease, duodenal ulcer, diverticulitis, constipation, and hemorrhoids. Prebiotic fibers appear to enhance immune function. Dietary fiber intake provides similar benefits for children as for adults (Anderson et al., 2009).

The effect of dietary soluble fiber on serum cholesterol levels has been extensively documented and promoted. The main mechanisms for the cholesterol-lowering effects of water-soluble and insoluble dietary fibers include binding and excretion of bile acids in the small intestine. The cholesterol-reducing effect of water-insoluble dietary fiber (DF), such as lignin or citric fiber is, rather low compared to water soluble DF and is mainly based on direct binding of bile acids (BA). In the small intestine the BA are bound to the insoluble DF and excreted from the enterohepatic circulation together with the undigested DF which results in a lowering of the blood cholesterol level (Phillips, 2005). Furthermore, food cholesterol bound by DF cannot be absorbed by the body and will be excreted. The cholesterol-lowering

effect of water-soluble dietary fibers such as psyllium, oat β-glucan or pectin is based on different mechanisms. The binding of water in the chyme and the resulting increase in viscosity is regarded as main effect. This leads to a reduced diffusion rate of bile acids, which cannot be reabsorbed by the body and thus are excreted (Zacherl et al., 2011).

In addition to that, soluble fibers are known to bind with bile acids in the small intestine, thereby removing them from the body and reducing the rate of bile acid recycling. The loss of bile acids in the stool stimulates the liver to increase cholesterol uptake from the circulation to replenish the bile acid supply. As a result, concentrations of serum total and LDL cholesterol are reduced, while HDL cholesterol and triglycerides are generally unaffected. Fiber may also indirectly inhibit the hepatic synthesis of cholesterol. Certain soluble fibers belonging to a class of compounds called oligosaccharides are fermented in the lower gut into short-chain fatty acids (SCFAs) and gases. When SCFAs enter the circulatory system, they may inhibit the liver from producing cholesterol and consequently have a direct hypocholesteremic effect (Pereira and Pins 2000; and Davidson and Maki 1999).

SUBJECTS AND METHODS

Subjects

Eighty subjects 40 males and 40 females participated in this study. All the participants were Saudi Arabian, and a written informed consent was obtained. Ethical approval was obtained from the Medical Research Ethics committee.

Experimental Design

The wheat bran was provided by the Department of Nutrition, in daily portions matching the individual subject's energy requirement (ER) and health situation. Most of the food was pre-portioned. The subjects were instructed to follow the diet plan very strictly, report any deviation from the diet plan and to maintain their habitual activity level throughout the study. On days 1 and 8 in each intervention period, the subjects came to the Department after an overnight fast (> 10 hours).

Data Collection

A self-reported questionnaire was administered to all students who agreed to participate. Information obtained included:

1. Personal and socio-economic data, age, gender and education.
2. Nutritional screening (11-items). questions on frequency of their meals and snacks, questions on their consumption of vegetables, fruits, beans, grains, questions on their consumption of fatty foods, sugars, food, questions on dairy products, questions on their consumption of meats, and questions related to their lifestyle practice, such as physical activity (exercise) and frequency of acquiring some diseases that related to hypercholesterolemia.
3. A dietary sheet of food intake record. The participants were informed about the study and were given instructions on how to fill out the questionnaire completely and truthfully.

Measurements

Anthropometry measurements were taken according to standard criteria and measuring procedures. Body weight (BW, Kg) and body height (BH, cm) were measured to the nearest 1.0 kg and 0.5 cm. Body weight was measured by a beam balance scale, and BH was measured with a stadia-meter. Body mass index was calculated as BMI (Kg/m2) = BW

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(Kg)/BH2 (m2). Body mass index categorizes were used to diagnose weight status. According to the National Institutes of Health, adults were classified based on their BMI to normal (BMI = 18.5-24.9), overweight (BMI= 25-29.9), or obese (BMI ≥ 30), (WHO 21012). Moreover, records of lipid profile were taken to be compared post to fiber treatment.

Blood Samples

Blood samples were drawn from superficial blood vessels of patients suffering from hypercholesterolemia and lipid profile were measures from Saudi Arabian patients in Makah & Jeddah.

Statistical Analysis

Data were expressed as mean ± SD and were analyzed statistically using the Statistical Package for Social Sciences version 19.0 (SPSS Inc, Chicago, IL, USA).

RESULTS

Table 1. Summary of Demographic Results

Parameter	*Classification*	*No.*	*%*
Gender	Male	40	50
	Female	40	50
Age group	10-30	20	25
	30-60	40	50
	60+	20	25
Education level	Illiterate	8	10
	Primary	16	20
	Secondary	16	20
	Graduate	8	10
	Postgraduate	32	40

Table 2. Classification of Participants According to BMI

Parameter	*Classification*	*No.*	*%*
BMI Classification	Normal	18	22.50
	Overweight	18	22.50
	Obese 1	18	22.50
	Obese 2	18	22.50
	Obese 3	8	10

Table 3. Frequency of Exercise Performance

Parameter	Yes		No	
	No.	%	No.	%
Regular exercise performance	20	25	60	75

Table 4. Number and Percentage of Individuals Acquired Disease Related to Hypercholesterolemia

Parameters	Yes		No	
	No.	%	No.	%
Heart Disease	--------	--------	80	100
Hypertension	44	55	36	45
Diabetes	64	80	16	20
Other disease	--------	--------	80	100

Table 5. Knowledge of individuals about the importance of meals:

Meal	Absolutely not important		Not important		Neutral		Important		Absolutely important	
	No.	%	No.	%	No.	%	No.	%	No.	%
Breakfast	36	45	---	---	18	22.5	--	---	26	32.5
Lunch	---	---	---	---	18	22.5	26	32.5	36	45
Dinner	40	50	24	30	---	---	8	10	8	10
Snack	28	35	18	22.5	8	10	18	22.5	8	10

Table (6). Consumption's Frequency of Some Foods Among Respondents

Food type	Not having		Having daily		Having weekly		Having monthly	
	No.	%	No.	%	No.	%	No.	%
Fast food	16	20	---	---	32	40	32	40
Whole fat dairy	16	20	8	10	48	60	8	10
Sweet and candy	8	10	26	32.5	30	37.5	16	20
Fatty meat	46	57.5	---	---	32	42.5	---	---
Fish	---	---	8	10	63	77.5	9	12.5
Margarine	62	75	18	25	---	---	---	---
Butter	8	10	26	32.5	46	57.5	---	---
Olive oil	18	22.5	36	45	18	22.5	8	10
Fruit	---	---	18	22.5	53	65	9	12.5
Vegetables	---	---	72	90	8	10	---	---
Brown bread	18	22.5	62	77.5	---	---	---	---

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Table 7. Serum Lipid Profile of Patients Suffering from Hypercholesterolemia before and after Consumption of Wheat Bran for One Month

Parameters	*Mean ± SD*		*T test*	*P value*
	Before	*After*		
Serum total cholesterol	214.11±43.052	193.89±42.30	21.11	0.00
Triglycerides	157.89±49.19	156.67±68.13	0.09	0.92
HDL-c	42.45±12.47	43.22±13.69	-0.59	0.55
LDL-c	149.67±39.62	121.89±44.38	2.66	0.01
Total cholesterol / HDL	4.85±2.05	4.71 ±1.78	0.27	0.78
LDL / HDL	3.76±1.35	3.17±1.62	1.54	0.14

DISCUSSION

Dietary fiber has received attention in more recent years for its ability to reduce plasma cholesterol levels. Fiber rich foods are not equally effective in this respect, the most active being legumes, fruit and vegetables. When high carbohydrate-high fiber diets are consumed, the hypertriglyceridaemic effect of carbohydrate is counteracted by dietary fiber. The hvpocholesterolaemic effect of a low saturated fat consumption and a high fiber intake are additive (Heimburger et al., 2007). A cholesterol lowering effect has been reported for a variety of soluble dietary fibers. The presented study evaluated the blood cholesterol-lowering effects of a dietary supplement of water-soluble fibers (wheat bran) in subjects with mild to moderate hypercholesterolemia (LDL cholesterol, 3.37-4.92 mmol/L). The effect of adding fiber to a diet low in total fat, saturated fat, and cholesterol to treat hypercholesterolemic patients with elevated plasma low-density lipoprotein (LDL) cholesterol levels was assessed**.**

In the present study, regarding Blood Pressure (BP) classification, 55% of both genders were hypertensive. Irozusta et al, (2007) studied the relationship between the nutritional patterns of late adolescence and health parameters related to cardiovascular risk in university students in Spain, they reported that 1.4% of females and 19.4% of males were hypertensive. This result was supported by King et al, (2007) who reported that unhealthy eating habits were a major cause of morbidity and mortality in the U.S.

Most participants followed unhealthy eating habits, they often eat snacks daily, and this may be due to their palatability, availability, and convenience. Moreover, over 77,5% of our participants ranging from overweight to obese type three and only about 22.5% have normal weight. A previous survey by the American Dietetic Association indicated that obesity or being severely overweight was a fast food related issue (Yahia et al., 2008; and Beydoun et al., 2011). Moreover, the present study revealed that most participants had a lower frequency of vegetables, beans, and grains consumption, but higher frequency of fatty and sweeten food. These present findings were in accordance with several authors (King et al.,2007 Knol et al.,2006 and Yahia et al.,2008), who stated that obesity was associated with an unhealthy diet, high intake of fast foods and other foods high in fat, and a low intake of fruits and vegetables. The present results showed that all students in both genders consumed high fat intake, low fibers as well as low vegetable and fruit intake. A negative correlation was detected between BMI and exercise in both genders. These data are consistent with those

of Gillman et al,(2001) who reported that regular participation in physical activity with eating a healthy diet strongly influences health status and reduces the risk of obesity and overweight, which are related to cardiovascular disease. Exercise improves blood circulation and increases activity of the muscles, with loss of calories, and hence reduction in weight.

Our study, in agreement with Heimburger et al., (2007), shows that a diet containing a high amount of fiber decreases total cholesterol low density lipoprotein (LDL), triglycerides and total serum cholesterol levels. Part of the value of fiber may be in replacing saturated fat and cholesterol in the diet. However, even after dietary saturated fat and cholesterol have been reduced, a further reduction in blood lipid levels can result from the consumption of foods high in fiber. These data therefore support current recommendations to increase the consumption of soluble-fiber foods in the context of a low-fat, low-cholesterol diet. In contrast, Other studies have noted greater reductions in serum lipid levels with lower intakes of fiber in subjects following more normal diets (Anderson et al.,2000). Also, it was proven that the inclusion of 10 to 30 g of soluble fiber in a diet results in an approximately 10% reduction in LDL cholesterol. HDL and triglyceride levels remain unchanged (Swain et al., 2000). Some investigators feel that the fiber actually binds cholesterol or bile salts in the gut and prevents its absorption, working in a way similar to that of cholestyramine. Other investigators have evidence showing that intake of fiber simply reduces the subsequent ingestion of saturated fat and cholesterol (Hermansen et al., 2011). In contrast, replacement of saturated fat with carbohydrate from grains, vegetables, legumes, and fruit reduces total and LDL cholesterol with only a minor effect on HDL cholesterol and triglyceride. It seems that when free living individuals change to a fiber rich high-carbohydrate diet appropriate food choices lead to a modest weight reduction. This may explain why the marked elevation of triglyceride and reduction of HDL cholesterol observed on strictly controlled high-carbohydrate diets may not occur when such diets are followed in practice (Turley et al., 1998).

CONCLUSION

From the result mentioned before, we can concluded that diet containing a high amount of wheat bran fiber decreases total cholesterol, low density lipoprotein (LDL), triglycerides and total serum cholesterol levels providing added benefit to the treatment of hypercholesterolemia. This study, along with recent analyses of ongoing prospective cohort studies, have provided new insights into the probable protective role of dietary fiber in the development of coronary heart disease and other cardiovascular diseases that may result from hypercholesteremia.

RECOMMENDATION

Our results support recommendations of a high-fiber diet intake. More research is needed with additional clinical trials in larger numbers of well-defined subjects will be needed to assess further the utility of fiber in food. Requirement for strategies and coordinated efforts at all levels (family, university, community, and government) to increase the awareness and to reduce the tendency of overweight and obesity among individuals, and to promote healthy eating habits and physical activity in adulthood.

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REFERENCES

[1] Anderson, J.W., Story, L., Sieling, B., Chen, W.J., Petro, M.S., & Story, J. (2000). Hypocholesterolemic effects of oat bran or bean intake for hypercholesterolemic men. *Am J Clin Nutr; 40*:1146-1155.

[2] Anderson, J.W.; Baird, P., & Davis, R.H. (2009). Health benefits of dietary fiber. *Nutr Rev., 67*(4).188-205.

[3] Ajila, C. M., & -Prasada Rao, U. J. S.(2013). Mango peel dietary fiber: Composition and associated bound Phenolics. *Journal of Functional Foods 5*, pp. 444-450

[4] Baghurst, P.A., Baghurst, K.I., & Record, S.J.(1996). Dietary fiber, non-starch polysaccharides and resistant starch – a review. *Food Aust;48*(Suppl).S3–S35.

[5] Beydoun, M.A., Powell, L.M., Chen, X., & Wang, Y. (2011). Food prices are associated with dietary quality, fast food consumption, and body mass index among U.S. children and adolescents. *J Nutr; 141*: 304-311

[6] Borghi, C., Veronesi, M., Bacchelli, S., Esposti, D.D., Cosentino, E., & Ambrosioni, E. (2004). Serum cholesterol levels, blood pressure response to stress and incidence of stable hypertension in young subjects with high normal blood pressure. *J Hypertens, 22*, 265-72.

[7] Davidson, M.H., &Maki, K.C. (1999). Effect of dietary inulin on serum lipids. *J Nutr. 129*(7 Suppl).1474S-1477S.

[8] Freeman, M. W., Junge, C. E.(2005). *The Harvard Medical School guide to lowering your cholestero*l, New York. London, McGraw-Hill.

[9] Gillman, M.W., Pinto, B.M., Tennstedt, S., Glanz, K., Marcus, B., & Friedman, R.H. (2001). Relationships of physical activity with dietary behaviors among adults. *Prev Med*; *32*: 295-301.

[10] Hermansen, K, et al., (2007). "Effects of soy and other natural products on LDL: HDL ratio and other lipid parameters: a literature review.", "National Institutes of Health", 2003 Jan–Feb. Retrieved 2011 May 31 Heimburger DC. Nutrition interface with health and disease. In: Goldman L, Ausiello D, editors. Cecil Textbook of Medicine. 23rd ed. Philadelphia (PA). Saunders Elsevier; p. 232

[11] King, K.A., Mohl, K., Bernard, A.L., & Vidourek, R.A. (2007). Does Involvement in Healthy Eating among University students differ based on Exercise status and reasons for exercise? *California Journal of Health Promotion*; *5*:106-119.

[12] Lupton, J.R., & Turner, N.D. (2000). Dietary Fiber. In: Stipanuk MH, ed. Biochemical and Physiological Aspects of Human Nutrition. Philadelphia: W. B. *Saunders; 143*-154.

[13] Phillips, M.C. (2005). Mechanisms of cholesterol-lowering effects of dietary insoluble fibers: Relationships with intestinal and hepatic cholesterol parameters. *British Journal of Nutrition, 94*, 331-337.

[14] Pereira, M.A., & Pins, J.J. (2000). Dietary fiber and cardiovascular disease: Experimental and epidemiologic advances. *Curr Athero Rep.;2*(6).494-502.

[15] Stevens, G., Mascarenhas, M., & Mathers, C. (2009). Global health risks: progress and challenges. *Bull World Health Organ, 87*, 646.

[16] *www.who.int/...disease/GlobalHealthRisks_report_part2*

[17] Swain, J.F., Rouse, I.L., Curley, C.B., & Sacks, F.M. (1990). Comparison of the effects of oat bran and low-fiber wheat on serum lipoprotein levels and blood pressure. *N Engl J Med. ;322*: 147–152.

[18] Turley, M.L., Skeaff, C.M., Mann, J.I., & Cox, B. (1998). The effect of a low-fat, high-carbohydrate diet on serum high density lipoprotein cholesterol and triglyceride. *Eur J Clin Nutr*, *52*, 728-32.

[19] Vyroubal, P., Chiarla, C., Giovannini, I., Hyspler, R., Ticha, A., Hrnciarikova, D., & Zadak, Z. (2008). Hypocholesterolemia in clinically serious conditions--review.*Biomed Pap Med Fac Univ Palacky Olomouc Czech Repub,152*,181-9.

[20] Yahia, N., Achkar, A., Abdullah, A., & Rizk, S.(2008). Eating habits and obesity among Lebanese University students. *Nutr J*; *7*: 32.

[21] Zacherl, C., Eisner, P., & Engel, K.H. (2011). In vitro model to correlate viscosity and bile acid-binding capacity of digested water-soluble and insoluble dietary fibres. *Food Chemistry*, *126*:423-428

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