Beta 1,3-Glucan Cholesterol Studies

Glucan Source: Yeast	
Citation	**Abstract**
Nicolosi R, Bell SJ, Bistrian BR, Greenberg I, Forse RA, Blackburn GL. **Plasma lipid changes after supplementation with beta-glucan fiber from yeast**. Am J Clin Nutr. 1999 Aug;70(2):208-12. PMID: 10426696 [PubMed - indexed for MEDLINE]	BACKGROUND: Dietary fiber has been shown to improve blood lipids. OBJECTIVE: The purpose of this study was to evaluate the effect on serum lipids of a yeast-derived beta-glucan fiber in 15 free-living, obese, hypercholesterolemic men. DESIGN: After a 3-wk period in which subjects ate their usual diet, 15 g fiber/d was added to the diet for 8 wk and then stopped for 4 wk. Plasma lipids were measured weekly during baseline and at week 7 and 8 of fiber consumption, and again at week 12. RESULTS: Compared with baseline, fiber consumption significantly reduced plasma total cholesterol (by 8% at week 7 and 6% at week 8; $P < 0.05$ using Bonferroni correction); week 12 values did not differ from baseline. No significant differences were noted between baseline LDL cholesterol and values at weeks 7, 8, or 12 when comparing individual groups by using Bonferroni correction, even though the overall one-way analysis of variance with repeated measures was highly significant ($P < 0.001$). LDL-cholesterol concentrations did decline by 8% at week 8 compared with baseline. There was a significant effect of diet on plasma HDL-cholesterol concentrations ($P < 0.005$ by one-way ANOVA with repeated measures). However, a group difference was observed only between baseline and week 12 (16% increase; $P < 0.05$ by Bonferroni correction). Triacylglycerol concentrations did not change. CONCLUSIONS: The yeast-derived beta-glucan fiber significantly lowered total cholesterol concentrations and was well tolerated; HDL-cholesterol concentrations rose, but only 4 wk after the fiber was stopped.
Brennan FX Jr, Fleshner M, Watkins LR, Maier SF. **Macrophage stimulation reduces the cholesterol levels of stressed and unstressed rats.** Life Sci. 1996;58(20):1771-6. PMID: 8637401 [PubMed - indexed for MEDLINE]	Male, Sprague-Dawley rats were either treated with zymosan, a nonspecific macrophage stimulator, or saline vehicle. Half of each group were then subjected to a stress procedure, the other half remained in their home cage. Results indicate that zymosan-treated animals had lower levels of total, low-density/very-low-density, and high-density lipoprotein than vehicle controls. Stressed animals had higher levels of the cholesterol parameters than did home cage controls. Manipulation of macrophage levels may be a prophylactic manipulation to combat stress-induced increases in cholesterol.
Bell S, Goldman VM, Bistrian BR, Arnold AH, Ostroff G, Forse RA. **Effect of beta-glucan from oats and yeast on serum lipids.** Crit Rev Food Sci Nutr. 1999 Mar;39(2):189-202. Review. PMID: 10198754 [PubMed - indexed for MEDLINE]	Heart disease is the leading cause of death in the U.S. One way to reduce the risk of developing the disease is to lower serum cholesterol levels by making dietary changes. In addition to reducing intake of total fat, saturated fat, and dietary cholesterol, serum cholesterol can be further reduced by added fiber, especially from sources rich in beta-glucan. In this review, two sources of beta-glucan are described; one source is oats and the other yeast. Their chemical structures and physical properties are compared, and their effect on serum lipid levels is described. Oat beta-glucans are found in various breakfast cereals and snacks. Usually, several servings of these products are required to meet the Food and Drug Administration's claim of reducing the risk of heart disease. The yeast-derived fiber is a more concentrated source of beta-glucan than the oat product. It is currently being tested in a wide variety of food products.

Beta 1,3-Glucan Cholesterol Studies

Glucan Source: Fungal	
Citation	**Abstract**
Fukushima M, Ohashi T, Fujiwara Y, Sonoyama K, Nakano M. **Cholesterol-lowering effects of maitake (Grifola frondosa) fiber, shiitake (Lentinus edodes) fiber, and enokitake (Flammulina velutipes) fiber in rats**. Exp Biol Med (Maywood). 2001 Sep;226(8):758-65. PMID: 11520942 [PubMed - indexed for MEDLINE]	The effects of mushroom fibers on serum cholesterol and hepatic low-density lipoprotein (LDL) receptor mRNA in rats were investigated. Rats were fed a cholesterol-free diet with 50 g/kg cellulose powder (CP), 50 g/kg maitake (Grifola frondosa) fiber (MAF), 50 g/kg shiitake (Lentinus edodes) fiber (SF), or 50 g/kg enokitake (Flammulina velutipes) fiber (EF) for 4 weeks. There were no significant differences in the body weight, food intake, liver weight, cecum weight, and cecum pH among the groups. Cecal acetic acid, butyric acid, and total short-chain fatty acid (SCFA) concentrations in the SF and EF groups were significantly higher than those in the other groups. The serum total cholesterol concentration in the CP group was significantly higher than that in the MAF and EF groups. The very LDL (VLDL) + intermediate-density lipoprotein (IDL) + LDL-cholesterol concentration in the CP group was significantly higher than that in the MAF, SF, and EF groups, whereas the high-density lipoprotein (HDL)-cholesterol concentration in the EF group was significantly lower than that in the other groups at the end of the 4-week feeding period. The hepatic LDL receptor mRNA level in the EF group was significantly higher than that in the CP group. The fecal cholesterol excretion in the MAF, SF, and EF groups was significantly higher than that in the CP group. The results of this study demonstrate that MAF and EF lowered the serum total cholesterol level by enhancement of fecal cholesterol excretion, and in particular, by enhancement of hepatic LDL receptor mRNA in EF group.
Fukushima M, Nakano M, Morii Y, Ohashi T, Fujiwara Y, Sonoyama K. **Hepatic LDL receptor mRNA in rats is increased by dietary mushroom (Agaricus bisporus) fiber and sugar beet fiber.** J Nutr. 2000 Sep;130(9):2151-6. PMID: 10958806 [PubMed - indexed for MEDLINE]	Plasma cholesterol concentration is reduced by feeding some dietary fibers and mushroom fruit body, but the mechanism is not fully understood. We examined the effects of mushroom (Agaricus bisporus) fiber and sugar beet fiber on serum cholesterol and hepatic LDL receptor mRNA in rats. Rats were fed a cholesterol-free diet with 50 g/kg cellulose powder (CP), 50 g/kg mushroom (Agaricus bisporus) fiber (MSF) or 50 g/kg sugar beet fiber (BF) for 4 wk. There were no significant differences in the body weight, food intake and cecum weight among the groups. The relative liver weight in the CP group was significantly greater than that in the MSF and BF groups. The cecal pH in the CP and MSF groups was significantly higher than that in the BF group. Cecal acetic acid, butyric acid and total short-chain fatty acid (SCFA) concentrations in the BF group were significantly higher than those in the other groups. The serum total cholesterol, VLDL + intermediate density lipoprotein (IDL) + LDL cholesterol concentrations in the CP group were significantly greater than those in the MSF and BF groups. The HDL cholesterol concentration in the MSF group was significantly lower than that in the CP group. The hepatic LDL receptor mRNA level in the MSF and BF groups was significantly higher than that in the CP group. The results of this study demonstrate that mushroom fiber and sugar beet fiber lowered the serum total cholesterol level by enhancement of the hepatic LDL receptor mRNA.
Bobek P, Galbavy S. **The oyster mushroom (Pleurotus ostreatus) effectively prevents the development of atherosclerosis in rabbits** Ceska Slov Farm. 1999 Sep;48(5):226-30. Slovak. PMID: 10566243 [PubMed - indexed for MEDLINE]	The addition of 10% dried fruiting bodies of the oyster mushroom (Pleurotus ostreatus) to the diet containing 1% of cholesterol reduced serum cholesterol levels by 65% and cholesterol content in the liver, heart, long extensor muscle and aorta of male rabbits (Chinchilla) by 60; 47; 25 and 79%, respectively. Oyster mushroom diet reduced the content of conjugated dienes by 60-70% in the plasma, erythrocytes and liver. However, it did not significantly affect the activities of antioxidant enzymes. Oyster mushroom diet reduced significantly the incidence of atherosclerotic plaques as estimated by sudanophilia (absence of a positive reaction in 3 of 5 animals) as well as plaque size (26% vs. 2% of the area with a positive reaction in control and oyster mushroom-treated animals, respectively). While all animals on control diet showed atherogenic changes in the aorta, oyster mushroom diet prevented the development of these changes in three animals. Fatty streaks and fibromatous plaques were found in the remaining two animals from this group. The oyster mushroom prevented the formation of atheroma plaques (found in three cases from the control diet group) and reduced the incidence of segmental injury of the coronary artery and of focal fibrosis of the myocardium. The oyster mushroom caused lower incidence of foam cells in all types of lesions.

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Bajaj M, Vadhera S, Brar AP, Soni GL. **Role of oyster mushroom (Pleurotus florida) as hypocholesterolemic/ antiatherogenic agent.** Indian J Exp Biol. 1997 Oct;35:1070-5. PMID: 9475042 [PubMed - indexed for MEDLINE]	Feeding of Pleurotus to hypercholesterolemic rabbits resulted in lowering of total lipids, total cholesterol and glyceride levels of plasma and liver whereas heart lipids were not affected. HDL cholesterol/total cholesterol and HDL cholesterol/LDL cholesterol ratios increased in experimental animals proving antiatherogenic potential of this mushroom. The effect was further supported by the severity of tissue damage as evidenced by histopathological studies. An increase in bile acid excretion could be taken as one of the possible attributes to hypocholesterolemic action of P. florida.
Kubo K, Nanba H. **Anti-hyperliposis effect of maitake fruit body (Grifola frondosa). I.** Biol Pharm Bull. 1997 Jul;20(7):781-5. PMID: 9255420 [PubMed - indexed for MEDLINE]	Experimental rat models (5-week-old Sprague-Dawley rats) with hyperlipemia were prepared by feeding high-cholesterol feed containing sodium cholate and casein as a protein source. Dried maitake (Grifola frondosa) powder was mixed with the basic high-cholesterol feed and the serum lipids were periodically measured. Values of cholesterol, triglyceride and phospholipid in serum of rats in the maitake-feed group were suppressed by 0.3-0.8 times those in animals fed the basic feed, the latter values being close to those in rats given normal feed. The value of high density lipoprotein (HDL)-cholesterol in serum which is generally reduced by the ingestion of high-cholesterol feed remained the level it was at the beginning of the experiment. Weights of extirpated liver and epididymal fat-pads were significantly less (0.6-0.7 times) than those in the basic feed group, indicating that maitake inhibits lipid accumulation in the body. Liver lipids were also measured and the values were found to be decreased by maitake administration as true of serum lipid, suggesting maitake has an anti-liver lipid activity. Measurement of the amount of total cholesterol and bile acid in feces showed, the ratio of cholesterol-excretion had increased 1.8 times and bile acid-excretion 3 fold by maitake treatment. From these results, it is believed that maitake helps to improve the lipid metabolism as it inhibits both liver lipid and serum lipid which are increased by the ingestion of high-fat feed.
Bobek P, Ozdin L, Kuniak L, Hromadova M. **Regulation of cholesterol metabolism with dietary addition of oyster mushrooms (Pleurotus ostreatus) in rats with hypercholesterolemia** Cas Lek Cesk. 1997 Mar 19;136(6):186-90. Slovak. PMID: 9221192 [PubMed - indexed for MEDLINE]	BACKGROUND: It is generally accepted that lowering of serum cholesterol levels reduces the risk of atherosclerosis. Identification and characterization of natural substances with hypocholesterolemic activity useful in dietetic prevention or treatment of hypercholesterolemia is still relevant in countries with persistent progression of hypercholesterolemia. Addition of oyster mushroom (Pleurotus ostreatus), an industrially produced wood-rotting fungus, to the diet effectively reduced cholesterol accumulation in serum and liver of rats fed a cholesterol diet. The aim of a series of experiments was to explain the biochemical mechanism of this effect. METHODS AND RESULTS: Male Wistar rats fed a cholesterol (0.3%) diet shortly after weaning for a period of 8-10 weeks were used in the experiments. The addition of 5% of dried oyster mushroom to the diet had following effects: reduction of cholesterol level both in serum (5.12 +/- 0.55 vs. 3.44 +/- 0.16 mmol/l, $p < 0.02$) and liver (241 +/- 12 vs. 113 +/- 11 mmol/kg, $p < 0.001$); redistribution of cholesterol in favour of high-density lipoproteins; reduced production of very-low-density lipoproteins (135 +/- 7 vs. 96.5 +/- 5 mumol/h/kg, $p < 0.001$); reduced cholesterol absorption (61.2 +/- 2 vs. 53 +/- 2%, $p < 0.02$) and reduced HMG-CoA activity in liver (137 +/- 16 vs. 86 +/- 9 pmol/min/mg proteins, $p < 0.02$). Simultaneously, an increase in 7 alfa-hydroxylase activity in liver (17 +/- 1 vs. 22 +/- 1 pmol/min/mg proteins. $p < 0.02$) and bile acid excretion (7 +/- 0.9 vs. 11 +/- 0.5 mg/day/rat, $p < 0.02$) was observed. (Values shown are means +/- SEM.) CONCLUSIONS: Biochemical mechanism of hypocholesterolemic effect of oyster mushroom on cholesterol-fed rats includes reduced production of cholesterol-rich very-low-density and low-density lipoproteins which principally determine cholesterol levels in serum. This effect is related to decreased absorption and biosynthesis of cholesterol together with increase in cholesterol catabolism and excretion of degradation products-bile acids.

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Bobek P, Ozdin L, Kajaba I. **Dose-dependent hypocholesterolaemic effect of oyster mushroom (Pleurotus ostreatus) in rats.** Physiol Res. 1997;46(4):327-9. PMID: 9728501 [PubMed - indexed for MEDLINE]	A highly significant negative correlation (r=-0.981, p < 0.001) between the amount of oyster mushroom (Pleurotus ostreatus) in the diet and cholesterol levels in the serum has been found in male Wistar rats fed shortly after weaning by a a diet with 0.3% cholesterol. The addition of 1.0, 2.5 and 5.0% of oyster mushroom to the diet reduced the levels of serum cholesterol by 11, 31 and 46%, respectively. The diet containing 5% of oyster mushroom suppressed cholesterol accumulation in the liver and increased the fraction of cholesterol carried by high-density lipoproteins.
Bobek P, Ozdin L. **Oyster mushroom (Pleurotus ostreatus) reduces the production and secretion of very low density lipoproteins in hypercholesterolemic rats**. Z Ernahrungswiss. 1996 Sep;35(3):249-52. PMID: 8896287 [PubMed - indexed for MEDLINE]	Oyster mushroom (Pleurotus ostreatus) reduced the production and secretion of nascent very low density lipoproteins in hypercholesterolemic rats. In male Wistar rats (initial body weight about 70 g) fed a semisynthetic diet with 0.3% of cholesterol, the addition of 5% of powdered oyster mushroom (Pleurotus ostreatus) to the diet reduced after 8 weeks the level of serum cholesterol (by 36%) and accumulation of cholesterol and triglycerides in liver (by 51 and 32%, respectively). The decreased levels of serum cholesterol were caused to the same extent by reduction of cholesterol content in very low density lipoproteins (VLDL) and in low density lipoproteins (LDL) (by 53 and 47%, respectively). Biosynthesis of all structural lipids of VLDL (phospholipids, cholesterol, triglycerides) in liver and incorporation of de novo synthesized lipids into secreted nascent VLDL (measured by simultaneous application of Na-acetate-1-14 C and Triton WR 1339 which inhibits peripheral lipolysis) was reduced by application of diet with oyster mushroom.
Kubo K, Nanba H. **The effect of maitake mushrooms on liver and serum lipids.** Altern Ther Health Med. 1996 Sep;2(5):62-6. PMID: 8795938 [PubMed - indexed for MEDLINE]	OBJECTIVE: To determine the efficacy of maitake mushrooms in inhibiting the elevation of liver and serum lipids in rats. DESIGN: Sprague-Dawley rats with hyperlipidemia were used to measure and compare the values of cholesterol, phospholipids, and triglycerides between cholesterol-fed rats and rats whose diets were fortified with 20% maitake mushroom dried powder. RESULTS: The values in maitake-fed rats were consistently less than those in the basic cholesterol-fed rats. The value of high-density lipoprotein cholesterol, which usually is decreased by taking high-cholesterol feed, maintained the level that it had at the beginning of the experiment. Weights of extirpated liver and epididymal fat pads were significantly less than those in the basic feed group. CONCLUSION: Our data suggest that maitake mushrooms have the ability to alter lipid metabolism by inhibiting both the accumulation of liver lipids and the elevation of serum lipids. Further studies are needed to elucidate the mechanism of activity of maitake mushrooms and to establish whether their action in humans is similar to that in the animal model tested here.
Bobek P, Ozdin L, Kuniak L. **Effect of oyster mushroom (Pleurotus Ostreatus) and its ethanolic extract in diet on absorption and turnover of cholesterol in hypercholesterolemic rat.** Nahrung. 1996 Aug;40(4):222-4. PMID: 8810086 [PubMed - indexed for MEDLINE]	The effect of the diet containing 5% of powdered oyster mushroom (Pleurotus ostreatus) or an equivalent amount of mushroom ethanolic extract on cholesterol content in serum and liver, on its distribution in lipoproteins, absorption and turnover was studied in male Wistar rats (initial body weight about 70 g) fed a diet with 0.3% cholesterol. 12 weeks of feeding with whole oyster mushroom or mushroom extract reduced cholesterol level in serum by 52 and 33%, respectively. However, cholesterol content in liver was reduced only by whole oyster mushroom (by 20%). Diminished serum cholesterol level was mediated in 60% by reduction of cholesterol in very-low-density lipoproteins. Both whole oyster mushroom and mushroom extract increased the concentration of cholesterol in high-density lipoproteins. Consuming whole oyster mushroom decreased cholesterol absorption (estimated by dual-isotope plasma ratio method) by nearly 16% while no significant effect of mushroom extract could be demonstrated. Feeding the diet containing whole oyster mushroom or its extract reduced the half-times of decay curve of cholesterol-4-14C by 29 and 35%, respectively and reciprocally increased the fractional catabolic rate of plasma cholesterol.

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Bobek P, Hromadova M, Ozdin L. **Oyster mushroom (Pleurotus ostreatus) reduces the activity of 3-hydroxy-3-methylglutaryl CoA reductase in rat liver microsomes.** Experientia. 1995 Jun 14;51(6):589-91. PMID: 7607302 [PubMed - indexed for MEDLINE]	The effect of dried oyster mushroom (Pleurotus ostreatus) on cholesterol (C)content in serum, in lipoproteins and in liver, and on the activity of 3-hydroxy-3-methylglutaryl CoA (HMG-CoA) reductase in liver microsomes, was studied in male rats (strain Wistar, initial body weight 75 g) fed on low-cholesterol (9 mg/100 g) and high-cholesterol (0.3%) diets. Addition of 5% oyster mushroom to both diets reduced significantly the C-content in serum (by 30%), in very-low- and low-density lipoproteins (in a 1:1 ratio to the decrease of total serum C) and in liver (by 50%), as well as the activity of HMG-CoA reductase (by more than 30%).
Bobek P, Ozdin O, Mikus M. **Dietary oyster mushroom (Pleurotus ostreatus) accelerates plasma cholesterol turnover in hypercholesterolaemic rat.** Physiol Res. 1995;44(5):287-91. PMID: 8869262 [PubMed - indexed for MEDLINE]	The effect of adding 5% powdered oyster mushroom (Pleurotus ostreatus) during 12 weeks on kinetic parameters of cholesterol metabolism was studied in male rats (Wistar, initial body weight 85 g) fed a semisynthetic diet containing 0.3% of cholesterol. The plasma cholesterol decay curve (examined for the final 29 days of the experiment after a single dose of cholesterol-4-14C) was evaluated by mathematical analysis using a two-pool model of plasma cholesterol metabolism. The oyster mushroom in the diet reduced the half-times of both exponentials resulting in lower calculated values (by 28%) of total entry of cholesterol into the body cholesterol pool (absorption+endogenous synthesis) and lower sizes of both pools (with slower and faster cholesterol exchange). The rate of cholesterol exchange between the pools was enhanced and the rate of total clearance of cholesterol from the system (metabolic turnover rate of cholesterol i.e. the rate of degradation and excretion of cholesterol from the organism) was enhanced by 50%. The oyster mushroom diet effectively prevented the progress of hypercholesterolaemia (decrease by 38%) and cholesterol accumulation in liver (decrease by 25%) that were induced by the cholesterol diet.
Bobek P, Ozdin L, Kuniak L. **Mechanism of hypocholesterolemic effect of oyster mushroom (Pleurotus ostreatus) in rats: reduction of cholesterol absorption and increase of plasma cholesterol removal.** Z Ernahrungswiss. 1994 Mar;33(1):44-50. PMID: 8197787 [PubMed - indexed for MEDLINE]	The content of cholesterol in the serum and liver of male Wistar rats fed, for the period of 8 weeks shortly after weaning, a diet containing 0.3% of cholesterol was reduced by 33 and 27% by the addition of 5% of dried oyster mushroom powder. Although the level of serum triacylglycerols was not affected by oyster mushroom, their content in liver of rats on mushroom diet was reduced by 41%. Very-low-density lipoproteins and low-density lipoproteins participated by 55 and 38%, respectively, in the total reduction of serum cholesterol. Cholesterol content in high-density lipoproteins was not significantly affected by oyster mushroom. Cholesterol absorption as determined by dual-isotope plasma ratio method was significantly reduced by 14% with oyster mushroom diet. Similarly, this diet increased by 42% the fractional catabolic rate of cholesterol determined by the analysis of decay curve of [4-14C]cholesterol.
Bobek P, Ozdin L. **The mushroom Pleurotus ostreatus accelerates plasma very-low-density lipoprotein clearance in hypercholesterolemic rat.** Physiol Res. 1994;43(3):205-6. PMID: 7993890 [PubMed - indexed for MEDLINE]	The administration of a diet containing 5% of dried oyster mushroom to male Wistar rats fed a cholesterol diet (0.3%) shortly after weaningy-lows ret f se tectiv cata

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Bobek P, Kuniak L, Ozdin L. **The mushroom Pleurotus ostreatus reduces secretion and accelerates the fractional turnover rate of very-low-density lipoproteins in the rat.** Ann Nutr Metab. 1993;37(3):142-5. PMID: 8373138 [PubMed - indexed for MEDLINE]	In male rats fed a diet containing 1.5% cholesterol and 5% of dried mushroom (Pleurotus ostreatus) a significantly reduced accumulation of cholesterol in serum (by 45%) and the liver (by 15%) was observed at the end of the 12th week of the experiment. The decrease in serum cholesterol level by more than 90% is a consequence of the decreased cholesterol concentration of very-low-density lipoproteins (VLDL) and of low-density lipoproteins. Consumption of P. ostreatus reduces the total VLDL entry into the circulation by 19% and accelerates (by 49%) fractional turnover rate of VLDL.
Bobek P, Ozdin L, Kuniak L. **Influence of water and ethanol extracts of the oyster mushroom (Pleurotus ostreatus) on serum and liver lipids of the Syrian hamsters.** Nahrung. 1993;37(6):571-5. PMID: 8121469 [PubMed - indexed for MEDLINE]	Extracts from the dried and ground fungus were prepared with water and with 30%, 60% and 85% ethanol, and thickened in vacuum. The whole fungus and extracts were added to the hyperlipidemic diet in amounts equivalent to 3% of the whole fungus. After 6 weeks the whole fungus, its water as well as 30% and 60% ethanol extracts have significantly reduced the contents of cholesterol (C) and triacylglycerols (TG) in the serum. The C and TG contents of the liver were reduced by 34-48% (in the case of TG insignificantly when applying the water and 60% ethanol extracts). The 85% ethanol extracts reduced the C and TG levels in both serum and liver statistically insignificantly by 18-22%. The reduction of serum C by addition of the whole fungus and its water and 30% ethanol extract was decisively affected by the reduction in the C contents in the very low density fraction of lipoproteins.
Sugiyama K, Kawagishi H, Tanaka A, Saeki S, Yoshida S, Sakamoto H, Ishiguro Y. **Isolation of plasma cholesterol-lowering components from ningyotake (Polyporus confluens) mushroom.** J Nutr Sci Vitaminol (Tokyo). 1992 Aug;38(4):335-42. PMID: 1291638 [PubMed - indexed for MEDLINE]	The present study was undertaken to isolate component(s) which contributes to the hypocholesterolemic action of Ningyotake (Polyporus confluens) mushroom. The mushroom powder was extracted with 80% ethanol, and the extract and residue were fractionated into five fractions according to the solubility to solvents. When each fraction was added to a diet containing 1% cholesterol and 0.25% sodium cholate and fed to rats, the plasma cholesterol level was significantly decreased only by ethyl acetate-soluble fraction. Therefore, ethyl acetate-soluble fraction was further fractionated by silica gel column chromatography. Two major compounds, which comprised 45.0% and 28.5% of the ethyl acetate-soluble fraction, were obtained in a pure form by the chromatography, and the compounds were identified as grifolin (2-trans, trans-farnesyl-5-methylresorcinol) and neogrifolin (4-trans, trans-farnesyl-5-methylresorcinol), respectively. The addition of grifolin and neogrifolin to the high cholesterol diet was found to lower plasma cholesterol level significantly.
Bobek P, Ginter E, Kuniak L, Babala J, Jurcovicova M, Ozdin L, Cerven J. **Effect of mushroom Pleurotus ostreatus and isolated fungal polysaccharide on serum and liver lipids in Syrian hamsters with hyperlipoproteinemia**. Nutrition. 1991 Mar-Apr;7(2):105-8. PMID: 1802191 [PubMed - indexed for MEDLINE]	In Syrian hamsters, a diet with 44% of the calories being fat and containing 52 mg cholesterol (C)/100 g induced an accumulation of blood plasma and liver C and triacylglycerol (TG). In these animals, we studied the effect of dried whole mushroom (Pleurotus ostreatus, 2% in the diet, 6-mo experiment) and ethanol-insoluble residue and structurally defined fungal polysaccharide, both isolated from the mushroom (in both cases, 4% in the diet, 2-mo experiments) on C and TG concentration in serum and liver. Whole mushroom effectively retarded the increase in C and TG in both serum and liver throughout the experiment. The mushroom also reduced the content of all lipids in lipoproteins with densities of less than 1.006 to less than 1.063 g/ml. Very-low-density lipoproteins played a substantial role in the decrease (65-80%) in serum lipids. As a result, the lipoprotein concentration of the specified density classes was reduced by 45-60%, and the concentration of the serum lipoprotein pool was reduced by 40%. Neither the chemical composition of high-density lipoproteins nor their serum concentration was affected by the mushroom. Ethanol-insoluble mushroom residue did not significantly affect serum lipid levels, but it reduced liver TG content. Fungal polysaccharide lowered the C content in serum and liver.

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Bobek P, Ginter E, Jurcovicova M, Kuniak L. **Cholesterol-lowering effect of the mushroom Pleurotus ostreatus in hereditary hypercholesterolemic rats.** Ann Nutr Metab. 1991;35(4):191-5. PMID: 1897899 [PubMed - indexed for MEDLINE]	We studied the effect of the edible mushroom Pleurotus ostreatus (4% in diet containing 1% of cholesterol) on serum and liver lipids in female rats with hereditary enhanced sensitivity to alimentary cholesterol. We found that the consumption of the mushroom-containing diet prevented serum cholesterol increase which was manifested at the end of the 4th week of the experiment. At the end of the 7th week of the experiment the cholesterolemia was lowered by almost 40% as compared with control animals kept on the same diet but without the mushroom. The decrease in serum cholesterol levels is a consequence of the decreased cholesterol concentrations of very-low-density lipoproteins and of low-density lipoproteins.
Li Khva Ren, Vasil'ev AV, Orekhov AN, Tertov VV, Tutel'ian VA. **Anti-atherosclerotic properties of higher mushrooms (a clinico-experimental investigation)** Vopr Pitan. 1989 Jan-Feb;(1):16-9. Russian. PMID: 2718411 [PubMed - indexed for MEDLINE]	Antiatherosclerotic properties of water and alcoholic extracts of 20 types of high-species mushrooms were investigated by evaluation of intracellular cholesterol accumulation and 3H-thymidine inclusion into the cells of the human aortal intima in culture. The influence of a single intake of some mushroom species on antiatherosclerotic properties of the human sera was studied. It has been shown that Ganoderma lucidum and Lentinus edodes possess pronounced antiatherosclerotic properties.
Bano Z, Rajarathnam S. **Pleurotus mushrooms. Part II. Chemical composition, nutritional value, post-harvest physiology, preservation, and role as human food.** Crit Rev Food Sci Nutr. 1988;27(2):87-158. Review. PMID: 3053051 [PubMed - indexed for MEDLINE]	The fruit bodies of Pleurotus species as a class of "Edible Fungal Foods" have been discovered to have definite nutritive and medicinal values. They are a good source of nonstarchy carbohydrates, dietary fiber (that can help in reducing the plasma cholesterol), most of the essential amino acids, minerals and vitamins of B group, and folic acid (necessary to counteract pernicious anaemia) in particular. Considering the essential amino acid index, biological value, in vitro digestibility, nutritional index, and protein score, Pleurotus species fall between high grade vegetables and low grade meats. Fractions of water-soluble polysaccharides are reported to possess antitumor activity. The physiological processes such as changes in water content, respiratory rate, texture, color, and activities of enzymes like proteases and polyphenol oxidases during the after-harvest life are delineated. The problems and prospects of processing the fruit bodies by various methods are discussed. Potentialities for production and consumption of the fruit bodies in different parts of the world are brought out.
Kabir Y, Yamaguchi M, Kimura S. **Effect of shiitake (Lentinus edodes) and maitake (Grifola frondosa) mushrooms on blood pressure and plasma lipids of spontaneously hypertensive rats**. J Nutr Sci Vitaminol (Tokyo). 1987 Oct;33(5):341-6. PMID: 3443885 [PubMed - indexed for MEDLINE]	To study the effect of Shiitake (Lentinus edodes) and Maitake (Grifola frondosa) on hypertension, spontaneously hypertensive rats (SHR) were fed a diet containing 5% mushroom powder and 0.5% NaCl solution as drinking water for 9 weeks. The dietary mushrooms decreased the blood pressure. The plasma free cholesterol level decreased in Shiitake-fed animals, whereas in Maitake-fed animals the total cholesterol level decreased. There was no difference in the plasma triglyceride and phospholipid levels among the experimental groups. Shiitake feeding resulted in a decrease in VLDL- and HDL-cholesterol whereas Maitake feeding caused a decrease in VLDL-cholesterol only. Plasma LDL-cholesterol was not affected by dietary mushrooms. The results suggest that dietary mushrooms prevent blood pressure increase in hypertension.

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Glucan Source: Oats	
Citation	**Abstract**
Lovegrove JA, Clohessy A, Milon H, Williams CM. **Modest doses of beta-glucan do not reduce concentrations of potentially atherogenic lipoproteins.** Am J Clin Nutr. 2000 Jul;72(1):49-55. PMID: 10871560 [PubMed - indexed for MEDLINE]	BACKGROUND: In 1997, the US Food and Drug Administration passed a unique ruling that allowed oat bran to be registered as the first cholesterol-reducing food at a dosage of 3 g beta-glucan/d. OBJECTIVE: The effects of a low dose of oat bran in the background diet only were investigated in volunteers with mild-to-moderate hyperlipidemia. DESIGN: The study was a double-blind, placebo-controlled, randomized, parallel study. Sixty-two healthy men (n = 31) and women (n = 31) were randomly allocated to consume either 20 g oat bran concentrate (OBC; containing 3 g beta-glucan) or 20 g wheat bran (control) daily for 8 wk. Fasting blood samples were collected at weeks -1, 0, 4, 8, and 12. A subgroup (n = 17) was studied postprandially after consumption of 2 meals (containing no OBC or wheat bran) at baseline and after supplementation. Fasting plasma samples were analyzed for total cholesterol, HDL cholesterol, triacylglycerol, glucose, and insulin. LDL cholesterol was measured by using the Friedewald formula. The postprandial samples were anlayzed for triacylglycerol, glucose, and insulin. RESULTS: No significant difference was observed in fasting plasma cholesterol, LDL cholesterol, glucose, or insulin between the OBC and wheat-bran groups. HDL-cholesterol concentrations fell significantly from weeks 0 to 8 in the OBC group (P = 0.05). There was a significant increase in fasting glucose concentrations after both OBC (P = 0.03) and wheat-bran (P = 0.02) consumption. No significant difference was found between the OBC and wheat-bran groups in any of the postprandial variables measured. CONCLUSIONS: A low dosage of beta-glucan (3 g/d) did not significantly reduce total cholesterol or LDL cholesterol in volunteers with plasma cholesterol concentrations representative of a middle-aged UK population.
Onning G, Wallmark A, Persson M, Akesson B, Elmstahl S, Oste R. **Consumption of oat milk for 5 weeks lowers serum cholesterol and LDL cholesterol in free-living men with moderate hypercholesterolemia.** Ann Nutr Metab. 1999;43(5):301-9. PMID: 10749030 [PubMed - indexed for MEDLINE]	The aim of this study was to investigate whether consumption of a newly developed oat milk deprived of insoluble fiber would result in lower serum cholesterol and low-density lipoprotein (LDL) cholesterol levels in men with moderate hypercholesterolemia. The study had a randomized, controlled double-blind design, and oat milk was compared with an identically flavored control drink. Sixty-six men were recruited from a screening program and were randomly assigned to two groups. Each group took either oat milk or a control drink (rice milk) for 5 weeks (0.75 liters/day) and then switched to the other drink regimen for another 5-week period with a 5-week washout period between the test periods. The oat milk contained more dietary fiber, especially beta-glucan (0.5 g/100 g), than the control drink (<0.02 g/100 g). Both drinks were well appreciated and got similar sensory evaluation, indicating that the double-blind design had been attained. In the final analysis 52 subjects remained. Compared with the control drink, intake of oat milk resulted in significantly lower serum total cholesterol (6%, p = 0.005) and LDL cholesterol (6%, p = 0.036) levels. The decrease in LDL cholesterol was more pronounced if the starting value was higher (r = -0.55, p < 0.001). The concentration of high-density lipoprotein cholesterol was not significantly different after consumption of the two drinks. Serum triglycerides did not change significantly after intake of oat milk, but a significant increase was observed after intake of the control drink (p = 0.003). It is concluded that also oat milk deprived of insoluble fiber has cholesterol-reducing properties.

Beta 1,3-Glucan Cholesterol Studies

Uusitupa MI, Miettinen TA, Sarkkinen ES, Ruuskanen E, Kervinen K, Kesaniemi YA. **Lathosterol and other non-cholesterol sterols during treatment of hypercholesterolaemia with beta-glucan-rich oat bran.** Eur J Clin Nutr. 1997 Sep;51(9):607-11. PMID: 9306087 [PubMed - indexed for MEDLINE]	OBJECTIVE AND SUBJECTS: Dietary fibre has been suggested to interfere with endogenous cholesterol synthesis in the liver. Therefore the effects of oat bran on the proportions of cholesterol synthesis precursors (squalene, delta(8-) cholesterol, desmosterol and lathosterol), cholestanol and plant sterols (campesterol and beta-sitosterol) to cholesterol were analysed in serum of 36 hypercholesterolaemic subjects. DESIGN: A randomized study of eight weeks duration when beta-glucan-rich oat bran (n = 20, subjects) or wheat bran (n = 16) was used as a part of a cholesterol lowering diet. Plant sterols and cholesterol synthesis precursors were analysed from frozen samples afterward. RESULTS: In the oat-bran group, but not in the wheat bran group, serum total cholesterol declined transiently. The proportions of plant sterols and cholesterol in serum, which reflect cholesterol absorption efficiency were unchanged. However, the proportions of squalene appeared to be transiently increased during the study. Subjects with apolipoprotein E 4 allele had higher serum campesterol and sitosterol levels (suggestive of efficient cholesterol absorption) than those with homozygous apolipoprotein E 3 allele. CONCLUSIONS: Since the cholesterol precursors in serum reflecting endogenous cholesterol synthesis remained almost unchanged the reduction in the serum cholesterol level by oat bran treatment can not be ascribed to an inhibition of the endogenous cholesterol synthesis.
Behall KM, Scholfield DJ, Hallfrisch J. **Effect of beta-glucan level in oat fiber extracts on blood lipids in men and women.** J Am Coll Nutr. 1997 Feb;16(1):46-51. PMID: 9013433 [PubMed - indexed for MEDLINE]	OBJECTIVE: An active hypolipidemic component in oats, the soluble fiber beta-glucan, has been concentrated in an oat fiber extract. The oat fiber extract has been used to replace fat in food products. This study was designed to determine if moderate levels of oat fiber extract could be incorporated into a typical diet and whether plasma lipids could be reduced by the amount of beta-glucan added to the diet. METHODS: Oat fiber extracts containing low (1% by weight) or high (10% by weight) beta-glucan were fed to 23 mildly hypercholesterolemic subjects (seven men and 16 women). A maintenance diet was fed for 1 week followed by diet containing an oat extract for 5 weeks each in a crossover pattern. Five percent of the energy from fat in the maintenance diet was replaced with the oat extract in the experimental diets. Caloric intake was adjusted to try to maintain each subject's initial weight. Fasting blood was collected several days apart after separate 12 hour fasts the end of each period. Plasma was analyzed for triglycerides, total cholesterol, and lipoprotein cholesterol fractions. RESULTS: HDL, HDL2, and VLDL cholesterol, and triglyceride levels after the oat extract diets were not significantly different from those after the

Beta 1,3-Glucan Cholesterol Studies

Beer MU, Arrigoni E, Amado R. **Effects of oat gum on blood cholesterol levels in healthy young men.** Eur J Clin Nutr. 1995 Jul;49(7):517-22. PMID: 7588502 [PubMed - indexed for MEDLINE]	OBJECTIVE: There is much evidence that oat products lower serum lipid concentrations in hypercholesterolaemic subjects. This effect has been attributed to the soluble fibre component of oat (1-->3)(1-->4)-beta-D-glucan. Therefore, the practical role of oat bran beta-glucan on serum lipid indices was examined. DESIGN: A metabolically controlled, randomised, single-blind, cross-over study. SETTING: Swiss Federal Institute of Technology, Department of Food Science and University Hospital, Zurich, Switzerland. SUBJECTS: 14 healthy young men, selected from university staff and students. INTERVENTIONS: After a 1-week run-in period subjects were randomly assigned to a test group (oat gum instant whip, 9 g beta-glucan/day) or a control group (placebo instant whip) for 14 days. After completing the first diet, subjects switched to the other diet for 14 days. The study was strictly metabolically controlled. Blood samples were collected for measurement of serum total cholesterol, HDL cholesterol, LDL cholesterol, and triglyceride concentrations. RESULTS: The dietary intake of the two groups was not significantly different. The body weights and physical activities of the subjects did not change significantly during the study. No statistically significant effect of the oat gum could be detected on serum total cholesterol, LDL cholesterol and triglyceride concentrations. HDL cholesterol was significantly higher ($P < 0.05$) during the test period. CONCLUSIONS: The cholesterol-lowering capacity of oat gum in healthy young men is weak. The effect of oat bran preparations on serum cholesterol levels cannot be estimated by the beta-glucan content but by measurement of the solubility and viscosity of the beta-glucan.
Winblad I, Joensuu T, Korpela H. **Effect of oat bran supplemented diet on hypercholesterolaemia.** Scand J Prim Health Care. 1995 Jun;13(2):118-21. PMID: 7569475 [PubMed - indexed for MEDLINE]	OBJECTIVE--To examine the effect of oat bran supplemented diet on serum cholesterol in hypercholesterolaemic males who had failed to comply with a conventional lipid lowering diet. DESIGN--Run-in period with a conventional lipid lowering diet followed by supplements of oat bran (70 g per day) for six weeks. Wash-out period without oat bran ended the survey. SETTING--The workplace of Pyhasalmi Mine, Finland. SUBJECTS--59 volunteer male miners whose serum cholesterol was over 6.1 mmol/l in spite of a conventional lipid lowering diet. MAIN OUTCOME MEASURES--Differences between means for serum cholesterol concentrations at different phases of the survey. RESULTS--During the oat bran supplemented diet serum total cholesterol decreased by 6.2%, from 6.93 to 6.50 mmol/l ($p = 0.000$) and LDL cholesterol by 9.5%, from 4.64 to 4.20 mmol/l ($p = 0.000$). During the wash-out phase serum total cholesterol increased by 2.3%, to 6.65 mmol/l ($p = 0.084$) and LDL cholesterol by 5.0%, to 4.41 mmol/l ($p = 0.021$). The reduction in cholesterol levels on oat bran supplement correlated positively with the pre-treatment values. CONCLUSIONS--Oat bran seems to offer an additional dietary means of coping with hypercholesterolaemia.
Hallfrisch J, Scholfield DJ, Behall KM. **Diets containing soluble oat extracts improve glucose and insulin responses of moderately hypercholesterolemic men and women.** Am J Clin Nutr. 1995 Feb;61(2):379-84. PMID: 7840078 [PubMed - indexed for MEDLINE]	The high amount of soluble beta-glucans in oats may be responsible for beneficial effects on glucose tolerance and blood lipids. We studied 16 women and 7 men (aged 38-61y) with moderately high cholesterol concentrations who consumed normal diets to which oat extracts with either 1% or 10% soluble beta-glucans were added. Oat extracts comprised 10% of energy and were consumed in a 5-wk crossover design after a 1-wk equilibration period. At the end of the equilibration period and each 5-wk period, a carbohydrate tolerance test was conducted and responses to glucose, glucose plus oat extract containing 1% glucan, or glucose plus oat extract containing 10% glucan were determined. Glucose responses were reduced by both extracts in both men and women; however, in women, responses to the 10% extract were lowest. Insulin responses did not differ between men and women, but were lower after oat extracts. Glucagon responses were higher initially in men and were lowered after oat extracts in men but not in women. Modest amounts of oat extracts can be incorporated into normal diets with beneficial effects on glucose tolerance factors.

Beta 1,3-Glucan Cholesterol Studies

Welch RW. **Can dietary oats promote health?** Br J Biomed Sci. 1994 Sep;51(3):260-70. Review. PMID: 7881325 [PubMed - indexed for MEDLINE]	Current consumption levels of oat products are low. However, oats are a nutritious foodstuff, supplying protein of relatively good quality and significant quantities of vitamins and minerals. As a bland and nutritious foodstuff, oats are valuable for the nutrition of infants and the sustenance of adults. Oats are generally consumed as oatmeal or rolled oats, but oat bran has become available in recent years. In addition to their nutritional attributes, dietary oat products exert a number of physiological effects that may be beneficial in the prevention or amelioration of pathophysiological states, including improvements in gastro-intestinal function, modulation of glucose metabolism, and decreasing blood cholesterol status. The latter effects have attracted considerable attention and a critical review of the data indicates that dietary oats have the ability to lower blood cholesterol and that they are most effective at high dose levels in hypercholesterolaemic individuals. Although the soluble fibre, beta-glucan gum appears to be the major hypocholesterolaemic agent, its mode of action is not fully understood.
Braaten JT, Wood PJ, Scott FW, Wolynetz MS, Lowe MK, Bradley-White P, Collins MW. **Oat beta-glucan reduces blood cholesterol concentration in hypercholesterolemic subjects.** Eur J Clin Nutr. 1994 Jul;48(7):465-74. PMID: 7956987 [PubMed - indexed for MEDLINE]	OBJECTIVE: Several studies have indicated that consumption of oat bran lowers blood cholesterol and this effect has been attributed specifically to oat bran's soluble fiber (beta-glucan). This study was designed to test this hypothesis. DESIGN: The purified fibre (oat gum, 80% beta-glucan) was isolated, and agglomerated in the presence of maltodextrin to facilitate dispersion in a drink. Subjects consumed the oat gum (2.9 g beta-glucan), or maltodextrin placebo, twice daily for 4 weeks, in a randomized, cross-over design with a 3 week wash-out between phases. Consumption was equivalent to a daily dose of about 70 g of oat bran. SETTING: The study was with free-living individuals. SUBJECTS: Twenty hypercholesterolemic male and female adults entered, and 19 completed, the study. INTERVENTIONS: Blood lipids from fasting individuals were measured weekly throughout the study. Diet was monitored using 3 day food diaries. RESULTS: There were no significant changes (P > 0.05) in blood lipids during the placebo phase. Mean initial total cholesterol (6.76 +/- 0.13 mmol/l) and low density lipoprotein (LDL) cholesterol (4.59 +/- 0.14 mmol/l) levels fell throughout the oat gum phase, and at week 4 each was reduced 9% relative to initial values (P = 0.0004 and 0.005 respectively). When oat gum was discontinued, total and LDL cholesterol returned to initial levels. There were no significant changes in high density lipoprotein (HDL) cholesterol. Triglyceride levels also remained unchanged except for a singular decrease at week 4 of the oat gum phase relative to the initial value, but not compared to the placebo value. The lowered mean total and LDL cholesterol levels occurred in the absence of any dietary changes. CONCLUSIONS: The main component of the soluble fibre of oats, beta-glucan, significantly reduced the total and LDL cholesterol levels of hypercholesterolemic adults without changing HDL cholesterol.
Torronen R, Kansanen L, Uusitupa M, Hanninen O, Myllymaki O, Harkonen H, Malkki Y. **Effects of an oat bran concentrate on serum lipids in free-living men with mild to moderate hypercholesterolaemia.** Eur J Clin Nutr. 1992 Sep;46(9):621-7. PMID: 1396480 [PubMed - indexed for MEDLINE]	An oat bran concentrate was prepared by removing non-fibre components by cold-water wet-milling, resulting in a 2- to 3-fold concentration of soluble fibre, with beta-D-glucan as its main component. The concentrate was baked in bread which was consumed for 8 weeks by free-living men with mild to moderate hypercholesterolaemia. The effects on serum lipids were assessed in a randomized, double-blind, placebo-controlled trial. Despite the large daily dose (11.2 g) of beta-glucan, the beta-glucan-enriched bread had only a small and statistically non-significant effect on serum lipid concentrations. Probable reasons for the weakness of the effect could be the poor solubility of beta-glucan in the preparation, its enzymatic hydrolysis after ingestion, and the consequently low viscosity in the intestine.

Beta 1,3-Glucan Cholesterol Studies

Uusitupa MI, Ruuskanen E, Makinen E, Laitinen J, Toskala E, Kervinen K, Kesaniemi YA. **A controlled study on the effect of beta-glucan-rich oat bran on serum lipids in hypercholesterolemic subjects: relation to apolipoprotein E phenotype.** J Am Coll Nutr. 1992 Dec;11(6):651-9. PMID: 1334101 [PubMed - indexed for MEDLINE]	The effects of beta-glucan-rich oat bran on serum lipids and lipoproteins were examined in a randomized 8-week study. After a 4-week run-in phase, subjects with mild to moderate hypercholesterolemia [serum total cholesterol (TC) 5.5-8.5 mmol/l] on cholesterol-lowering diets were randomly allocated to an oat bran (10.3 g beta-glucan/day) or wheat bran group. Thirty-six subjects (20 in the oat bran group, 16 in the wheat bran group) completed the study. The diet was identical in both groups during the trial and no significant changes in body weight were found. Serum TC and low-density lipoprotein cholesterol (LDL-C) significantly declined in the oat bran group during the first 4 weeks from 7.03 +/- 0.81 to 6.72 +/- 0.97 (p = 0.028) and from 4.90 +/- 0.69 to 4.61 +/- 0.89 mmol/l (p = 0.038), respectively, but at 8 weeks the values were not significantly different from baseline. Changes in serum TC were mainly confined to those who ate at least two-thirds of the planned daily dose of oat bran. In wheat bran group no changes were observed in serum TC or LDL-C levels. Apolipoprotein A1 and B did not change significantly in either group. Only subjects with apolipoprotein E 3/3 phenotype (n = 12) had hypocholesterolemic response to oat bran at 4 weeks, but no change was found in those with apolipoprotein E 4/4 or 4/3 (n = 7).(ABSTRACT TRUNCATED AT 250 WORDS)
Leadbetter J, Ball MJ, Mann JI. **Effects of increasing quantities of oat bran in hypercholesterolemic people.** Am J Clin Nutr. 1991 Nov;54(5):841-5. PMID: 1659171 [PubMed - indexed for MEDLINE]	The effects of increasing quantities of oat bran on plasma lipids were examined in 40 hypercholesterolemic men and women. Using a four-by-four Latin-square design, subjects added 30, 60, and 90 g oat bran/d or no oat bran to their usual diet for 1-mo experimental periods. Self-selected background diets remained unchanged and weight did not change significantly. No differences in plasma total or low-density-lipoprotein cholesterol were found. Supplementation of the usual diet with less than or equal to 90 g oat bran does not appear to significantly lower cholesterol in hypercholesterolemic subjects continuing to follow a diet relatively high in saturated fatty acids.
Keenan JM, Wenz JB, Myers S, Ripsin C, Huang ZQ. **Randomized, controlled, crossover trial of oat bran in hypercholesterolemic subjects.** J Fam Pract. 1991 Dec;33(6):600-8. PMID: 1660530 [PubMed - indexed for MEDLINE]	BACKGROUND. Despite animal and metabolic ward studies that support the benefit of oat bran as a useful dietary supplement for the lowering of cholesterol, there have been few controlled studies on free-living subjects that have convincingly demonstrated this benefit. METHODS. This is a report of a randomized, controlled, blinded clinical trial with a crossover design using oat bran (28 g [1 oz] twice daily) vs wheat cereal as a supplement to a fat-modified diet for the reduction of total cholesterol and low-density lipoprotein (LDL) cholesterol. The study included male and female subjects aged 20 to 70 years, with baseline LDL cholesterol in the 50th to 95th percentile. All subjects were instructed in the American Heart Association Step I (AHA-I) diet, and eating behavior was monitored using 4-day food records during each study period. RESULTS. Eighty-two percent (n = 145) of the total number of subjects who were randomized to treatment groups completed the study. Blood lipid studies demonstrated significantly greater reductions in total cholesterol (average -2.2%) and LDL cholesterol (average -3.9%) in the oat-bran groups than in the wheat-cereal groups (average total cholesterol +3.3%, average LDL cholesterol +4.0%) or in the diet alone group (total cholesterol +6.0%; LDL cholesterol +6.4%). All groups did comparably well at adhering to the AHA-I diet; however, dietary factors alone, when analyzed by the Keys equations, could not explain the group differences in lipid change. CONCLUSIONS. The addition of oat bran (28 g [1 oz] twice daily) to the AHA-I diet provided significant added benefit in lowering total cholesterol and LDL cholesterol in most hypercholesterolemic subjects. Analysis for factors that predict LDL cholesterol response to oat bran revealed a significant age-by-sex interaction (P less than .001). Women under the age of 50 years, as a group, showed essentially no increased benefit from the addition of oat bran to their diet. Cholesterol levels in older women appear to be significantly more responsive to a modified diet containing oat bran than those of younger women.

Beta 1,3-Glucan Cholesterol Studies

Davidson MH, Dugan LD, Burns JH, Bova J, Story K, Drennan KB. **The hypocholesterolemic effects of beta-glucan in oatmeal and oat bran. A dose-controlled study.** JAMA. 1991 Apr 10;265(14):1833-9. PMID: 2005733 [PubMed - indexed for MEDLINE]	Oat cereals rich in the water-soluble fiber beta-glucan have been studied as a dietary therapy for hypercholesterolemia. To determine the hypocholesterolemic response of beta-glucan in the diet, 156 adults with low-density lipoprotein cholesterol (LDL-C) levels above 4.14 mmol/L (160 mg/dL) or between 3.37 and 4.14 mmol/L (130 and 160 mg/dL) with multiple risk factors were randomized to one of seven groups. Six groups received either oatmeal or oat bran at doses (dry weight) of 28 g (1 oz), 56 g (2 oz), and 84 g (3 oz). A seventh group received 28 g of farina (beta-glucan control). At week 6 of treatment, significant differences were found for both total cholesterol and LDL-C levels among the farina control and the treatment groups who were receiving 84 g of oatmeal, 56 g of oat bran, and 84 g of oat bran, with decreases in LDL-C levels of 10.1%, 15.9%, and 11.5%, respectively. Fifty-six grams of oat bran resulted in significantly greater reductions in LDL-C levels than 56 g of oatmeal. Nutrient analysis shows no difference in dietary fat content between these treatment groups; therefore, the higher beta-glucan content of oat bran most likely explains the significantly greater LDL-C reductions. A dose-dependent reduction in LDL-C levels with oat cereals supports the independent hypocholesterolemic effects of beta-glucan.
Demark-Wahnefried W, Bowering J, Cohen PS. **Reduced serum cholesterol with dietary change using fat-modified and oat bran supplemented diets.** J Am Diet Assoc. 1990 Feb;90(2):223-9. PMID: 2154513 [PubMed - indexed for MEDLINE]	A low-fat, low-cholesterol diet and oat bran supplementation for treatment of hypercholesterolemia were studied for their effectiveness in lowering blood lipids and their impact on dietary intake. Seventy-one free-living men and women with hypercholesterolemia (serum cholesterol greater than 75th percentile) were randomly assigned to one of the following four groups: low-fat, low-cholesterol diet (LFLC); low-fat, low-cholesterol diet plus 50 gm/day oat bran (LFLC + OB); 50 gm/day oat bran supplemented diet (OB); or 42.5 gm/day processed oat bran (ready-to-eat cereal containing beta-glucan concentrated from oat bran) (POB). Subjects assigned to regimens OB and POB were requested to add the oat supplement without making additional changes in their diet. Serum cholesterol and high-density lipoprotein cholesterol analyses were performed at 4-week intervals, and diet records were assigned and analyzed. All groups experienced significant decreases in cholesterol from original levels (p less than .05). The average decrease in total serum cholesterol varied from 10% to 17%, with no significant differences among the four groups. High-density lipoprotein cholesterol concentrations decreased in all groups except group 4, in which there was a slight increase; however, no differences were found between groups. Energy, fat, and cholesterol intakes decreased in all groups, suggesting that displacement of higher fat foods from the diet may be one of the many mechanisms whereby oat supplements lower serum cholesterol. In addition, all groups reduced their intakes of calcium, copper, folic acid, and potassium from marginal levels at the beginning of the study.(ABSTRACT TRUNCATED AT 250 WORDS)
Anderson JW, Story L, Sieling B, Chen WJ, Petro MS, Story J. **Hypocholesterolemic effects of oat-bran or bean intake for hypercholesterolemic men.** Am J Clin Nutr. 1984 Dec;40(6):1146-55. PMID: 6095635 [PubMed - indexed for MEDLINE]	Oat or bean products, rich in water-soluble fiber, have distinct hypocholesterolemic effects in humans. After a control diet, 20 hypercholesterolemic men were randomly allocated to oat-bran or bean supplemented diets for 21 days on a metabolic ward. Control and test diets provided equivalent energy, fat, and cholesterol but test diets had twice more total and 3-fold more soluble fiber. Oat-bran diets decreased serum cholesterol concentrations by 19% (p less than 0.0005) and calculated low-density lipoprotein cholesterol by 23% (p less than 0.0025). Bean diets decreased serum cholesterol concentrations by 19% (p less than 0.0005) and low-density lipoprotein cholesterol by 24% (p less than 0.0005). Oat-bran increased fecal weight by 43% but beans did not. While oat-bran increased fecal bile acid excretion, beans had the opposite effect. Oat-bran or bean supplements may have an important role in nutritional management of selected hypercholesterolemic patients.

Beta 1,3-Glucan Cholesterol Studies

Lia A, Hallmans G, Sandberg AS, Sundberg B, Aman P, Andersson H. **Oat beta-glucan increases bile acid excretion and a fiber-rich barley fraction increases cholesterol excretion in ileostomy subjects.** Am J Clin Nutr. 1995 Dec;62(6):1245-51. PMID: 7491888 [PubMed - indexed for MEDLINE]	The purpose of this study was to investigate whether oat beta-glucan is responsible for the increased bile acid excretion previously observed with oat-fiber diets. The excretion patterns in ileostomy subjects given diets containing oat-bran bread with and without added beta-glucanase, a beta-glucan-degrading enzyme, were compared. The effect of a beta-glucan-rich barley fraction on sterol excretion was also investigated. Nine ileostomy subjects were served four diets in random order, each diet for 2 consecutive days. Four different kinds of bread, mainly made from oat bran (OB diet, 12.5 g beta-glucan/d), oat bran with beta-glucanase (OBE diet, 3.8 g beta-glucan/d), barley (B diet, 13.0 g beta-glucan/d), or wheat flour (W diet, 1.2 g beta-glucan/d) were added to a basal diet. The 24-h excretion of bile acids was 53% higher in the OB diet period than in the OBE diet period ($P < 0.05$) and also was significantly higher than in the B and W diet periods ($P < 0.05$). Median (range) bile acid excretion was 851 (232-1550), 463 (123-1414), 755 (133-1187), and 606 (101-980) mg/d in the OB, OBE, B, and W diet periods, respectively. The excretion of cholesterol was significantly higher in the B diet period than in the OBE and W diet periods ($P < 0.05$), but the mechanism behind this effect of barley fiber is unknown. In oat bran, however, beta-glucan mediates an increase in bile acid excretion, which most probably explains the effect of oat fiber in lowering serum lipids.
Whyte JL, McArthur R, Topping D, Nestel P. **Oat bran lowers plasma cholesterol levels in mildly hypercholesterolemic men.** J Am Diet Assoc. 1992 Apr;92(4):446-9. PMID: 1313467 [PubMed - indexed for MEDLINE]	The effects of oat bran and wheat bran on plasma lipid concentrations were compared in a crossover study. Each bran (123 g oat bran or 54 g wheat bran) added nearly 18 g of nonstarch polysaccharide to a background diet containing about 10 g nonstarch polysaccharide. Twenty-three men (average plasma cholesterol level = 5.84 mmol/L, and low-density-lipoprotein (LDL) cholesterol level = 4.11 mmol/L) were randomly assigned to either the oat or wheat bran diet for 4 weeks and then changed to the alternate bran diet for a similar period. The oat bran diet produced significantly lower levels of plasma total cholesterol and LDL cholesterol: 5.65 +/- 0.16 and 3.88 +/- 0.15 mmol/L (mean +/- standard error) for oat bran vs 5.89 +/- 0.16 and 4.11 +/- 0.16 mmol/L for wheat bran. Food intake diaries showed that average consumption of total fat and saturated fat was identical during the two test periods, which excluded displacement of fat as an explanation for lowering of plasma cholesterol by oat bran. Our results indicate that in mildly hypercholesterolemic men, a diet high in soluble oat fiber can significantly lower plasma total cholesterol and LDL cholesterol and thus potentially lower the risk of coronary heart disease.

Beta 1,3-Glucan Cholesterol Studies

Glucan Source: Barley	
Citation	**Abstract**
McIntosh GH, Whyte J, McArthur R, Nestel PJ. **Barley and wheat foods: influence on plasma cholesterol concentrations in hypercholesterolemic men.** Am J Clin Nutr. 1991 May;53(5):1205-9. PMID: 1850576 [PubMed - indexed for MEDLINE]	Twenty-one mildly hypercholesterolemic men aged 30-59 y were provided with comparable barley and wheat foods for each of 4 wk in a crossover-designed experiment. The purpose of the study was to examine the influence of two sources of dietary fiber (nonstarch polysaccharides, NSP) on blood lipids and glucose concentrations. Barley contains beta-glucan as a source of soluble dietary fiber (DF) whereas wheat contains the largely insoluble cellulose and hemicellulose fiber. Total dietary fiber increased from a previous intake of 21-38 g/d during the period of study for the two groups. Consumption of barley relative to wheat foods was associated with a significant fall in both plasma total cholesterol (6%, P less than 0.05) and in low-density-lipoprotein cholesterol (7%, P less than 0.02) whereas triglyceride and glucose concentrations did not change significantly. It is concluded that barley dietary fiber is more effective than wheat dietary fiber at lowering blood cholesterol in hypercholesterolemic men.

Glucan Source: Barley purified b-glucan additive	
Citation	**Abstract**
Bourdon I, Yokoyama W, Davis P, Hudson C, Backus R, Richter D, Knuckles B, Schneeman BO. **Postprandial lipid, glucose, insulin, and cholecystokinin responses in men fed barley pasta enriched with beta-glucan.** Am J Clin Nutr. 1999 Jan;69(1):55-63. PMID: 9925123 [PubMed - indexed for MEDLINE]	BACKGROUND: Fiber regulates the rate and site of lipid and carbohydrate digestion and absorption and thus can modify the alimentary responses to a meal. When fiber sources containing viscous polysaccharides are included in a meal, a slower rate of carbohydrate and lipid absorption will modify the alimentary hormone and lipid responses. OBJECTIVE: We investigated in 11 healthy men the response of insulin, glucose, cholecystokinin, and lipid to 2 test meals containing beta-glucan. DESIGN: One of the meals was high in fiber (15.7 g) and the other meal was low in fiber (5.0 g). The low-fiber meal contained pasta made with wheat flour. The high-fiber meals contained pasta prepared by replacing 40% of the wheat with 2 types of barley flour: barley naturally high in beta-glucan and the other a flour enriched in beta-glucan during processing. RESULTS: Plasma glucose and insulin concentrations increased significantly after all meals but the insulin response was more blunted after the barley-containing meals. The test meals were low in fat (25% of energy) but elicited an increase in plasma triacylglycerol and cholecystokinin. Cholecystokinin remained elevated for a longer time after the barley-containing meals. After the low-fiber meal, plasma cholesterol concentrations did not change significantly; however, 4 h after the barley-containing meals, the cholesterol concentration dropped below the fasting concentration and was significantly lower than that after the low-fiber meal. CONCLUSIONS: Carbohydrate was more slowly absorbed from the 2 high-fiber meals. Consumption of the barley-containing meals appeared to stimulate reverse cholesterol transport, which may contribute to the cholesterol-lowering ability of barley.

Beta 1,3-Glucan Cholesterol Studies

Glucan Source: Soy, Pea, Corn	
Citation	**Abstract**
Knopp RH, Superko HR, Davidson M, Insull W, Dujovne CA, Kwiterovich PO, Zavoral JH, Graham K, O'Connor RR, Edelman DA. **Long-term blood cholesterol-lowering effects of a dietary fiber supplement.** Am J Prev Med. 1999 Jul;17(1):18-23. PMID: 10429748 [PubMed - indexed for MEDLINE]	BACKGROUND: The study evaluated the blood cholesterol-lowering effects of a dietary supplement of water-soluble fibers (guar gum, pectin) and mostly non-water-soluble fibers (soy fiber, pea fiber, corn bran) in subjects with mild to moderate hypercholesterolemia (LDL cholesterol, 3.37-4.92 mmol/L). METHODS: After stabilization for 9 weeks on a National Cholesterol Education Program Step 1 Diet, subjects were randomly assigned to receive 20 g/d of the fiber supplement (n = 87) or matching placebo (n = 82) for 15 weeks and then receive the fiber supplement for 36 weeks. The efficacy analyses included the 125 subjects (58 fiber; 67 placebo) who were treatment and diet compliant. One hundred two (52 fiber; 50 placebo) completed the 15-week comparative phase. Of these subjects 85 (45 fiber; 40 placebo) elected to continue in the 36-week noncomparative extension phase. RESULTS: The mean decreases during the 15-week period for LDL cholesterol (LDL-C), total cholesterol (TC), and LDL-C/HDL-C ratio were greater ($P < 0.001$) in the fiber group. The mean changes from pre-treatment values in LDL-C, TC, and LDL-C/HDL-C ratio for subjects in the fiber group were -0.51 mmol/L (-12.1%), -0.53 mmol/L (-8.5%), and -0.30 (-9.4%), respectively. The corresponding changes in the placebo group were -0.05 mmol/L (-1.3%), -0.05 mmol/L (-0.8%), and 0.05 (1.5%), respectively. The fiber supplement had no significant effects ($P > 0.05$) on HDL cholesterol (HDL-C), triglyceride, iron, ferritin, or vitamin A or E levels. Similar effects were seen over the subsequent 36-week noncomparative part of the study. CONCLUSIONS: The fiber supplement provided significant and sustained reductions in LDL-C without reducing HDL-C or increasing triglycerides over the 51-week treatment period.
Hunninghake DB, Miller VT, LaRosa JC, Kinosian B, Jacobson T, Brown V, Howard WJ, Edelman DA, O'Connor RR. **Long-term treatment of hypercholesterolemia with dietary fiber.** Am J Med. 1994 Dec;97(6):504-8. PMID: 7985708 [PubMed - indexed for MEDLINE]	PURPOSE: To evaluate the hypocholesterolemic effects of long-term treatment (36 to 51 weeks) with a mixture of dietary fibers (guar gum, pectin, soy, pea, corn bran) administered twice a day. PATIENTS AND METHODS: Fifty-nine subjects with moderate hypercholesterolemia who completed a 15-week, placebo-controlled study with the dietary fiber were treated for an additional 36 weeks with 20 g/day of fiber. Subjects were counseled and monitored on a National Cholesterol Education Program (NCEP) Step-One Diet before starting and during treatment. Analyses of changes in lipoprotein values during the additional 36 weeks of treatment took into account changes in weight, diet, and other variables that might have affected the response to treatment. RESULTS: There were no significant effects on the levels of either triglycerides or high-density lipoprotein cholesterol (HDL-C). Levels of total cholesterol (TC) and low-density lipoprotein cholesterol (LDL-C) and the LDL/HDL ratio were significantly reduced during treatment. The mean percentage reductions from baseline after 51 weeks of treatment were approximately 5% for TC, 9% for LDL-C, and 11% for the LDL/HDL ratio. Changes were apparent after 3 weeks of treatment, with the maximum reductions occurring by the 15th week of treatment. CONCLUSIONS: For subjects on a Step-One Diet who complied with the treatment regimen, the moderate cholesterol-lowering effects of the fiber persisted throughout the 36-to-51 week treatment period.