

Actual Reviews for Selected Medicinal Properties of Mushrooms

Cholesterol-Lowering Effect of *Pleurotus* Species (Agaricomycetidae) (Abstracts of papers published in 1991–1999)

Ann Nutr Metab, 1991, 35(4):191–195

Cholesterol-lowering effect of the mushroom *Pleurotus ostreatus* in hereditary hypercholesterolemic rats

Bobek P., Ginter E., Jurcovicova M., Kuniak L.

We studied the effect of the edible mushroom *Pleurotus ostreatus* (4% in a diet containing 1% 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.

Nutrition, 1991 Mar–Apr, 7(2):105–108

Effect of mushroom *Pleurotus ostreatus* and isolated fungal polysaccharide on serum and liver lipids in Syrian hamsters with hyperlipoproteinemia

Bobek P., Ginter K., Kuniak L., Babala J., Jurcovicova M., Ozdin L., Cerven J.

In Syrian hamsters, a diet with 44% of the calories provided by 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-month experiment) and ethanol-insoluble residue and structurally defined fungal polysaccharide, both isolated from the mushroom (in both cases, 4% in the diet, 2-month 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 <1.006 to <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.

Physiol Res, 1991, 40(3):327–332

Effect of oyster fungus (*Pleurotus ostreatus*) on serum and liver lipids of Syrian hamsters with a chronic alcohol intake

Bobek P., Ginter E., Jurcovicova M., Ozdin L., Mekinova D.

The authors studied the effect of oyster mushroom (*Pleurotus ostreatus*) (2% dried fruiting bodies in a standard diet) on the serum and liver lipids of growing male Syrian hamsters with a chronic alcohol intake (a 15% aqueous solution). After 8 weeks of alcohol intake there was an increase in their serum cholesterol, triacylglycerol (TG), and phospholipid (PL) concentrations, 40–60% of which was accounted for by an increase in the very-low-density lipoprotein (VLDL) concentration. The proportion of VLDL in the lipoprotein pool rose by almost 15%, whereas the proportion of high-density lipoproteins (HDL) declined. The simultaneous administration of the fungus in the diet reduced the cholesterol level below the value in the control animals not given any alcohol. Both the serum TG and the VLDL concentration declined by 30%, but neither the chemical composition and concentration of the HDL nor the cholesterol concentration was affected. The addition of the mushroom to the diet completely abolished the increase of cholesterol and TG concentration induced in the liver by the chronic intake of alcohol.

Nutr Res (United States), 1993, 13/8:885–890

Oyster mushroom (*Pleurotus ostreatus*) accelerates the plasma clearance of low-density and high-density lipoproteins in rats

Bobek P., Ginter E., Ozdin L.

In Wistar rats fed after weaning a semisynthetic diet containing 0.3% cholesterol (C), the addition of 4% dried whole oyster mushroom (*Pleurotus ostreatus*) led to a reduced level of serum and liver C at the end of the 10th week of the experiment by 25%, 33%, respectively. The level of serum triacylglycerols was not influenced by the mushroom, but was significantly reduced by 13% in liver. The decrease in serum C level is a consequence of the decreased C concentration in very-low-density lipoproteins (VLDLs) and in low-density lipoproteins (LDLs). Content of C in high-density lipoproteins (HDLs) was not influ-

enced by the mushroom. Dietary *Pleurotus ostreatus* increased the fractional turnover rate of LDL (by 28%) and HDL (by 31%) as determined by the analysis of decay curves of ^{1,2,5}I-labeled lipoproteins. The increase in rate of LDL and HDL catabolism is one of the decisive mechanisms that mediates the hypocholesterolemic effect of mushrooms in the rat.

Nahrung, 1993, 37(6):571–575

Influence of water and ethanol extracts of the oyster mushroom (*Pleurotus ostreatus*) on serum and liver lipids of the Syrian hamsters

Bobek P., Ozdin L., Kuniak L.

Extracts from the dried and ground mushroom were prepared with water and with 30%, 60% and 85% ethanol, and thickened *in vacuo*. The whole mushroom and extracts were added to the hyperlipidemic diet in amounts equivalent to 3% of the whole mushroom. After 6 weeks the whole mushroom, its water, as well as 30% and 60% ethanol extracts 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 mushroom 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.

Cesk Farm, 1993 Aug, 42(4):160–166

Phytherapeutic aspects of diseases of the circulatory system. 2. The oyster mushroom and its potential use

Opletal L.

The oyster mushroom (*Pleurotus ostreatus* (Jacq. ex Fr.) Kumm., Pleurotaceae) is a wood-worming mushroom with a significant use in the food in-

dustry. Of the products of the primary and special metabolisms, which were found in the fruiting bodies in the 1970s, it is possible to mention mainly lipids; sterols; lipophilic vitamins; B vitamins; mono-, oligo-, and polysaccharides; amino acids; peptides; some enzymes; and derivatives of aliphatic hydrocarbons as fragrant substances. Some of these substances exert antiviral, antineoplastic, and hypocholesterolemic activities. Not all substances that promote the hypocholesterolemic effect have been isolated and identified yet. The fruiting bodies of the oyster mushroom became a basis for some dietetic preparations in the Czech Republic and Slovakia, for example, HLIVETA Eritaden and PLEUROS 600. They are usable for the prevention and adjuvant treatment of hypercholesterolemia. Besides this, the oyster mushroom is a source of other substances that can be used in prevention or treatment of other conditions.

Ann Nutr Metab, 1993, 37(3):142–145

The mushroom *Pleurotus ostreatus* reduces secretion and accelerates the fractional turnover rate of very-low-density lipoproteins in the rat

Bobek P., Kuniak L., Ozdin L.

In male rats fed a diet containing 1.5% cholesterol and 5% 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 (VLDLs) and of low-density lipoproteins. Consumption of *P. ostreatus* reduces the total VLDL entry into the circulation by 19% and accelerates (by 49%) the fractional turnover rate of VLDL.

Physiol Res, 1993, 42(3):175–179

Effect of the oyster fungus on glycemia and cholesterolemia in rats with insulin-dependent diabetes

Chorvathova V., Bobek P., Ginter E., Klvanova J.

We investigated the effect of a diet containing 4% oyster mushroom (*Pleurotus ostreatus*) and 0.1% cholesterol on glycemia and hyperlipoproteinemia in rats with insulin-dependent diabetes (streptozotocin 45 mg/kg). After 2 months, the rats with diabetes kept on the oyster mushroom diet had a significantly lower basal and postprandial glycemia, the insulinemia remained unchanged. The cholesterol concentration was decreased by more than 40%; the lipoprotein profile was upgraded by the decrease of cholesterol in both the low-density and very-low-density lipoproteins. The oyster mushroom decreased the cholesterol accumulation in the liver and had no significant effects on the levels of serum and liver triacylglycerols.

FEMS Microbiol Lett, 1993, 111:203–206

Screening fungi for the production of an inhibitor of HMG CoA reductase: Production of mevinolin by the fungi of the genus *Pleurotus*

Gunde-Cimerman N., Friedlich J., Cimerman A., Benicki N.

We tested 380 strains of our Fungal Culture Collection (MZKIBK) for the activity of the inhibitor of 3-hydroxy-3-methylglutaryl-CoA (HMG-CoA) reductase, mevinolin. All mushroom strains were cultivated in a two-step submerged fermentation on selected substrates. For the first screening, samples of broth extracts were tested by thin-layer chromatography (TLC) and positive results were further evaluated by HPLC analysis. In addition to already known microbial producers of HMG-CoA reductase inhibitors and some newly identified strains having moderate activity, we found that mushrooms of the basidiomycetous genus *Pleurotus*, especially the species *P. ostreatus*, *P. saca*, and *P. sapidus*, are an as yet unknown but promising source of the hypocholesterolemic agent.

Pleurotus fungi produce mevinolin, an inhibitor of HMG CoA reductase

Gunde-Cimerman N., Plemenitas A., Cimerman A.

Mushrooms of the genus *Pleurotus* were shown to produce the 3-hydroxy-3-methylglutaryl-CoA (HMG-CoA) reductase inhibitor mevinolin. Crude methanol extracts and the purified inhibitor from three different species, *P. sapidus*, *P. saca* and *P. ostreatus*, were tested using the solubilized microsomal HMG-CoA reductase from Chinese hamster ovary cells. The identity of the inhibitor was also confirmed by thin-layer chromatography, high pressure liquid chromatography, and mass spectroscopy.

Patent Number DE 4402591, 1994-10-20

Process for the biotechnological production of lovastatin and/or mevinolin acid

Gunde-Cimerman N., Friedrich J., Berovic M., Cimerman A., Benicki N., Radez I., Pokorny M.

A process is proposed for the biotechnological production of lovastatin and/or mevinolin acid using basidiomycetes mushrooms from the genus *Pleurotus*, such as *Pleurotus ostreatus*, *Pleurotus sapidus*, and *Pleurotus saca*, preferably *Pleurotus sapidus* G 24 and *Pleurotus saca* G 23, which are deposited in the microbiological collection of Kemijski Institut Ljubljana, Slovenia (MZK-IBK). These mushrooms are cultivated by the submerged or surface method or the fruiting bodies of the said mushrooms are used. To inoculate the production phase 5–10% of the broth is removed sterile. The cultivation in the production phase takes place submerged or on the surface. After the end of the production phase the pH of the broth is adjusted to 3.0 so that the product is obtained in lactone and acid form, or to pH 7.7 so that only the acid is obtained. Methanol is added, and the product is extracted by shaking. After the extraction the mycelium is filtered off, and

lovastatin and/or mevinolin acid are obtained in the filtrate.

Nutr Res (United States), 1994, 14/11:1683–1688

Oyster mushroom (*Pleurotus ostreatus*) decreases serum and liver cholesterol and increases cholesterol 7 α -hydroxylase activity and fecal excretion of neutral sterols and bile acids in hypercholesterolemic rats

Bobek P., Ondreicka R., Klvanova J., Ozdin L.

Wistar rats fed a semisynthetic diet containing 0.3% cholesterol and supplemented with 5% dried whole oyster mushroom (*Pleurotus ostreatus*) had serum and liver cholesterol levels reduced by 32% and 55%, respectively, at the end of the 8th week of the experiment. The reduction of cholesterol was due to the decreased cholesterol content in very-low-density lipoproteins (VLDLs) and in low-density lipoproteins (LDLs). Cholesterol concentration in high-density lipoproteins (HDLs) increased significantly, by 34%. Animals fed the oyster mushroom diet had elevated levels of fecal excretion of neutral sterols by 32% and the excretion of bile acids by 55%. Activity of cholesterol 7 α -hydroxylase (a rate-limiting enzyme of cholesterol catabolism) was enhanced by 33% and the activity of lecithin: cholesterol acyltransferase was also increased by 13%.

Physiol Res, 1994, 43(3):205–206

The mushroom *Pleurotus ostreatus* accelerates plasma very-low-density lipoprotein clearance in hypercholesterolemic rat

Bobek P., Ozdin L.

The administration of a diet containing 5% dried oyster mushroom to male Wistar rats fed a cholesterol diet (0.3%) shortly after weaning for 8 weeks reduced cholesterol levels in the serum and liver by 27% and 33%, respectively, and increased the fractional turnover rate of ¹²⁵I-very-

low-density lipoproteins (VLDLs) by more than 30%.

Z Ernährungswiss, 1994 Mar, 33(1):44–50

Mechanism of hypocholesterolemic effect of oyster mushroom (*Pleurotus ostreatus*) in rats: reduction of cholesterol absorption and increase of plasma cholesterol removal

Bobek P., Ozdin L., Kuniak L.

The content of cholesterol in the serum and liver of male Wistar rats fed for 8 weeks shortly after weaning, a diet containing 0.3% 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 livers of rats on the 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 the oyster mushroom. Cholesterol absorption as determined by the dual-isotope plasma ratio method was significantly reduced by 14% with the 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.

Exp Mycol, 1995, 19:1–6

***Pleurotus* fruiting bodies contain the inhibitor of 3-hydroxy-3-methylglutaryl-coenzyme A reductase—lovastatin**

Gunde-Cimerma N., Cimerman A.

In the fruiting bodies of the *Pleurotus ostreatus*, also called the oyster mushroom, we found a competitive inhibitor of 3-hydroxy-3-methylglutaryl-coenzyme A reductase—lovastatin. The appearance of the inhibitor during the development of fruiting bodies was followed and lovastatin deter-

mined in the vegetative mycelium, in the primordia, as well as in different parts of sporocarps of different sizes. Less lovastatin was found in stipes as compared to PILI or in mature stages in the lamellae and basidiospores.

Physiol Res, 1995, 44(5):287–291

Dietary oyster mushroom (*Pleurotus ostreatus*) accelerates plasma cholesterol turnover in hypercholesterolemic rat

Bobek P., Ozdin O., Mikus M.

The effect of adding 5% powdered oyster mushroom (*Pleurotus ostreatus*) for 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% cholesterol. The plasma cholesterol decay curve (examined for the final 29 days of the experiment after a single dose of [4-¹⁴C]cholesterol 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, that is, the rate of degradation and excretion of cholesterol from the organism) was enhanced by 50%. The oyster mushroom diet effectively prevented the progress of hypercholesterolemia (decreased by 38%) and cholesterol accumulation in the liver (decreased by 25%) that were induced by the cholesterol diet.

Ceska Slov Farm, 1995 Aug, 44(4):190–195

Phytotherapeutic aspects of diseases of the circulatory system. 4. Chitin and chitosan

Chobot V., Kremenak J., Opletal L.

Chitin and chitosan are nitrogenous polysaccharides. The structure of the chitin molecule is similar to that of cellulose but it is composed of 2-acetylamino-2-deoxy-D-glucopyranose units bound (1 → 4) by a glycosidic bond. In contrast to chitin, chitosan amino groups are not mostly acetylated. These polysaccharides occur particularly in the fungal kingdom, in invertebrate animals, in some brown algae, and very negligibly in higher plants. Great attention has been paid to chitin and chitosan in recent years. Of great interest are their antihypercholesterolemic and antihyperlipidemic activities, which have been experimentally demonstrated. In practice there already exist some medicinal preparations and food products with medicinal and preventive properties against some risk factors for atherosclerosis. In addition, the anticoagulative and antiaggregative effects of sulfated derivatives of chitosan are not negligible. The research in this field is, however, at the initial stage. Both polysaccharides have been introduced into pharmaceutical technology, where they can be employed as very good drug vehicles. Promising results have been achieved in experiments with antineoplastics (5-fluorouracil and methotrexate), with nonsteroidal antiphlogistics (ibuprofen) and others. It is considered very advantageous that chitin and chitosan possess low toxicity, induce very minor allergic reactions, and exert moderate immunostimulating effects. Both polysaccharides are metabolized by lysosome. Chitin is obtained from the cuticles of sea animals which are waste products from the food industry. The technologies of obtaining chitin from lower fungi (e.g., the genus *Aspergillus*) have been worked out. Chitosan is obtained by deacetylation of chitin. Chitin and chitosan are polysaccharides with ever-extending use. Increasing attention is paid to them also because they are contained in large amounts in edible mushrooms, for example, *Pleurotus ostreatus*.

Ceska Slov Gastroenterol (Germany), 1995, 49/2:46-49

Hypocholesterolemic and antilipoperoxidative effect of dietary oyster mushroom (*Pleurotus ostreatus*) and its ethanolic extract in hypercholesterolemic rats

Bobek P., Ozdin L., Kuniak L.

The effect of addition of 5% powdered oyster mushroom (*Pleurotus ostreatus*) or of an equivalent amount of oyster mushroom extract in 30% ethanol to the diet on lipid peroxidation and antioxidant enzyme activities in liver was studied in male Wistar rat fed a diet containing 0.3% cholesterol soon after weaning. After 10 weeks, the diet with oyster mushroom and its extract reduced to a similar extent the concentrations of cholesterol, conjugated dienes, and hydroperoxides in serum and liver. The reduction of cholesterolemia can be explained mainly by decreased cholesterol content in very-low-density lipoproteins. Oyster mushroom and its extract increased to the same degree the resistance of liver tissue to lipid peroxidation in the system generating free oxygen radicals (Fe^{2+} + ascorbic acid). Whole oyster mushroom and to a lesser extent also its extract stimulated the activities of superoxide dismutase, catalase, and glutathione peroxidase.

Experientia, 1995, Jun 14, 51(6):589-591

Oyster mushroom (*Pleurotus ostreatus*) reduces the activity of 3-hydroxy-3-methylglutaryl CoA reductase in rat liver microsomes

Bobek P., Hromadova M., Ozdin L.

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 (Wistar strain, initial body weight 75 g) fed 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%).

Effect of oyster mushroom (*Pleurotus ostreatus*) and its ethanolic extract in diet on absorption and turnover of cholesterol in hypercholesterolemic rats

Bobek P., Ozdin L., Kuniak L.

The effect of a diet containing 5% powdered oyster mushroom (*Pleurotus ostreatus*) or an equivalent amount of mushroom ethanolic extract on cholesterol content in serum and liver and 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. Twelve 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 the 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 of [4-¹⁴C]cholesterol by 29% and 35%, respectively, and reciprocally increased the fractional catabolic rate of plasma cholesterol.

Z Ernährungswiss, 1996, Sep, 35(3):249–252

Oyster mushroom (*Pleurotus ostreatus*) reduces the production and secretion of very low density lipoproteins in hypercholesterolemic rats

Bobek P., Ozdin L.

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% cholesterol, the addition of 5% 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 (VLDLs) and in low-density lipoproteins (LDLs) (by 53% and 47%, respectively). Biosynthesis of all structural lipids of VLDLs (phospholipids, cholesterol, triglycerides) in liver and incorporation of *de novo* synthesized lipids into secreted nascent VLDLs (measured by simultaneous application of [1-¹⁴C]Na-acetate and Triton WR 1339, which inhibits peripheral lipolysis) was reduced by application of a diet containing oyster mushroom.

Cas Lek Cesk, 1997, Mar 19, 136(6):186–190

Regulation of cholesterol metabolism with dietary addition of oyster mushrooms (*Pleurotus ostreatus*) in rats with hypercholesterolemia (Article in Slovak)

Bobek P., Ozdin L., Kuniak L., Hromadova M.

It is generally accepted that lowering 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*), a commercially 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. 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% dried oyster mushroom to the diet had the 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 favor of high-density lipoproteins; reduced production of very-low-density lipoproteins (135 ± 7 vs. 96.5 ± 5 μ mol/h/kg, $p < 0.001$); reduced cholesterol absorption (61.2 ± 2 vs. $53 \pm 2\%$, $p < 0.02$) and reduced 3-hydroxy-3-methylglutaryl-CoA (HMG-CoA) activity in liver (137 ± 16 vs. 86 ± 9 pmol/min/mg of proteins, $p < 0.02$). Simultaneously, an increase in 7 α -hydroxylase activity in liver (17 ± 1 vs. 22 ± 1 pmol/min/mg of 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 \pm SEM). The 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 an increase in cholesterol catabolism and excretion of degradation products—bile acids.

Klin Biochem Metab (Czech Republic), 1997, 512:108–112

Hypocholesterolemic and antioxidant effect of oyster mushroom (*Pleurotus ostreatus*) in rats with chronic ethanol intoxication

Bobek P., Ozdin L., Kuniak L., Hromadova M.

The effect of ingestion of oyster mushroom extract in 20% ethanol on cholesterol metabolism, lipoperoxidation, and on antioxidant status was studied in male Wistar rats. The animals were put on a diet containing 0.2% cholesterol shortly after weaning. The exclusive source of liquid for drinking was 20% ethanol (or ethanolic mushroom extract). The oyster mushroom extract significantly reduced the cholesterol serum level (5.51 ± 0.43 and 4.23 ± 0.44 mmol/liter for ethanol and mushroom extract, respectively), mainly at the expense of very-low-density lipoproteins. Neither ethanol intoxication nor mushroom extract influenced significantly cholesterol absorption and the activity of lecithin:cholesterol

acyltransferase. The oyster mushroom extract reduced ethanol-stimulated HMG-CoA reductase activity in the liver by 34%. Ethanol intoxication did not affect significantly the content of conjugated dienes in plasma, in erythrocytes, and in liver, nor the body antioxidant status. Compared to ethanol intoxication, the oyster mushroom extract stimulated the activities of catalase and glutathione peroxidase in erythrocytes more than twice (with simultaneous reduction of superoxide dismutase activity) when compared to ethanol intoxication. On the contrary, the activities of these enzymes and glutathione level were reduced in the livers of animals fed mushroom extract.

J Nutr Biochem, 1997, 8(8):469–471

Effect of oyster mushroom and isolated beta-glucan on lipid peroxidation and on the activities of antioxidative enzymes in rats fed the cholesterol diet

Bobek P., Ozdin L., Kuniak L.

The effect of 5% dried oyster mushroom (*Pleurotus ostreatus*) or beta-glucan isolated from oyster mushroom on cholesterol levels in serum and liver, on lipid peroxidation, and on activities of antioxidative enzymes was studied in male Wistar rats. Animals were fed a diet with 0.3% cholesterol for 10 weeks after weaning. The diet containing whole oyster mushroom strikingly reduced cholesterol content in serum and in liver (kV 27 and 46%, respectively). In addition, a shift in cholesterol distribution in lipoproteins (70% decrease in very low-density lipoprotein cholesterol and 50% increase in high-density lipoprotein cholesterol) was observed. Beta-glucan in the diet did not affect cholesterol levels in serum and liver. Whole oyster mushroom reduced the levels of conjugated dienes in erythrocytes and in liver (by 40% and 36%, respectively), reduced the activity of catalase in erythrocytes, and stimulated the activities of superoxide dismutase and catalase antglutathione peroxidase in liver by 30–70%. The diet supplemented with beta-glucan did not affect either lipid peroxidation or activities of antioxidative enzymes.

Dose-dependent hypocholesterolemic effect of oyster mushroom (*Pleurotus ostreatus*) in rats

Bobek P., Ozdin L., Kajaba I.

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 after administering a diet with 0.3% cholesterol. The addition of 1.0%, 2.5%, and 5.0% oyster mushroom to the diet reduced the levels of serum cholesterol by 11%, 31%, and 46%, respectively. The diet containing 5% oyster mushroom suppressed cholesterol accumulation in the liver and increased the fraction of cholesterol carried by high-density lipoproteins.

Br J Biomed Sci, 1997 Dec, 54(4):240–243

Evidence for the anti-hyperlipidemic activity of the edible fungus *Pleurotus ostreatus*

Opletal L., Jahodar L., Chobot V., Zdansky P., Lukes J., Bratova M., Solichova D., Blunden G., Dacke C. G., Patel A. V.

The effects of adding either the dried fruiting bodies of the oyster mushroom *Pleurotus ostreatus*, or an ethanolic extract of it, to the diet of normal Wistar male rats and a strain with hereditary hypercholesterolemia are described. Addition of the dry oyster mushroom to the diet significantly increased, by more than twofold, the triacylglycerol (TAG) level in the plasma of both groups of rats compared with their respective controls. In contrast, the ethanolic extract did not significantly change TAG levels. Values for total cholesterol and its high- and low-density lipoprotein fractions in the plasma, as well as the calculated atherogenic index, did not show any significant change. Levels of liver cholesterol were significantly lowered by the dried oyster mushroom in both hypercholesterolemic and normal groups of rats, and by the ethanolic extract in normal rats. A significantly increased

phospholipid-to-cholesterol ratio in the aortas of both groups of rats, after the administration of either dried oyster mushroom or the ethanolic extract, suggests a favorable antiatherogenic effect for both.

Indian J Exp Biol, 1997 Oct, 35(10):1070–1075

Role of oyster mushroom (*Pleurotus florida*) as hypocholesterolemic/antiatherogenic agent

Baijaj A. F., Vadhera S., Brar A. P., Soni G. L.

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. High-density lipoprotein (HDL) cholesterol/total cholesterol and HDL cholesterol/low-density lipoprotein (LDL) cholesterol ratios increased in experimental animals, proving the anti-atherogenic 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*.

Nutrition, 1998, Mar, 14(3):282–286

Dose- and time-dependent hypocholesterolemic effect of oyster mushroom (*Pleurotus ostreatus*) in rats

Bobek P., Ozdin L., Galbavy S.

The effect of the dose of oyster mushroom in the diet (1.0%, 2.5%, and 5.0%) and of the period of application (8, 16, 28, and 52 weeks) on cholesterol accumulation in blood and body organs was studied in weanling male Wistar rats fed a diet containing 0.3% cholesterol. Reduction of cholesterol in serum and body organs was found to be dependent on the amount of dietary oyster mushroom administered. A negative correlation between the mushroom dose and cholesterol level was found after 8 and 28 weeks of feeding ($r = -0.9821$ and -0.9803 , respec-

tively; $p < 0.02$ for both cases). A dose of 1% oyster mushroom did not affect cholesterol levels in serum or body organs. A significant reduction of cholesterol levels was observed in serum (31–46%) and liver (25–30%) at a dose of 5% oyster mushroom for all time periods. Reduced cholesterol content in very low-density lipoproteins (VLDLs) was also observed at this level. The highest dose of oyster mushroom induced a decrease in conjugated diene levels in erythrocytes and an increase in the levels of reduced glutathione in the liver, and stimulated the activities of catalase and glutathione peroxidase in the liver in the final period of the experiment.

Ceska Slov Farm, 1999, 48(5):226–230

The oyster mushroom (*Pleurotus ostreatus*) effectively prevents development of atherosclerosis in the rabbit

Bobek P., Galbavy S.

The addition of 10% dried fruiting bodies of the oyster mushroom (*Pleurotus ostreatus*) to a 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. An 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. The oyster mushroom diet reduced significantly the incidence of atherosclerotic plaques as estimated by sudanophilia

(absence of a positive reaction in three of five 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 the control diet showed atherogenic changes in the aorta, the 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 a lower incidence of foam cells in all types of lesions.

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Medicinal value of the genus *Pleurotus* (Fr.) P. Karst. (Agaricales s.l., Basidiomycetes)

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Species of the genus *Pleurotus* are widespread in hardwood forests around the world. Since the beginning of their commercial cultivation, their popularity has increased mainly because of the ease of their cultivation and the nutritional value. Traditional medicine attributed to *Pleurotus* spp. Scientific evidence supports their importance as producers of substances with antibiotic, antiviral, anticarcinogenic, antiinflammatory, and hypcholesterolemic activities.