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THE HYPO CHOLESTEROLEMIC EFFECT OF MUSHROOM (*Pleurotus columbinus*) GROWN ON RICE STRAW

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ABSTRACT

The present work was carried out in the Central Lab. for Food and Feed to show the effect of mushroom on the level of total cholesterol or its fractions. Male and female albino rats were used in a seventy three days experimental period study. Hypercholesterolemic rats were used to study the effect of feeding Mushroom (*Pleurotus columbinus*) on serum total cholesterol(T.C.), High Density Lipoprotein cholesterol (HDL), serum Low Density Lipoprotein cholesterol (LDL) and Very Low Density Lipoprotein (VLDL). Purified basal diets supplemented with mushroom did not result in important changes in serum total cholesterol. However, changes were noticed clearly with T.C. distribution between HDL, LDL and VLDL on supplemented basal diet 1 and 2 with 4% mushroom. A noticeable increase in the HDL and a decrease in both LDL and VLDL were noticed.

INTRODUCTION

Oyster mushroom (*Pleurotus columbinus*) is grown on agriculture-crop-wastes to produce mainly suitable feeds for farm animals due to fungi action in degrading lignocelluloses and increasing protein content. As a by- product from such technique, mushroom fruits are produced, which are considered to be a human food of good nutritional and economical values.

It has been reported that *Agaricus bisporus* (Fukushima *et al.*, 2000) and *Pleurotus ostreatus* (Bobek and Ozdin 1996) contain some factors that affect the cholesterol and its fractions levels in rat serum. As oyster mushroom, *Pleurotus columbinus,* fruits have good nutritional value, it is worthy to find out also, if they contain hypocholesterolemic factors that may affect serum total cholesterol and /or its fractions levels.

MATERIALS AND METHODS

The experimental work was carried out in the Central Lab. for Food and Feed (CLFF) laboratories and facilities of the Agricultural Research Center,Egypt.

To study the effect of mushroom feeding on rats, six experimental diets were formulated (Table 1), 3 diets being basal diets (BD) and the other three were the mushroom supplemented diets (MBD). The basal diets were actually purified diets according to Bobek *et al.*, (1993) with some modifications Butter and/or corn oil were used instead of pork fat. The main features of basal diets were:

(1) basal diet 1 (BD1) : 5% butter + 5% corn oil.
(2) basal diet 2 (BD2) : 10% corn oil.
(3) basal diet 3 (BD3) : same as BD1 plus 1% pure cholesterol.

The Biotechnology section of CLFF produced and prepared mushroom for the use in feeding rats. The mushroom used was *Pleurotus columbinus*. Sun dried rice straw was chopped (ca 2-6 cm), soaked in tap water to increase moisture content to 60-70%, followed by soaking in boiled water to decrease contamination. To adjust pH(5) calcium carbonate was added at a rate of 1%. The substrate (rice straw) was spread, after cooling to room temperature, in 15 cm thick layer into plastic containers. Fungi spawn was spread over the substrate at 5% rate (w/w). A Five cm thick substrate layer was used to cover the spawn. Each container can hold 2 kg substrate. The containers were covered with plastic sheets and incubated for 2 weeks at room temperature (28-32°C) till mycelium covered all the surface of the substrate. At the end of incubation period the plastic sheets were removed. The relative humidity of the room was adjusted to 70-80% by watering the containers and spraying the floor of the room with water.

After 2 weeks from the removal of plastic sheets, mature fruit bodies were picked up. Samples of mature fruiting bodies were prepared for analytical and biological work by drying in an oven at 60°C and grinding the dried mushroom.

The ground mushroom was added to basal diets 1, 2 and 3 at a 4% level on expense of cellulose as follows (See Table 1):

(1) BD1 + 4% mushroom (MBD1)
(2) BD2 + 4% mushroom (MBD2)
(3) BD3 + 4% mushroom (MBD3)

Pure cholesterol (Winlab 99%) was added (10g(Pure cholesterol) / kg diet) on expense of cellulose for BD3 and MBD3. 48 weanling albino rats brought from Nasr Co. for Pesticides, Cairo, Egypt,were divided into 6 groups. Each group included 8 rats, 4 Males and 4 females of approximately the same weight.

During the first feeding period (1-15 day) the six groups of rats were fed on the 3 basal diets. Groups 1 and 4 were fed on BD1, groups 2 and 5 were fed on BD2 and groups 3 and 6 were fed on BD3.

During the second feeding period (16-73 days). The six groups of rats were fed as follows :

- 3 groups of rats 1,2 and 3 continued to get the basal diets BD1,BD2 and BD3, respectively.
- 3 groups of rats were fed on the 3 basal diets supplemented with 4 % mushroom as follows:
  Groups 4 fed on MBD1 [BD1 (5% butter + 5% corn oil) + 4% mushroom]
  Group 5 fed on MBD2 [BD2 (10% corn oil) + 4% mushroom]
  Group 6 fed on MBD3 [BD3: (containing 5% butter + 5 % corn oil + 1% pure cholesterol)+ 4% mushroom].

Blood samples were drawn from individual rats on days 1, 16, 57 and 73 of the experiment using reterio oribtal pulex vein technique. Rats were deprived of food 12 hrs before blood sampling. Serum total cholesterol (T.C.) and High Density Lipoprotein Cholesterol (HDL) were determined using biocon kits*. Serum low density lipoprotein cholesterol (LDL) was determined using Bio Mérieux sa.**

* (Biocon Diagnosemittel, GmbH & Co. Produktions-KG Hecke 8, D-34516 Vohl-Marien hagen - Germany)

** (BioMerieux sa 69280 l'Etoile - France)

Table 1: Experimental Diets.

Ingredients	Basal diets (BD) Fed up to 15 days			Mushroom Supplemented. BD Fed from the 16 -73 days		
	Experimental Groups & Diets			Experimental Groups & Diets		
	1	2	3	4	5	6
	BD1	BD2	BD3	MBD1	MBD2	MBD3
Casein	18.00	18.00	18.00	18.00	18.00	18.00
Corn starch	60.00	60.00	60.00	60.00	60.00	60.00
Butter, unsalted	5.00	-	5.00	5.00	-	5.00
Corn oil	5.00	10.00	5.00	5.00	10.00	5.00
Cellulose	6.30	6.30	5.30	2.30	2.30	1.30
Cholesterol, pure	0.00	0.00	1.00	0.00	0.00	1.00
Mushroom, dried	0.00	0.00	0.00	4.00	4.00	4.00
Vitamin mixture	1.00	1.00	1.00	1.00	1.00	1.00
Mineral mixture	4.00	4.00	4.00	4.00	4.00	4.00
Choline chloride	0.15	0.15	0.15	0.15	0.15	0.15
Bile salts	0.55	0.55	0.55	0.55	0.55	0.55

RESULTS AND DISCUSSION

The results of the experiment are shown in Tables (2, 3 and 4). Feeding rats on BD1, showed an increase of 24% (22 mg/dl) in serum total cholesterol (T.C.) on day 16 compared to day 1 of the experiment (Table 2). The increament in T.C. was distributed between HDL (increase of 20 mg/dl) and VLDL (increase of 3 mg/dl) and a reduction in LDL (of 1 mg/dl). However, as a percent of T.C., HDL was increased by 8%, while LDL and VLDL were reduced by 25% and 9% on day 16 respectively when compared to day 1 of the experiment. Supplementing BD1 with mushroom did not change greatly T.C. level in serum on day 57 and 73, being 114 and 110 mg/dl respectively. HDL as percent of T.C. was increased on days 57 and 73 by 4 and 8% when compared with day 16. On the other hand, LDL and VLDL as percent of serum T.C. were reduced by 22 and 5% on day 57 and by 11 and 25 on day 73 respectively.

Serum total cholesterol in rats fed on BD2, where corn oil was the only source of fat, showed an increase on day 16 amounting to 6% (5 mg/dl) only of day 1 (Table 3) compared to that of diet containing butter. A small increase in HDL took place on day 16 amounting to 6 mg/dl (11% increase). HDL, LDL and VLDL cholesterol constituted 69, 22 and 9% respectively of T.C. A reduction of 44% took place in VLDL % of T.C. on day 16 when compared with day 1 of the experiment. Supplementing BD2 with mushroom caused an increase of 28 and 25% in HDL % of T.C., on days 57 and 73 respectively

when compared to those on day 16. LDL contributed only 7 and 6% of T.C. on days 57 and 73 showing a respective reduction of 68 and 73% than day 16 respectively. Also VLDL % of T.C. was reduced from 9% on day 16 to 5 and 8% on days 57 and 73, a reduction of 44 and 11% respectively from day 16. No important changes could be noticed with serum T.C. as affected by mushroom supplementation.

Table 2: Effect of feeding BD1 and mushroom supplementation on serum cholesterol.

Cholesterol	Feed BD1		Feed mushroom supplemented BD1	
			Days of blood sampling	
	1	16	57	73
Total cholesterol mg/dl	92	114	114	110
HDL as % of T.C.	66	71	74	77
LDL as % of T.C.	12	9	7	8
VLDL as % of T.C.	22	20	19	15

Table 3: Effect of feeding BD2 and mashroom supplementation on serum cholesterol.

Cholesterol	Feed BD2		Feed mushroom supplemented BD2	
			Days of blood sampling	
	1	16	57	73
Total cholesterol mg/dl	81* 81-80**	86 89-83	84 76-95	93 86-102
HDL as % of T.C.	65 65-65	69 66-72	88 87-88	86 86-85
LDL as % of T.C.	20 21-18	22 20-24	7 6-9	6 6-7
VLDL as % of T.C.	16 14-18	10 14-4	5 7-3	8 8-8

* Average of females and males.
** Average of males then average of females.

Table 4: Effect of feeding BD3 and mushroom supplementation on serum cholesterol.

Cholesterol	Feed BD3		Feed mushroom supp. BD3	
			Days of blood sampling	
	1	16	57	73
Total cholesterol mg/dl	83	326	479	567
HDL as % of T.C.	61	9	7	8
LDLas % of T.C.	16	37	40	47
VLDL as % of T.C.	23	54	53	46

Basal diet 3, is actually BD1 supplemented with 1% cholesterol. Feeding diet BD3 to rats caused great increase in serum T.C. from 83 on day 1 up to 326 mg/dl on day 16 (almost 4 times). At the same time a great reduction was noticed in HDL % of T.C. on day 16, being 9% when compared to 61% on day 1. On the other hand, LDL and VLDL contribution to T.C. increased from 16 and 23% on day 1 to 37 and 54%, respectively. On day 16 LDL and VLDL cholesterol composed 91% on day 16, of T.C. No effect was noticed to mushroom supplementation.

Many investigators found that some oyster mushrooms cause a reduction in serum total cholesterol. Bobek *et al.*, (1995), (1994); Bobek and Ozdin (1996) (using *Pleurotus ostreatus*) and Fukushima *et al.*, (2000) (using *Agaricus bisporus*). In the present work supplementary purified basal diets with mushroom (*pleurotus columbinus*) did not result in important changes in serum T.C. However, changes were noticed clearly with T.C. distribution between HDL, LDL and VLDL. On supplementing BD1 and BD2 with 4% mushroom a good increase in the HDL cholesterol and a decrease in both LDL and VLDL were noticed. As HDL cholesterol is strongly associated with reduced risk of coronary heart disease (CHD) and LDL and VLDL cholesterols are the most important cause of atherosclerosis, oyster mushrooms *Pleurotus columbinus* may be considered a food for adjusting the balance between HDL and LDL of blood cholesterol. More detailed studies would be beneficial.

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التأثير الخافض للكوليسترول و الخاص بالتغذية على (عيـــش الغـــراب) جنـــس بلوروتس كولمبينس المنمي علي قش الارز

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المعمل المركزى للأغذية والأعلاف – مركز البحوث الزراعية

أجريت التجارب في المعمل المركزي للأغذية والاعلاف لبيان تأثير التغذية علـــي فطـــر (عيش الغراب) جنس بلوروتس كولمبينس المنمي علي قش الارز علي مستويات الكوليســـترول الكلي وشقوقه ٠ حيث اجريت الدراسة علي ذكور واناث فئران الالبينو لمدة ٧٣ يوما والتـــي تـــم زيادة نسبة الكوليسترول في سيرم دمها ٠

تدعيم الوجبات الحافظة بعيش الغراب لم يؤد الي تغيرات مهمة في ســـيرم الكوليســـترول الكلي علي الرغم انه لوحظ تغيرات واضحة في الكوليسترول الكلي والمـــوزع بيـــن البروتينـــات الدهنية ذات الكثافة المرتفعة والبروتينات الدهنية ذات الكثافـــة المنخفضـــة وكذلـــك ذات الكثافـــة المنخفضة جدا وهما الوجبتان ١ ، ٢ المدعمة بـــ ٤% عيش غراب . حيث لوحـــظ زيـــادة فـــي البروتينات الدهنية ذات الكثافة المرتفعة وانخفاض في كل من البروتينات الدهنيـــة ذات الكثافـــة المنخفضة والمنخفضة جدا٠