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Effect of Level of White button mushroom (*Agaricus. bisporus*) on blood biochemical characteristics of Japanese quails (*Coturnix Japonica*)

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ABSTRACT

This study, the blood biochemical characteristics of Japanese quails supplemented with the edible mushroom (*Agaricusbisporus*) powder was evaluated. A total of 240 seven- day old mix sexes quail chicks were randomly allocated to four experimental treatments. In 21 days old males and female chicks were separated. Each treatment consisted of 3 replicates of 20 birds. The birds within the control group were given the basal diet for the respective growth stage. The other three groups were fed experimental diets based on the basal diets containing 0.5, 1, and 2 percent of dried mushroom powder. Birds were allowed to free access to have feed and water during the 35day of growth period. Total cholesterol (TC), triglyceride (TG), low-density lipoprotein (LDL) were significantly decreased (P<0.05) by the 2% mushroom compared to the control.HDL cholesterol was significantly increased (P<0.05) by the 2% mushroom compared to the control, but plasma glucose, uric acid, total protein were not significantly influenced by the dietary treatments. Inclusion of 2% mushroom in the diet, positively affects cholesterol, triglyceride, HDL and LDL of quails. Therefore it seems that mushroom may be a beneficial component in quail diet.
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Key words: Blood biochemical, mushroom (*Agaricusbisporus*), quail.

INTRODUCTION

Cardiovascular disease and diabetes are the major causes of morbidity and mortality in the Asia-Pacific region. Epidemiological studies suggested that the risk factors for cardiovascular disease and diabetes include hypercholesterolemia and hyperglycemia, which are largely influenced by diet (Kaur et al., 2002 and Tourlouki et al., 2009). Most research has shown that many medical herbal and mushrooms had beneficial effects on blood cholesterol and cardiovascular disease. Mushrooms have a great nutritional value since they are quite rich in protein, with an important content of essential amino acids and fiber, and poor in fat. Edible mushrooms also provide a nutritionally significant content of vitamins (B1, B2, B12, C, D and E) (Mattila et al., 2001). Edible mushrooms could be a source of many different nutraceuticals such as unsaturated fatty acids, phenolic compounds, tocopherols, ascorbic acid and carotenoids. Thus, they might be used directly in diet and promote health, taking advantage of the additive and synergistic effects of all the bioactive compounds present (Barros et al., 2007; Ferreira et al., 2009; Pereira et al., 2012; Vaz et al., 2010).

Agaricus bisporus, commonly known as white button mushroom (WBM), constitutes the bulk of the total mushrooms consumed in most Asian countries. Information is limited on health benefits of WBM. They are reported that several species of mushroom, including white button mushroom (*Agaricus bisporus*), oyster mushroom (*Pleurotus ostreatus*) and Shiitake (*Lentinus edodes*), reduce the cholesterol level in serum and/or liver (Jeong et al., 2010 and Fukushima et al., 2001). In addition, WBM intake inhibited MCF-7aro tumor growth in nude mice. Conjugated linoleic acid was identified as an active

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component with anti-aromatase activity (Chul, 2010).

Feeding hypercholesterolemic Sprague-Dawley albino rats a diet containing 5% fruiting bodies of Pleurotusnebrodensis reduced plasma total cholesterol, triglyceride, low density lipoprotein, total lipid, phospholipids and LDL/HDL ratio by 31.01, 47.71, 62.50,31.91, 24.65 and 53.06%, respectively, with significant reductions in body weight. No adverse effects were reported on plasma albumin, total bilirubin, direct bilirubin, creatinin, blood urea nitrogen, uric acid, glucose, total protein, calcium, sodium, potassium, chloride, and inorganic phosphate, magnesium, or enzyme profiles. The feeding of these mushrooms increased total lipid and cholesterol excretion in feces. The data suggest that *P. nebrodensis* was acting on the atherogenic lipid profile in the hypercholesterolemic rats (Alam et al., 2011). Essentially identical results were also reported for *Pleurotus* ferulae in the same animal model (Alam et al., 2011).

Therefore, the aim of this study was to investigate the effects of supplementation of different levels of dried mushroom (*Agaricus bisporus*) powder on blood biochemical characteristics of Japanese quails.

MATERIALS AND METHODS

Birds and experimental design

A total of 240 seven day old mix sexes quail chicks were randomly allocated to four experimental treatments. In 21th days of age, male and female chicks were separated. Treatment consisted of three replicates of 20 birds. Each replicate was housed in separate stainless floor pens under controlled temperature and light conditions. Each pen was 100×100 cm. The lighting cycle was 23 h/day maintained at all growth times. The diets were formulated to meet the nutrients requirements of broilers as recommended by the National Research Council (NRC, 1994). Table 1 presents the ingredients and the composition of the basal diets fed in mash form. The birds within the control group were given the basal diet for the respective growth stage. The other three groups were given experimental diets based on the basal diets containing 0.5, 1, and 2 percentage of ground dried mushroom (*A. bisporus*). Birds were allowed to free access to have feed and water during the 35days of growth period.

Preparation of white button mushroom diet

Fresh fruiting bodies of *Agaricus bisporus*were obtained from mushroom growers. The whole mushrooms were dried out at 60°Cfor 12h and were added to experimental diets of chicks after carefully grinding. After drying, fruiting bodies were milled to a powder approximately less than 1 mm in particle size using a cyclotec grinder (Tecator, Hoganas, Sweden). The chemical composition of *Agaricus bisporus* powder (ABP) as determined by the Standard AOAC (Association of Official Analytical Chemists) methods (Conniff, 1995) is shown in Table 2.

Biochemical analyses

At 35 day of age, quail were slaughter and collected blood for analysis blood biochemical. Plasma glucose, uric acid, total protein, total cholesterol (TC), triglyceride (TG), high-density lipoprotein (HDL) cholesterol, were measured using commercial kits (Pars Azmoon Co, Auto analyzer Alison- 300, America). The LDL cholesterol, were calculated using the following formula (Friedeward et al., 1972).

LDL cholesterol = total cholesterol − HDL cholesterol− (triglyceride/5)

RESULTS AND DISCUSSION

The effect of level of mushroom in diet of quails on the blood biochemical components and are shown in table 3 and 4. In the present study glucose, uric acid, total protein were not significantly influenced by the supplementation of mushroom, but total cholesterol (TC), triglyceride (TG), high-density lipoprotein (HDL) and LDL cholesterol significantly varied amongst treatments ($P<0.05$). These results are in agreement with those reported by Bobek et al., (1991).

Oyster mushroom (4% dry oyster mushroom fruit body) lowered cholesterol content by more than 60% in the liver although it did not significantly affect either the serum triacylglycerol level or the content in liver (Bobek et al., 1991). The hypocholesterolemic effects of oyster mushrooms have been demonstrated to be dose-dependent (Bobek et al., 1997). A similar hypocholesterolemic effect of the oyster mushroom (*Pleurotus ostreatus*) was also observed in hamsters (Bobek et al., 1991) and in rabbits (Bobeket al., 1999).

Plasma cholesterol in animal models has been shown to be reduced by mushroom consumption. The hypocholesterolemic effect appears to be due partly to an increased rate of low density lipoprotein (LDL) and high density lipoprotein (HDL) catabolism. While some studies have postulated eritadenine or angiotensin I –convertingenzyme inhibitory peptides as the hypocholesterolemicagents, similar effects on cholesterol, and other biomarkers of cardiovascular

Table 1. Composition of experimental diets with or without mushroom

Ingredients	**Control**	**%0.5 Mushroom**	**%1 Mushroom**	**%2 Mushroom**
Yellow Corn	53.31	52.00	52.00	52.08
Soybean Meal	39.69	39.00	38.75	39.50
Corn Gluten Meal	3.07	4.20	4.00	2.5
Vegetable Oil	1	1.38	1.33	0.98
Mushroom	-	0.50	1.00	2.00
Oyster Shell	1.22	1.22	1.22	1.22
Di Calcium Phosphate	0.77	0.77	0.77	0.77
L- Lysine	0.06	0.06	0.06	0.06
DL-Methionine	0.12	0.12	0.12	0.12
Mineral-Vitamin Premix*	0.5	0.5	0.5	0.5
Sodium Chloride	0.25	0.25	0.25	0.25
Calculated analysis				
ME (Kcal/Kg)	2900	2900	2900	2900
CP (%)	24	24	24	24
Calcium (%)	0.805	0.805	0.805	0.805
Phosphor (%)	0.299	0.299	0.299	0.299
Sodium (%)	0.115	0.115	0.115	0.115
Lysine (%)	1.30	1.30	1.30	1.30
Methionine + Cycteine (%)	0.89	0.89	0.89	0.89

**Supplemented for kg of the diets: Vit. A, 12000 IU; D3, 2000 IU; E, 20 mg; K3, 3 mg; B2, 7 mg; B3, 12 mg; B5, 3mg; B12, 0.03 mg; Biotin, 0.1 mg; Choline chloride, 300 mg; Mn, 130 mg; Fe, 70 mg; Zn, 60 mg; Cu,12 mg; I,1 mg;Se, 0.2 mg, and adequate antioxidant*

Table 2. Proximate analysis of *Agaricus bisporus* powder

Component	**Composition (%)**
Moisture	15.11
Crude ash	12.18
Crude fat	2.5
Crude protein	23.21
NFE	47

risk, have been demonstrated by consumption of mushroom (e.g. *Agaricus bisporus*) fiber. Such a cholesterol-lowering effect has also recently been reported in humans.

A water-soluble polysaccharide extract of *Pleurotuseryngii* has been shown to significantly increase the activity of antioxidant enzymes and effectively remove free radicals in a liver-injury mouse model. Furthermore, in a high-fatload mouse model, the extract decreased total cholesterol, total triglyceride, and low-density lipoprotein cholesterol, and increased high-density lipoprotein cholesterol (HDL). Histopathological observations indicated that the extract of mushroom could effectively prevent excessive lipid formation in liver tissue (Chen et al., 2012).

Although the mechanism of action is unclear, the anti-TG and anti-TC activities of ABP may be attributable to the fermentation of dietary fiber in diabetic rats fed ABP. Short chain fatty acid such as propionate generated by bacterial fermentation of dietary fibers has been shown to inhibit hepatic cholesterol synthesis (Chen et al., 1984 and Haraet al., 1998).

Attempts to elucidate the mechanism involved in the cholesterol-lowering effect of dietary mushroom fiberhave been reported (Thompson et al., 1984; Fukushima et al., 2001 and Preusset al., 2007). It has been suggested that mushroom dietary fiber might bind bile acids to reduce theirentry into enterohepatic circulation, which then leads to an increase in gut bile acid secretion (Cheung et al., 1996). As a result, the liver responds by increasing hepatic conversion of cholesterol in to bile acids, thus, reducing its circulating levels.

The observed beneficial effects of *A.bisporus* on hypercholesterolemia are likely to becomplex,

Table 3. Effects of dietary of mushroom on some of serum biochemical parameters in male quail chicks (35 days age)

Treatments	**Glucose (mg/dl)**	**uric Acid (mg/dl)**	**Triglyceride (mg/dl)**	**Total cholesterol (mg/dl)**	**HDL (mg/dl)**	**LDL (mg/dl)**	**Total protein (g/dl)**
Control	335.50	8.78	224.45[a]	199.50[a]	114.58[c]	39.99[a]	3.48
Mushroom 0.5%	335.00	8.73	192.55[b]	184.21[b]	119.76[b]	25.91[b]	3.49
Mushroom 1%	334.83	8.77	183.16[c]	180.30[c]	123.08[a]	20.55[c]	3.50
Mushroom 2%	328.33	8.73	174.37[d]	174.81[d]	124.69[a]	15.19[d]	3.50
SEM	5.04	0.29	0.58	0.59	0.64	0.98	0.10
P- value	0.7154	0.9992	<.0001	<.0001	<.0001	<.0001	0.9987

Means with different superscripts in the same column represent significant difference at P < 0.05

Table 4. Effects of dietary of mushroom on some of serum biochemical parameters in female quail chicks (35 days age)

Treatments	Glucose (mg/dl)	uric Acid (mg/dl)	Triglyceride (mg/dl)	Total cholesterol (mg/dl)	HDL (mg/dl)	LDL (mg/dl)	Total protein (g/dl)
Control	330.16	11.61	225.72[a]	187.55[a]	115.66[c]	26.72[a]	3.70
Mushroom 0.5%	331.50	11.67	193.39[b]	180.26[b]	118.37[b]	23.17[b]	3.69
Mushroom 1%	329.16	10.98	182.73[c]	172.19[c]	122.19[a]	13.40[c]	3.71
Mushroom 2%	325.83	11.11	175.28[d]	169.66[d]	123.55[a]	11.02[c]	3.72
SEM	2.86	0.30	0.61	0.55	0.56	0.96	0.12
P- value	0.5545	0.3015	<.0001	<.0001	<.0001	<.0001	0.9972

Means with different superscripts in the same column represent significant difference at P < 0.05

probably involving a combination of bioactivecomponents in the mushrooms, including short-chain fatty acids generated by bacterial fermentation of fibers in the colon. For example, numerous studies have shown that propionate generated from dietary fibers containing poly saccharides exhibits hypocholesterolemic effects and offsets acetate generation, which tends to increase serum cholesterol via a mechanism probably involving liver lipogenesis (Chen et al., 1984, Cook and Sellin, 1998).

CONCLUSION

To conclude, the data presented in this study show that WBM possesses anti-hypercholesterolemic effect. Moreover, it has a positive influence on lipid metabolism and liver function. Effects of WBM are likely the result of a number of mechanisms involving dietary fiber and other active components in the mushroom acting alone or in combination. These results suggest that dietary content of mushroom could decrease total cholesterol (TC), triglyceride (TG) and LDL cholesterol. In an overall conclusion, the mushroom (*Agaricus. bisporus*) could be a beneficial supplement in quail diet.

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