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ORIGINAL ARTICLE

Effect of Common mushroom (*Agaricus. bisporus*) Levels on Growth Performance and Carcass yields of Japanese quails (*Coturnix coturnix Japonica*)

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ABSTRACT
In this study, the performance parameters and carcass yields of Japanese quails supplemented with the edible mushroom (Agaricus bisporus) powder were evaluated. A total of 480 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 35 day of growth period. Weight gain and feed intake were significantly increased (P<0.05) by the 2% mushroom compared to the control. Feed conversion ratio was significantly decreased (P<0.05) by the 2% mushroom compared to the control. Bursa and liver weights of quail chicks were significantly increased (P<0.05) by the 2% mushroom compared to the control, but total body weight (TBW), breast, thigh, spleen and heart weights as a percentage of live weight and intestine length of quails were not significantly influenced by the dietary treatments. Inclusion of 2% mushroom in the diet, positively affects performance parameters and some internal organs of quails. There, for it seems that mushroom may be a beneficial component in quail diet.
Key words: Mushroom (Agaricus bisporus), performance, quail, carcass

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INTRODUCTION

Antibiotics are widely used as growth promoters in poultry production. In recent years, usage of antibiotics as growth promoter in poultry diet has been banned due to concerns about their residues in animal tissues and subsequent induction of emerging antibiotic resistant strains of microorganisms [1, 2 and 3]. Therefore, researchers are looking for safe alternatives candidates such as natural products and phytobiotics. Recently, natural materials such as medicinal plants, mushrooms and herbs have been investigated. Wang *et al.* [4] reported antimicrobial activities, immune enhancement and stress reduction in farm animals given natural medicinal products from fungi and herbs. Mushrooms have long been appreciated as an important source of bioactive compounds of medicinal value [5]. Some fungi have been used for centuries to combat disease outbreaks in many parts of the world and are still used in ethnoveterinary medicine in Asian and Mediterranean countries [6]. Mushrooms may have a wide range of activities [7]. For particular interest are extracts derived from various mushrooms because they are known to confer health-promoting benefits, due to a multitude of compounds with antioxidant, antibacterial, immune- enhancing, and stress reduction properties on farm animals [8 and 9].
Guo et al. [10] reported that the population of bifidobacteria and lactobacilli were significantly increased with the addition of shiitake mushroom extract (*Lentinus edodes*). It was found that the immunologically active components in medical mushrooms and plants may include polysaccharides, glycosides, alkaloids, volatile oils, and organic acids [11]. Certain polysaccharides from mushrooms and herbs that have been used as immune enhancers have shown antibacterial, antiviral, and antiparasitic activities in chickens

[12]. Such mushrooms and herbs may also act as prebiotics and thereby enhance colonization resistance of the host gut to potential pathogens. However, little is known about the effects of these polysaccharides on the microbial community and its activities or about the microbial ecosystem within the gut of chickens. Recently, it has been reported that the combined use of Chinese herbal and mushroom extracts can operate as alternatives to antibiotic growth promoters in broiler chicken [10]. Also, Giannenas *et al.* [13] observed the beneficial influence of mushroom (*Agaricus bisporus*) on broilers performance and tissue antioxidant-protective activity. However, there have been few reports on the effect of the mushroom in chickens.

Therefore, the aim of this study was to investigate the effects of supplementation of different levels of dried mushroom (*Agaricus bisporus*) powder on performance parameters and carcass components in Japanese quails.

MATERIALS AND METHODS

Birds and experimental design

A total of 480 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 (1 m^2 per 15 chicks). The lighting cycle was 23 h/day maintained at all growth times. The ambient temperature in experimental house was maintained at 37°C during the first week and then gradually decreased by 3°C in the third week, and finally fixed at 22°C thereafter. The experiment lasted for 35 days. The diets were formulated to meet the nutrients requirements of broilers as recommended by the National Research Council [14]. 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 percent of ground dried mushroom (*A. bisporus*). Birds were allowed to free access to have feed and water during the 35 days of growth period.

Table 1**-** Composition of experimental diets with or without mushroom

Ingredients	Control	%0.5 mushroom	%1 mushroom	%2 mushroom
Yellow Corn	53.31	52	52	53.30
Soybean Meal	39.69	39	38.75	39.50
Corn Gluten Meal	3.07	3.5	3.5	2.5
Vegetable Oil	1	1.35	1.33	0.98
Mushroom	-	0.5	1	2
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, 3*
mg; 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

Mushroom preparation and supplementation

The mushrooms were purchased from Andisheyeh Sabz Mushroom Institute in Iran. The whole mushrooms were dried out at 60°C for 12h and were added to experimental diets of chicks after carefully

grinding. For chemical analyses, mushrooms were used according to the procedures described by AOAC [15]. Dried mushrooms were analysis for protein, fat, fiber, and ash. Total protein content was measured by Kjeldahl, crude fat content was extracted from the samples with petroleum ether in a Soxhlet apparatus, crude fiber content was analyzed in a Dosi fiber apparatus, and ash was determined by incinerating dried samples at 600°C for about 6 h in a furnace and moisture by oven drying.

Analytical procedures

At 35 day of age, the feed consumption and total weight of each pen were used to calculate live body weight (LBW), average daily gain (ADG), feed intake (FI) and feed conversion ratio (FCR).

At 35 ages, three male birds from each pen were picked out randomly, chosen based on the average weight of the group and slaughtered through partial slicing of the neck by a manual neck cutter. Live body weight, breast weight and thigh weight, organs (spleen, bursa, heart and liver) were weighed and calculated as a percentage of live weight.

Statistical analysis

Data were statistically analyzed using the General Linear Model (GLM) procedure of SAS [16]. Test of significance for the differences between means of each classification was done by Duncan's multiple range test [17].

RESULTS AND DISCUSSION

Previous studies had shown putative beneficial effects of different mushrooms on broiler chicken performance and in particular immune-enhancing benefits in Eimeria-challenged chicken [7]. The present study, the amount of dried mushroom (*Agaricus. bisporus*) added to the basal diet and performance parameters and carcass yields of quail were taken.

Performance parameters

There were significant differences (P<0.05) in weight gain, feed intake and feed conversion ratio in the 2-5-wk period (table 2). In addition, the level of mushroom had a significant effect on quail feed intake, weight gain and feed conversion ratio.

Table 2- Body weight gain (BWG), feed intake (FI), and feed conversion ratio (FCR) values of male quail chicks

Treatments	Feed Intake (g)	Weight gain (g)	Feed Conversion Ratio
Control	430.43^{b}	146.32^{c}	2.906^{a}
Mushroom 0.5%	423.35^{b}	147.58^{c}	2.863^{ab}
Mushroom 1%	438.42^{b}	154.53^{b}	2.830^{b}
Mushroom 2%	457.89^{a}	167.48^{a}	2.730^{c}
SEM	4.8006	2.1590	0.0188
P- value	0.0051	0.0004	0.0010

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

Quails belonging to treatment mushroom 2% had the highest feed intake and weight gain and lower FCR as compared with other treatments. These data support the observation that the mushroom extract did not impede weight gain. This is further supported by the work of Guo *et al.* [10] that showed increase BWG in broilers with the use of mushroom and herb polysaccharides. The mushroom composition in relation to physiochemical properties and the phenolic compounds and polysaccharide fractions as well as sugar composition, molecular weights, and structures could be the basis for the observed results Guo *et al.* [7]. Hu *et al.* [18] indicated that the immune response of chickens was significantly increased by a mushroom polysaccharide supplement from 7 to 14 days of age, and its efficacy could be observed in the third week after feed supplementation.

The mushroom and herb polysaccharides have been demonstrated anti-bacterial [11], anti-viral [11] or anti-parasitic activity [18 and 19] in chickens, when given to the birds for a short period or as an adjuvant of vaccines.

The immunological challenges that increase caloric demands as suggested by Martin *et al.*[20] could influence the performance of the male and female broiler chickens. In a study conducted by Netherwood *et al.* [21], their observation implies that probiotics have to be continuously supplied in the diet to provide beneficial effects. The literature does not contain many studies in this area; therefore, more research is needed. It is clear that one must be selective in the type of mushroom utilized in order to avoid reduction in body weight performance.

Carcass and internal organs analysis

The effect of level of mushroom in diet of quails on the carcass components and internal organs analysis are shown in table 3. In the present study live body weight (LBW) and proportions of breast, thigh, spleen and heart weights as a percentage of LBW and intestine length of birds were not significantly influenced by the supplementation of mushroom, but bursa and liver percentage significantly varied amongst treatments (P<0.05). These results are in agreement with those reported by Willis *et al.* [22]. Several studies showed that mushroom and herb polysaccharides used as immune enhancers, significantly increased growth of immune organs such as thymus, bursa and spleen weights in both normal and immune inhibitor treated animals such as chickens and rats [23, 24 and 25. The results of this study showed, spleen weight was slightly increased by the mushroom, although the expected statistically significant effect on the relative weights of the organ was not found.

Table. 3. Carcass components and internal organs of 35 day old male Japanese quails (% of body weight)

Treatments	TBW (g)	Breast	Thigh	Liver	Spleen	Bursa	Heart	Length of intestine (cm)
Control	163.74	27.52	20.12	2.35^{c}	0.074	0.13^{d}	0.836	61.00
Mushroom 0.5%	163.89	27.60	20.12	2.41^{b}	0.076	0.15^{c}	0.843	61.11
Mushroom 1%	164.86	27.69	20.57	2.51^{b}	0.075	0.18^{b}	0.842	61.12
Mushroom 2%	166.12	27.77	20.76	2.81^{a}	0.084	0.23^{a}	0.843	61.33
SEM	3.282	0.5300	0.465	0.077	0.007	0.011	0.039	2.076
P- value	0.8006	0.9431	0.2413	<.0001	0.3857	<.0001	0.9962	0.9978

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

Different natural species of mushrooms and herbs were detected with different physico-chemical properties and immune activities. Immune activities of the polysaccharides from two mushrooms *Lentinus edodes* and *Tremella fuciformis* have been reported by Zhng *et al.* [25]. These immune active polysaccharides generally can stimulate growth of immune organs, enhance number and activities of immunocytes and induce both cellular and humoral immune responses [26].

The immune-modulating effect of mushroom may result from an increase of the biological effect regulators, cAMP and cGMP, which play a role in regulating proliferation, differentiation and secretion of immune cells Lee *et al. [27]*. The results from this data clearly suggest that certain mushrooms positive health attributes as reflected by immune organs weights.

CONCLUSION

This paper clearly demonstrates that certain mushroom have greater abilities to provide performance enhancement protection to quail chicks with metabolic disorders. These results suggest that dietary content of mushroom could improve growth performance of infected quails possibly through enhanced immune function. In the used of mushroom showed significant effects on weight gain, feed intake and feed conversion ratio as well as growth of immune organs in quail chicks. In an overall conclusion, the mushroom (*Agaricus. bisporus*) could be a beneficial supplement in quail diet.

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Citation of This Article

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