

1-1-2005

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### Recommended Citation

YALÇIN, SUZAN; OĞUZ, FATMA; and YALÇIN, SAKİNE (2005) "Effect of Dietary Hazelnut Meal Supplementation on the Meat Composition of Quails," *Turkish Journal of Veterinary & Animal Sciences*: Vol. 29: No. 6, Article 11. Available at: <https://journals.tubitak.gov.tr/veterinary/vol29/iss6/11>

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## Effect of Dietary Hazelnut Meal Supplementation on the Meat Composition of Quails

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Received: 11.11.2005

**Abstract:** This experiment was conducted to study the effects of dietary hazelnut meal supplementation on the meat composition of quails. A total of 312 one-day-old Japanese quail chicks (*Coturnix coturnix japonica*) were divided into 6 equal groups. Six different levels of hazelnut meal (0%, 10%, 15%, 20%, 25% and 30%) were included in their diets. At the end of the 5-week experiment, 12 quails (6 male and 6 female) were slaughtered from each group at random. The levels of dry matter, protein, fat, ash and some mineral elements of the meat were determined. The values of protein, ash, energy, calcium, phosphorus, iron and zinc in the meat were not influenced by dietary treatment or sex. Significant differences ( $P < 0.05$ ) in dry matter content of the meat between the control group and the groups fed 15%, 20% and 25% hazelnut meal and in fat content between the control group and the group fed 20% hazelnut meal were detected. However, when analysis of male and female carcass meat was performed separately, there were no significant differences in dry matter or fat content. It was concluded that the supplementation of hazelnut meal up to 30% to quail diets did not have any adverse effect on the meat composition.

**Key Words:** Hazelnut meal, quail, meat composition

### Rasyona Fındık Küspesi İlavesinin Bildiricilerde Et Bileşimi Üzerine Etkisi

**Özet:** Bu çalışma rasyona fındık küspesi ilavesinin bildiricilerde et bileşimi üzerine etkilerini belirlemek amacıyla yapılmıştır. Toplam 312 adet Japon bildiricini civivi (*Coturnix coturnix japonica*) 6 eşit gruba bölünmüştür. Rasyonlara 6 farklı düzeyde fındık küspesi (% 0, % 10, % 15, % 20, % 25 ve % 30) ilave edilmiştir. Beş haftalık deneme sonunda her gruptan 12 bildiricini (6 erkek ve 6 dişi) rasgele seçilerek kesilmiştir. Ette kuru madde, protein, yağ, kül ve bazı mineral madde düzeyleri belirlenmiştir. Ette protein, kül, enerji, kalsiyum, fosfor, demir ve çinko rasyondaki muameleden ve cinsiyetten etkilenmemiştir. Kontrol grubu ile % 15, % 20 ve % 25 fındık küspesi ile beslenen gruplar arasında ette kuru madde miktarı, kontrol grubu ile % 20 fındık küspesi ile beslenen grup arasında yağ miktarı bakımından önemli farklılıklar ( $P < 0,05$ ) belirlenmiştir. Bununla birlikte erkek ve dişi karkas eti analizleri ayrı ayrı yapıldığında kuru madde ve yağ miktarı bakımından önemli farklılıklar bulunmamıştır. Sonuç olarak bildiricini rasyonlarına % 30'a kadar fındık küspesi ilavesinin bildiricini et bileşimi üzerine herhangi bir olumsuz etkisinin olmadığı kanısına varılmıştır.

**Anahtar Sözcükler:** Fındık küspesi, bildiricini, et bileşimi

### Introduction

In recent years quail meat has been gaining in popularity among consumers. Quality is an important attribute affecting consumer reactions to poultry meat. It has been demonstrated that a number of factors, such as the strain, age and sex of the bird, diet formulation and nutrient intake, affect the meat composition of poultry (1,2). Although the meat composition of broilers has been studied extensively (1-4), only limited studies have been reported on that of quail (5-7).

Hazelnut production in Turkey was about 480,000 t in 2003 (8). Hazelnuts, produced in the Black Sea coastal region, are utilized mainly for human consumption. They are used in the production of oil, chocolate, cakes and biscuits and are used as nuts. In addition, hazelnut oil production for human consumption has been increasing recently in Turkey. Hazelnut meal obtained after oil extraction has high nutritive value for poultry due to its high protein and low fiber content (9,10).

Although the utilization of hazelnut meal in poultry

diets has been studied previously (9-11), there are no published reports on the effects of the usage of hazelnut meal on meat composition as far as we know. Therefore, the aim of this study was to determine the effects of hazelnut meal in the diets of quail on meat composition.

**Materials and Methods**

In this study, 312 one-day-old Japanese quail chicks (*Coturnix coturnix japonica*) were divided randomly into 1 control group and 5 treatment groups, each containing 52 quail chicks. They were housed in wire cages. The quails were assigned to 6 different isocaloric and isonitrogenous dietary treatments containing 0%, 10%, 15%, 20%, 25% and 30% hazelnut meal. Hazelnut meal has 39.52% crude protein, 7.62% ether extract, 8.10% crude fiber, 6.20% crude ash, 0.41% calcium, 0.60% phosphorus and 2210 kcal/kg metabolizable energy. The composition of the diets is given in Table 1. Food and

water were provided ad libitum throughout the 5-week experimental period.

At the end of the experiment, 12 quails (6 male and 6 female) were selected from each group at random. They were individually slaughtered, scalded, plucked and allowed to drain. The carcasses were wrapped individually in polythene bags and immediately placed in a freezer (-20 °C). Frozen meat was thawed for 24 h in a refrigerator (+4 °C) prior to chemical analysis. Meat was separated from the bone and skin and then mixed thoroughly for homogeneity. The samples of meat were analyzed for moisture, fat, protein and ash contents according to AOAC (12) methods. The energy values of meat samples were calculated according to the Atwater system (13). The levels of calcium, zinc and iron were measured using an atomic absorption spectrophotometer (Thermo Jarrel Ash Video 12E) and phosphorus by Beckman spectrophotometer (14).

Table 1. Composition of the diets (%).

Ingredient	Treatment groups					
	Control group	1	2	3	4	5
Barley	15.70	15.20	16.30	17.45	18.60	19.75
Maize	35.00	33.50	31.72	30.00	28.28	26.56
Soyabean seed meal	33.00	24.00	19.50	15.00	10.50	6.00
Hazelnut meal	-	10.00	15.00	20.00	25.00	30.00
Sunflower seed meal	6.00	7.00	7.00	7.00	7.00	7.00
Meat and bone meal	3.00	3.00	3.00	3.00	3.00	3.00
Vegetable fat	4.50	4.50	4.68	4.75	4.82	4.89
Dicalcium phosphate	0.70	0.70	0.70	0.70	0.70	0.70
Limestone	1.35	1.35	1.35	1.35	1.35	1.35
Salt	0.30	0.30	0.30	0.30	0.30	0.30
DL-methionine	0.10	0.10	0.10	0.10	0.10	0.10
Vitamin premix*	0.25	0.25	0.25	0.25	0.25	0.25
Mineral premix**	0.10	0.10	0.10	0.10	0.10	0.10
Chemical composition (Analyzed)						
Metabolizable energy, kcal /kg	2818	2798	2833	2828	2839	2794
Crude protein, %	22.44	22.60	22.48	22.60	22.53	22.69
Ether extract, %	7.14	7.35	7.47	7.62	7.78	7.82
Crude ash, %	7.43	7.41	7.41	7.36	7.65	7.69
Calcium, %	1.18	1.20	1.39	1.31	1.20	1.20
Phosphorus, %	0.70	0.70	0.77	0.79	0.70	0.76

\* Composition (per 2 kg of mixture): 15,000,000 IU vit A, 3,000,000 IU vit D<sub>3</sub>, 15,000 IU vit E, 2.5 g vit K<sub>3</sub>, 1 g vit B<sub>1</sub>, 10 g vit B<sub>2</sub>, 70 g niacin, 20 g calcium-D-pantotenic acid, 4 g vit B<sub>12</sub>, 2 g folic acid, 0.1 g biotin, 125 g BHT.

\*\* Composition (per 2 kg of mixture): 80 g Mn, 25 g Fe, 50 g Zn, 7 g Cu, 0.3 g I, 0.15 g Se, 350 g choline chloride.

Proximate analyses of the diets were carried out using the methods of the AOAC (12) and metabolizable energy values were calculated according to the TSI (15).

Data were statistically analyzed by one way ANOVA in which the significance of mean differences was tested by Duncan's test using SPSS (version 9.0, SPSS Inc., Chicago, IL, USA). General linear model procedures were used to evaluate the effect of sex and group (different concentrations of hazelnut meal) on the meat composition of quails (16). The statistical analysis was performed using SPSS.

## Results

The effects of different levels of dietary hazelnut meal supplementation on the proximate composition and contents of some minerals of quail meat are given in Tables 2 and 3, respectively.

Significant differences in the dry matter content of meat between the control group and the groups fed 15%, 20% and 25% hazelnut meal were detected ( $P < 0.05$ ). However, when analyses of male and female carcass meat were performed separately, there were no significant differences in dry matter content among the

Table 2. The effects of different levels of dietary hazelnut meal supplementation on meat composition.

Carcass composition	Sex	Control group	Treatment groups					SEM
			1	2	3	4	5	
Dry matter (%)	Male	24.44	25.86	25.23	26.01	25.71	24.50	0.21
	Female	24.49	24.89	25.79	25.28	25.28	24.72	0.18
	Mean	24.46c	25.37abc	25.51ab	25.65a	25.49ab	24.61bc	0.14
Protein (%)	Male	19.79	20.00	19.72	20.17	20.06	19.79	0.17
	Female	19.36	19.42	20.28	19.43	19.87	19.96	0.14
	Mean	19.58	19.71	20.00	19.80	19.97	19.87	0.11
Fat (%)	Male	3.52	4.63	4.31	4.61	4.43	3.54	0.16
	Female	3.99	4.30	4.30	4.65	4.23	3.61	0.14
	Mean	3.75bc	4.46ab	4.31ab	4.63a	4.33ab	3.57c	0.11
Ash (%)	Male	1.17	1.23	1.21	1.17	1.22	1.17	0.01
	Female	1.12	1.18	1.21	1.20	1.19	1.15	0.02
	Mean	1.14	1.20	1.21	1.19	1.20	1.16	0.01
Energy (kcal/100 g)	Male	110.83	121.67	117.67	122.15	120.11	111.01	1.76
	Female	113.35	116.38	119.83	119.56	117.57	112.34	1.52
	Mean	112.09	119.02	118.75	120.86	118.84	111.67	1.16
			Statistical analyses (F values)					
			Dry matter	Protein	Fat	Ash	Energy	
Group			2.480*	0.328	2.711*	1.147	1.953	
Sex			0.660	0.768	0.001	0.869	0.102	
Group X Sex			0.824	0.764	0.293	0.371	0.317	

Means within a row followed by the same superscript are not significantly different ( $P > 0.05$ ).

\* $P < 0.05$

SEM: Pooled standard error of mean

Table 3. The effects of different dietary levels of hazelnut meal on the contents of some minerals in meat (mg/kg).

Carcass composition	Sex	Control group	Treatment groups					SEM
			1	2	3	4	5	
Calcium	Male	133.3	150.0	130.0	137.5	149.0	148.3	4.8
	Female	144.8	149.5	148.2	165.2	149.0	148.0	4.7
	Mean	139.1	149.8	139.1	151.3	149.0	148.2	3.4
Phosphorus	Male	1748.3	1825.0	1655.0	1785.0	1721.7	1741.7	21.1
	Female	1743.3	1766.7	1708.3	1805.0	1713.3	1766.7	23.4
	Mean	1745.8	1795.8	1681.7	1795.0	1717.5	1754.2	15.6
Iron	Male	6.6	8.3	7.4	7.0	7.5	7.0	0.2
	Female	7.0	8.0	7.3	8.1	7.7	8.1	0.2
	Mean	6.8	8.1	7.4	7.6	7.6	7.5	0.1
Zinc	Male	10.9	11.5	9.6	11.3	9.8	9.2	0.3
	Female	10.2	8.8	9.6	9.2	10.9	10.0	0.2
	Mean	10.5	10.2	9.6	10.2	10.3	9.6	0.2

  

	Statistical analyses (F values)			
	Calcium	Phosphorus	Iron	Zinc
Group	0.412	1.284	1.457	0.750
Sex	1.804	0.019	1.931	2.341
Group X Sex	0.472	0.236	0.705	2.681*

\*P < 0.05

SEM: Pooled standard error of mean

dietary treatments. The values of protein, ash, energy, calcium, phosphorus, iron and zinc in meat were not influenced by dietary treatment or sex.

**Discussion**

The mean values of meat dry matter of groups fed 15%, 20% and 25% hazelnut meal were significantly higher (P < 0.05) than that of the control group. The mean dry matter contents of quail meat were between 24.46% and 25.65% (Table 2). The present results were similar to those reported by Caron et al. (17) and Marks (18), but lower than those given by some other researchers (6,19-21). These differences could be partially explained by the diet formulation, breed and age of the quails. Similarly, Edwards and Denman (3) reported that breed, sex and diet in combination caused

significant differences in the moisture content of the total carcass. Studies by some researchers (6,22) revealed that the water content of the carcasses decreases as the dietary protein content and the age of the birds increase. However, Marks (18) found little difference between the sexes in the water content of meat.

In this study, the fat content of meat of the group fed 20% hazelnut meal was significantly higher (P < 0.05) than that of the control group. However, fat content of the meat of males and females evaluated separately did not show any significant differences among the groups. Mean fat content of quail meat in the groups ranged from 3.57% to 4.63%. However, similar (23-24), lower (8,18,19,25) and higher (7,17) results were found in the literature. There are several explanations for these differences: firstly, the content of carcasses such as feather, bone, skin, and abdominal fat could change the

level of fat. Secondly, breed, sex and diet formulation could have significant effects on the fat content of the carcass (3). Thirdly, Japanese quail are very active and carcass fat remains very low until the bird reaches maturity, as in this study.

Mean protein content (19.58%-20.00% wet meat) of carcass meat in this study was similar to that reported by Sunder et al. (25) but higher than that given by Marks (18) and lower than those in some other studies (6,19). The protein content of carcass meat was not influenced by dietary treatment or sex in this study. Some researchers (6,22) reported that the water and protein content of the carcass was influenced by diet and age. The ash content and energy level of the carcass meat in this study were not influenced by dietary treatment or sex. The ash content of the meat was similar to those in some

reports (17,25) but lower than those in others (19,21). The differences in protein and ash content of carcass meat between the results in this study and the literature could be due to the omission of bones from meat, the age and breed of quails and diet formulation.

The levels of calcium, phosphorus, iron and zinc in quail meat were not influenced by hazelnut supplementation to the diets or by sex (Table 3). The mean calcium and phosphorus contents of quail meat in this study were similar to those given by Hamm and Ang (5).

In conclusion, quail meat contains high nutritive substances, particularly protein and minerals. The present study indicates that the inclusion of hazelnut meal up to 30% in diets gives a meat composition similar to that of the control diet

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