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EFFECT OF FREE CHOICE FEEDING BASED ON EMMER, TRITICALE AND WHEAT TO JAPANESE QUAIL (*COTURNIX COTURNIX JAPONICA*) ON PERFORMANCE, INNER ORGANS AND INTESTINAL VISCOSITY

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Abstract

When choose feeding applied in poultry breeding birds can adjust their ration and this may be considered in terms of animal welfare and performance and carcass quality improvement. The complete ration costs may be higher than individual feedstuffs. When breeders achieved satisfactory results with choice feeding based on cereals they can obtain economical advantages. This study was conducted to investigate the effects of free choice feeding based on emmer (Triticum dicoccon), triticale (Triticale) and wheat (Triticum sp.) on Japanese quail (Coturnix coturnix japonica) growth performance, inner organ traits and intestinal viscosity. In the experiment, basal diet and ground emmer, triticale and wheat were offered separately in two different feeders. The treatments were: (1) Control (C, basal diet), (2) C and emmer (CE) (3) C and triticale (CT) and (4) C and wheat (CW). A total of 240 three-day-old Japanese quail were randomly distributed to 4 equal groups with 6 replicate and fed for 35 d. Body weight (BW) and feed intake (FI) were determined at 3, 10, 24 and 38 d of age. Carcass and inner organ weights were determined at end of the experiment. Intestinal viscosity was measured. There was no difference among the group in terms of BW at 3 d ($p>0.05$), but on d 10, 24 BW of C group was higher than other groups and BW of wheat group was higher than CE and CT group at 10 d ($p<0.01$). The BW of CE group was higher than C and CW group at 38 d ($p<0.01$). The body weight gain (BWG) in the C group was higher than CE and CT groups at 3 to 10 days but C group's BWG was lower than CE and CW groups at 24 to 38 days ($p<0.01$). The BWG of CE group's was higher than C and CW groups at 3 to 38 d ($p<0.01$). The FI and feed conversion ratio (FCR) of quail were not statistically influenced ($p>0.05$) by the treatments. There was no difference among the groups in terms of mortality. The carcass yield, liver, small intestine, heart and total gastrointestinal tract ratio were not statistically influenced by the free choice feeding based on triticale emmer and wheat ($p>0.05$). However, in the wheat group's gizzard ratio was higher than triticale and emmer groups and in this group abdominal fat pad was higher than other groups ($p<0.01$). Intestinal viscosity of quail was not influenced by choice feeding ($p>0.05$). These results show that ground emmer, triticale and wheat may be given separately together as basal ration and some advantageous in performance may gain with choice feeding based on emmer.

Key words: *carcass, choice feeding, emmer, quail, performance, triticale, viscosity, wheat.*

INTRODUCTION

Choice feeding based on grain has been considered for economic and health reasons in poultry feeding (Forbes and Covasa, 1995; Erener et al., 2006; Amerah and Ravindran, 2008; Gabriel et al., 2008). When whole or ground grains were given to chicks, many handling procedures are eliminated. Acceptable growth rate can be achieved when poultry allowed free access both basal diet and grain cereals such as wheat (Leeson and Caston, 1993) and triticale (Korver et al., 2004; Konca et al., 2012; Özek et al., 2012). Furthermore, beneficial effects of choice feeding method were also observed on digestive system activity and microflora (Engberg et al., 2004). However, different cereal cultivars vary with respect to their nutrient content, which may cause difference in broiler growth rate (Austin et al., 1999).

Triticale is a hybrid of wheat and rye and it has been proposed as an alternative cereal in animal feeding because of its potential combination of wheat feeding characteristics and rye winter hardness and disease resistance (Vieira et al., 1995). Boros (1999) reported that triticale is genetically close to wheat than rye and properties more similar to wheat; therefore it might be successfully replaced instead of wheat in poultry diets. Konca et al. (2012) reported that feeding with triticale in a separate feeder increased BW of turkeys.

Emmer is one of the primitive cereals and they are locally grown by the farmers, called "siyez" "gacer" "gernik" by Turkish producers. Emmer is popular among the local producers for making pasta, pilaw and soup. It is difficult to find emmer in public or global markets. However, its harvest is very difficult due to cover shells (hulls) remained with grain by machine, therefore hulls is separated by hand. In addition to this, there is growing interest by consumers due to organic nutrition and it is assumed that local traditions and ancient foods are close to organic production. In our field observations emmer is suitable for organic production due to original genetic species and may be desirable by the consumers. On the other hand, emmer has high protein and antioxidant capacity compared to durum wheat (Giuliani et al., 2009). Wild emmer has high concentrations of zinc, iron and protein in seeds (Peleg et al., 2008).

Wheat is well known grain used for human and animal nutrition. Wheat mostly used in choice feeding trials and positive results were obtained related to performance and health status (Plavnik et al., 2002; Bennet et al., 2002; Preston et al., 2002; Erener et al., 2003; Gabriel et al., 2003; Amerah and Ravindran, 2008). The aim of the present study was to determine the effects of choice feeding based on ground emmer, triticale and wheat on the performance, carcass yield, inner organs/carcass indices, abdominal fat and intestinal viscosity in Japanese quail. It was hypothesized that in a free choice feeding system based on cereals; they may consume appropriate levels of basal diet, emmer, triticale and wheat and satisfactory growth rate could be achieved. Therefore quail meat might be produced at lower cost compared to a complete basal diet.

MATERIALS AND METHODS

Animal and diets

A total of 240 unsexed quail chicks with three-day-old were individually weighed, wing banded and then ranked for minimal differences and distributed into 4 treatment groups with 6 replicates, 10 chicks each. The each cage was furnished with a heater, two waterier and two feeders. The rearing cage dimensions were 50 × 90 × 20 cm. The replicates were designated as the experimental units, and randomized with respect to the dietary treatments. The treatments were: (1) Control (C, basal diet), (2) C and triticale (CT), (3) C and emmer (CE) and (4) C and wheat (CW). The experimental diets were offered to respective quail for 5 weeks. Maize-soybean based diets were utilized and all formulated on similar level of nutrient composition. The emmer has been obtained from villagers in Develi-Kayseri, and triticale and wheat have been obtained from a commercial company. All experimental diets nutrient compositions were prepared according to NRC (1994) recommendations. The compositions of experimental diets used in this study were given in Table 1.

Measurements

Determination of performance traits

Individual body weight (BW) was measured on days 3, 10, 24 and 38. Body weight gain was calculated for 3 to 10, 10 to 24, 24 to 38 and 3 to 38 days. Daily feed consumption (DFC) was measured on pen bases on the same days. Leftovers of feed were reweighed. Total feed consumption for each period determined and daily feed intake were calculated from this data. In case of mortality, feed intake rates were corrected for number of animals in the pen. Feed conversion ratio was calculated as the ratio DFC:BWG of all birds in each pen.

Determination of carcass, inner organs and viscosity traits

For carcass evaluation 24 birds (12 male and 12 female) in each group were randomly selected at 38 d of age and slaughtered. Their feathers were plucked, and the carcasses were eviscerated by hand. The small intestine, large intestine, and gizzard were removed, the contents were expelled. The carcass, liver, heart, proventriculus, gizzard, empty intestine (duodenum+ileum+ jejunum+cecum+colon), total gastro-intestinal system (proventriculus+gizzard+intestine) and abdominal fat were recorded individually and part yields were obtained as part weight: carcass weight × 100. Cold carcass weight was recorded after the carcasses had been stored at +4°C for 18 h.

The total intestinal content (duodenum and jejunum) was collected for viscosity determination. Several microtubes were filled with each sample, labelled and centrifuged (4300 g, for 10 minutes at room temperature).

The centrifuge tubes with fresh digesta were immediately placed on ice in an isolated box until viscosity measurements were performed within 1 h following slaughter. The supernatant was withdrawn and the viscosity of a 0.5 mL aliquot measured using a Brookfield Digital Viscometer (Model DVII+ PRO, Brookfield Engineering Laboratories, Stoughton, MA) maintained at 40°C.

Statistical analysis

The data were subjected to one-way Anova using General Linear Models in SPSS computer program (SPSS, 1998). The model included hempseed level of diets. The means were separated using Duncan′s multiple range tests. The results of statistical analysis were shown as mean values and standard error of means (SEM) in the tables. Statistical significance was considered at p<0.05.

Table 1. Diet′s feedstuff and nutrient composition

Feedstuffs	Amount, kg/ton
Corn	450.0
Wheat	63.75
Soybean meal	342.99
Sunflower meal	100.0
Sodium chloride	3.37
Limestone	14.07
Vegetable oil	14.99
DL-Methionine	1.24
L-Lysine	0.70
Vitamin-mineral premix[1]	2.00
Dicalcium phosphate	6.89
Total	1000
The calculated values	
Dry matter, %	88.29
Crude protein, %	24.00
Crude cellulose, %	4.92
Metabolisable energy, kcal/kg	2900
Crude fat, %	4.45
Calcium, %	0.80
Available phosphorus, %	0.30
Lysine, %	1.30
Methionine, %	0.50

[1]Vitamin-mineral premix per kilogram of the diet, Vitamin A, 15,000 IU; Vitamin D3, 2000 IU; Vitamin E, 40.0 mg; Vitamin K, 5.0 mg; Vitamin B1 (thiamine), 3.0 mg; Vitamin B2 (riboflavin), 6.0 mg; Vitamin B6, 5.0 mg; Vitamin B12, 0.03 mg; Niacin, 30.0 mg; Biotin, 0.1 mg; Calcium D-pantothenate, 12 mg; Folic acid, 1.0 mg, Choline chloride, 400 mg, Manganese, 80.0 mg; Iron, 35.0 mg; Zinc, 50.0 mg; Copper, 5.0 mg; Iodine, 2.0 mg; Cobalt, 0.4 mg; Selenium, 0.15 mg assures.

RESULTS AND DISCUSSIONS

The BW, BWG, FC and FCR values were given in the Table 2. Day 3 body weights of quail was not significantly differ (p>0.05) but on d 10, 24 BW of C group was higher than other groups and BW of wheat group was higher than CE and CT group at 10 days (p<0.01). However, on d 38 BW of CE group was higher than C and CW group (p<0.01). The BWG in C group was higher than CE and CT groups at 3 to 10 days but C group′s BWG was lower than CE and CW groups at 24 to 38 days (p<0.01). At 3 to 38 days BWG of CE group′s was higher than C and CW groups (p<0.01). Over the 3 to 38 day experimental period, no statistically differences were found the FC and FCR values by the C and choice feeding with triticale, emmer and wheat (p> 0.05). The cereal consumption share for emmer, triticale and wheat groups were; 32.48, 30.69 and 29.04 % respectively. The mortality rate was not influenced by the treatments (p>0.05).

Table 2. Effects of treatments on the body weight (BW), weight gain (BWG), feed consumption (FC) and feed conversion ratio (FCR) in quail

Days	Treatments					
	Control	Emmer	Triticale	Wheat	SEM	P
Body weigh						
3	10.17	9.91	9.97	9.77	0.09	NS
10	36.79[a]	30.14[c]	30.42[c]	32.81[b]	0.81	*
24	117.89[a]	105.48[b]	106.08[b]	106.99[b]	1.77	*
38	157.70[bc]	169.7 [a]	164.8 [ab]	154.9[c]	2.83	*
Body weight gain, g/day						
3 to 10	3.80[a]	2.90[b]	2.92[b]	3.28[ab]	0.11	*
10 to 24	5.81	5.42	5.57	5.35	0.15	NS
24 to 38	2.87[c]	4.54[a]	4.01[ab]	3.58[b]	0.23	*
3 to 38	4.21[bc]	4.57 [a]	4.42[ab]	4.14[c]	0.08	*
Daily feed consumption, g**						
3 to 10	6.56	6.72 (1.88)	5.66 (1.39)	6.18 (1.68)	0.24	NS
10 to 24	14.28	16.06 (4.95)	14.50 (3.86)	14.60 (3.55)	0.69	NS
24 to 38	25.00	23.38 (8.17)	21.16 (7.24)	21.59 (7.02)	0.76	NS
3 to 38	16.99	17.12 (5.62)	15.39 (4.72)	15.71 (4.57)	0.48	NS
Average consumed cereal ratio, %	-	32.48	30.69	29.04	-	-
Feed conversion ratio, g feed/g BWG						
3 to 10	1.72	2.32	1.94	1.88	0.23	NS
10 to 24	2.46	2.97	2.60	2.73	0.10	NS
24 to 38	8.71	5.15	5.28	6.02	0.43	NS
3 to 38	4.03	3.75	3.48	3.79	0.10	NS
Mortality, %						
3 to 38	1.33	3.17	2.00	2.33	0.78	NS

SEM: pooled standard error of the means; P: probability, NS: non significant; [a, b]: Means within a row different alphabet are significant; *(P<0.01). ** Cereal consumptions were given in the parenthesis.

The effect of choice feeding based on cereals on carcass yield and intestinal organ traits and their relative incidence and viscosity were shown in Table 3. The carcass yield was not affected from choice feeding treatment (p>0.05). Similarly, the liver, heart, empty small intestine and total digestive system ratios were not significantly different among the groups (p>0.05). However, the gizzard ratio in the choice feeding group based on wheat was higher than emmer and triticale groups and this group′s abdominal fat ratio significantly higher than other groups (p<0.01). On the other hand intestinal viscosity was not influenced by the choice feeding based on cereals.

Table 3. Effect of hempseed in quail diet on carcass yield and intestinal organ traits and small intestinal viscosity

Traits	Treatments					
	Control	Emmer	Triticale	Wheat	SEM	P
Carcass ratio, %	66.55	65.58	65.64	65.17	1.69	NS
Liver, %	4.81	5.01	4.95	4.84	0.25	NS
Proventriculus, %	0.63	0.70	0.61	0.67	0.128	NS
Gizzard, %	3.04[ab]	2.61[c]	2.90[bc]	3.42[a]	0.14	*
Small intestine, %	2.67	2.89	2.68	3.06	0.11	NS
Heart, %	1.64	1.54	1.52	1.70	2.69	NS
Abdominal fat, %	1.24[b]	1.20[b]	1.23[b]	1.44[a]	0.10	*
Total gastrointestinal system, %	6.13	6.20	6.11	6.98	3.80	NS
Viscosity	2.27	2.06	2.37	2.24	0.13	NS

SEM: pooled standard error of the means; NS: non significant; [a, b]: Means within a row different alphabet are significant; *(P<0.01).

We couldn′t reach research about effect of choice feeding based on cereals in quail. However, in broilers, choice feeding applications based on whole cereals very attractive for animal health and economic reasons (Forbes and Covasa, 1995; Ferket, 2000; Gabriel et al., 2008). However, one week old broiler chicks have some difficulties to eat whole cereals at initial of growth period and whole cereal consumption lower compared to older ages (Özek et al., 2012). Quail chicks have smaller body weight than broilers chicks and they may not able to eat whole cereals. Therefore in this experiment control rations and ground cereals were offered in two separate feeders. Initial of the experiment we observed that quail went to a feeder (control or cereal) and long time consumed only ones. According to our observations they didn't choice appropriate feed type, therefore in the first week quails consumed unbalanced diets and BWG of quail with choice feeding based on emmer, triticale and wheat was lower than control group. However, C group BW in the end of the experiment was lower than choice feeding groups. But FC and FCR of quail did not significantly influenced by the treatments. However, at the end of experiment, cereal consumption ratios in choice feeding groups were about one third of total feed consumption (32.48, 30.69 and 29.04 % for emmer, triticale and wheat, respectively). Therefore, free choice feeding groups quail consumed lower percentage of protein, minerals and vitamins but similar or higher level of energy (the protein and energy content of basal diet: 24%, 2900 kcal ME/kg, and cereals about 12%, 3000 to 3150 kcal ME/kg respectively, according to standard nutrient content of emmer, triticale and wheat).Protein consumption of choice feeding groups was lesser than C group, however, their BW higher than C group at the end of experiment. Compared to cost of complete diet and single cereal, this situation may get advantageous. There is no research on emmer usage in quail or poultry diets and effect on performance traits. However, triticale usage in poultry diets in general had no effect (Rao, et al., 1976; Vieira et al., 1995) or improved (Karaalp et al., 2003) in BW and BWG. Also feed efficiency was better (Ruiz et al., 1987) or not influenced (Vieira et al., 1995) with triticale diets than corn based diets. Most of the choice feeding trials have been performed with whole wheat (Bennett and Classen, 2003; Gabriel et al., 2008), and maize (Erener et al., 2006) but a little triticale (Korver et al., 2004; Konca et al., 2012; Özek et al., 2012) in poultry.

In the present study carcass yield, proventriculus, liver, small intestine, heart and total gastrointestinal system ratio (%) were not affected by choice feeding treatment. Previous researches indicated that choice feeding with cereals didn't influence carcass yield in broilers (Olver and Jonker, 1977; Golian et al., 2008; Özek et al., 2012). On the other hand, Leeson and Caston (1993) reported that choice feeding lowered carcass yield in broilers. Canoğulları et al. (2004) stated that carcass, heart and liver weights were not affected by the ground wheat compared to control group. Also, Özek et al. (2012) reported that choice feeding with triticale didn't affect liver and small intestine ratios but affected proventriculus. However, the gizzard ratio in the CW group was higher than CE and CT groups. Similarly, it is found that free choice feeding with whole or ground wheat (Canoğulları et al., 2004; Amerah and Ravindran (2008) and triticale (Özek et al., 2012) caused increase in gizzard weight and ratio. In the present experiment cereals were ground due to eating difficulty. However, whole wheat stimulated larger gizzard and pancreas in broilers (Svihus et al., 2002). The abdominal fat ratio in the CW group was higher than others. Wheat one of these three cereals, others didn't increase abdominal fat. Erener et al. (2003) expressed that whole wheat feeding increased abdominal fat in broilers. It may be related to their nutrient content. Austin et al. (1999) claimed that different cereal cultivars nutrient content are varying which may cause difference in broiler performance.

Intestinal (ileum+jejunum content) viscosity was not influenced by the feeding style. In this experiment consumed cereals ratio in total about 30 % compared to C group. Cereals contain β-glucans and they may create a viscous environment within the intestinal lumen and decreased nutrient utilization (Choct and Annison, 1992; Smits and Annison, 1996). Özek et al. (2012) noted that duodenal viscosity was not affected by the free choice feeding based on triticale. In contrast to this, J´ozefiak et al. (2007) found that cereals decreased intestinal viscosity in broilers. Konca et al. (2012) reported that triticale and barley (mixed with C diet or separate in two feeders) didn′t affect jejunal viscosity but separate feeding with triticale decreased ileal viscosity in turkeys.

CONCLUSIONS

In conclusion, our results showed that, quail performance and carcass yield, inner organs and intestinal viscosity traits were not negatively influenced by the choice feeding based on emmer, triticale and wheat. However, in the CW group′s gizzard ratio was higher than C, EC and CT groups and this group′s abdominal fat ratio was higher than other groups. Taken together, quail may be fed with triticale, emmer and wheat as choice feeding and could provide economic advantages. However, there is no enough number of experiments about the effects of choice feeding with different cereals. Further experiments are needed to determine the effect of choice feeding with cereals in quails.

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