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Evaluation of Using Distillers Dried Grains with Solubles (DDGS) in Japanese Quail Diets

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Abstract: The effect of feeding distillers dried grains with solubles (DDGS) on Japanese quail chicks performance was studied. An experiment of 42 days was conducted with a flock of 180 unsexed one-day old chicks, distributed at random into 3 groups each in 3 replicates. Treatments were (T1, control no replacing), T2 containing 50% DDGS and T3 containing 100% DDGS). All chicks had free access to feed and water *adlibitum* during the 6-wk experiment. Average daily gain, feed intake and feed conversion efficiency were determined. The results indicated that, chicks fed 50% and 100 % DDGS had higher body weight gain at 42 days, performance index, higher feed intake and better feed conversion ratio compared to the control diet. Feeding diet containing 50% and 100 % DDGS had the highest total plasma protein, globulin concentrations, moreover lower in GOT and GPT than the control diet. No significant effect of DDGS levels on the averages values of carcass characteristics. In conclusion, use of DDGS at 100% recorded the best results compared to the other treatments. The results obtained cleared that DDGS can be successfully fed at level 100% as replacement for yellow corn in Japanese quail diets.

Key words: Japanese quail · DDGS · Growth performance · Blood constituents · Carcass traits

INTRODUCTION

The most critical nutritional components for poultry are protein and energy. The escalated production of ethanol from corn as a bio-fuel in the U.S. increased, leading to the demand for corn in the global market, causing a sharp increase in the corn price. Distillers dried grains with solubles (DDGS) are a co-product obtained from the dry- milling process for ethanol production, using fermentation with yeast (*Saccharomycen cerevisiae*) [1]. Production of ethanol from 100 kg of corn using the dry-milling method produces approximately 34.4 kg of ethanol, 34.0 kg of carbon dioxide and 31.6 kg of DDGS [2]. Also, there were three types of residual co-products produced from grains. These include Distillers Dried Grains (DDG), Distillers Dried Solubles (DDS) and Distillers Dried Grains with Solubles (DDGS).Wang *et al.* [3] described that among the three co-products the (DDS) fraction is the richest source of vitamins, the lowest in fiber and the highest in fat, yielding approximately 91% digestible energy (DE) value of the corn. The DDGS as a common commercially available product is a blend of DDS and DDG with the intermediate nutrient composition. Now, the new generation of DDGS from modern ethanol plants was an acceptable feed ingredient for broiler diets with different recommended percentages in all grower periods. The differences in dried distillers grains with solubles may be associated with the processing methods, type of ethanol plant design (old vs. new generation) and storage capacity [4]. Variations in nutrient contents of DDGS may create difficulty in feeding poultry and least cost formulation [5]. In order to understand the possible impact of new processing technologies used to produce DDGS it is important to review the nutrient consistency and other characteristics of DDGS. In previous studies on broilers, it was shown that using DDGS in broiler diets at levels of 5, 10 up to 15% could decrease feed cost by replacing a part of corn and soybean meal without any negative effect on growth performance [6]. Also, Oryschak *et al.* [7] found that there was no adverse affect of including corn or wheat DDGS up to 10% of the diet on broiler performance. Wang *et al.* [3,8,9] reported that the good quality DDGScan be used in starter and grower broiler diets at levels of 15-20% with even higher of 30% in the finisher diet with little or no adverse effect on live broiler performance.

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The objective of this study is to evaluate the effect of replacing distillers dried grains with solubles (DDGS) for corn at level 100% on Japanese quail broiler performance, carcass traits, some blood parameters and economical efficiency of quail chicks from 1-42 days of age.

MATERIALS AND METHODS

The present study was carried out at private poultry farm located at Kafr El-Shikh, Kafr El-Shikh Governorate, Egypt, in order to investigate the influence of replacing distillers dried grains with solubles (DDGS) for yellow corn at level 50% and 100% on Japanese quail chicks performance, carcass traits, some blood parameters and economical efficiency of quail chicks. One hundred and eighty, unsexed one-day old Japanese quail chicks with an average weight of 9.8 g were randomly divided into three dietary treatment groups, of 60 birds each. Each group was subdivided into 3 replicates pens of 20 birds each. Birds were reared in pens with litter (rice straw) from 1 day to 42 days of age under similar managerial and hygienic condition. Feed and water were provided *adlibitum* through the experimental period. Artificial light was used to provide 24 hours/ day photo period. First group was used as a control (T1) and fed the starter and finisher basal diet, the second group (T2) was fed distillers dried grains with solubles (DDGS) at 50% and the third group (T3) was fed distillers dried grains with solubles (DDGS) at 100% (Table 1). The chemical composition of distillers dried grains with solubles (DDGS) is presented in Table 2. All diets were formulated to meet the nutrient requirements of the chicks. Feed consumption and body weight of the birds were recorded weekly. Body weight gain, feed conversion and economical efficiency were calculated. Performance index (PI) was calculated according to North [10] as follow:

PI= live body weight (kg) x 100/feed conversion.

At the end of 6 weeks of age, 10 birds were randomly taken from each treatment, fasted overnight, weight and slaughtered to complete bleeding, followed by plucking the feathers. Dressing, giblets (liver, heart and gizzard) were expressed relative to live body weight. Blood samples were taken at slaughter time from each bird into Hibernicized tubes and plasma was separated by centrifugation at 3500 rpm for 15 min and frozen at - 20°C for the determination of total protein, glucose, creatinine, (GOT) glutomic oxalo acetic trans aminase and (GPT) glutamic pyruvic transaminase. The proximate analysis of feed was determined according to the methods of A.O.A.C. [11]. The economical efficiency was calculated from the input-output analysis [12], assuming that other head costs were constants, as follows: [(price of kg weight gain-feed cost/kg gain)/feed cost/kg gain x100] under local conditions.

Table 1: Composition and calculated analysis of the experimental diets fed during (1-42) days of age.

	Starter diets		
Ingredients	Control	50 %DDGS	100 % DDGS
Yellow corn	50	30.5	-
Soybean meal (44%)	38.5	30	5
DDGS	-	25	79
Ca carbonate	1.50	1.50	1.50
Sodium chloride	1.30	1.30	1.30
Vit and mineral premix[1]	1.30	1.30	1.30
Di Ca phosphate	1.70	1.70	1.70
Cotton seed oil	4.00	7.00	8.50
Dl-methionine[2]	1.20	1.20	1.20
Lysine	0.50	0.50	0.50
Total	100	100	100
Calculated analysis[2]			
Crude protein %	21.2	22.2	22.7
ME (kcal/kg)	2867	2904	2811
Phosphorus, %	0.24	0.31	0.32
Methionine	0.42	0.41	0.41

[1]Vitamin and mineral premix. Each 3 kg of vitamin and minerals mixture contain: Vit A 10.000.000 IU. Vit. D3 2,000,000 IU. Vit E 10,000 mg. vit k 1.000 mg vit B1 1.000 mg, vit B2 5,000 mg, vit B6 1,500 mg, Vit B12 10 MG. Niacin 20.000 mg. Pantothenic acid 10.000 mg. Folic acid 1.000 mg. Biotin 50 mg. Choline chloride 500.000 mg. Copper 4.000 mg. Iodine 300 mg. iron 30.000 mg. Manganese 60.000 mg. Cobalt 100 mg. and Selenium 100 mg. [2]Calcaulated according to NRC [18].

Table 2: The chemical composition of the distillers dried grains with solubles (DDGS)

Composition	%
Dry matter	92.2
ME (Kcal/Kg)	2480
Crude protein	26
Crude fiber	7.30
Crude fat	17.70
Ca	0.06
P	0.39

Statistical Analyses: The data obtained were statistically analyzed by the completely randomized design using the general linear models (GLM0 procedure of statistical analysis system [13] and the differences among means were determined using Duncan's Multiple Rang test [14]. Percentages were transformed to the corresponding arcsine values before statistical analysis.

The model applied was:

Yij = u+ ai + Eij, where:
Yij = An observation, u= overall mean.
Ai = Effect of treatment (i = 1, 2, 3) and
Eij = Experimental random error.

RESULTS AND DISCUSSION

Growth Performance: Table 3 presents the mean ± SE of body weight, body weight gain, feed intake, feed conversion ratio and performance index of Japanese quail chicks fed distillers dried grains with solubles (DDGS) at level 100% at 21 days of age. Results showed that quail fed DDGS had the highest ($P \leq 0.05$) body weight gain, performance index and significantly the lowest ($P \leq 0.05$) feed conversion compared to the control treatment. This is may be related to increasing feed intake, that confirmed with Ghazalah *et al.* [15]. Sherief *et al.* [16] showed that no significant differences with respect to feed intake and feed conversion at the first (1-22d) and second (22-35d) growing periods.

Blood Constituents: Results of blood constituents as affected by replacing DDGS for yellow corn at level 50% and 100% are summarized in Table 5. It is clear that feeding diet containing 50% and 100 % DDGS had the highest total plasma protein, globulin concentrations, moreover lower in GOT and GPT than the control diet.

Carcass Characteristics: Carcass characteristics relative to the pre-slaughter weight of quail as affected by dietary substituting yellow corn by DDGS are summarized in Table 6. Results showed that there were a numerically differences ($P \leq 0.05$) due to DDGS level. These results are in agreement with those reported by Lumpkins *et al.* [17] who observed that feeding broiler chicks on diets containing 0,6,12 or 18% DDGS had no effect on carcass yield. Furthermore, Wang *et al.* [3, 8] found that there were no effects on carcass quality when they fed broilers on diets containing DDGS up to 15%.

Economical Efficiency: One of the main objectives of the present study was to investigate the optimal DDGS levels to get the best economical efficiency for quail. The economical efficiency of the experimental groups in Table 7 shows that the highest economical and relative economical efficiency values were obtained with the diet (T3) fed distillers dried grains with solubles (DDGS) at 100%. This result is in agreement with those obtained by Choi *et al.* [6] who found that the cost of feed decreased as the levels of DDGS increased in broiler diets without adverse effects on the performance.

Table 3: Effect of substitution yellow corn by DDGS on growth performance at 21 days of age.

	Dietary treatments			
Item	0 % DDGS (control)	50% DDGS	100 %DDGS	Sig.
Initial body weight,(g)	9.55 ± 0.11	9.30 ± 0.13	9.50 ± 0.13	NS
Final body weight,(g)	99.8 ± 0.55^{b}	103.7 ± 0.21^{a}	105.7 ± 0.41^{a}	*
Body weight gain,(g)	90.25 ± 0.58^{b}	95.2 ± 0.28^{a}	96.2 ± 0.48^{a}	*
Feed intake, (g/bird)	216 ± 0.98^{c}	235 ±0.99^{b}	248 ± 0.99^{a}	*
Feed conversion, (g feed/g gain)	2.39± 0.74^{b}	2.46 ± 0.10^{a}	2.57 ± 0.12^{a}	*
Performance index[1] %	4.17 ± 0.02	4.21 ± 0.05	4.11 ± 0.03	NS

Means within the same row with different superscripts are significantly different ($P \leq 0.05$).
Performance index[1] % = (live body weight, g x 100)/feed conversion.

Table 4: Effect of substitution yellow corn by DDGS on growth performance at 42 days of age.

	Dietary treatments			
Item	0 % DDGS(control)	50% DDGS	100 % DDGS	Sig.
Initial body weight,(g)	9.55 ± 0.11	9.30 ± 0.13	9.50 ± 0.13	NS
Final body weight,(g)	190 ± 0.32^{ab}	205.91 ± 0.15^{a}	212.61 ± 0.25^{a}	*
Body weight gain,(g)	180.45 ± 0.12^{ab}	196.61± 0.02^{ab}	203.11± 0.02^{a}	*
Feed intake,(g/bird)	750 ± 0.31	760 ± 0.11	780 ± 0.13	NS
Feed conversion,(g feed/g gain)	4.15 ± 0.01	3.86 ± 0.06	3.84 ± 0.05	NS
Performance index[1] %	4.57 ±0.12^{b}	5.33± 0.33^{a}	5.53± 0.22^{a}	*

Means within the same row with different superscripts are significantly different ($P \leq 0.05$).
Performance index[1] % = (live body weight, g x 100)/feed conversion.

Table 5: Effect of substitution yellow corn by DDGS on some blood plasma constituents.

Item	0 % DDGS (control)	50% DDGS	100% DDGS	Sig.
Total protein, (g/dl)	3.01 ± 0.02	3.85 ± 0.02	4 ± 0.10	NS
Globulin, (g/dl)	1.63 ± 0.02[b]	1.93 ± 0.01[b]	2.6 ± 0.02[a]	*
Creatinine, (mg/dl)	1.33 ± 0.01	0.90 ± 0.03	1.1 ± 0.01	NS
Glucose, (mg/ dl)	207 ± 0.03	190 ± 2.08	200 ± 0.01	NS
Got	19 ± 0.11[a]	7 ± 0.01[b]	10 ± 0.02[b]	*
GPT	9 ± 0.33[a]	5 ± 0.01[b]	6 ± 0.01[b]	*

Means within the same row with different superscripts are significantly different (P≤0.05).

Table 6: Effect of substitution yellow corn by DDGS on carcass and organ's percentage of Japanese quail

Items	0 % DDGS (control)	50% DDGS	100% DDGS	Sig.
Pre-slaughter weight,(g)	182.2 ± 0.51[b]	200 ± 0.31[a]	205.5 ± 0.45[a]	*
Dressing weight,(g)	158 ± 0.62[b]	170 ± 0.22[a]	180.4 ± 0.42[a]	*
Dressing, %	86.7 ± 0.33	85 ± 0.21	87.7 ± 0.32	NS
Liver,%	2.8 ± 0.01	2.5 ± 0.03	2.5 ± 0.02	NS
Heart,%	0.65 ± 0.05[b]	0.80 ±0.01[a]	0.92 ± 0.01[a]	*
Gizzard,%	2.79 ± 0.01	2.75 ±0.02	3.06 ± 0.02	NS

Means within the same row with different superscripts are significantly different (P≤0.05).

Table 7: The economical efficiency of the experimental diets.

Item	Control	50% DDGS	100% DDGS
Price of kg feed (L.E.)*	3.80	3.70	3.10
Feed conversion,(g feed/g gain)	4.15	3.86	3.84
Feed cost of kg weight gain, (L.E.)	15.75	14.28	11.90
Market price of 1 kg live weight, L.E.)	20	20	20
Net revenue, (L.E.)[1]	4.23	5.72	8.10
Economical efficiency, (%)[2]	26.8	40.1	68

Net revenue= revenue from gain – feed cost. Economical efficiency = (net revenue / feed cost)*100.

Price of Kg live body weight was 20 L.E. *According to local market price at 2013

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