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Effect of choline chloride supplement and canola oil on the performance and feed efficiency in the Japanese Quail

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ABSTRACT

This experiment was carried out to evaluation usage different levels of Canola Oil (CO) (0, 2 and 4%) and Choline Chloride Supplement (CCS) (0, 500 and 1000 mg/kg) in the basal diets (corn and soybean meal) and their effect on the Japanese quails performance. This trial was conducted in 3 × 3 factorial experiment with Completely Randomized Design (CRD) with 270 male quail. All diets were isoenergetic and isonitrogenous and balanced with NRC recommendation. Result shown that interaction effects of CO and CCS could affect Live Body Weight (LBW), Feed Intake (FI) and Feed Conversion Ratio (FCR). In quails, CO and CCS in 9 and 6 treatment (T9 = 4% CO + 1000 mg/kg CCS and T6 = 2% CO + 1000 mg/kg CCS) could significantly increase the LBW, respectively (p<0.0001) and CO and CCS in 6, 9 and 8 treatment (T6 = 2% CO + 1000 mg/kg CCS, T9 = 4% CO + 1000 mg/kg CCS and T8 = 4% CO + 500 mg/kg CCS) could significantly increase the feed intake (p<0.0001).

Key words: Japanese quail, Canola oil, Choline Chloride Supplement, live body weight, feed intake, and feed conversion ratio.

INTRODUCTION

During the past 20 years, canola has passed peanut, sunflower and most recently, cottonseed in worldwide production. In 2000-2001, world production of rapeseed/canola totaled 33.86 million tons (t) or 13% of oilseed production (ERS, 2001). Determining the level of energy of a diet is probably the most important decision to be made in formulating diets for poultry. Energy alone contributes to about 70% of the total cost of poultry diets (ERS, 2001); thus, choosing the proper level of energy that will optimize growth, carcass quality and feed efficiency, while still allowing for profitable production is a major concern to any integrator. Current commercial hybrids with high performance require high energy diets which would enable the maximum explosion of those genetic potential. The number 3 refers to the place on the molecule where the first unsaturated double bond is found. Canola oil provides varying quantities of the essential nutrient good fatty acids. Canola oil is an excellent source of good fats. It is very high in monounsaturated fat, contains intermediate amounts of the precursor omega-6 and omega-3 polyunsaturated fatty acids Linoleic Acid (LA) and Alpha-Linolenic Acid (ALA), respectively and is very low in saturated fat. Canola oil as a good contains significant amounts of vitamin E and phitosterols. Canola oil contains both an appreciable amount o ALA as well as an optimal balance of omega-6 to omega-3 Essential Fatty Acids (EFAs). Besides supplying energy, the addition of fat to animal diets improves the absorption of fat-soluble vitamins, increase diet palatability and the efficiency of utilization of the consumed energy.

Choline is an essential nutrient for the poultry. One of its functions is to furnish methyl groups (Pesti *et al*., 1980; Lowry *et al*., 1987; Pesti, 1989). Choline has three chemically reactive methyl groups attached to the nitrogen atom of the glycine molecule. Therefore, it can be used as a methyl group donor partially to replace methionine in poultry and pig (Scharma and Gerrits, 2000). In poultry, choline's methyl group is available after the conversion to betaine in the liver. Resent work suggests that betaine and choline has an energy sparing role by reducing maintenance requirement poultry and pig (Scharma and Gerrits, 2000). The aims of this study are the measured the performance and feed efficiency in the Japanese quail with consumption of dissimilar canola oil and choline chloride in diet. The results obtained from the experiment were analyzed by analyses of variance using the General Linear Model (GLM) procedure of SAS and means were compared by Duncan's Multiple Range Test (SAS Institute, 2000).

Table 1: percentage composition of experiment diet in starter period

Ingredient	(%)
Corn	53.5
Soybean	34
Canola oil	0.5
Starch	8
Wheat bran	0
DL-Methionine	0.54
Lysine	0
Choline (60%)	0
DCP	1.38
Oyster	1.33
Vitamin	0.25
Mineral	0.25
Salt	0.25
Coccidiostat	0
Sand	0
	100
Calculated nutrient content	
ME kcal/kg	2919.594
Crude protein (%)	20.901
Calcium (%)	0.942
Available P (%)	0.434
ME/CP	139.658
Ca/P	2.169

MATERIALS AND METHODS

Animals and diets: A total of 270 one-day old Japanese quail chicks were placed in 27 pens of 1×1 m with ten birds per each pen. Feed and water were provided *ad libitum*. The experiment arrangement consisted of 3×3 factorial design (3 fat levels and 3 choline chloride level) with 3 replicate per each treatment.

Canola oil was used at 0, 2 and 4% in diets and choline chloride was used at 0, 500 and 1000 mg/kg in diet. Crude protein levels and metabolisable energy were NRC (1994) recommendation and few lower than recommendation as NRC recommendation. Vitamin content of diets provided per kilogram of diet: vitamin A, D, E and K. Composition of mineral premix provided as follows per kilogram of premix: Mn, 120,000 mg; Zn, 80,000 mg; Fe, 90,000 mg; Cu, 15,000 mg; I, 1,600 mg; Se, 500 mg; Co, 600 mg. Metabolisable energy of canola oil was 7450 kcal/kg that used for diet formulation. These diets (Table 1-3) were formulated to meet nutrient requirements according to NRC (1994). Diets were containing the same levels of methionine, lysine, vitamins and minerals. The treatment diets of were isoenergetic and isonitrogenous:

T1 = Control (Soybean + Corn)
T2 = 0% CO + 500 mg/kg CCS
T3 = 0% CO + 1000 mg/kg CCS
T4 = 2% CO + 0 mg/kg CCS
T5 = 2% CO + 500 mg/kg CCS
T6 = 2% CO + 1000 mg/kg CCS
T7 = 4% CO + 0 mg/kg CCS
T8 = 4% CO + 500 mg/kg CCS
T9 = 4% CO + 1000 mg/kg CCS

The quails were weighted at the start of the experiment, live weight and total feed intake were recorded and feed conversion ratio was calculated at 12, 21 and 42 days of the experiment. Mortality was also recorded for each treatment.

Statistical analyses: Data were analyzed in complete randomized design using the GLM procedure of SAS version 12 (SAS Inst. Inc. NC).

$$Y_{ijk} = \mu + \alpha_i + b_j + (a \times b)_{ij} + \varepsilon_{ijk}$$

Where,

Y_{ijk} = All dependent variable
μ = Overall mean
α_i = The fixes effect of CO levels (i = 1, 2, 3)
b_j = The fixed effect of CCS levels (j = 1, 2, 3)
ε_{ij} = The random effect of residual

Table 2: percentage composition of experimental

Ingredient	T1	T2	T3	T4	T5	T6	T7	T8	T9
Corn	64	64	64	60	60	60	55	55	55
Soybean	27.4	27.4	27.4	28	28	28	27.1	27.1	27.1
CO	0	0	0	2	2	2	4	4	4
Starch	3.74	3.74	3.74	2.06	2.06	2.06	1.22	1.22	1.22
Wheat bran	1	1	1	2	2	2	5.5	5.5	5.5
Methionine	0	0	0	0	0	0	0	0	0
Lysine	0	0	0	0	0	0	0	0	0
CCS (60%)	0	0.000084	0.000168	0	0.000084	0.000168	0	0.000084	0.000168
DCP	0.89	0.89	0.89	0.92	0.92	0.92	0.89	0.89	0.89
Oyster	1.5	1.5	1.5	1.48	1.48	1.48	1.46	1.46	1.46
Vitamin	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Mineral	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Coccidiostat	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Sand	0.33	0.33	0.33	2.42	2.42	2.42	3.66	3.66	3.66
	100	100	100	100	100	100	100	100	100
Calculated nutrient content									
ME kcal/kg	2920.238	2920.238	2920.238	2920.242	2920.242	2920.242	2919.984	2919.984	2919.984
CP	18.236	18.236	18.236	18.160	18.160	18.160	18.170	18.170	18.170
Calcium	0.903	0.903	0.903	0.898	0.898	0.898	0.899	0.899	0.899
Available P	0.351	0.351	0.351	0.350	0.350	0.350	0.358	0.358	0.358
ME/CP	160.136	160.136	160.136	160.806	160.806	160.806	160.708	160.708	160.708
Ca/P	2.574	2.574	2.574	2.565	2.565	2.565	2.515	2.515	2.515

Vitamin content of diets provided per kilogram of diet: vitamin A, D, E and K. Composition of mineral premix provided as follows per kilogram of premix: Mn, 120,000 mg; Zn, 80,000 mg; Fe, 90,000 mg; Cu, 15,000 mg; I, 1,600 mg; Se, 500 mg; Co, 600 mg.

Table 2: percentage composition of experimental

Ingredient	T1	T2	T3	T4	T5	T6	T7	T8	T9
Corn	66.5	66.5	66.5	57.5	57.5	57.5	56	56	56
Soybean	24.1	24.1	24.1	25.58	25.58	25.58	24	24	24
CO	0	0	0	2	2	2	4	4	4
Starch	3.81	3.81	3.81	4.34	4.34	4.34	1.94	1.94	1.294
Wheat bran	0	0	0	5	5	5	6	6	6
Methionine	0.44	0.44	0.44	0.45	0.45	0.45	0.45	0.45	0.45
Lysine	0.043	0.043	0.043	0.015	0.015	0.015	0.08	0.08	0.08
CCS (60%)	0	0.000084	0.000168	0	0.000084	0.000168	0	0.000084	0.000168
DCP	0.89	0.89	0.89	0.92	0.92	0.92	0.89	0.89	0.89
Oyster	1.38	1.38	1.38	1.36	1.36	1.36	1.31	1.31	1.31
Vitamin	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Mineral	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Coccidiostat	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Sand	1.937	1.937	1.937	1.665	1.665	1.665	4.43	4.43	4.43
	100	100	100	100	100	100	100	100	100
Calculated nutrient content									
ME kcal/kg	2920	2920	2920	2920	2920	2920	2920	2920	2920
CP	16.5	16.5	16.5	16.4	16.4	16.4	16.5	16.5	16.5
Calcium	0.79	0.79	0.79	0.79	0.79	0.79	0.74	0.74	0.74
Available P	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
ME/CP	176.8	176.8	176.8	177.4	177.4	177.4	176.6	176.6	176.6
Ca/P	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6

Vitamin content of diets provided per kilogram of diet: vitamin A, D, E and K. Composition of mineral premix provided as follows per kilogram of premix: Mn, 120,000 mg; Zn, 80,000 mg; Fe, 90,000 mg; Cu, 15,000 mg; I, 1,600 mg; Se, 500 mg; Co, 600 mg.

The 3 oil levels (0, 2 and 4% canola oil) and three choline chloride supplement levels (0, 500 and 1000 mg/kg) were analyzed as a 3×3 factorial. When interaction means were separated using Duncan multiple range test to compare different treatment means.

RESULTS AND DISCUSSION

Body weight: Results for live body weight in 12-21 day old is showing in Table 4. Results shown that interaction effects of canola oil and choline chloride supplement could affected Live Body Weight (LBW). In 12-21 day old canola oil and choline chloride in 9 and 6 treatment (T9 = 4% canola oil + 1000 mg/kg choline chloride supplement and T6 = 2% canola oil + 1000 mg/kg choline chloride supplement) could significantly increase the live body weight respectively ($p<0.0001$). Result for body weight in 21-42 day old is showing that in Table 5. In 21-42 day old canola oil and choline chloride supplement in 9, 6 and 5 treatment (T9 = 4% canola oil + 1000 mg/kg choline chloride supplement and T6 = 2% canola oil + 1000 mg/kg choline chloride supplement and T5 = 2% canola oil + 500 mg/kg choline chloride supplement) could significantly increase the live body weight respectively ($p<0.0001$). This finding it has according with finding of Fouladi *et al.* (2008) on the broiler chicks. Roth Maier *et al*. (1988) indicate that use 5, 10, 15, 20 and 25% of full-fat canola seed in the broiler ration has the negative effect on the chickens growth so that, body weight in experimental groups in comparison with control diet. This issue does not support some results of researchers. In one research feeding 1000 mg/kg of choline from 42 day was a significant effect on body weight (Waldroup and Fritts, 2005), but in the other study there were no significant differences on the weight gain among the groups of the different levels of choline (Harms and Russell, 2002). The addition of canola oil to animal diets improves the absorption of fat-soluble vitamins, increase diet palatability and the efficiency of utilization of the consumed energy (Baiao and Lara, 2005). Ours findings about the Japanese quail corresponding with these results. This results about the Japanese quail is interesting because it has seemed the usage of the choline chloride supplement and canola oil in the quail diets; it has increase the live body weigh in Japanese quail and in the other hands this subject has not research in the other researchers study.

Feed intake: Results for feed intake in the 12-21 day old is showing that in Table 4. Canola oil and choline chloride supplement in 9, 6 and 8 treatment (T9 = 4% canola oil + 1000 mg/kg choline chloride supplement and T6 = 2% canola oil + 1000 mg/kg choline chloride supplement and 4% canola oil + 500 mg/kg choline chloride supplement) could significantly increase the feed intake respectively ($p<0.0001$). Result for feed intake in 21-42 day old is showing that in Table 5. Canola oil and choline chloride supplement in 6, 9, 8, 7 and 3 treatment (T6 = 2% canola oil + 1000 mg/kg choline chloride supplement, T9 = 4% canola oil + 1000 mg/kg choline chloride supplement, T8 = 4% canola oil + 500 mg/kg choline chloride supplement, T7 = 4% canola oil + without choline chloride supplement and T3 = without canola oil + 1000 mg/kg choline chloride supplement) could significantly increase the feed intake respectively ($p<0.0001$). It has seemed gastronome of canola oil in diet will cause increase of food consumption among the different groups diets (Baiao and Lara, 2005; Talebali and Farzinpour, 2005). In other research feeding 1000 mg/kg of choline chloride was a significant effect on body weight (Waldroup and Fritts, 2005), but in the one study there were no significant differences on the feed consumption among the groups of the different levels of choline (Harms and Russell, 2002). Harms *et al*. (1990) reported that hens would respond to choline supplementation of cornsoy bean meal diet. Ours findings about the Japanese quail corresponding with these results. This result on the Japanese quail is interesting because it has seemed the usage of the CCS and CO it has increase the feed intake in Japanese quail and in the other hands this subject has not research in the other researchers study.

Table 4: Least square means for performance parameters in 12-21 day old

	Treatment										
	1	2	3	4	5	6	7	8	9	SEM	P>F
LBW	101de	80f	190cd	91e	174cde	278b	182cd	201c	280a	12.34	<0.0001
FI	157d	131e	256cd	140de	238d	342b	249cd	273c	350a	37.23	<0.0001
FCR	1.56b	1.64a	1.35c	1.53b	1.37c	1.23d	1.37c	1.36c	1.25d	0.010	<0.0001

LBW= Live Body Weight, FI= Feed Intake, FCR= Feed conversion ratio

Table 5: Least square means for performance parameters in 21-42 day old

	Treatment										
	1	2	3	4	5	6	7	8	9	SEM	P>F
LBW	367de	367de	379cd	364e	388c	427b	379cd	423bc	497a	14.22	<0.0001
FI	785def	775ef	801d	753f	792de	837a	799d	821c	831b	39.66	<0.0001
FCR	2.14a	2.11ab	2.11ab	2.07ab	2.04bc	1.96cd	2.11ab	1.94cd	1.87e	0.006	<0.0001

LBW= Live Body Weight, FI= Feed Intake, FCR= Feed conversion ratio

Feed conversion ratio: Results for feed conversion ratio in the 12-21 day old is showing that in Table 4. In 9 and 6 treatment (T9 = 4% canola oil + 1000 mg/kg choline chloride supplement and T6 = 2% canola oil + 1000 mg/kg choline chloride supplement) treatment could significantly decrease the feed conversion ratio respectively ($p<0.0001$). Result for feed conversion ratio in 21-42 day old is showing that in Table 5. Canola oil and choline chloride supplement in 9, 8 and 6 treatment (T9 = 4% canola oil + 1000 mg/kg choline chloride supplement, T8 = 4% canola oil + 500 mg/kg choline chloride supplement and T6 = 2% canola oil + 1000 mg/kg choline chloride supplement) could significantly decrease the feed conversion ratio respectively ($p<0.0001$). From 12-21 days the best feed conversion ratio has been belonged to the groups the fed 9, 6, 3 and 8 treatments, respectively, and from 21-42 days, the best feed conversion ratio has been belonged to the groups that fed 9, 8, 6 and 5 treatments, respectively. These results are agreement Dora-Roth Maier *et al*. (1988). These finding it have according with finding of Fouladi *et al.* (2008) on the broiler chicks. Ours findings about the Japanese quail corresponding with these results. This result on the Japanese quail is interesting because it has seemed the usage of the choline chloride supplementation and canola oil it has increase the feed intake in Japanese quail and in the other hands this subject has not research in the other researchers study.

CONCLUSION

Canola oil and choline chloride supplement in the interaction effects, it has increase the live body weight and feed intake and decrease the feed conversion ratio in each two periods (grower and finisher). Choline chloride supplement in 1000 mg/kg and canola oil in the 4% it has highest effect on the live body weight, feed intake and feed conversion ratio.

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