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Effect of Choline Chloride Supplement and Canola Oil on the Performance and Feed Efficiency in the Broiler Chickens

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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^{-1}) in the basal diet (corn and soybean meal) and their effects on the broiler chick's performance. This trial was conducted in 3 × 3 factorial experiment with Completely Randomized Design (CRD) with 270 male chicks (Ross 308). All diets were isoenergetic and isonitrogenous and balanced with NRC recommendation. Result shown that interaction effects of canola oil and choline chloride supplement could affected Live Body Weight (LBW), Feed Intake (FI) and Feed Conversion Ratio (FCR). In 22-42 day old canola oil and choline chloride supplement in 9 and 6 treatment (T9 = 4% canola oil + 1000 mg kg^{-1} choline chloride supplement and T6 = 2% canola oil + 1000 mg kg^{-1} choline chloride supplement) could significantly increase the live body weight, respectively ($p<0.0001$) and canola oil and choline chloride supplement in 8, 7 and 6 treatment (T8 = 4% canola oil + 500 mg kg^{-1} choline chloride supplement, T7 = 4% canola oil + without choline chloride supplement and T6 = 2% canola oil + 1000 mg kg^{-1} choline chloride supplement) could significantly increase the feed intake respectively ($p<0.0001$) and in 9 and 8 treatment (T9 = 4% canola oil + 1000 mg kg^{-1} choline chloride supplement and T8 = 4% canola oil + 500 mg kg^{-1} choline chloride supplement) could significantly decrease the feed conversion ratio respectively ($p<0.0001$). In 43-56 day old canola oil and choline chloride supplement in 6 and 4 treatment (T6 = 2% canola oil + 1000 mg kg^{-1} choline chloride supplement and T4 = 2% canola oil + without choline chloride supplement) could significantly increase the live body weight ($p<0.0001$) and canola oil and choline chloride supplement in 1, 2, 4 and 7 treatment (T1 = basal diet, T2 = without canola oil + 500 mg kg^{-1} choline chloride supplement, T4 = 2% canola oil + without choline chloride supplement and T7 = 4% canola oil + without choline chloride supplement) could significantly increase the feed intake respectively ($p<0.0001$) and in 9 and 8 treatment (T9 = 4% canola oil + 1000 mg kg^{-1} choline chloride supplement and T8 = 4% canola oil + 500 mg kg^{-1} choline chloride supplement) could significantly decrease the feed conversion ratio respectively ($p<0.0001$). No mortality was in all over period.

Key words: Broiler chicks, canola oil, choline chloride, 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 Tones (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 exploitation 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 phytosterols. Canola oil contains both an appreciable amount of 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

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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 chicken. 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 (Schrama and Gerrits, 2000). In poultry, choline's methyl group is available after the conversion to betaine in the liver. Recent work suggests that betaine and choline has an energy sparing role by reducing maintenance requirement poultry and pig (Schrama and Gerrits, 2000). The aims of this study are the measured the performance and feed efficiency in the broiler chickens 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).

MATERIALS AND METHODS

Animals and diets: A total of 270, one-day old broiler chicks of a commercial strain (Ross-308) from mail sex were placed in 27 pens of 1.65 × 0.671 m with ten birds per each pen. Feed and water were provided ad libitum. The experiment arrangement consisted of a 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^{-1} 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, 80,000mg; 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^{-1} that used for diet formulation. This diet (Table 1-3) were formulated to meet nutrient requirements according to NRC (1994). Diets were containing the same level of methionine, lysine, vitamins and minerals. The treatment diets of were isoenergetic and isonitrogenous:

T1 = Control (Soybean + Corn)
T2 = 0% CO + 500 mg kg^{-1} CCS
T3 = 0% CO + 1000 mg kg^{-1} CCS
T4 = 2% CO + 0 mg kg^{-1} CCS

Table 1: percentage composition of experiment diet in starter period

Ingredients	(%)
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^{-1}	2919.594
Crude protein (%)	20.901
Calcium (%)	0.942
Available P (%)	0.434
ME/CP	139.658
Ca/P	2.169

T5 = 2% CO + 500 mg kg^{-1} CCS
T6 = 2% CO + 1000 mg kg^{-1} CCS
T7 = 4% CO + 0 mg kg^{-1} CCS
T8 = 4% CO + 500 mg kg^{-1} CCS
T9 = 4% CO + 1000 mg kg^{-1} CCS

The chickens were weighed at the start of the experiment and during the experiment, live weight and total feed consumption per pen were recorded and feed conversion ratio was calculated at 21, 42 and 56 days of the experiment. Mortality was also recorded for each treatment.

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

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

Where,

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

The 3 oil levels (0, 2 and 4% canola oil) and three choline chloride supplement levels (0.500 and 1000 mg kg^{-1}) were analyzed as a 3×3 factorial. When interactions occurred ($p<0.05$), interaction means were separated using Duncan multiple range test to compare different treatment means.

Table 2: Percentage composition of experimental diet in grower period

	Experimental diets (%)								
Ingredients	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
Canola fat	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
Choline (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
Mineral	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Vitamin	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^{-1}	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 3: Percentage composition of experimental diet in finisher period

	Experimental diets (percent)								
Ingredients	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	25.85	25.85	25.85	24	24	24
Canola fat	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	1.94
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
Choline (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
Mineral	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Vitamin	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^{-1}	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

RESULTS AND DISCUSSION

Body weight: Result for live body weight in 22-42 day old is showing that in Table 4. Result shown that interaction effects of canola oil and choline chloride supplement could affected Live Body Weight (LBW).

In 22-42 day old canola oil and choline chloride supplement in 9 and 6 treatment (T9 = 4% canola oil + 1000 mg kg^{-1} choline chloride supplement and T6 = 2% canola oil + 1000 mg kg^{-1} choline chloride supplement) could significantly increase the live body weight respectively ($p<0.0001$). Result for body weight in 43-56

Table 4: Least square means for performance parameters in 22-42 day old

	Treatment										
	1	2	3	4	5	6	7	8	9	SEM	p>F
LBW	1891def	1860f	1880ef	1881ef	1920cde	2101b	1937cd	1954c	2213a	21.35	<0.0001
FI	3041d	3038d	3076cd	3193bc	3076cd	3301ab	3354a	3341a	2856e	58.44	<0.0001
FCR	1.7033a	1.6366b	1.6366b	1.59bc	1.5833bc	1.6066b	1.6333b	1.5166d	1.5333cd	0.012	<0.0001

LBW= Live body weight, FI= Feed intake, FCR= Feed conversion ratio

Table 5: Least square means for performance parameters in 43-56 day old

	Treatment										
	1	2	3	4	5	6	7	8	9	SEM	p>F
LBW	2880ab	2824cd	2800d	2888a	2837bcd	2898a	2835bcd	2849abcd	2870abc	24.38	<0.0001
FI	6220a	6015ab	5964b	6035ab	5844b	5767bc	6038ab	5584c	5453cd	62.36	<0.0001
FCR	2.16a	2.13ab	2.13ab	2.09ab	2.06bc	1.99cd	2.13ab	1.96de	1.90e	0.014	<0.0001

LBW= Live body weight, FI= Feed intake, FCR= Feed conversion ratio

day old is showing that in Table 5. In 43-56 day old canola oil and choline chloride supplement in 6 and 4 treatment (T6 = 2% canola oil + 1000 mg kg^{-1} choline chloride supplement and T4 = 2% canola oil + without choline chloride supplement) could significantly increase the live body weight ($p<0.0001$). Roth Maier *et al.* (1988) indicate that use of 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^{-1} 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).

Feed intake: Result for feed intake in 22-42 day old is showing that in Table 4. Canola oil and choline chloride supplement in 8, 7 and 6 treatment (T8 = 4% canola oil + 500 mg kg^{-1} choline chloride supplement, T7 = 4% canola oil + without choline chloride supplement and T6 = 2% canoal oil + 1000 mg kg^{-1} choline chloride supplement) could significantly increase the feed intake respectively ($p<0.0001$). Result for feed intake in 43-56d old is showing that in Table 5. Canola oil and choline chloride supplement in 1, 2, 4 and 7 treatment (T1 = basal diet, T2 = without canola oil + 500 mg kg^{-1} choline chloride supplement, T4 = 2% canola oil + without choline chloride supplement and T7 = 4% canola oil + without 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 feed consumption among the different group's diets (Baiao and Lara, 2005; Talebali and Farzinpour, 2005). In other research feeding 1000 mg kg^{-1} of choline 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 a corn-soybean meal diet.

Feed conversion ratio: Result for feed conversion ratio in 22-42 day old is showing that in Table 4. In 9 and 8 treatment (T9 = 4% canola oil + 1000 mg kg^{-1} choline chloride supplement and T8 = 4% canola oil + 500 mg kg^{-1} choline chloride supplement) could significantly decrease the feed conversion ratio respectively ($p<0.0001$). Result for feed conversion ratio in 43-56 day old is showing that in Table 5. Canola oil and choline chloride supplement in 8 and 9 treatment (T8 = 4% canola oil + 500 mg kg^{-1} choline chloride supplement and T9 = 4% canola oil + 1000 mg kg^{-1} choline chloride supplement) could significantly decrease the feed conversion ratio respectively ($p<0.0001$). From 22-42 days, the best feed conversion ratio has been belonged to the groups that fed 8, 9, 5 and 4 diets, respectively and from 43-56 days, the best feed conversion ratio has been belonged to the groups that fed 9, 8, 6 and 5 diets respectively. These results are agreement Dora-Roth Maier *et al.* (1988).

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REFERENCES

Baiao, N.C. and L.J.C. Lara, 2005. Oil and fat in broiler nutrition, Braz. J. Poult. Sci., 7 (3): 129-141.

Economic Research Service (ERS), 2001. Oil crops situation and outlook. OCS-2000, ERS, USDA, pp: 66.

Harms, R.H. and G.B. Russell, 2002. Betaine dose not improve performance of laying hens when the diet contains adequate cholrine. Poult. Sci., 81: 99-101.

Harms, R.H., N. Ruiz and R.D. Miles, 1990. Conditions necessary for a response by commercial laying hen to supplemental choline and sulfate. Poult. Sci., 69: 1226-1229.

Lowry, K.R., A. Izuierdo and D.H. Baker, 1987. Efficiency of betaine relative to choline as a dietary methyl donor. Poult. Sci., 66 (Suppl. 1): 135.

National Research Council, 1994. Nutrient Requirements of Domestic Animals. 3rd Edn. National Academy of Science, Washingtonj, D.c.

Pesti, G.M., 1989. The nutrition of labile methyl group donors in broiler chickens. In: Proceedings of the Maryland Nutrition Conference, College Park, MD., pp: 145-150.

Pesti, G.M., A.E. Harper and M.L. Sunde, 1980. Choline nutrition of starting broiler chicks: Three models for estimating the choline requirements with economic considerations. Poult. Sci., 59: 1073-1081.

Roth-Maier, A. Dora and M. Kirchgessner, 1988. Feeding of DD-rapeseed to fattening chicken and laying hens. Landwirtsch. Forschung, 41: 140-150.

SAS Institute, 2000. SAS Institute Inc., Cary, NC.

Schrama, J.W and W.J.J. Gerrits, 2000. Effect of dietary betain supplementation on energy partitioning in pigs. Internal report, wagering en Agricultural University, the Netherlands, pp: 24.

Talebali, H. and A. Farzinpour, 2005. Effect of different levels of full fat canola seed as a replacement for soybean meal on the performance of broiler chickens. Int. J. Poult. Sci., 3: 982-985.

Waldroup, P.W. and C.A. Fritts, 2005. Evaluation of separate and combined effects of choline and betaine in diets for male broilers. Poult. Sci., 4 (7): 442-448.