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Effect of Triticale on Performance and Blood Chemistry of Commercial Growing Turkeys

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Abstract: A trial was conducted to study the performance of male broiler turkeys fed diets with five different levels of triticale replaced for corn (0, 25, 50, 75 and 100%). Each diet was fed to five groups of twelve male birds each. The diets were provided isocalric and isonitrogenous for each period of 30-53, 54-83, 84-94 and 95-116 day of age. Feed and water were fed *ad-libitum*. Similar weight gain, feed intake and feed conversion were observed in birds fed control or diets contained up to 75% triticale replaced for corn. However, the average daily weight gain decreased, feed intake and feed conversion were increased when 100% of corn was replaced with triticale during all periods ($P<0.05$). Whereas birds fed triticale contained diets showed a decrease in carcass yield, increase in small intestine and large intestine weights and an increase in blood serum TG and decrease in HDL and LDL when measured at 116 d of age ($p<0.05$). In conclusion, this study revealed that grower and finisher diets containing up to 35-50% of triticale have no negative effect on turkey performance.

Key words: Turkeys · Triticale · Performance · Blood chemistry

INTRODUCTION

Triticale, a hybrid of wheat and rye is an alternative cereal grain in maintaining metabolizable energy of poultry diets. Triticale has an excellent yield and a greater flexibility to adapt to harsh agronomic conditions than wheat [1]. It is a relatively new grain and it is not been used to great extent in poultry diet. One of the main reasons, is that there is apparently a fair amount of variation in the nutrient content of the different varieties of triticale [2]. The genetic improvements in triticale have increased grain plumpness and lowered the protein content. Boros [3] proposed that the negative effects observed in early triticale varieties are less prominent in newer varieties that have a smaller proportion of the rye genome as compared with the wheat genome.

Although, several studies showed that using different varieties of triticale at different levels in the diet, may be fed to broiler without any adverse effect on performance [4, 5], but some studies showed negative effects of including high level of triticale in diet and sagged to replace as little as 15 percent of total grain in chicken diets [2, 6]. Other studies reported no deteriorating effect observed on productivity of broilers even when diets grain portion consisted of 75% [7] and/or 100% triticale [6]. Some studies showed that triticale has a lowering effect on serum cholesterol, triglycerides and HDL in chickens [7] and plasma cholesterol in rats [8].

Information on the use of triticale in turkey diets is limited as compared to other cereal grains. Therefore, the purpose of the present studies was to compare the performance of broiler turkeys fed corn base diets contained different levels of triticale. In addition carcass yield and blood chemical characteristics of turkeys were evaluated.

MATERIALS AND METHODS

Birds, Housing and Care: Four hundred day old male broiler turkey poulte of commercial strain (Kody) were obtained from a commercial hatchery and kept in an environmentally controlled floor house and fed a corn-soy diet from 1 to 29 d of age followed by the experimental diets. The house temperature was initially maintained at 32-35°C and reduced 2.5°C every week to reach a constant temperature of 16-18°C. A continuous lighting was used for the first 7 days and a 14:10 hours light:dark cycle was applied for the total experimental period. On day thirty, 300 birds were individually weighed and were randomly assigned to five dietary treatments (n= 60; r= 5)

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Table 1: Composition of experimental diets use at 30-53 and 54-83 d

		30-53 d					54-83 d				
		Percentage of triticale replacement for corn [1]									
Ingredients (%)		0	25	50	75	100	0	25	50	75	100
Corn		44.70	34.00	23.2	11.50	0.00	51.80	40.00	26.65	13.40	0.00
Triticale		0.00	11.30	23.2	35.10	47.10	0.00	12.45	26.65	40.50	54.60
Soy-meal		29.90	29.10	28.20	27.24	26.40	20.18	19.20	18.04	17.01	15.96
Canola meal		10.00	10.00	10.00	10.00	10.00	12.00	12.00	12.00	12.00	12.00
Soy-Oil		3.50	3.67	3.96	4.20	4.51	4.30	4.60	4.90	5.28	5.60
Meat meal		10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Bon meal		0.92	0.90	0.87	0.86	0.85	0.65	0.65	0.65	0.65	0.61
Limestone		0.00	0.02	0.02	0.05	0.05	0.00	0.00	0.00	0.00	0.02
DL-Met		0.15	0.14	0.14	0.13	0.13	0.14	0.14	0.13	0.13	0.12
Hcl-lys		0.23	0.23	0.24	0.25	0.26	0.31	0.31	0.32	0.33	0.34
Vit-min per[2]		0.50	0.50	0.05	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Na-HCo3		0.00	0.02	0.05	0.05	0.05	0.05	0.06	0.07	0.10	0.15
Na Cl		0.10	0.10	0.10	0.12	0.15	0.07	0.08	0.09	0.10	0.10
Calculated nutrients											
ME	Kcal/kg	2950	2950	2950	2950	2950	3100	3100	3100	3100	3100
CP	%	26.00	26.00	26.00	26.00	26.00	23.00	23.00	23.00	23.00	23.00
Ca	%	1.28	1.28	1.28	1.28	1.28	1.17	1.17	1.17	1.17	1.17
Av. P	%	0.70	0.70	0.70	0.70	0.70	0.65	0.65	0.65	0.65	0.65
Na	%	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
Lys	%	1.60	1.60	1.60	1.60	1.60	1.45	1.45	1.45	1.45	1.45
Met	%	0.56	0.56	0.56	0.56	0.56	0.52	0.52	0.52	0.52	0.52
Met+Cys	%	0.99	0.99	0.99	0.99	0.99	0.92	0.92	0.92	0.92	0.92
Analyzed nutrients											
Dry matter	%	89.5	90.5	89.0	90.0	90.5	89.5	89.4	89.0	90.5	90.9
CP	%	24.5	25.0	25.5	25.5	25.0	21.5	22.0	22.5	22.5	22.3
CF	%	4.5	4.5	5.0	5.0	5.0	4.0	4.4	4.7	5.0	5.0
Ca	%	1.2	1.2	1.3	1.3	1.2	1.2	1.1	1.1	1.2	1.1
Phosph	%	0.7	0.6	0.7	0.7	0.6	0.6	0.6	0.5	0.5	0.6

1-Supplied per kilogram of diet: vitamin A, 10000 IU; vitamin D3, 9790 IU; vitamin E, 121 IU; vitamin K2, 2 mg; vitamin B12, 0.02 mg; thiamine, 4 mg; riboflavin, 0.0044 mg; niacin, 22 mg; pyridoxine, 4 mg; biotin, 0.03 mg; folic acid, 1 mg; Ca-panthotenate, 40 mg; choline chloride, 840 mg; etoxycoin, 0.125 mg; Zn-sulfate, 60 mg; Mn-sulfate, 100 mg; Cu-sulfate, 100 mg; Se, 0.2 mg; I, 1 mg; Fe, 50 mg.

Table 2: Composition of experimental diets use at 84-94 and 95-116 d

	84-94 d					95-116 d				
	Percentage of triticale replacement for corn [1]									
Ingredients (%)	0	25	50	75	100	0	25	50	75	100
Corn	56.17	42.50	28.75	14.50	0.00	63.90	48.60	32.90	16.50	0.00
Triticale	0.00	14.40	28.75	44.00	59.00	0.00	16.30	32.90	50.00	67.60
Soy-meal	16.50	15.40	14.40	13.10	12.00	14.50	13.10	11.80	10.60	9.10
Canola meal	10.00	10.00	10.00	10.00	10.00	7.00	7.00	7.00	7.00	7.00
Soy-Oil	6.00	6.35	6.70	6.00	7.50	5.56	5.90	6.29	6.75	7.10
Meat meal	10.00	10.00	10.00	10.00	10.00	7.00	7.00	7.00	7.00	7.00
Bon meal	0.32	0.31	0.31	0.31	0.30	1.00	1.00	0.95	0.95	0.95
Limestone	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.02
DL-Met	0.13	0.13	0.13	0.12	0.11	0.11	0.11	0.10	0.09	0.09
Hcl-lys	0.27	0.28	0.29	0.31	0.32	0.28	0.30	0.31	0.32	0.34
Vit-min Per2	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Na (HCo3)2	0.00	0.02	0.07	0.10	0.15	0.02	0.06	0.08	0.11	0.14
NaCl	0.10	0.10	0.10	0.10	0.10	0.12	0.12	0.14	0.15	0.16

Table 2: Continued

Calculated nutrients											
ME	Kcal/kg	3250	3250	3250	3250	3250	3300	3300	3300	3300	3300
CP	%	21.00	21.00	21.00	21.00	21.00	18.00	18.00	18.00	18.00	18.00
Ca	%	1.05	1.05	1.05	1.05	1.05	0.98	0.98	0.98	0.98	0.98
Av. P	%	0.59	0.59	0.59	0.59	0.59	0.55	0.55	0.55	0.55	0.55
Na	%	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
Lys	%	1.30	1.30	1.30	1.30	1.30	1.12	1.12	1.12	1.12	1.12
Met	%	0.48	0.48	0.48	0.48	0.48	0.42	0.42	0.42	0.42	0.42
Met+Cys	%	0.85	0.85	0.85	0.85	0.85	0.74	0.74	0.74	0.74	0.74
Analyzed nutrients											
Dry matter	%	90.5	90.9	89.5	89.4	90.0	90.0	89.0	91.0	90.0	92.0
CP	%	20.0	20.5	20.6	20.5	20.4	17.4	17.5	18.0	17.7	17.5
CF	%	3.8	4.0	4.0	4.6	4.5	3.5	3.7	4.0	4.0	4.5
Ca	%	1.1	1.0	1.1	1.0	1.0	1.1	1.0	0.9	1.0	0.9
Phosph	%	0.5	0.5	0.6	0.6	0.6	0.5	0.4	0.5	0.6	0.5

1-Supplied per kilogram of diet: vitamin A, 10000 IU; vitamin D3, 9790 IU; vitamin E, 121 IU; vitamin K2, 2 mg; vitamin B12, 0.02 mg; thiamine, 4 mg; riboflavin, 0.0044 mg; niacin, 22 mg; pyridoxine, 4 mg; biotin, 0.03 mg; folic acid, 1 mg; Ca-panthotenate, 40 mg; choline chloride, 840 mg; etoxycoin, 0.125 mg; Zn-sulfate, 60 mg; Mn-sulfate, 100 mg; Cu-sulfate, 100 mg; Se, 0.2 mg; I, 1 mg; Fe, 50 mg.

and housed in floor pen (12 chicks per pen with 8 m^2 space that covered with wood shaving). Birds were allowed free access to feed from handle pan feeder and fresh water from automatic round drinker throughout the experiment.

Experimental Design and Diets: The experiment was a completely randomized design with five dietary treatments including: T_1 (control) corn-soy based diet, T_2 = control ration with triticale replaced for 25% of corn, T_3 = control ration with triticale replaced for 50% of corn, T_4 = control diet with triticale replaced for 75% of corn and T_5 = control ration with triticale replaced for 100% of corn. Four feeding phases were used during the course of the experiment (Table 1). All diets were formulated according to the nutrient requirements recommended by the lesson and summers 2005. The diets were in mash form and provided isocalric with similar nutrients for every phase and fed ad-libitum. The composition of the experimental diets is shown in Table 1, 2.

Measurements: Group feed consumption and body weights (BW) were recorded in 30, 53, 83, 94 and 116 d of age. Daily mortalities were weighed, recorded and added to the total pen live body weight for the adjustment of weight gain (WG) and feed conversion ratio (FCR) during each phase. Weight gain per birds per days (WG, g/ b/ d) and feed intake per birds per day (FI, g/ b/ d) were calculated by dividing the group records by the number of live birds. Feed conversion ratio (FCR) was calculated by dividing the FI by WG. One bird from each replicate was randomly selected and 3 ml of blood from wing vein was withdrawn into a syringe at 53 and 116 d of age after 8 hours of starvation. The blood serum samples were used to determine fast blood sugar (FBS), triglyceride (TG), cholesterol (Ch), high-density lipoproteins (HDL) and low-density lipoproteins (LDL). On the last day of experiment, one bird from each replicate that was close to the average pen weight was randomly selected and after 8 hours of starvation weighed, slaughtered to measure weight of carcass, breast, femur and digestive tracts (crop, pro-ventriculus, gizzard, small intestine and large intestine), liver, heart, pancreas and abdominal fat were dissected and weighed and calculated as a percentage of LBW. Eviscerated carcass was obtained by removing head, legs below the tibia-tarsal joint, feathers and gastro-intestinal tract from the slaughtered birds. Diet samples were analyzed for dry matter at 105°C for 24 h, crude protein by the Kjeldahl method, crude fiber, calcium by the dry ash method and phosphorus by the photometric method.

Statistical Analysis: Data were subjected to one way Analysis of variance (ANOVA) procedure using the GLM procedure of the SAS software [9]. Different group means were compared using Duncan's Multiple Range Test. Percentage data were transformed into arcsine before analysis and actual percentages are reported in Tables.

RESULTS

The average body weight at 29 d old birds was about 1059 g and pen weights were similar before they were allocated to the dietary treatment on d 30 of age.

Table 3: Effect of dietary levels of triticale replacement for corn on weight gain (WG), feed intake (FI) and feed conversion (FC) of turkey fed corn-soy based diet from 30-116 d of age

Triticale replacement for corn (%)	30-53 d			54-83 d			84-94 d			95-116		
	WG (g/d)	FI (g/d)	FC (g/d)	WG (g/d)	FI (g/d)	FC (g/d)	WG (g/d)	FI (g/d)	FC (g/d)	WG (g/d)	FI (g/d)	FC (g/d)
0	94.9	148.0	1.56	135.3	315.6	2.33	125.4	435.0	3.47	134.7	430.1	3.19^{c}
25	93.0	153.4	1.65	132.0	316.6	2.40	135.1	473.3	3.50	131.0	442.7	3.37^{b}
50	92.5	151.1	1.63	125.9	301.0	2.39	136.8	458.5	3.35	118.5	413.7	3.49^{ab}
75	94.2	156.9	1.67	130.6	327.0	2.50	133.8	471.0	3.52	133.4	454.0	3.40^{b}
100	94.6	153.5	1.62	133.1	327.6	2.46	125.0	441.5	3.53	117.0	421.5	3.60^{a}
SEM	39.4	61.4	0.01	74.0	232.0	0.02	436.0	1016.0	0.39	171.0	1394.0	0.09
Probability	0.96	0.48	0.46	0.52	0.07	0.51	0.91	0.27	0.95	0.07	0.49	0.03

Mean with no common superscript differ significantly (P < 0.05)

Table 4: Effect of dietary levels of triticale replacement for corn on mean body weight, weight gain (WG), feed intake (FI) and feed conversion (FC) of turkey fed corn-soy based diet from 30-116 d of age

Triticale replacement for corn (%)	30 d	53 d	83 d	84 d	116 d	30-116		
	Mean Body Weight					WG	FI	FC
0	1036	3218	7278	8656	11620^{a}	123.1^{a}	308.3^{b}	2.50^{b}
25	1064	3201	70162	8649	11531^{ab}	121.7^{ab}	317.8^{ab}	2.61^{b}
50	1080	3247	7166	8638	11572^{a}	116.5^{b}	309.1^{b}	2.65^{ab}
75	1042	3219	7212	8650	11167^{bc}	122.0^{ab}	329.4^{a}	2.70^{ab}
100	1069	3196	6974	8478	11085^{c}	117.7^{b}	325.5^{ab}	2.77^{a}
SEM	225	296	4975	9547	8494	234.0	171.0	0.05
Probability	0.80	0.99	0.62	0.87	0.02	0.04	0.05	0.01

Mean with no common superscript differ significantly (P < 0.05)

The average BW, WG, FI and FCR of birds fed diets with different levels of triticale replaced for corn are shown in Tables 3 and 4. The body weight showed a significantly difference ($p<0.02$) in birds fed with diets varying in triticale level at 116 days age; whereas the final body weight decreased with increased triticale level in diets. In the whole experiment period (30-116 d) the WG significantly ($p<0.05$) decreased in birds fed with triticale replaced for 100% of corn as compared with birds that fed with corn-soy diet. Whereas FI and FCR were numerically increased with increased triticale level but significant ($P<0.05$) increase in FI observed in birds fed diets with triticale replaced for 75 or 100% of corn as compared those fed control or diet with triticale replaced for 25 or 50% of corn during whole period. The FCR for birds fed diet with triticale replaced for total corn was significantly ($p<0.01$) higher as compared to these fed control diet or diet with 25% triticale replaced for corn.

The average carcass yield, portion relative weight and digestive organ relative weight of birds fed diets with different levels of triticale replacement for corn are shown in Table 5.There were not significant differences in carcass portion weight of birds fed with different treatments at 116 d of age. Whereas eviscerate carcass as percentage of LBW was significantly ($p<0.05$) lower in birds fed with triticale based diet than birds fed with control, or 25, 50 and/or 75% triticale replaced for corn. The small intestine weight as a percentage of LBW at 116 d of age was significantly increased ($P<0.05$) in birds fed with 75 or 100% triticale replaced for corn than birds fed with control, 25 and 75% triticale replaced for corn. The large intestine weight as percentage of LBW at 116 d of age was significantly increased ($P<0.03$) in birds fed with triticale-soy diet than birds fed with control, or 25, 75 and /or 75% triticale replaced for corn. The pancreas weight as percentage of LBW increased with increased level of triticale in diet whereas highest pancreas weight observed in birds fed with 75 and 100% triticale replaced for corn diet and lowest pancreas weight observed in birds fed with control diet but differences didn't significance.

The average fast blood sugar (FBS), triglyceride (TG), cholesterol (Ch), low-density lipoproteins (LDL) and high-density lipoprotein (HDL) in total serum of chicks in 53 and 116 d fed diets with different levels of triticale replacement for corn are shown in Table 6. There were no significant differences in FBS, TG, Ch, LDL and HDL between birds fed with different treatments measured at 53 d of age. The replacement of triticale for corn in diet did not have a significant effect on FBS and Ch concentration in total serum at 116 d of age but with increasing triticale in diet the average serum Ch concentration decreased.

Table 5: Effect of dietary levels of triticale replacement for corn on relative weights of eviscerated carcass and carcass portion and digestive organs of turkey fed corn-soy based diet at 116 days of age

Triticale replacement for corn (%)	Carcass and carcass portion				Digestive organ					
	Carcass	Pectoral	Femur	Abdominal fat	Crop	Pro-Ventriculus	Gizzard	Pancreas	Small Intestine	LargeIntestine
	(% LBW)									
0	80.8a	26.9	21.6	1.5	0.33	0.12	1.20	0.08	1.30^{b}	0.53^{b}
25	80.3a	26.1	22.0	1.8	0.23	0.13	1.20	0.09	1.30^{b}	0.50^{b}
50	81.4a	29.0	22.5	1.5	0.27	0.11	1.10	0.10	1.30^{b}	0.45^{b}
75	80.3a	26.7	21.9	1.4	0.33	0.12	1.20	0.11	1.50^{a}	0.52^{b}
100	78.5b	25.7	21.8	1.2	0.29	0.14	0.93	0.11	1.50^{a}	0.77^{a}
SEM	0.9	1.2	1.6	1.9	0.07	0.01	0.94	0.03	0.10	0.06
Probability	0.05	0.13	0.97	0.5	0.13	0.13	0.36	0.35	0.04	0.03

Mean with no common superscript differ significantly (P < 0.05)

Table 6: Effect of dietary levels of triticale replacement for corn on fast blood sugar (FBS), triglyceride (TG), Cholesterol (Ch), high-density lipoproteins (HDL) and low-density lipoproteins (LDL) of turkey fed corn-soy based diet measured at 53 and 116 days of age

Triticale replacement for corn (%)	53 d					116 d				
	FBS	Ch	TG	HDL	LDL	FBS	Ch	TG	HDL	LDL
	mg/ dl									
0	305.8	137.8	93.8	76.6	42.2	310.0	141.0	49.0^{b}	77.4^{ab}	44.8^{a}
25	304.8	146.0	105.4	81.4	43.6	305.0	137.0	60.0^{ab}	75.0^{ab}	35.4^{b}
50	309.4	136.4	98.4	76.4	41.0	309.0	144.0	61.0^{ab}	79.0^{a}	41.0^{ab}
75	319.4	150.6	91.8	86.4	45.6	315.0	149.0	57.0^{ab}	78.5^{a}	44.7^{a}
100	311.6	136.4	86.6	76.4	42.6	305.1	128.0	70.0^{a}	74.4^{b}	38.2^{ab}
SEM	26.2	173.0	1125	75.0	41.8	26.2	385	10.0	5.0	12.9
Probability	0.63	0.33	0.92	0.3	0.83	0.65	0.54	0.05	0.05	0.04

Mean with no common superscript differ significantly (P < 0.05)

The blood serum HDL and LDL significantly ($p<0.05$) decreased in birds fed with triticale replaced for 100% of corn than in birds fed other experiment diets and TG significantly increased ($p<0.05$) in birds fed with triticale-corn-soy diets than birds fed with control diet.

DISCUSSION

In the percent experiment, triticale replaced for corn up to 75% in corn-soy diet did not have any negative effect on performance of broiler turkeys, the performance index were increased when 100% of corn was replaced with triticale during all periods. Similarly, Vieira *et al.* [5] found that the graded inclusion of triticale up to 40% (substituted for corn) had no negative effect on weight gain or final body weight of broilers and poorer FCR was observed in birds fed triticale-soy based diet as compared to those fed corn-soy based diet [2,5,7]. But, some studies showed that production of birds, even when fed diet contained triticale as a grain portion was similar to those fed control diet [6].The poor FCR of birds fed triticale based diet may be related to lower nutrients, lower nutrient digestibility or higher anti-nutrient factors in triticale as compared to corn. The anti-nutritional factors in triticale includes: soluble pentosans, trypsin inhibitor, alkyl-resorcinols and pectins [1,10].

The significant decreased in eviscerate carcass in bird had higher triticale in their diet may be due to enhanced function of intestine with increased in intestine weight (Table 5), it may be due to enhanced function of these part of gut with subsequent increase in feed intake (Table 4). The higher non starch polysaccharides in triticale as compared to corn can increase gut digesta viscosity and reduce enzyme-nutrient and their subsequent substrates, leading to significant modifications of the structure and function of intestine [11 and to adapt to these changes, the activities of the intestinal secretary mechanisms may be enhanced. Thus, this may lead to an increase in the size of the gastro intestinal tract (GIT), pancreas and liver. Brenes *et al.* [12] indicated that this increased size of intestine and GIT could be an adaptive response to an increased need for enzymes.

Brds fed triticale contained diets showed an increase in blood serum TG and decrease in HDL and LDL when measured at 116 d of age ($p<0.05$). Similarly, Zarghi and

Golian [7] reported that with increasing level of triticale in broiler diets the blood serum concentrations Chol, HDL and LDL chickens in end of production period numerically decreased. Soluble dietary fibers, such as mixed linked β-Glucans, may reduce the absorption of fat and cholesterol and are known to have cholesterol lowering properties. These effects are all associated with the viscosity-forming properties of soluble dietary fibers [13]. Aline *et al.* [8] reported that plasma cholesterol was lower than control rats fed whole wheat and triticale flour diets. Several mechanisms might explain the hypocholesterolemic effect of dietary fiber, whether working alone or in combination, have been proposed as slowing down the rate of gastric emptying, modification of bile acid absorption and metabolism, interference with lipid absorption and metabolism, production of short-chain fatty acids (SCFA) from fermentation of fiber in the colon, up regulation of the hepatic LDL receptor and alterations in plasma concentration or tissue sensitivity to insulin or other hormones [13, 14].

It Could Be Concluded That:

- Triticale may be used as an alternative source of ingredients feed in turkey diets.
- Turkeys can be fed diets with up to 35-50% triticale in grower and finisher of production periods without a reduction in performance.
- Triticale may be to have a lowering effect on serum Chol, LDL and HDL in turkeys.

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