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Long-Term Effects of Oxymetholone vs. Testosterone with or Without $ZnSO_4$ on Growth Performance of Turkey Chicks

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Abstract: Oxymetholone at 0.6 mg/kg feed or mixed with $ZnSO_4$ (45mg/kg feed), testosterone at 10 mg/kg feed or mixed with $ZnSO_4$ (45 mg/kg feed) and 0 mg/kg of either one were given to 180 turkey chicks (n = 9; r = 4) from 6-18 weeks of age to determine their effects on growth performance. Body Weight (BW) was increased gradually in all treatments when compared to the control group with the highest level for oxymetholone and testosterone alone respectively. Feed Intake (FI) during 12 weeks of study decline slightly in all treatments with the lowest level for oxymetholone + $ZnSO_4$ and the highest level for control group. Feed Conversion Ratio (FCR) at the end of study was 4.77 for control group and 4.15, 4.32, 4.50 and 4.69 for different treatments, respectively. Growth Rate (GR) differed for each week and treatment. Overall, the treatment groups showed higher GR when compared to control group in every week. The percentage of Carcass Weight (%CW) was increased significantly ($p<0.05$) in all treatments in comparison with control group with highest level for testosterone + $ZnSO_4$. The treatments did not influence significantly on the internal organs by the end of study. Oxymetholone induced BW and %CW ($p<0.05$) with less FI and FCR when compared to testosterone and control group in turkey chicks.

Key words: Oxymetholone, testosterone, $ZnSO_4$, growth performance, Turkey chick

INTRODUCTION

The androgen and anabolic steroids are well known for their anabolic activities including increased nitrogen retention, body weight and bone growth. Some studies showed that anabolic hormones play an important role in bone development, physiology and metabolism (Oursler *et al*., 1996; Pederson *et al*., 1999). Recent study showed that testosterone increased Ca and P contents of bone but lowered the blood Ca and P concentrations (Chen *et al*., 2006) while, the alkaline phosphates activity in blood did not change in chicken (Tsay *et al*., 2004). Other researchers observed that testosterone and its analogues have different bioactivity on chicken growth (Fennell *et al*., 1990; Fennell *et al*., 1996). A placebo-controlled study showed in man that supraphysiologic dosages of testosterone resulted in an increase of muscle mass and strength in normal, subjects (Bhasin *et al*., 1996).

Oxymetholone imposes some anabolic effects since it has relative binding affinity for androgen receptors located on skeletal muscle and prostate gland but lower than testosterone (Saartok *et al*., 1984). Another study showed that testosterone, methandrostenolone and oxymetholone increased body weight in rat (Boris *et al*., 1972). Also, oxymetholone has been used as a safe and promoted weight gain drug in patients with HIV-1 infection (Hengge *et al*., 1996). The report indicated that adding graded levels of zinc up to 2000 ppm (basal diet containing 28 ppm Zn) had no effect on hen performance (Stahl *et al*., 1990). However, other study showed that 800 ppm of dietary zinc oxide reduced growth rate and ash content of bone (Berg and Martinson, 1972). Lin and Hsu (2000) reported that the average daily weight gain and feed conversion ratio among treatments (50, 100, 200 and 300 ppm zinc sulfate) were not significantly different ($p>0.05$) at 0-6 weeks of age in broiler chicks. In the last few years, the exogenous anabolic drugs have received noticeable attention among commercial poultry growers using them in combination for efficiency and weight gain of broiler chicken, but it is unclear whether, these drugs act on growth and feed efficiency. Therefore, this study was designed to determine the effects of oxymetalone *vs* methyl testosterone on growth performance, feed intake and carcass analysis in male turkey chicks.

MATERIALS AND METHODS

One hundred eighty male turkey chicks (Canadian commercial breed, Broad-Breasted Bronze), from 6-18 weeks of age were randomly assigned to five groups equally (n = 36; r = 4) and housed in cage system (9 chicks per cage with 6 m^2 floor space and free access to water and feed). The chicks received five dietary treatments including: T_1 (control) = a basal ration which was formulated according to NRC (1994) with no additive, T_2 = basal ration + oxymetholone (0.6 mg/kg feed), T_3 = basal ration + methyl testosterone (10 mg/kg feed), T_4 = basal ration + oxymetholone (0.6 mg/kg feed) + $ZnSO_4$ (45 mg/kg feed) and T_5 = basal ration + methyl testosterone (10 mg/kg feed) + $ZnSO_4$ (45 mg/kg feed).

Data were collected weekly during study for Feed Intake (FI) and Body Weight (BW). At the end of experiment, Feed Conversion Ratio (FCR) was calculated by dividing the total feed consumed per bird by its body weight. On the last day of experiment, one bird from each replicated treatment was randomly selected and slaughtered for weight of Carcass (CW), Breast (BrW), Legs (LeW), Gut (GW), Liver (LW), Heart (HW), Fat-cavity (FW) and Testes (TW) and calculated as a percentage of BW.

The data were subjected to one way Analysis of Variance (ANOVA) procedures (Steel and Torrie, 1980) using the GLM procedure of SAS (1996). 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 the Table 5. Contrasts between treatment means were used to determine the significance of difference between drug treatments and control and to identify whether supplementation with $ZnSO_4$ would change the effect of oxymetholone and testosterone on production parameters. Significant differences were reported at p<0.05 in the following tables.

RESULTS

The results of performance parameters including BW, FI, GR, FCR and carcass analysis are shown during 12 weeks of treatments (week 6-18 of age) in table one through five.

Body weight: Table 1 shows higher BW in control group in comparison with treatment group in the first week of treatment. But the treatment group gradually increased up to week 5th with highest for T_5 and lowest for T_4 (p<0.05). By the end of study, the BW of birds in each treatment was increased when compared to control group but not significantly.

Feed intake: Table 2 shows highest FI in T_5 and lowest for T_4 in 2nd week of study (p<0.05). But the F1 was highest for control group when compared to treatment groups in the last week of experiment. The feed consumption trend was $T_1>T_2>T_5>T_3>T_4$ among treatments and control group, respectively.

Growth rate: Table 3 shows highest level of GR for T_1 and T_5 with lowest level for T_4 in the first week of feeding treatment. This trend has slowly changed by week 5th with highest level for T_5 and lowest level for T_4 (p<0.05). At week 7th , the highest level of GR was for T_5 and the lowest level for T_2 (p<0.05). The GR compensation has occurred for T_3 and T_2 on week 11th and 12th, respectively.

Feed conversion ratio: Table 4 shows highest level of FCR for T_4 and lowest level for T5 (p<0.05) on week 5th. This turned was reduced for treatment group in

Table 1: Effects of oxymetholone, testosterone, oxymetholone + $ZnSO_4$ and testosterone + $ZnSO_4$ on body weight (kg) of turkey chicks

	Week after treatment											
Treatment	1	2	3	4	5	6	7	8	9	10	11	12
T^1	1.63	2.38	3.00	3.82	4.72^{ab}	5.70	6.7	7.40	8.53	9.46	10.37	11.21
T_2	1.58	2.22	2.84	3.77	4.66^{ab}	5.77	6.57	7.47	8.52	9.45	10.38	11.4
T_3	1.57	2.20	2.94	3.79	4.77^{ab}	5.73	6.74	7.54	8.51	9.30	10.33	11.26
T_4	1.59	2.24	2.92	3.80	4.49^{b}	5.70	6.73	7.38	8.44	9.23	10.21	11.03
T_5	1.60	2.26	2.81	3.75	5.01^{a}	5.77	6.86	7.66	8.64	9.49	10.42	11.24
Pooled SEM	0.036	0.061	0.05	0.06	0.10	0.113	0.122	0.161	0.16	0.172	00.195	0.196
p-value												
Contrast												
T_5 vs. T_1	NS	NS	p<0.05	NS	p<0.05	NS	NS	NS	NS	NS	NS	NS
T_4 vs. T_5	NS	NS	NS	NS	p<0.01	NS	NS	NS	NS	NS	NS	NS
T_5 and T_4 vs. T_1	NS	NS	p<0.05	NS	NS	NS	NS	NS	NS	NS	NS	NS

T_1 = Control; T_2 = Oxymetholone; T_3 = Testosterone; T^4 = Oxymetholone+$ZnSO_4$; T_5 = Testosterone+$ZnSO_4$;
^{ab}Means in a row with different superscripts are significantly different (p<0.05)

Table 2: Effects of oxymetholone, testosterone, oxymetholone + $ZnSO_4$ and testosterone + $ZnSO_4$ on feed intake (kg) of turkey chicks

	Week after treatment											
Treatment	1	2	3	4	5	6	7	8	9	10	11	12
T_1	0.84	1.18$_{ab}$	1.50	2.02	2.61	2.90	3.19	3.82	2.43	3.62	4.20	3.90
T_2	0.83	1.18$_{ab}$	1.44	1.99	2.66	2.80	3.29	4.23	2.43	3.89	4.06	3.87
T_3	0.84	1.13$_{ab}$	1.49	2.04	2.59	2.81	3.44	3.92	2.41	3.68	3.96	3.68
T_4	0.83	1.09$_{b}$	1.37	2.03	2.80	3.05	3.76	4.20	2.71	3.99	3.90	3.60
T_5	0.84	1.25$_{a}$	1.43	2.06	2.57	2.86	3.20	3.77	2.37	3.48	3.81	3.69
Pooled SEM	0.006	0.031	0.04	0.054	0.061	0.077	0.204	0.174	0.151	0.20	0.259	0.237
p-value												
Contrast												
T_4 vs. T_1	NS	p<0.01	p<0.02	NS	NS	NS	NS	NS	NS	NS	NS	NS
T_4 vs. T_5	p>0.07	p<0.01	NS	NS	NS	NS	NS	p>0.08	NS	p>0.07	NS	NS

T_1 = Control; T_2 = Oxymetholone; T_3 = Testosterone; T_4 = Oxymetholone+$ZnSO_4$; T_5 = Testosterone+$ZnSO_4$,
^{ab}Means in a row with different superscripts are significantly different (p<0.05)

Table 3: Effects of oxymetholone, testosterone, oxymetholone + $ZnSO_4$ and testosterone + $ZnSO_4$ on growth rate (g) of turkey chicks

	Week after treatment											
Treatment	1	2	3	4	5	6	7	8	9	10	11	12
T_1	525[a]	745	620	823	975[ab]	900	917[ab]	698	1132	927	907	847
T_2	498[ab]	640	620	925	915[ab]	1085	803[b]	905	1050	925	935	1015
T_3	468[ab]	630	738	858	975[ab]	960	920[ab]	803	965	792	1030	925
T_4	443[b]	650	683	880	783[b]	1115	1007[ab]	645	1065	782	980	825
T_5	505[a]	668	548	940	1156[a]	905	1110[a]	795	985	847	930	822
Pooled SEM	17.33	53.82	55.89	61.22	72.27	99.64	63.98	69.02	76.96	67.33	86.47	122.98
p-value												
Contrast												
T_4 vs. T_1	p<0.01	NS	NS	NS	p>0.07	NS	NS	NS	NS	NS	NS	NS
T_4 vs. T_5	p<0.05	NS	NS	NS	p<0.01	NS	NS	NS	NS	NS	NS	NS
T_5 andT_4 vs. T_1	p<0.05	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

T_1 = Control; T_2 = Oxymetholone; T_3 = Testosterone; T_4 = oxymetholone+$ZnSO_4$; T_5 = Testosterone+$ZnSO_4$,
[ab]Means in a row with different superscripts are significantly different (p<0.05)

Table 4: Effects of oxymetholone, testosterone, oxymetholone + $ZnSO_4$ and testosterone + $ZnSO_4$ on feed ratio of turkey chicks

	Week after treatment											
Treatment	1	2	3	4	5	6	7	8	9	10	11	12
T_1	1.61	1.62	2.56	2.5	2.71[ab]	3.32	3.31	5.63	2.17	3.95	4.76	4.77
T_2	1.67	1.87	2.31	2.2	2.98[ab]	2.61	4.1	4.8	2.36	4.23	4.39	4.15
T_3	1.79	1.82	2.05	2.38	2.66[ab]	3.01	3.66	4.93	2.56	4.86	3.97	4.32
T_4	1.87	1.73	2.06	2.33	3.65[a]	2.74	3.71	6.89	2.58	5.09	3.99	4.69
T_5	1.68	1.88	2.67	2.21	2.36[b]	3.39	2.96	4.87	2.46	4.13	4.32	4.5
Pooled SEM	0.061	0.167	0.249	0.161	0.263	0.308	0.44	0.651	0.253	0.329	0.51	0.676
p-value												
Contrast												
T_4 vs. T_1	p<0.01	NS	NS	NS	p>0.06	NS	NS	NS	NS	NS	NS	NS
T_4 vs. T_5	p<0.05	NS	NS	NS	p<0.01	NS	NS	NS	NS	p>0.05	NS	NS
T_5 and T_4 vs. T_1	p<0.05	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

T_1 = Control; T_2 = Oxymetholone; T_3 = Testosterone; T_4 = Oxymetholone+$ZnSO_4$; T_5 = Testosterone+$ZnSO_4$,
[ab]Means in a row with different superscripts are significantly different (p<0.05)

Table 5: Effects of oxymetholone, testosterone, oxymetholone + $ZnSO_4$ and testosterone + $ZnSO_4$ on carcass (%) of turkey chicks

	Body weight (%)							
Treatment	Carcass	Breast	Femur	Gut	Liver	Heart	Fat	Testes
T_1	78.49_b	34.78	28.17	4.60	1.28	0.49	0.88	0.24
T_2	81.59_{ab}	35.05	28.02	4.44	1.33	0.51	0.73	0.21
T_3	79.46_{ab}	33.38	27.83	4.88	1.33	0.58	0.92	0.19
T_4	81.88_{ab}	34.97	28.06	4.73	1.23	0.49	0.93	0.15
T_5	82.67_a	33.68	27.21	4.23	1.20	0.55	0.96	0.23
Pooled SEM	00.986	0.765	0.644	0.235	0.69	0.035	0.13	0.045
p-value								
Contrast								
T_4 vs. T_1	p<0.05	NS	NS	NS	NS	NS	NS	NS
T_5 vs. T_1	p<0.01	NS	NS	NS	NS	NS	NS	NS
T_5 and T_4 vs. T_1	p<0.01	NS	NS	NS	NS	NS	NS	NS

T_1 = Control; T_2 = Oxymetholone; T_3 = Testosterone; T_4 = Oxymetholone+$ZnSO_4$; T_5 = Testosterone+$ZnSO_4$,
[ab]Means in a row with different superscripts are significantly different (p<0.05)

comparison with control group by the end of experiment $T_2<T_3<T_5<T_4<T_1$, respectively.

Carcass parameters: Table 5 shows higher %CW for treatment group in comparison with control group with highest level for T_5 and lowest level for T_1 (p<0.05). The treatments had no significant influence on the percentage of Br.W, Le.W, GW, LW and HW with exception of higher TW in control group and highest and lowest levels of FW in T_5 and T_2, respectively.

DISCUSSION

Oxymetholone has relative binding affinity for androgen receptors which is located on skeletal muscle but lower than testosterone (Saartok *et al*., 1984). In this study, oxymetholone showed lower BW compared to control

group during the first 10 weeks of study then after increased sharply (Table 1). It seems that, oxymetholone takes longer time but more effective to act on BW in comparison with methyl testosterone (11.40 kg/11.26 kg), respectively. Similarly, a research showed that testosterone, methandrostenolone and oxymetholone increased body weight in rat (Boris *et al*., 1972). The FI and FCR were declined in all treatments by the last week of experiment when compared to control group (Table 2 and 3). Furthermore, the T_2 and T_3 showed higher GR in the last 2 weeks of study leading to increased CW ($p<0.05$). Also, oxymetholone has been used as a safe and promoted weight gain drug in patients with HIV-1 infection (Hengge *et al*., 1996). In present study, oxymetholone also promoted percentage of CW, BrW, LW and HW but reduced FW when compared to control group (Table 5). This result is similar to study by Chen *et al*. (2005) who found that high dose of testosterone implantation reduce abdominal fat accumulation.

Exogenous androgens have been found to cause androgen deficiency and reduced energy but increased BW and FW in male chickens (Chen *et al*., 2000). These results are similar to the effect of T3 on BW and FW in this study (Table 1 and 5). Moreover, methyl testosterone showed higher BW, GR and %CW with lower FI and FCR compared to control group by the end of study (Table 1-5). The T_3 began to increase BW and GR on week 5th and decrease FI and FCR on week 5th and 3rd respectively (Table 1-4). Earlier study showed no negative effects of testosterone on leg bone integrity in the domestic fowl (Johnson and Rendano, 1984). Recently, a report showed that higher BW in male chickens treated with exogenous androgens (Chen *et al*., 2006). Other researchers found that 19-nortestosterone (19-Nor.T) and 5"-Dihydrotestosterone (5"-DHT) were increased chicken growth (Astiningsih and Rogers, 1996; Fennell *et al*., 1996; Fennell and Scanes, 1992). Overall, oxymetholone showed higher BW, GR, %CW and lower FW in comparison with methyl testosterone. Pederson *et al*. (1999) reported that androgen receptors are present in the avian skeleton which stimulated osteoblast ossification and inhabits osteoclast; therefore, GR and BW may also increased internal organs. In present study, the treatments apparently showed adverse effects on TW and FW compared to control group. But overall, treatment effects showed some fluctuations in BW, GW, LW and HW (Table 5).

In this study, dietary Zn supplementation + oxymetholone or and methyl testosterone reduced the level of FI, FCR and %CW (Table 2, 4 and 5). The Zn supplementation in T4 and T5 also decreased BW and GR but increased FW (Table 1, 3 and 5). Several studies reported that Zn supplemented diets at different level did not alter the average daily weight gain, growth performance and feed conversion ratio in chickens (Kidd *et al*., 1992). Stahl *et al*. (1990) reported that adding different level of Zn up to 2000 ppm (basal diet containing 28 ppm Zn) had no effect on hen performance. However, Berg and Martinson (1972) showed that 800 ppm of dietary Zn from Zinc oxide reduced growth rate and ash content of bone. Therefore, the cause of this discrepancy is perhaps due to duration and the amount and source of treatment that have used in these studies.

It was concluded that oxymetholone at the recommended dose of 0.6 mg/kg feed affect on BW and CW significantly with less FI and FCR in comparison with testosterone with or without $ZnSO_4$ in turkey chicks.

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