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The Effects of Triticale Substitution in Corn-Based Diets under Reared the Different Photoperiod Lengths on Broilers Growth Performance

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Abstract

This study was carried out to determine the effect of different levels of triticale substitution in corn diets under the different photoperiod lengths (PL) would have a detrimental effect of broilers growth performance. The experiment used a completely randomized design with a 3x4 factorial arrangement of treatments consisting of three dietary triticale levels (0% -T0, 50% -T50 and 100% -T100) fed from 0 to 42 d and under four photoperiod length programs (Continuous - CON, Intermittent - INT, Increasing - INC, Decreasing - DEC). A total of 960, one-day-old, sexed Ross 308 broilers were used in total 48 groups at 4 lighting rooms divided into12 floor pens with four replicates. Average body weight (BW), feed intake (FI) and feed conversion ratio (FCR) were determined weekly. A significant interaction (P<0.01) between triticale substitution levels and PL was observed. INC-TO lighting schedule caused initially growth delay but over time can exhibit compensatory gain and shown that those BW 5.7% exceed the control group of CON-TO at 6 wk. However, the BW of CON-T50 and CON-T100 birds 5 and 35% lighter and had consumed 13 and 35% less feed than birds CON-T0 respectively by the end of 6 wk. Mortality rate was not affected by treatments. As a result, dietary triticale replacement at 50% or 100% of corn under CON, INT, INC and DEC photoperiod lengths negatively affected BW, FI and FCR for the entire starter and grower period (1-4 wk.) (P<0.01).

Keywords: Broilers, triticale, lighting, photoperiod length, growth performance

Farklı Aydınlatma Programları Altında Yetiştirilen Etlik Piliçlerde Mısıra Dayalı Rasyonlara Tritikale İkamesinin Büyüme Performansı Üzerinde Etkileri

Öz

Bu çalışma farklı aydınlatma süreleri altında yetiştirilen etlik piliçlerin mısır esaslı yem karmalarına farklı seviyelerde tritikale ikamesinin büyüme performansı üzerinde olumsuz etkisi olup olmadığını belirlemek amacıyla yürütülmüştür. Denemede 0-42 günler arasında, tamamıyla şansa bağlı 3x4 faktöriyel düzende, 4 farklı (Sürekli-CON, Kesikli-INT, Artan-INC, ve Azalan-DEC) aydınlatma programı ile 3 farklı tritikale seviyesi (%0 -T0; %50 -T50 ve %100 -T100) kullanılmıştır. Çalışmada, 4 farklı aydınlatma odasında 12 bölme ve toplam 48 grupta 4 tekerrürlü olarak, günlük yaşta, cinsiyet ayrımı yapılmış 960 adet Ross 308 etlik civciv kullanılmıştır. Ortalama canlı ağırlık (CA), yem tüketimi (YT) ve yemden yararlanma oranları (YYO) haftalık olarak belirlenmiştir. Tritikale ikame seviyeleri ve aydınlatma programları (PL) arasında interaksiyon önemli bulunmuştur (P<0.01). INC-TO aydınlatma programında CA artışı başlangıçta yavaşlamış fakat 6. haftanın sonunda telafi büyümesi göstererek CON-T0 grubunun ortalama canlı ağırlığını %5.7 oranında ileri geçmiştir. Bununla birlikte, 42. gün sonunda CON-T50 ve CON-T100 grubu etlik piliçler, CON-T0 grubuna göre sırasıyla %5 ve %35 daha düşük CA'ya erişmiş ve sırasıyla %13 ve %35 daha az yem tüketmişlerdir. Ölüm oranı muamelelerden etkilenmemiştir. Sonuçta, CON, INT, INC ve DEC aydınlatma programlarında etlik piliç yem karmalarında mısırın %50 ve %100 oranında tritikale ile ikame edilmesi başlangıç ve büyüme dönemlerinde (ilk 4 hafta) CA, YT ve YYO oranlarını önemli derecede olumsuz etkilemiştir (P<0.01).

Anahtar Kelimeler: Etlik piliç, tritikale, aydınlatma, ışık periyodu uzunluğu, büyüme performansı

Introduction

Corn is almost an unalterable energy source in poultry diets but its high cost is a major delimiting factor in formulating the ration and should be reduced for economic reasons (Korver et al. 2004; Zarghi and Golian, 2009). Cereal grains as wheat, barley and triticale are commonly used in rations in areas of the world where it is available or considered economical. Triticale grain with a total global production 13,2 million ton in 2014 (Faostat, 2014) is also an alternative feed source to corn for poultry. Variable results from triticale feeding experiments are reported in the scientific literature. However, triticale has not traditionally been a popular component of feed mixtures for broiler chickens due to highly variable chemical composition of grains. In addition, triticale contains some anti-nutritional factors (Pourreza et al. 2007) such as soluble arabinoxylane that can inhibit digestion and absorption of nutrients in digestive tract and decrease the performance of broiler chickens (Bedford and Schulze, 1998). The nutritive value of rye, wheat and triticale is highly related to their soluble Non Starch Polysaccharide (NSP) contents that increase gut viscosity. This in turn affects the availability of nutrients for digestion and absorption (Bedford and Classen, 1992; Choct, 2006). However, broilers lack enzymes that digest fibrous components or cell wall fractions of diets such as those that contain cereal grains, so the high inclusion of cereal grains in poultry diets can retard digestive organs, increase unwanted gut microbial activity, reduce feed conversion and inhibit growth and carcass quality (Choct, 2006). It is likely that the feed ingredients and environmental factors such as using different level of triticale under different photoperiod length (PL) may effect on early growth rate of broiler.

Studies on lighting programs for broilers have to take into account of the new European legislation (EU Council Directive 2007/43/EG) that imposes a photoperiod of minimum 6 h per day with a period of at least 4 h uninterrupted darkness since 30 June 2010. Lighting programs have shown to influence the performance of broiler chicken. Classen and Riddell (1989), reported that broilers tend to eat in the light rather than in the dark, indicating that under continuous lighting programs, feed intake and growth rate can be maximized. Renden et al. (1993) and Sanotra et al. (2002) demonsrated that CON lighting programs increase mortality rate of the birds due to metabolic disorders and leg abnormalities compared to periods of darkness. INT schedules consist of repeated short light (L) and dark (D) cycles effect bird behavioral patterns of activity and sleep when imposed at young age. Classen (2004b) and Rahimi et al. (2005) reported that INT programs have resulted in superior broiler productivity in comparison to constant light. It has been also reported that the broilers exposed to more frequent alternation of light and dark periods are more active during periods of light (Ferrante et al. 2006) and that the rhythm of feeding in moderate photoperiod changes so that the peak of the food intake is reached at the beginning and at the end of the light period (Gordon, 1999). Charles et al. (1992), reported that a lighting program beginning with an long dark period and increased the day length gradually resulted not only reduced early growth rate, reduced feed intake, but also improved FCR, compensatory growth, stimulated sexual maturity as early as 7 wk and improved chicken livability when compared with those exposed to near CON constant photoperiod program. However, INC PL where the photoperiod increases abruptly from 6 h to 23 h at 21 days of age or more gradually (INC: d0-d3: 24L:0D; d4-d14: 6L:18D; d15-d21: 10L:14D; d22-d28: 14L:10D; d29-d35:18L:6D; d36-d42: 3L:1D) have proved to be successful (Gordon, 1994). It is common knowledge that long photoperiods negatively affect feed intake and hence growth rate of broilers (Olanrewaju et al. 2013). Birds required for constant energy intake for maintenance and then growing therefore, it is possible that shorter day lengths may result in adverse effects on production performance of broilers fed triticale.

Feed intake is affected by light duration, indicating that there may be interactions between the lighting length and nutrient main source as triticale. Some researchers also reported that triticale can have effects on BW, FC and FCR on negative or positive way (Korver et al. 2004; Józefiak et al. 2007). Despite the potential for important interactive effects, relatively there was no study the interactions between triticale as a main feed source and PL. Therefore the objective of this study was to determine whether there exist interactions between different PL as CON, INT, INC and DEC and triticale 0, 50 and 100% as a main feed source to corn substitute in feed mixtures of broiler chickens grown to 42 d to achieve high yield performance while reducing early rapid growth and its associated mortality.

Materials and Methods

Animals, diets and lighting treatments

A total of 960 sexed Ross 308 broilers was reared under four different PL as CON, INT, INC (step-up) and DEC (step-down) and the amount of corn replaced with triticale as T0, 0% Triticale (control); T50, 50% Triticale; and T100, 100% in a corn based diet within a crumble form. Chicks were weighed for their initial weight and randomly placed into four light-tight environmentally controlled experimental rooms were subdivided into 12 experimental pens (1.0×2.0 m). Each treatment combination consisted of twenty experimental birds (10 birds/m^2 -10 males and 10 females) and replicated four times. Each pen was provided pine shaving litter, a hanging feeder and a bell drinker. Birds had access to feed and water on an *ad-libitum* basis. The house temperature was maintained at 32 ^oC during the first week of age, and a reduction of 3 ^oC/wk was practiced until the house attained a temperature to 25 ^oC/wk. Three dietary triticale levels (T0, T50 and T100) that consisted of starter, grower, and finisher diets were formulated to meet or exceed NRC (1994) recommendations (Table 1).

Birds were provided feed as starter (23% CP and 3000 kcal ME/kg of feed), grower (21% CP and 3175kcal ME/kg of feed), and finisher diet (20 CP and 3225 kcal ME/kg of feed) were provided from 0 to 11, from 12 to 28, from 29-42 days of age respectively. Nutrient compositions of experimental feeds are presented in Table 1. The treatment T0, served as control diet did not include any triticale. Triticale provided to starter, grower and finisher diets as 50, 55 and 58% in 0-42 d of age and T50 group triticale percentages were 25%, 27.5 and 29% respectively. Diets were formulated in *isocaloric* and *isonitrogenous*. No enzymes, antibiotics, coccidiostatic or other external agents were added to feed or drinking water.

For all bird, 23L:1D (20 lx) lightning program was provided in four rooms between 0-3 days of age. Lighting treatments were applied between 4-42 days of age with light intensity 5 lx. Summarizes specific details of each photoperiod length schedule programs is given Table 2. Birds BW and FI were determined at 1, 7, 14, 28, 35, and 42 d of age and were used to calculate average bird weight and FCR. Mortality rate and weight of all mortalities were recorded on a daily basis and these data were used to determine total percentage of mortality and correct FCR.

Table 1. Feed ingredient and nutrient composition of the experimental diets on as-fed basis

Ingredients (%)	Starter			Grower			Finisher		
	T0	T50	T100	T0	T50	T100	T0	T50	T100
Corn grain	50.00	25.00	---	55.00	27.50	27.50	58.0	29.00	---
Triticale grain	---	25.00	50.00	---	27.50	27.50	---	29.00	58.00
Soybean meal	32.18	28.18	25.50	31.30	27.00	27.00	30.00	24.80	18.70
Sunflower meal	8.00	10.94	12.30	4.00	7.00	7.00	2.40	6.33	11.00
Vegetable oil	3.52	4.63	6.00	5.12	6.02	6.02	5.23	6.50	7.95
Meat and bone meal	4.00	4.00	3.80	1.80	1.70	1.70	1.70	1.70	1.70
Limestone	0.80	0.78	0.80	0.90	0.90	0.90	0.90	0.90	0.90
Premix (Vit,Min)*	0.20	0.20	0.30	0.25	0.25	0.25	0.20	0.20	0.20
DCP	0.84	0.87	1.00	1.20	1.20	1.20	1.20	1.20	1.20
DL-methionine	0.04	0.04	0.06	0.08	0.08	0.08	0.04	0.04	0.02
L-Lysine	0.08	0.06	0.05	0.05	0.07	0.07	0.03	0.03	0.03
NaCl	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Calculated analysis									
ME (Kcal/Kg)	3000	3000	3010	3176	3178	3179	3210	3209	3210
CP (%)	23.0	23.1	23.0	20.9	20.9	20.9	19.9	19.9	19.9
CF (%)	4.63	4.69	4,72	3.64	4.64	4.64	3.41	4.41	4.42
Calcium (%)	1.00	1.00	1.00	0.88	0.88	0.88	0.86	0.87	0.87
Available P (%)	0.50	0.50	0.51	0.45	0.44	0.46	0.44	0.44	0.43
Lysine (%)	1.40	1.40	1.40	1.27	1.26	1.26	1.14	1.14	1.14
Methionine (%)	0.55	0.55	0.54	0.53	0.53	0.53	0.43	0.43	0.43
Meth.+Cysteine (%)	0.95	0.95	0.96	0.85	0.85	0.86	0.78	0.78	0.77

*The vitamin and mineral premix provide the following quantities per kilogram of diet: vit. A, 9000 IU; vit. D_2, 1500 IU; vit. E, 10 IU; vit. K_3, 0.5mg; vit. B_{12}, 0.007 mg; thiamin 6 mg; folic acid, 1 mg; biotin 0.15mg, niacin, 35 mg; pyrodoxine, 4 mg; kolin klorid, 1.000 mg; ethoxyquin, 0.125 g; manganese, 60 mg; copper, 5 mg, zinc, 50 mg; selenium, 0.1 mg; iodine, 0.35 mg.

Table 2. Experimental photoperiod length schedule program (L: Light, D: Dark)

CON		**INT**		**INC**		**DEC**	
Age (days)	Photoperiod	Age (d)	Photoperiod	Age (d)	Photoperiod	Age (d)	Photoperiod
0-42	23L:1D	0-3	23L:1D	0-3	23L:1D	0-3	23L:1D
		4-42	6x 3L:1D	4-14	12L:12D	4-14	18L:6D
				15-21	14L:10D	15-21	16L:8D
				22-28	16L:8D	22-28	14L:10D
				29-42	18L:6D	29-42	12L:12D
Total (h/42d)	972		702		565		565
Average (h/d)	23.0		16.7		13.5		13.5

All statistical analyses were done from pen means. Data were analyzed as a 4×3 factorial design with pen representing the experimental unit. The significance of treatment main effects and interactions for BW, FI, FCR and mortality parameters were determined using ANOVA - GLM procedure of the SAS (2002) statistical package. The ANOVA included the main effects of nutrient triticale levels (3) and PL (4) as well as 2-way interactions that may have occurred between these factors. Mean values were separated by using Duncan's multiple range test. The data were assumed to be statistically significant when $P<0.05$.

Results and Discussion

The replacement of triticale in starter and grower diets of broilers resulted in lower BW in T50 and T100 groups as compared to control (T0) diet under all lighting schedules from d 7 to d 42 ($P< 0.01$). The highest BW was obtained from the broilers fed with INC-T0 of group, while the lowest was the INC-T100 group. Body weight was significantly affected by dietary high level of triticale ($P< 0.01$). In this experiment, even the more severe group T100, not allowed the recovery of final BW. ABW results and interactive data with statistical interpretation are shown in (Table 3). The overall effect of the treatments was that chicks' growth rate decreased with increasing triticale levels with INC-T100 treatment being more growth inhibitive than T50 groups under different photoperiod lengths. The general trend was observed that as triticale increased up to 50-58% in the diet, BW tended to be decrease. Triticale used as a main feed source more than 25% of starter and grower diets in first 3 weeks reduced BW and FI, but increased FCR of broiler under CON, INT, INC and DEC photoperiod length. Body weights are changing initially reduces BW gain at a young age then followed by a period of compensatory growth after 4 wk. On the other hand, T50 and T100 treatments compensatory growth were not completed up to d 42, resulting in a lower body weight at slaughter age compared to that of their age-matched T0 counterparts under all 4 PL. Long photoperiod programs reduced the early BW and FI, but increased FCR of broilers chicks that were fed T100 triticale, however, the FCR of chicks declined after d 28. These results also confirm that "early growth restriction induced by feed restriction has resulted in improved FCR, because of the decline in energy requirements for maintenance, and improved carcass quality resulted from the decrease in fat deposition" (Plavnik and Hurwitz, 1988). The study of Classen et al. (2004), stated that the treatments of 12L:12D,

Table 3. The effect of triticale levels and photoperiod length on average BW of broilers grown to 42 d[1]

Treatments		Average Body Weight (g/bird)						
		d 0	d 7	d 14	d 21	d 28	d 35	d 42
CON	T0	38.86	141.20^{a}	343.02^{a}	721.55^{a}	1194.00^{a}	1584.68^{ab}	2022.29^{ab}
	T50	38.82	118.03^{de}	261.34^{cd}	603.65^{cd}	1059.17^{bc}	1547.77^{abc}	1896.41^{b}
	T100	38.83	114.70^{e}	206.25^{fg}	357.81^{e}	581.19^{d}	1039.43^{d}	1395.41^{c}
INT	T0	38.89	146.11^{a}	350.44^{a}	738.37^{a}	1178.61^{a}	1637.00^{a}	1989.85^{ab}
	T50	38.83	116.54^{de}	270.62^{c}	602.33^{bc}	1020.23^{c}	1476.83^{bc}	1871.57^{b}
	T100	38.83	127.49^{cd}	227.15^{ef}	369.63^{cd}	541.31^{d}	968.45^{de}	1373.06^{c}
INC	T0	38.87	126.85^{dc}	311.30^{b}	664.62^{bc}	1116.24^{ab}	1636.69^{a}	2137.74^{a}
	T50	38.82	114.60^{e}	253.35^{cde}	549.65^{d}	980.40^{c}	1453.84^{c}	1968.47^{ab}
	T100	38.81	108.53^{f}	189.57^{g}	285.33^{f}	397.91^{e}	748.38^{f}	1129.95^{d}
DEC	T0	38.86	140.12^{ab}	301.57^{b}	630.31^{bc}	1064.77^{bc}	1551.56^{abc}	2020.02^{ab}
	T50	38.83	113.10^{e}	255.25^{cde}	583.75^{cd}	1029.10^{bc}	1463.02^{bc}	1898.83^{b}
	T100	38.87	129.65^{bc}	236.21^{de}	358.04^{e}	504.95^{d}	896.87^{e}	1319.83^{c}
SEM		0.02	2.59	6.79	12.16	20.37	27.27	41.4
		Probability						
Light ×Triticale		NS	**	**	**	*	**	**

[1] Values are least squares means of 48 pens with each pen having 20 birds at placement
Values presented as X; [a-f] :Means within columns with no common superscript differ at *: P<0.05, **: P<0.01,
NS: Non-Significant

16L:8D and 20L:4D lighting schedules demonstrated clearly that longer periods of darkness prevent regular access to feed and consequently reduce feed intake and limited growth. Choct, (2006) reported that broilers lack enzymes that digest fibrous components or cell wall fractions of diets such as those that contain cereal grains. That's why birds in the early stage have an immature gastrointestinal tract which may reduce triticale utilization, On the other hand, broiler chicks reared under DEC photoperiod showed a temporary growth delay during the early growth period as INC treatment but after adaptation, compensated the growth during the late period. These data indicated that T50 or T100 triticale levels under CON, INT, INC and DEC PL can reduce the early growth rate, but that not allow birds to compensate as they approach market age, comparing with T0 with all lighting program.

The treatments of INC photoperiod also reduced both early growth rate and feed intake in comparison with longer day lengths (23L:1D) with CON photoperiod. However, the characteristic effect of INC lighting program became apparent with 12L:12D starting from d 4 and followed by increasing 2 hours light each week. On the other hand, broiler chicks subjected to INC-T0 treatment not only attained a significantly higher BW and FI, but also had slightly better FCR as compared to CON-T0 treatment at 6 wk. The effects of short day length on the growth rate were expected and similar to the results of previous research (Gordon, 1994; Duve et al. 2011; Olanrewaju et al. 2013). In contrast these findings do not fully concur with the result of Classen and Riddell (1989) who observed under continuous lighting programs which feed intake and growth rate should be maximized. The reduction in BW with prolonged exposure to darkness might be due to the decreased duration of feed intake (Renden et al. 1993), which implies that, the 12L:12D photoperiod length was not sufficient to allow birds to achieve their growth potential, especially for those on T100 diet in our study. It appears that the main effect of INC and DEC lighting programs is slowing the growth in the early stages of broiler to alleviate early high growth in order to gain more BWG (Figure 1).

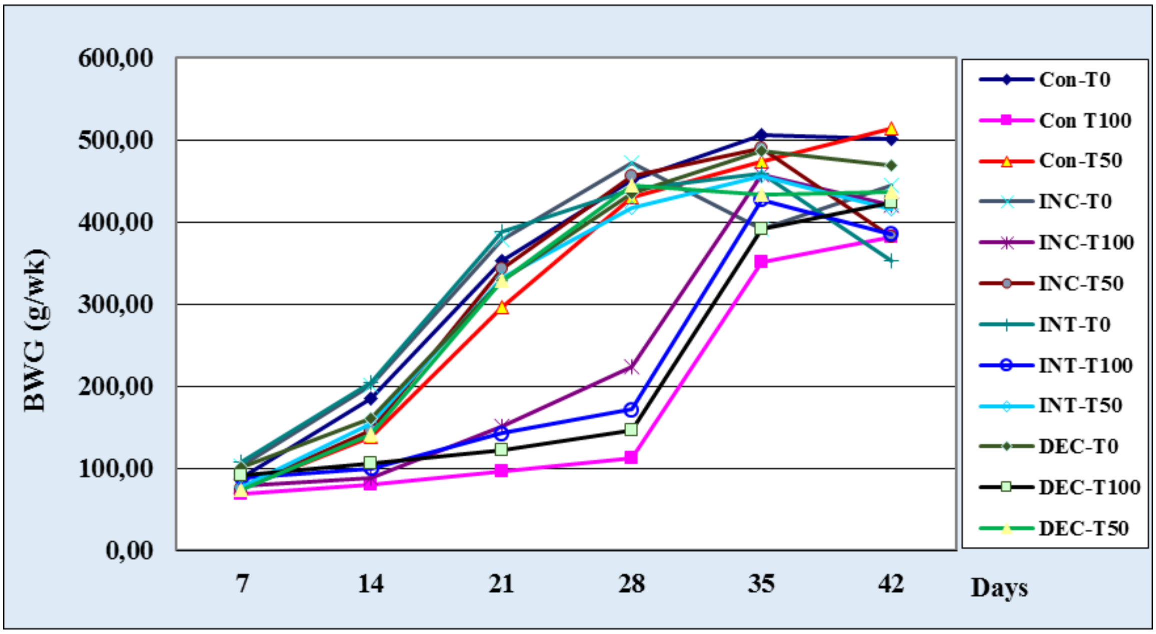

Figure 1. The effect of photoperiod length and triticale levels on body weight gain of broilers

Broilers provided with CON-T0 and INC-T0 ate more feed overall than the birds provided with INT-T0 and DEC-T0 respectively (Figure 1.). Birds in the INC and DEC treatments consumed less feed, which resulted in reduced BW. On a calculated basis, the FI of T50 and T100 diets were 11 and 36% lower than diet T0 respectively. Broilers demonstrated the remarkable ability to response light stimulation with triticale feeding at different age by increasing feed intake and the increasing growth rate (Table 4). Triticale as a main feed ingredient under all four PL affected the feed intake during the entire period except 35d phase, but performance of birds fed T0 were a slightly better than those fed T50 as evidence by higher weight gain.

Table 4. The effect of triticale level and photoperiod length on average feed intake of broilers grown to 42 d[1]

Treatments		Average Feed Intake (g/bird)					
		d 0 to 7	d 0 to 14	d 0 to 21	d 0 to 28	d 0 to 35	d 0 to 42
CON	T0	132.56[a]	454.86[a]	1141.23[a]	2177.20[a]	3105.31	4227.35[a]
	T50	114.15[bcd]	327.73[c]	932.07[bc]	1725.49[d]	2680.59	3662.56[d]
	T100	113.21[bcd]	300.59[cd]	634.20[ef]	1064.05[ef]	1788.90	2725.93[e]
INT	T0	137.43[a]	451.09[a]	1111.61[a]	2148.94[ab]	3069.15	3994.61[bc]
	T50	111.25[cd]	252.75[d]	829.10[cd]	1628.22[d]	2543.59	3549.66[d]
	T100	119.16[bc]	323.97[c]	733.80[de]	1146.79[e]	1845.79	2725.68[e]
INC	T0	117.74[bc]	397.63[b]	991.98[b]	2043.99[bc]	3043.87	4196.22[ab]
	T50	106.10[de]	336.33[c]	854.24[c]	1628.38[d]	2572.07	3708.51[d]
	T100	96.59[f]	267.31[d]	593.15[f]	943.05[f]	1526.36	2328.59[f]
DEC	T0	132.74[a]	412.41[ab]	981.86[b]	1933.29[c]	2865.00	3938.97[c]
	T50	101.69[ef]	335.05[c]	862.30[c]	1634.09[d]	2523.05	3587.30[d]
	T100	121.45[b]	340.70[c]	668.09[ef]	1062.04[ef]	1705.48	2557.34[e]
SEM		2.67	13.65	29.74	37.46	54.14	69.73
				ability			
Light ×Triticale		**	**	*	*	NS	**

[1] Values are least squares means of 48 pens with each pen having 20 birds at placement
Values presented as X; [a-f]: Means within columns with no common superscript differ at *: P<0.05, **: P<0.01, NS: Non-Significant

However, CON-T0 broiler group was the most efficient group between 7-42 d periods as compared to the other photoperiod length groups. The birds in INC-T50 consumed more feed than those in the other 3 PL (CON, INT and DEC) with T50 but that they had similar body weight at 42 d. Hence, the findings draw attention to the need to consider that T100 treatment not only reduced growth rate and FI of broilers but also increased the FCR based on photoperiod length. Contrary to the results of our experiment, Vieira et al. (1995), reported that inclusion of the graded triticale up to 40% (substituted for corn) had no negative effect on weight gain or final BW of broilers. Whereas, negative effects regarding the decrease in birds' BW by feeding triticale were observed by Korver et al. (2004) who is in agreement with our results. Additionally, our present study concur with the findings of Hermes and Johnson (2004) who reported that feeding broiler chicks with triticale up to 15% in corn diet have no negative effect their performance. In the current study, minimum substitution level of triticale to corn was 25% in T50 diets (containing 25, 27.5 and 29 percent in starter, grower and finisher period) and this percentage of triticale caused a negative effect for BW, FI and FCR. Interestingly, the BW of birds fed T100 under INT, DEC and INC photoperiods were 2, 5 and 19% lower than CON-T100 at d 42 respectively. From the viewpoint of performance of broiler chickens, it can say that a suggestible substitute percentage of triticale may be below 50% of corn in broiler diets. Korver et al. (2004), reported that the limited replacement of the main cereal grain might have hidden any negative effects of triticale. At this manner, this suggestion is to be an answer the research question that “the substitution level of corn should be reduced in broiler diet for economic reasons” mentioned previously by (Korver et al. 2004; Zarghi and Golian 2009). High level of triticale feeding reduced feed intake significantly; however, the degree of reduction was greater when broilers were fed T100 treatment. An interaction was also found between triticale levels and photoperiod length on average feed intake except 5 wk. of age (P<0.01). Feed intake declined in a linear manner as dietary triticale inclusion increased when birds were fed T100 (Figure 2).

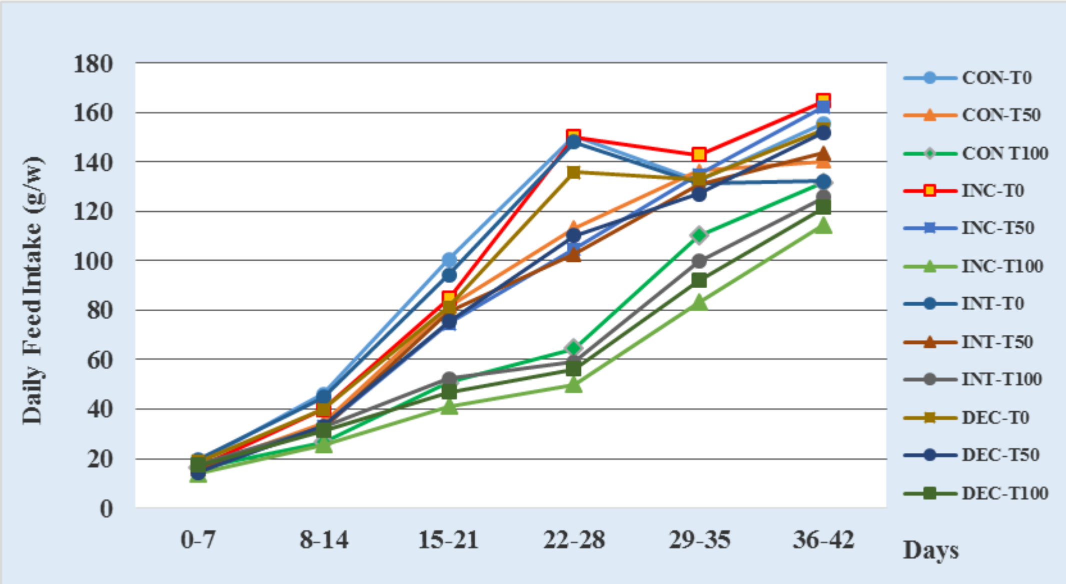

Figure 2. The effect of photoperiod length and triticale levels on daily feed intake of broilers

It was noted that a lower FI was obtained with improved FCR and the superior BW of the chicks under INC-T0 group due to the short meal feeding period, followed by a longer period of digestion (Figure 2.). Lower FI and BW of T100 treatment under all photoperiod length might have been caused by the fact that absent of enzymes in gastrointestinal tract of broiler chicks in early period up to 28 d of age.

Lighting programs, affect physical activity rhythm of feeding of chickens. It is believed that the broilers exposed to more frequent alternation of light and dark periods are more active during periods of light (Ferrante et al. 2006) and that the rhythm of feeding in moderate photoperiod changes so that the peak of the feed intake is reached at the beginning and at the end of the light period (Gordon, 1999). Additionally, Classen et al. (1991) and Classen (2004) reported that livability, BW, FCR and percentage condemnations were improved in broilers exposed to restricted photoperiods, as compared to broilers subjected to continuous light [24]. This result was also reflected in the current study with INT PL program.

Broilers can regulate their feed intake based on lighting length levels as long-dark period may reduce their feed intake in comparison with those fed in the long-light period. In the current study, this regulation related with long-dark period during the first 1-4 wk. of age might have caused the BW reduction by feeding high level triticale as T100. On the other hand, broilers that were exposed to the long-dark period in early periods, especially those fed T0 and T50 levels triticale under the INC or DEC lighting programs, showed that broiler chicks regulated their feed intake to achieve a compensatory growth, but the situation is not the same extent as T100 treatment. In the present experiment, high levels triticale as T100 under all 4 photoperiod length for broilers negatively affected FI while worsening BW and FCR of broiler chicks d 7 to d 42.

FCR was affected by triticale levels under all 4 photoperiod length regimes. A triticale level x photoperiod length interaction (P<0.01) was detected for FCR for all measurement periods except 0 to 7d but as birds aged, there was an increasingly significant effect of high level of triticale (Table 5.). FCR decreased linearly with decreasing triticale levels as T50 level under all PL.

Table 5. The effect of triticale level and photoperiod length on FCR and mortality of broilers to 42 d[1]

Treatment		FCR						Mortality
		d 0 to 7	d 0 to 14	d 0 to 21	d 0 to 28	d 0 to 35	d 0 to 42	%
CON	T0	1.29	1.50[ab]	1.67[c]	1.89[cd]	2.01[b]	2.12[a]	0.0
	T50	1.51	1.46[b]	1.65[c]	1.69[de]	1.77[c]	1.93[c]	1.25
	T100	1.43	1.80[a]	1.98[b]	1.96[c]	1.79[c]	1.92[c]	0.0
INT	T0	1.28	1.45[b]	1.59[c]	1.88[cde]	1.92[bc]	2.05[ab]	0.0
	T50	1.43	1.10[c]	1.46[c]	1.66[de]	1.77[c]	1.91[c]	5.0
	T100	1.34	1.72[ab]	2.23[ab]	2.29[b]	1.99[b]	2.07[ab]	3.75
INC	T0	1.34	1.46[b]	1.59[c]	1.90[cd]	1.93[bc]	2.01[bc]	0.0
	T50	1.40	1.57[ab]	1.68[c]	1.73[cde]	1.82[c]	1.92[c]	1.25
	T100	1.39	1.77[a]	2.41[a]	2.63[a]	2.16[a]	2.13[a]	3.75
DEC	T0	1.31	1.57[ab]	1.66[c]	1.88[cde]	1.90[bc]	1.99[bc]	0.0
	T50	1.37	1.55[ab]	1.58[c]	1.65[e]	1.77[c]	1.93[c]	1.25
	T100	1.34	1.73[ab]	2.10[b]	2.29[b]	1.99[b]	1.99[bc]	0.0
SEM		0.02	0.052	0.054	0.046	0.029	0.022	-
				Probability				
Light ×Triticale		NS	*	**	**	**	**	NS

[1] Values are least squares means of 48 pens with each pen having 20 birds at placement
Values presented as X; [a-f]: Means within columns with no common superscript differ at *: P<0.05, **: P<0.01,
NS: Non-Significant

Accordingly, Choct (2006), reported that broilers lack enzymes that digest fibrous components or cell wall fractions of diets such as those that contain cereal grains, so the high inclusion of cereal grains in poultry diets can retard digestive organs, increase unwanted gut microbial activity, reduce feed conversion and inhibit growth and carcass quality. Furthermore, King et al. (2000) reported that changes in trace mineral absorption and excretion through the gastrointestinal tract are the primary mechanisms for maintaining trace mineral homeostasis. The effect of triticale with T100 on FCR in relation to age of birds was higher than T0 and T50 up to 28 d of age. FCR of broilers increased from 7 to 28 d for INC, DEC and INT within T100 treatment, but it declined after 28 d (Figure 3).

Relatively large differences were observed for the triticale treatments for shorter day lengths. This can be readily seen by comparing the relative FCR of birds fed T0 diets. Therefore, explanation may have been the result of differences cause of PL with nutrient digestibility and effects on the dietary ingredients as triticale and corn. However, poorer FCR with triticale-based diets for broilers were observed (Vieira et al. 1995). Smith et al. (1989) who reported that 4 to 5% reduction in average FCR for broilers fed triticale compared with a corn control diet from 0 to 2 wk and from 2 to 3 wk of age. Many other factors, such as lower nutrient amounts, limited nutrient availability, or anti-nutritional factors, variability in triticale genotypes, bird genotype may affect the results of poorer FCR of the triticale-fed birds.

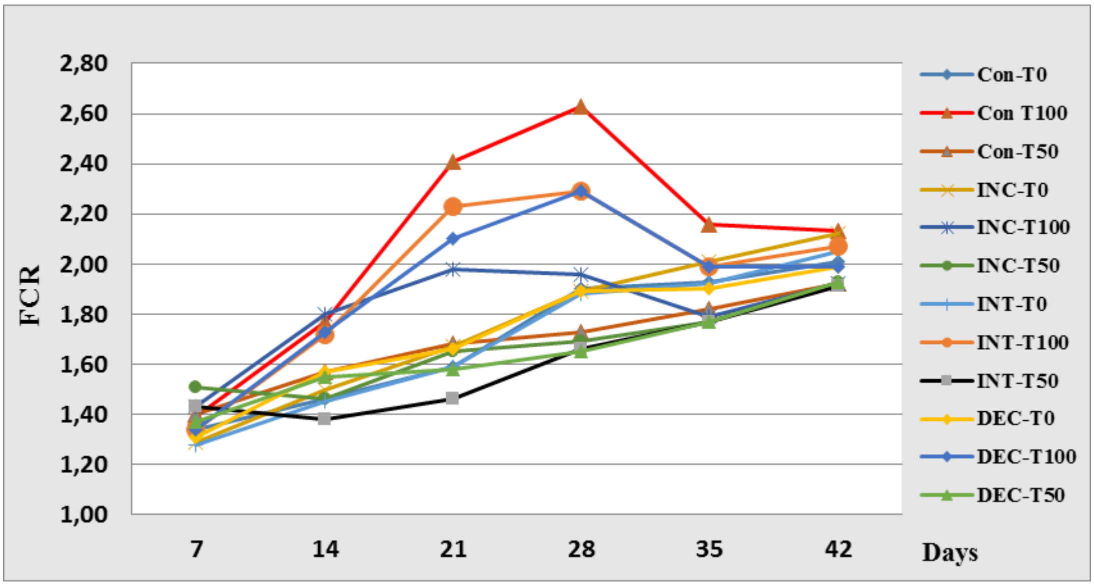

Figure 3. The effect of photoperiod length and triticale levels on FCR of broilers

Mortality rate did not differ between increasing levels of triticale diets under all photoperiod length (Table 5). Overall mortality for birds feeding T50 and T100 triticale diets were numerically slightly higher in comparison with fed T0 diets. However, broilers fed T100 rations within INC and INT had a higher incidence of mortality (3.75%) than broilers fed corn rations (T0). CON lighting programs have a significant effect on mortality compared with birds exposed to periods of darkness (Scott, 2002). In the current study, the reason of lower mortality was probably due to the low bird density in (10 birds/m^2) each pen.

Conclusion

It is concluded that different levels of triticale in broiler diets under different photoperiod lengths have significantly affected of broiler performance as BW, FI and FCR and also an interactive effect identified between triticale as a main diet source and different photoperiod lengths. INC-TO lighting schedule caused initially growth delay but over time can exhibit compensatory gain and shown that those BW exceed 5.7% of the control group of CON-TO at 42 d. However, the BW of CON-T50 and CON-T100 birds 5 and 35% lighter and they consumed 13 and 35% less feed than birds CON-T0 respectively by the end of 42 d. Birds fed T100 had (P<0.01) lower BW than those fed T0 (control) and T50, whereas BW of T50 was also better than those T100 under all photoperiod lengths. Mortality rate was not affected by treatments. As a result, triticale usage more than 50% instead of corn in broiler diets under CON, INT, INC and DEC photoperiod schedule broiler performance characteristics significantly affected (P<0.01). INC photoperiod can be used as a successful tool to reduce early growth rate for T0 diet, but that not allow birds to compensate as they approach market age with T50 and T100 diet. Using graded levels of triticale, this study has clearly demonstrated deleterious effects of increasing triticale on early body weight, feed intake and gain to feed. Dietary triticale replacement at or above quite modest levels (50% of corn) under CON, INT, INC and DEC photoperiod lengths negatively affected BW, FI and FCR for the entire starter and grower period (7-28 days).

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