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THE EFFECTS OF TRITICALE REPLACEMENT IN MAIZE BASED BROILER DIETS WITHOUT ENZYMES SUPPLEMENTATION ON GROWTH PERFORMANCE AND CARCASS TRAITS

Eyup BAŞER[1]*

[1]Bahri Dağdaş International Agricultural Research Institute, Konya, Turkey
*Corresponding author: ebaser32@gmail.com

Abstract

The effects of different levels of triticale replacement with maize based diets without any enzymes supplementation on growth performance and carcass traits of broiler chickens were studied. A 42-day feeding trial involving sexed 960 day old Ross-308 broilers with 48 group four replicates for 3 feed treatments in 4 rooms was carried out in a completely randomized design. Starter (23% CP and 3000 kcal ME/kg of feed), grower (21% CP and 3175kcal ME/kg of feed), and finisher diets (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 as the dietary phase respectively. Diets containing either maize (M) as a control group; triticale (T) as a sole grain source and Maize+Triticale (MT) mixture were used. Triticale was provided % 50, 55 and %58 in starter, grower and finisher M and T groups' diets in total and MT group percentages were 25%, 27.5, and 29% in the feeding periods respectively. No enzyme added to diets phytase included. Live body weihgt (BW), feed consumption (FC) were recorded weekly up to the 42d of age. At 42 d, 6 bird (3 male and 3 female) per pen in total 288 birds were used for evaluation of carcass traits. Overall, the triticale-fed birds had lower final body weight (BW) and higher feed conversion ratio (FCR). Eviscerated carcass, thigh, drum and breast as a percentage of carcass weight were lower in T and MT groups 36 and 6% than M (control group) respectively as BW and FC. Final BW, carcass weight and slaughter traits of broilers fed triticale were affected negatively within similar percentage by increasing inclusion of triticale to diets without any enzyme.

Keywords: *broilers, maize, triticale, enzyme, growth and carcass performance*

Introduction

Maize is the most important inputs in feed mixtures for broilers and uses extensively as an energy source for poultry but its content in diets should be reduced for economic reasons (Korver et al., 2004; Józefiak et al., 2007; Zarghi and Golian, 2009). Studies on the possibility of using triticale in broiler chicken diets were carried out in the 1980s and 1990s (Proudfoot and Hulan, 1988; Klocek and Adamczyk, 1994), but they generally concentrated on the estimation of rearing performance and showed decreased live weight gain and increased feed conversion ratio. Triticale is a grain that competes with other species in terms of lower soil requirements and high yielding potential and nutritive value. Triticale, however, was not a popular component of mixtures for broiler chickens because it has the most changeable chemical composition of all grains and contains anti-nutritional factors (Pourreza et al., 2007). Triticale is a hybrid of wheat and rye and its nutritive value vary between its parents. It is established that the main antinutritional factor of these grains is soluble arabinoxylane that can inhibits digestion and absorption of nutrients in digestive tract and decrease the performance of broiler chickens (Bedford and Schulze, 1998). Soluble indigestible polysaccharides may also affect the water consumption in broilers (Van der Klis et al., 1993). Nowadays above mentioned problems are seems solved by supplementation of specific feed enzymes to the diets. Some negative effects can be eliminated that way of addition of enzymes such as ß-glucanase, arabinase and xylanase to grain-based feed mixture have been reported (McNab, 1999; Malthlouthi et al. 2002; Toker and Ergene, 2004). On the other hand, different effects on broilers have been reported that using enzymes with triticale in broiler feed mixture. Azman et al., (1997) reported that have no any positive impact on the broiler performance using xylanase and protease enzyme complex containing 1g/kg dose in triticale. Karaalp and Ozsoy, (2001), also reported that more than 30% triticale in broiler diets has been reduced yield performance and efficiency and hasn't improved in that situation

even adding enzyme to triticale. However, broilers lack enzymes that digest fibrous components or cell wall fractions of diets such as those that contain cereal grains. In broilers, different enzymes play an imperative role in the utilization of different nutrients i.e. amylase can digest starch, protease can digest protein and lipase can digest fats. Although the role of enzymes in improving feed utilization, growth, meat quality and economics has been well reported, their quality, consistency and reproducibility have been questioned by many researchers (Anjum and Chaudhry, 2010). There are some uncertainty about the enzymes usage with triticale in poultry nutrition and also particularly conflicting about the positive or negative effects of enzyme supplementation to triticale in poultry feed. Recent findings (Korver et al., 2004; Józefiak et al., 2007; Santos et al., 2008) were not so clear and in most cases showed no effect of grain on slaughter traits and quality of poultry meat. Therefore the objective of this study was to determine the effect of triticale without any enzyme supplementation as a partial or complete maize substitute in feed mixtures on some yield performance and carcass traits of broiler chickens.

Materials and Methods

A 42-day, 3 feed resources feeding trial involving sexed 960 day old Ross-308 broilers was carried out in a completely randomized design. There were 320 chicks per treatment within 48 sub-groups each and 4 replication having 20 chicks in separated 4 rooms. The initial live weights of the day old chicks were about 38g. New wood shavings at a depth of approximately 10 cm were used as bedding material over the concrete floor. The house temperature was maintained at 32 °C during the first week of age, and a reduction of 3°C/wk was practiced until the house attained a temperature of 25°C. Feed (crumbled) and water were provided ad libitum and 24-h 23L 1D lighting was provided throughout of the study. The dietary treatments groups were M (100% maize + 0% triticale) T (100%triticale + 0% maize) and MT (50% maize+50% triticale). Triticale was provided % 50, 55 and %58 in starter, grower and finisher M and T groups' diets in totally and MT group percentage was 25%, 27.5, and 29% in the feeding periods respectively (Table 1). No enzyme added to diets phytase included. The basal starter and grower diets were formulated in izocaloric and izonitrogenic according to the Ross requirements guideline. Any enzymes or antibiotics, coccidiostat and other external agents were not added to feed or drinking water. The birds were not vaccinated any disease. Live BW, feed consumption (FC) and FCR were recorded weekly up to the 42d of age. FCR for a whole period was calculated dividing the total feed consumed by the cumulative BW attained the period.

Table 1: Feed Ingredients of maize-based diet used in broiler starter, grower and finisher periods of experiment replacing by different levels of triticale

Ingredients (%)	**Starter (1 to 11 d)**			**Grower (12 to 28 d)**			**Finisher (29 to 42 d)**		
	M	**T**	**MT**	**M**	**T**	**MT**	**M**	**T**	**MT**
Maize grain	50.00	---	25.00	55.00	---	27.50	58.0	---	29.00
Triticale grain	---	50.00	25.00	---	55.00	27.50	---	58.00	29.00
Soybean meal	32.18	25.50	28.18	31.30	26.00	27.00	30.00	18.70	24.80
Sunflower meal	8.00	12.30	10.94	4.00	6.50	7.00	2.40	11.00	6.30
Vegetable oil	3.52	6.00	4.63	5.10	7.50	6.50	5.20	7..9	6.50
Meat and bone meal	4.00	3.80	4.00	1.80	2.10	1.70	1.70	1.70	1.70
Limestone	0.80	0.80	0.74	0.90	1.00	0.90	0.90	0.90	0.90
Premix (Vit,Min)*	0.20	0.30	0.20	0.25	0.25	0.25	0.20	0.20	0.20
DCP	0.84	1.00	0.87	1.20	1.20	1.20	1.20	1.20	1.20
DL-methionine	0.04	0.06	0.04	0.08	0.08	0.08	0.04	0.02	0.04
L-Lysine	0.08	0.05	0.06	0.05	0.06	0.07	0.03	0.03	0.03
Salt(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	3010	3000	3167	3174	3179	3211	3210	3209
CP (%)	22.9	23.0	23.1	20.9	21.0	20.9	19.8	19.9	19.9
CF (%)	4.13	5.19	4.72	3.64	4.64	4.26	3.41	4.90	4.10
Calcium (%)	1.00	1.04	1.00	0.88	0.95	0.88	0.86	0.88	0.87
Available P (%)	0.50	0.51	0.50	0.45	0.46	0.44	0.44	0.43	0.44
Lysine (%)	1.40	1.39	1.40	1.27	1.31	1.26	1.13	1.16	1.15
Methionine (%)	0.55	0.54	0.55	0.53	0.51	0.53	0.40	0.44	0.43
Meth.+Sistin (%)	0.88	0.96	0.92	0.81	0.86	0.85	0.73	0.81	0.78

*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.

Carcass Yield Evaluation

At the 42 d of age, 6 bird/pen (3 male and 3 female) in total 288 birds were randomly selected which representing an average pen weight for slaughter and carcass traits. The birds were weighed, after overnight fasting of feed but not without water, slaughtered by severing the jugular vein and allowed to bleed thoroughly. Birds were scalded at 75°C in a water bath for about 30 seconds before defeathering and then the birds were eviscerated. Abdominal fat (surrounding the gizzard, cloaca and adjacent abdominal muscles) was removed and weighted for calculations. Hot carcass weights were recorded and dressing percentages calculated as a percent of live weight. The wings were removed by cutting anteriorly severing at the humeo-scapular joint; the cuts were made through the rib head to the shoulder girdle. Thighs and drumstick were dissected from each carcass and weighed separately.
Analyze the carcass characteristics such as live weight, carcass weight, carcass yields and the weights of breast, thigh, drumstick, wings, neck, giblets (gizzard, heart, liver) and abdominal fat data were collected and recorded by ex-pressed as kg a measuring scale. Carcass dressing percentage was calculated as total weights of the whole carcass + giblets, percentages of live body weight.

Statistical Analysis

All statistical analyses were done from pen means. Treatment effects were evaluated by ANOVA using the General Linear models (GLM) procedure of SAS software (SAS Institute, 1999). Duncan Test was used to estimate significant differences among treatment means.

Results and Discussion

Performance

BW, FC and FCR mean values of the study are summarized from 7.d to 42.d of age in Table 2. and Figure 1. Inclusion of different levels triticale to broiler diets caused a significant (P<0,01) differences in BW, total FC and FCR. Birds fed triticale were significantly (P<0,01) lower BW, when compared with the control-M and MT groups. The FC were also significantly decreased with inclusion of triticale in the broiler diet with 100% Triticale in overall periods when compared with the M, and MT (Figure 1.).

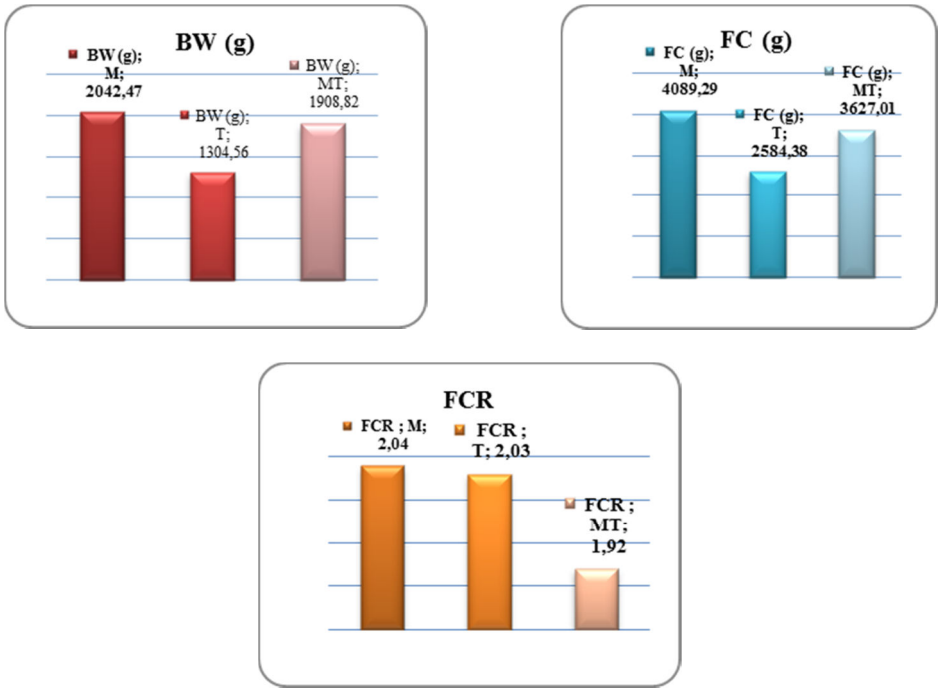

Figure 1. Performance Characteristics of broilers fed different level triticale replacement without any enzyme.

In this study, FCR was showed same pattern in M and T groups, but MT group's different that's FCR 6% was lower than in the control M group (P<0.01) (Table 1.). This may give an indication that inclusion of triticale without any enzyme did have a negative effect on performance characteristics.

Table 2. Performance Characteristics of broilers fed different level triticale replacement without any enzyme (Mean+SE)

Traits	Feed	7. d	14. d	21. d	28. d	35. d	42. d
BW	M	138.57 ± 2.21 *a*	326.58 ± 6.06 *a*	688.72 ± 13.00 *a*	1138.41 ± 18.20 *a*	1602.48 ± 18.80 *a*	2042.47 ± 21.00 *a*
	T	120.92 ± 2.60 *b*	214.79 ± 5.73 *c*	342.70 ± 10.20 *c*	506.34 ± 19.60 *c*	913.28 ± 30.60 *c*	1304.56 ± 33.80 *c*
	MT	114.75 ± 1.02 *c*	260.14 ± 3.70 *b*	584.85 ± 08.22 *b*	1022.23 ± 11.20 *b*	1485.37 ± 14.70 *b*	1908.82 ± 25.00 *b*
	P	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
FC	M	130.12 ± 2.17 *a*	429.00 ± 07.16 *a*	1056.67 ± 21.30 *a*	2075.85 ± 29.80 *a*	3020.83 ± 35.70 *a*	4089.29 ± 43.60 *a*
	T	112.60 ± 2.84 *b*	308.14 ± 09.31 *b*	657.31 ± 18.00 *c*	1053.98 ± 28.90 *c*	1716.63 ± 47.10 *c*	2584.38 ± 57.50 *c*
	MT	108.30 ± 1.83 *b*	312.96 ± 14.40 *b*	869.43 ± 24.90 *b*	1654.05 ± 18.90 *b*	2579.83 ± 27.90 *b*	3627.01 ± 36.80 *b*
	P	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
YDK	M	1.31 ± 0.010 *b*	1.50 ± 0.016 *b*	1.63 ± 0.016 *b*	1.89 ± 0.016 *b*	1.94 ± 0.017 *a*	2.04 ± 0.016 *a*
	T	1.38 ± 0.022 *a*	1.76 ± 0.025 *a*	2.18 ± 0.056 *a*	2.29 ± 0.072 *a*	1.98 ± 0.042 *a*	2.03 ± 0.025 *a*
	MT	1.43 ± 0.020 *a*	1.42 ± 0.069 *b*	1.59 ± 0.041 *b*	1.68 ± 0.014 *c*	1.78 ± 0.010 *b*	1.92 ± 0.009 *b*
	P	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01

a, b, c, :Means in rows with no common superscript differ significantly (P<0.01). Initial weights of treatment groups were not significant, then they not given on the table.

The poorer FCR of the triticale-fed birds may be due to lower nutrient amounts, limited nutrient availability, or antinutritional factors not found to the same extent in maize. However, other researchers have observed poorer FCR with triticale-based diets in broilers (Gerry, 1975; Proudfoot and Hulan, 1988; Vieira et al.(1995) Smith et al. (1989) reported 4 to 5% reduction in average FCR for broilers fed triticale compared with a maize control diet from 0 to 2 wk and from 2 wk to 3 wk of age.

Variable results in triticale feeding experiments are reported in the scientific literature. Azman et al., (1997) reported that 35% triticale (Tatlıcak) may be substituted to broiler diets. Karaalp and Ozsoy, (2001) reported that the rate of 30% triticale can be used without performance-enhancing feed additives for broiler chicks feed mixtures but the usage of a high rate triticale in feed mixtures cause decreasing of performance, so triticale cannot be used as a sole sources instead of maize for broiler chickens. Elsewhere, poultry feeding studies shows that diets containing up to 30% triticale have had no negative effect on performance with enzyme and result in significant saving of feed cost. Hermes and Johnson (2004) reported that feeding broiler chicks triticale up to 15% with maize did not affect their performance. Başer and Yetişir (2007), reported that triticale rate should not exceed 20% for broilers, 30% for laying hens, and 40% for quail and partridge feed mixtures. Negative effects regarding the decrease in birds' body weight by feeding triticale were observed by Korver et al., 2004) and others (Gerry, 1975; Ruiz et al., 1987; Smith et al., 1989) which agreed with our findings. However, other researchers disagreed with our results by reporting non-detrimental effect of triticale in poultry feeding trials. Vieira et al. (1995) found that the graded inclusion of triticale up to 40% (substituted for maize) had no negative effect on weight gain or final weight of broilers. In those studies, the limited replacement of the main cereal grain might have hidden any negative effect of triticale. Antinutritional factors in triticale include soluble pentosans (Pettersson and Aman, 1988, Rundgren, 1988) trypsin inhibitor, alkyl resorcinols, and pectins (Smith et al., 1989).
It was found that there were significantly differences between M,T, and MT groups for broilers BW, BWG, FC, and FCR at the end of trail. BW of birds fed M were %36 and %6 heavier than that fed T and MT groups respectively (P<0.01). The FC and FCR M, T and MT groups were (4089.29 ; 2.24); (2584.38 ; 2.20); (3627.0 ; 1.89) respectively at the end of the trail (P<0.01). Livability was not affected by M, T and MT groups treatments. Supplementation of triticale by 50-58% for broilers diets within the first 4 weeks without any kind of enzyme including phytase causes a very significant growth retardation. To obtain optimum efficiency broiler chicks should not feed triticale alone as a sole source without any kind of enzyme including phytase prior to 4 weeks. Instead of triticale alone as a sole source, a 50% corn and triticale mixing by half in the case generally compensated possible growth retardation.

Carcass characteristics

Carcass characteristics as a mean values of the broiler chicks fed triticale with different levels without any enzyme at 42 d of age has shown Table 3.

Table 3. Carcass and Organs Characteristics of Birds (0-42d) fed different level triticale replacement without any enzyme. Mean+SE)

Parameters	M (Maize)	T (Triticale)	MT (Maize+Triticale	P
Live Weight (kg)	2049,44±12,70 a	1312,77±14,90 c	1925,43±16,60 b	<0,01
Eviscerated Percentage (%)	76,21±0,168 a	71,11±0,187 c	74,05±0,162 b	<0,01
Eviscerated Weight (kg)	1561,60±09,80 a	934,06±11,30 c	1426,24±13,10 b	<0,01
Edible Giblets or Internal Organs (% EW) (g)				
Liver	32,19±0,62 a	22,48±0,39 c	29,79±0,51 b	<0,01
Heart	9,91±0,19 a	6,76±0,01 c	8,39±8,39 b	<0,01
Gizzard	41,57±0,79 a	33,99±0,54 c	38,60±0,72 b	<0,01
Cut up parts (% EW) (g)				
Breast weight	413,19±4,36 a	203,73±3,68 c	359,22±4,49 b	<0,01
Thigh weight	121,07±1,25 a	76,24±0,87 c	113,92±1,49 b	<0,01
Durumstick weight	97,52±1,00 a	62,27±0,99 c	90,83±1,08 b	<0,01
Wing	83,34±0,94 a	52,42±0,53 c	74,41±0,87 b	<0,01
Neck	64,14±1,18 b	46,70±0,77 c	66,68±1,30 a	<0,01
Abdominal fat	33,03±0,65 a	20,37±0,45 c	29,93±0,45 b	<0,01

[a,b,c]means in rows with no common superscript differ significantly (P<0.01)

All the parameters measured among the treatment groups differences showed as a similar percentages. Live weight value of birds in the control group was significantly higher than those of MT and T groups (P>0.01). Carcass weight was decreased significantly (P<0.01) when 100% triticale was replaced to maize diet. Birds with 100% triticale had the least live and eviscerated weight. MT group was only lower 6% than M group but T group was lower 36%. The Eviscerated percentage were 76, 71 and 74% respectively M, T and MT groups. Breast meat weight of T group chicks was decreased significantly (P<0.01) compared with the chicks the control (M) and MT. Big reduction was seen about breast weight as 51%. This is important because broiler chicken breast is more valuable than other carcass parts. Breast, thight, drumstick weights relative to eviscerated weight for T diet with 100% triticale were significantly (P<0.01) lower than those of diets groups with M and MT. The thight and drumstick weight was found to be significantly (P<0.01) lower in chicks from the T group compared with other groups. Dietary triticale was also decreased the gizzard, heart and liver weights relative to eviscerated weight (P<0.01). Wing weights decreased when dietary triticale level was increased to 100%. The highest neck weight was obtained from MT, while the least was T group. There were significant differences between all groups in term of abdominal fat weight. However, the abdominal fat weight were higher for chicks fed maize compared with other groups. Abdominal fat weight, as percentage of eviscerated weight, was decreased with replacement of triticale when compared with those maize based diet (P<0.01).

The analysis of slaughter and carcass characteristics were different. Control birds (M group) with higher body weight compared to the other groups (P<0,01), their eviscerated weight were also different, which shows that the introduction of triticale into the feed mixtures had effect on this parameter. Korver et al. (2004) reported that feeding triticale to broiler had a negative effect on eviscerated carcass weight and many portion weights, which agreed with our findings. On the other hand, Charalambous et al. (1986) observed that carcass yield carcass plus edible giblets yield, and dressing percentage were higher in birds fed maize or maize–triticale diets than in broilers fed a diet with triticale as the only cereal grain. These findings support our results which conclude that feeding higher triticale as decreases eviscerated carcass weight and many portion weights and the deposition of abdominal fat in broiler when compared with using maize. Therefore, high inclusion of cereal grains may result in poor growth, less efficient digestive organs, poor feed conversion ratio and carcass downgrades of broiler birds. Such negative effects are usually associated with the presence of high levels of non-starch polysaccharides (NPS) in cereal grains such as wheat and corn or their by-products. Enzymes may overcome these problems by increasing the digestibility and reducing the amount of excreta in broilers. Digestive enzymes typically hydrolyse the dietary components and so are classified as hydrolases (Taylor-Pickard, 2008). Although numerous research articles and reviews have been published on various aspects of enzyme use in the poultry industry (Bedford, 1996; Choct, 2006; Kamyab and Houshmand, 2006; Aksu 2007; Brzoska and Steck, 2007), it is still unclear how these enzymes could remain effective in improving feed utilisation in the foreseeable future. We conclude that eviscerated carcass, thigh, drum and breast as a percentage of carcass weight were lower in T and MT groups 36 and 6% than M (control group) respectively. Abdominal fat yield in T and MT

groups were also lower 9 and 38% than those of M group. Final BW, carcass weight and slaughter traits of broilers fed triticale were affected negatively within similar percentage by increasing inclusion of triticale to diets without any enzyme (phytase included).

Conclusion

The replacement of triticale in broiler chicken starter and grower diets resulted in lower live weight of T and MT groups as compared to control diets M. The general trend observed as triticale increases up to 100% it tended towards decreased live BW gain. 100% maize group had the highest FC and also the highest live BW gain. MT group's FCR was 6% lower than others that maize consumption may be compensated triticale's negative effect. Slaughter and carcass characteristics were also affected birds fed triticale and caused a significant decrease on breast, thigh, drumstick and other carcass part . From the technical point of view, %100 triticale substitution was not successful, but the 50% triticale replacement even without any enzyme (25% grower and 30% for finisher diets but not starter diets) is better than %100 triticale. Therefore, %100 triticale replacement is not advisable that triticale and it shouldn't be used without any enzyme within first starter period for broiler chicken under commercial conditions. However, we can conclude that birds in the MT group may be compensated triticale's negative effect with maize consumption even not use any enzyme (phytase) include with triticale relation of yield performance and carcass characteristics of broiler chicken. Further research is needed to study the effect of using enzymes especially starter period to overcome the negative effect of the antinutritional factors in triticale which may reduce nutrient utilization by broiler chicks.

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