RESIDUAL FEED INTAKE, FEED CONVERSION RATIO AND EFFICIENCY OF FEED UTILIZATION OF TURKEY BIRDS FED ON GLIRICIDIA (*Gliricidia sepium*) LEAF MEAL AND HYBRID NAPIER CO3 (*Pennisetum perpureum* x *Pennisetum americarnum*) GRASS MEAL CONTAINING DIETS

S.C. Somasiri[1], W.P.S.A. Weerasinghe[1] and N.G. Nimalasiri[2]

[1]Department of Animal and Food Sciences, Faculty of Agriculture, Rajarata University of Sri Lanka, Anuradhapura, Sri Lanka
[2]Assistant General Manager, National Livestock Development Board, Ardigama Farm, Dambadeniya, Sri Lanka

Abstract

Feed conversion ratio (FCR) and residual feed intake (RFI) are the measures of efficiency of feed utilization (EFU). A feeding experiment was conducted to assess the feed efficiency parameters (FCR and RFI) in the Nicolas turkey birds (unsexed, day-old birds weighed 58.28 ± 0.027g) fed three different rations reared under intensive system. The treatment rations were; Treatment 1, Gliricidia (Gliricidia sepium) leaf meal incorporated ration, Treatment 2, hybrid Napier CO3 (Pennisetum perpureum x Pennisetum americarnum) grass leaf meal incorporated ration and the Control, commercial broiler rations (starter and finisher). There were three replicates (ten birds per replicate) per each treatment. The highest and the lowest (P<0.05) feed intakes (kg per day) were reported from the treatments 1 and 2, respectively. Residual feed intake of Treatment 2 was lower (P<0.05) than Treatment 1 and control. Lower (P<0.05) FCR values were observed in Treatment 2 and Control than Treatment 1. Efficiency of feed utilization in the present study was higher (P<0.05) in Treatment 2 and Control compared to Treatment 1. Better (P<0.05) feed efficiency parameters were attained by feeding hybrid Napier CO3 leaf meal incorporated ration compared to the ration incorporated with Gliricidia leaf meal. Thus, feeding hybrid Napier CO3 leaf meal incorporated ration to Nicholas cross breed turkey birds is more economical than feeding commercial broiler starter and finisher rations.

Keywords: *Efficiency of feed utilization, feed conversion ratio, leaf meal rations, residual feed intake, Turkey birds*

INTRODUCTION

In Sri Lanka, the turkey birds are mainly reared for meat purposes. Lack of high producing genetic materials and proper feeding regimes are the main draw backs in the turkey meat industry in Sri Lanka. Turkey birds are reared feeding broiler rations which are expensive in the market. The age at slaughter of turkey birds is 6 to 8 months and feeding broiler rations until then incurs an extra cost for the farmers. Thereby, feeding turkey birds involves a higher investment under local conditions.

In general, the feed conversion ratio (FCR) and residual feed intake (RFI) are the measures of efficiency of feed utilization (EFU) (Arthur & Herd, 2008; Yi *et al.*, 2018). Residual feed intake had been used to evaluate the production performances in layers since 1970s (Yi *et al.,* 2018). According to Yi *et al.* (2018), it is an indepth analysis of metabolic differences prevailing in individaul animals. Higher the RFI, lower the EFU (Arthur and Herd, 2008). The measure of RFI was adopted in the past by Koch (1963). Acording to those researchers, there are two components known to relate with feed intake of animals which include (i) the expected feed intake

for a given production level and (ii) the residual (Arthur and Herd, 2008). The studies revealed that RFI can be derived by regression of actual feed intake with metabolic liveweight and avergae daily liveweight gain for a given period or by using the formulas obtained from feeding standards such as NRC (1996) and NRC (2001).

Measuring EFU is vital in poultry industry to identify the ways and means to overcome the high cost of feeding which is more than 70% of total cost of production (Begli *et al.*, 2016). The research has proven that the birds with less feed intake are higher in EFU but negative in RFI (Arthur & Herd, 2008; Begli *et al.*, 2016; Yi *et al.*, 2018). Thus, the objective of this paper is to analyse the feed efficiency parameters (FCR and RFI) in the Nicolas turkey birds fed on gliricidia *Gliricidia sepium*) leaf meal and hybrid Napier CO3 (*Pennisetum perpureum* x *Pennisetum americarnum*) grass meal containing diets. Nicolas turkey is a wild type slow growing bird reared at commercial level in Sri Lanka.

MATERIALS AND METHODS

The general ethical guidelines related to animal trails were strictly followed. The study was conducted at Siringapatha Farm of National Livestock Development Board, Badalgama (7.29^0 N and 79.98^0 E) located in the Intermediate Zone. The experimental design was Completely Randomized Design with three treatments; The treatment rations were as follows; Treatment 1, Gliricidia (*Gliricidia sepium*) leaf meal incorporated ration, Treatment 2, hybrid Napier CO3 (*Pennisetum perpureum* x *Pennisetum americarnum)* grass leaf meal incorporated ration and Control, commercial broiler starter (ME 3300 kcal/kg, CP 21.5%) and finisher (ME 3000 kcal/kg, CP 19%) rations. Treatments 1 and 2 were formulated according to the nutrient standards for poultry given in NRC (1994). There were three replicates per each treatment and each replicate had ten poults.

Leaf meal rations were prepared using leaves that were harvested and dried under shade under local conditions. The dried leaves of Gliricidia and hybrid Napier CO3 were ground to make the respective leaf meals. Maize meal, soya bean meal (47% CP – crude protein content), coconut poonac, fish meal (60% CP) and vitamin and mineral premix were common to both treatments (Treatment 1 and 2). The treatments were formulated according to the calculated composition given in Table 1.

Feeding trial

Nicholas cross bred day-old turkey poults (unsexed, day-old birds weighed 58.28 ± 0.027g) were randomly assigned into nine groups having 10 poults per each group. Each group was considered a replicate. During a 7-d brooding period the poults were fed with a commercial broiler starter ration till they were 12 days old. Nine groups were then randomly allocated into three dietary treatments having three replicates per each. Treatment rations were gradually introduced and the feeding experiment was commenced upon feeding of full-fed rations (100%). The experiment therefore, was conducted from 14-d to 12 weeks of age. In Control commercial broiler starter ration was fed from 1-d to 28-d and commercial broiler finisher ration was fed from 29-d to 12 weeks of age. Rations and water were given *ad-libitum.* Birds were reared under intensive management system on deep litter. Daily feed intakes were measured. Live body weights (LW) were measured every fortnight by measuring the mass body weights using an electronic weighing balance (Weightechrolex 2P-15B, Scent Company Ltd, Fujian, China). Group live

Table 1: Calculated composition of the Gliricidia leaf meal and hybrid Napier CO3 incorporated two rations

Feed Ingredient	Treatment 1[1] (%)	Treatment 2[2] (%)
Maize meal	35	35
Soya bean meal	10	10
Coconut poonac	24	24
Fish meal	10	10
Gliricidia sepium leaf meal	20	0
Hybrid Napier CO3 *(Pennisetum perpureum* x *Pennisetum americarnum*) leaf meal	0	20
Vitamin and Mineral premix[3]	1	1

[1] Feed ration incorporated with *Gliricidia sepium* leaf meal.

[2] Feed ration incorporated with hybrid Napier CO3 (*Pennisetum perpureum* x *Pennisetum americarnum*) leaf meal.

[3] Biopremix (vitamin and mineral premix for poultry), Chemifarma International (Pvt) Ltd, 138D, Ganemulla Road, Batuwatte, Ragama, Sri Lanka.

Note: Some parts of the methods were already published in Weerasingha *et al.,* 2018 and Weerasinghe *et al.*, 2019.

weight gain (LWG) was calculated as the difference between initial and final live weights divided by the experimental period. Calculations were corrected for mortality only in replicate 2 of Treatment 1.

At the age of 47 days Biospark – v liquid supplement was given to all the birds via drinking water. New Castle disease vaccine was given at the age of 3 and 6 weeks, respectively and fowl pox vaccine was given at the age of 10 weeks to all the birds through drinking water as directed by the manufacturer.

Chemical analysis

Proximate analysis of treatment rations (Dry matter (using oven dry method), either extract (using Soxhlet Extractor method), crude protein (using Kjeldhal method), total ash (using a muffle furnace method), crude fibre (using Van Soest Analysis method) was conducted according to the Association of Official Analytical Chemist (AOAC) methods (2003).

Calculation of residual feed intake (RFI), feed conversion ratio (FCR) and efficiency of feed utilization (EFU)

Residual feed intake (RFI) was calculated using the regression model provided by Aggrey et al. (2010). The expected feed intake (EFI) was calculated using the following equation.

$$EFI = a + b(LW^{0.75}) + c(LWG)$$

Where,

$LW^{0.75}$ is the metabolic live weight,

LWG is the live weight gain during the study period,

'a' is the intercept,

'b' and 'c' are the partial regression coefficients for $LW^{0.75}$ and LWG, respectively.

Residual feed intake(RFI) was derived by getting the difference between the actual feed intake and the expected feed intake.

$$RFI = FI - EFI$$

Where FI is the actual feed intake

Table 2: Analyzed nutrient composition of the Gliricidia leaf meal and hybrid Napier CO3 incorporated rations and Control (mean ± SE)

Treatment	Crude protein (CP)	Ether extract (EE)	Crude fibre (CF)	Ash
Treatment 1[1]	20.84 ± 0.33	5.32^{b} ± 0.20	2.49^{a} ± 0.11	5.14^{a} ± 0.35
Treatment 2[2]	21.78 ± 0.33	6.45^{c} ± 0.20	2.29^{a} ± 0.11	7.94^{b} ± 0.35
Control[3]	20.44 ± 0.59	3.10^{a} ± 0.36	3.24^{b} ± 0.19	6.04^{a} ± 0.62

[1]Feed ration incorporated with Gliricidia leaf meal.
[2]Feed ration incorporated with hybrid Napier CO3 leaf meal.
[3]Commercial broiler finisher ration.
[a,b,c] means within the same column with different superscripts are significantly different ($p < 0.05$).

The feed conversion ratio (FCR) was taken as the net feed conversion per unit of LWG for a given period. The efficiency of feed utilization (EFU) was derived using the cumulative feed intake and final live weight in the present paper.

Feed intake, final live weight (LW), live weight gain (LWG), metabolic live weight ($LW^{0.75}$), residual feed intake (RFI), feed conversion ratio (FCR) and efficiency of feed utilization (EFU) were subjected to one-way analysis of variance (ANOVA) using Statistical Software SAS, (2002). Means were separated using least significant difference (LSD) test and $P<0.05$ was considered as the significant level.

RESULTS AND DISCUSSION

Analyzed nutrient composition of the dietary treatments

Ether extract (EE) and ash contents were higher ($P<0.05$) in Treatment 2 (Table 2). Treatment 1 had a higher ($P<0.05$) EE content than the Control ration. Treatment 1 and Control ration had a lower ($P<0.05$) ash content than Treatment 2. Crude fibre content was higher ($P<0.05$) in control than the other two treatments. The mean crude protein contents were not different in treatment rations. Zubair *et al.,* (1996) observed that a diet contains a high fibre content (up to 9% crude fibre) was beneficial for the growth of turkey birds. Duke *et al.,* (1984) observed that high fibre diets fed for turkey birds enhanced the cellulose utilization. The crude protein and the fibre content in the leaf meal incorporated rations tested in the present study were according to the recommended levels for growing turkey birds (NRC 1994).

Feed intake, final live weight (LW), live weight gain (LWG) and mean metabolic live weight ($LW^{0.75}$) of Nicolas Turkey birds

The highest and the lowest ($P<0.05$) feed intakes (kg per day) were reported from the treatments 1 and 2, respectively (Table 3).

Final body weight of turkey birds fed with broiler finisher ration (Control) was higher ($P< 0.05$) than Treatment 2 which in turn was higher ($P<0.05$) than Treatment 1 (Table 3). Comparatively, metabolic live weights and the live weight gain in Treatment 2 and Control were similar and higher ($P<0.05$) than Treatment 1. It has been observed that feeding hybrid Napier CO3 leaf meal ration has shown similar performances to the broiler finisher ration.

Table 3: Effect of dietary treatments on feed intake, final body weight, live weight gain and mean metabolic live weight (LW $^{0.75}$) of turkey birds (mean ± SE)

Treatments	Feed intake (kg per day)	Final body weight (kg)	Live weight gain (g/day)	Metabolic live weight (kg)
Treatment 1[1]	$0.103^{c} \pm 0.001$	$1.11^{a} \pm 0.02$	$11.65^{a} \pm 0.32$	$0.550^{a} \pm 0.022$
Treatment 2[2]	$0.086^{a} \pm 0.001$	$1.95^{b} \pm 0.02$	$20.96^{b} \pm 0.32$	$0.752^{b} \pm 0.022$
Control[3]	$0.099^{b} \pm 0.001$	$2.04^{c} \pm 0.02$	$22.00^{b} \pm 0.32$	$0.789^{b} \pm 0.022$

[1]Feed ration incorporated with Gliricidia leaf meal.
[2]Feed ration incorporated with hybrid Napier CO3 leaf meal.
[3]Commercial broiler finisher ration.
[a,b,c] means within the same column with different superscripts are significantly different (P<0.05).

Effect of dietary treatments on residual feed intake (RFI), feed conversion ratio (FCR) and efficiency of feed utilization (EFU) of turkey birds

Residual feed intake of Treatment 2 was lower (P<0.05) than Treatment 1 and the Control. Similarly lower (P<0.05) FCR were observed in Treatment 2 and Control than Treatment 1 (Table 4). Efficiency of feed utilization in the present study was higher (P<0.05) in Treatment 2 and the Control compared to Treatment 1 (Table 4). Both RFI and FCR are vital indicators of EFU. Lower the RFI and FCR, higher the EFU. Residual feed intake was considered as a makeup to overcome the defects in FCR calculation (Yi *et al.,* 2018). The aforementioned statement has reconfirmed by FCR values in the present study. Treatment 2 and the Control had similar FCR but in Treatment 2, RFI and the mean feed intake values were significantly lower. It is supported by the cost benefit analysis data. The profit per bird were Rs 112.00, Rs 458.00 and Rs 356.00, respectively for Treatment 1, Treatment 2 and Control.

The highest profit was recorded from Treatment 2. It is mainly due to the lower cost of feeding in Treatment 2 compared to Treatment 1 and the Control. In practise, both lower FCR and RFI individuals are considered as high performing traits in poultry breeding. It is also used when selecting genetically superior parent stocks (Begli *et al.,* 2016; Yi *et al.,* 2018).

Therefore, Treatment 2 shows better performances exhibiting lower values for feed intake, RFI and FCR than Treatment 1.

Table 4: Effect of treatments on residual feed intake (RFI), feed conversion ratio (FCR) and efficiency of feed utilization (EFU) of turkey birds (mean ± SE)

Treatment	RFI (kg/day)	FCR Based on final live weight gain	EFU (%)
Treatment 1[1]	$0.019^{a} \pm 0.0018$	$8.9^{b} \pm 1.36$	$12.5^{a} \pm 1.53$
Treatment 2[2]	$0.010^{b} \pm 0.0015$	$4.1^{a} \pm 1.36$	$24.5^{b} \pm 1.53$
Control[3]	$0.019^{a} \pm 0.0015$	$4.5^{a} \pm 1.36$	$24.4^{b} \pm 1.53$

[1]Feed ration incorporated with Gliricidia leaf meal.
[2]Feed ration incorporated with hybrid Napier CO3 leaf meal.
[3]Commercial broiler grower ration.
[a,b] means within the same column with different superscripts are significantly different (P<0.05).

Similarly, the birds in Treatment 2 had higher ($P< 0.05$) live weight gain and metabolic body weights than those in Treatment 1. Thus, feeding hybrid Napier CO3 leaf meal ration had a positive impact on the turkey birds similar to broiler finisher ration.

The Gliricidia leaf meal incorporated feed (Treatment 1) had the highest feed intake but the lowest final body weight, metabolic body weight and live weight gain. It might be due to the antagonistic effect of tannin in the Gliricidia leaf meal affecting the metabolism of proteins contributing to lower performances in the growing turkey birds.

It was observed that the growth and feed intake of turkey birds also depend on the breed of turkey birds (Ilori *et al.*, 2010). The Nicolas breed is a wild type slow growing bird and thus the slow growth obtained in the present study is mainly in line with the genetic potential of the breed.

CONCLUSIONS

Of the two leaf meals assessed, feeding a ration incorporated with hybrid Napier CO3 leaf meal to Nicholas cross bred turkeys results better feed efficiency parameters (RFI and FCR). Feeding hybrid Napier CO3 leaf meal to Nicholas cross bred turkey birds is more cost effective than the commercial broiler finisher ration.

Conflicts of Interest Statement

Authors state that there are no conflicts of interest exist.

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