Comparative Performance of Broiler Finisher Feeds in Zanzibar

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Abstract

Poor quality of feeds reduce performances of broilers and reduce profit margin. The main objective of this study was to evaluate three commercial and one ZALIRI formulated broiler finisher feeds in view of providing quality and affordable feeds to chicken farmers. Three commercial feeds i.e. Diet 1 – pellets (Control), Diet 3 – Mash and Diet 4 - Mash Finisher feeds and ZALIRI formulated ration marked Diet-2. Complete Randomised Research Design was used to execute the study. A total of 800 day old "Cobb 500" broiler chicks were purchased and brooded for two weeks achieving all management practices together. At the beginning of third week, 240 chicks were selected and allotted to four different treatments and their replicates. Initial weight of each chick, feed intake, weight gain and carcass characteristics were taken and recorded from third to sixth week. The stocking density of 7.5 broilers per metre square was used i.e. 15 birds/2m^2. Deep litter system was applied and materials used were wood shavings at a depth of 4 inches from the concrete floor. Feed intake, weight gain and carcass weight data were subjected to ANOVA and treatments' means were compared using A General Linear Model (GLM) procedure of SAS (2002) was used to analyse data to obtain means, cost-benefit analysis was done using excel (Office 2013). Results showed that the control treatment had overall higher performance ($p<0.05$) on live and carcass weights and gross-profit margin. Diet 2 and 3 achieved almost the same average daily gain, total weight gain and carcass weight were significantly ($p<0.05$) higher compared to D4. The diet 2 had higher ($p<0.05$) gross-profit margin comparing to mash diets D3 and D4. It is concluded that "the locally formulated feed" is capable of producing live weight broiler of 2.247kg and carcass weight of 1.8 kg at sixth week. Quality and affordable feeds can be produced locally under supervision of Regulatory Body to boost the sub sector development in the country.

Keywords: Carcass weight, Feed intake, Gross margin and Weight gain.

Introduction

Domestication of chicken has a long history since 5400 BC where people used to keep red jungle fowls (*Gallus gallus*) from South and South East Asia as reported by Dorji *et al* (2012) and cited by Khadidja *et al.,* (2015). There have been deliberate effort through artificial selection aimed at improving traits of economic importance in chickens worldwide reported by Emad *et al.,* (2017). The current synthetic breeds of commercial layers and broilers is the result of such processes, where several high performing chickens are benefiting the entire world.

Broiler breeding process has been executed to improve important aspects such as shortening rearing period, reducing feed conversion ratio, and increasing weight gain and meat quality (Nassar *et al.,* 2012). Management of chickens play an important role to ensure breeding goals are achieved. Flock density per given space in a poultry house determine positive or negative performance of the broilers. High stocking density elicit low growth rate due to accumulation of metabolic heat from individual birds (Gororo and Kashangura 2016) described as a biological reaction of animal species when their homeostasis is threatened. Crowding has been reported to adversely affect growth performance, survivability, feather condition,

comfort behaviour, aggression, underlying fearfulness and incidence of lameness and skin injuries in broilers (Estevez 2007). Growth performance of broiler chickens observed at best stocking density of 0.5-1ft2 per broiler at 6th week reported by Nishma et al (2019), which is equivalent to the density of 10-20 broilers per meter square of the given area.

Feed intake is another important parameter determining performance of the chicken. According to Wade *et al* (2018) a day old broiler chick to the point of disposal i.e. six week consumes 4.03 - 4.11kg of feed and attain a desirable weight gain of 2.4-2.6kg live body weight.

Normally a broiler finisher ration is offered at age of 3rd-6th week, during the period it consumes 3.6 - 3.8kg feed containing nutritional values of 3,000kcal/kg and 20% crude protein.
Feed conversion ratio is another important parameter determining quality of a particular feed, this always reflects the economic feasibility of a feed in question. Kawu *et al* (2019) reported feed conversion ratio of 2.15-2.56 for Cob 500 broiler breed in tropical environment finished in seven weeks, while Singh *et al* (2019) in India reported feed conversion ratio of 2.61and 2.68 for the broilers at the age of 29-42 days respectively for Hubbard and Vencobb broiler chickens

Broiler production has been a viable business among smallholder farmers in developing countries especially in Zanzibar. There has been some obstacles hindering development of the sector in the country such as higher feed cost which alone contributes about 75% of the production cost as reported by Nkukwana (2018). The proportion could be increased in Zanzibar given the availability of raw materials, transport cost and profit margin prescribed by feed manufacturing companies.

Inadequate availability of quality feed ingredients and skills for compounding chicken diets, give rise to local feed millers and farmers formulating poor quality feeds which eventually affect production performances of broiler chickens. On the other hand imported feeds are of good quality however are sold at exorbitant prices and consequently increase broiler production costs and reduce profit margin.

There is inadequate information in Zanzibar regarding studies on poultry feed aiming to come up with quality and affordable feeds to smallholder farmers as a mean towards subsector development. This justifies the necessity to conduct such a study to address the existing challenges. Therefore, the main objective of this study is to compare performance effects of the broiler finisher feeds. Specifically, to determining chemical composition of the feeds in question, assess growth performance, carcass characteristics of the broilers and cost-benefit analysis of the experimental feeds. The results will assist farmers and other stakeholders in reducing production cost arising from feeds and increasing broiler meat production at lowest affordable cost while maximizing profit.

Materials and Methods

The study was conducted at ZALIRI, Kizimbani, Zanzibar and involving three commercial diets popularly used by the poultry farmers in the Island and one locally formulated at ZALIRI. Diet 1 was a commercial finisher pellet, supplied by a well-known feed manufacturing company X in Dar-es-salaam. Diet 3 was mash finisher feed supplied from the same X feed Manufacturing Company while Diet 4 was mash feed supplied by a different company Y in Dar-es-salaam. The feeds were purchased from input supply centres just a week after the production date. On the other hand, ZALIRI locally formulated a diet compounded at the station where the feed ingredients were purchased from input supply centre based on quality aspects.
Diet 1 (T1) as control was pelleted, Diet 2 (mash) i.e. T2 was locally compounded at the station while Diet 3 (T3) and Diet 4 (T4) were also mash form diets. At the end of the study, feed samples were taken for nutritive analysis at Tanzania Veterinary Laboratories Authority (TVLA) in Dar-es-salaam.

A total of eight hundred (800) day old "Cobb 500 broiler chicks" were purchased from "Kilacha Poultry Breeding Company" in Dar-es-Salaam and were brooded receiving all management practices together for two weeks in a poultry house at ZALIRI's research station. The study was conducted in an open sided

house on a deep litter system of production. A Completely Randomised Research Design was employed to execute the experiment. At the beginning of third week (15th day), two hundred and forty (240) out of eight hundred (800) chicks based on individual live weight (590±25g) and health parameters were selected for the study. The chicks were allotted to four different treatments and their respective replicates, where initial weight of each chick was taken and recorded. Each treatment was replicated 4 times and the chicks were assigned to their respective replicates of fifteen (15) chicks while the stocking density of 7.5 broilers per metre square was used i.e. 15birds/2m^2 was applied. Deep litter system of wood shavings at a depth of 4 inches from the concrete floor was used. Turning and replacement of litter material was done after every three days for disease prevention and control measures. During the growing period, twelve natural day light and 10 artificial light with the use of electric bulbs were provided in the night.

Initial weight was taken during allotment of the experimental chicks to their respective treatments and replicates. Thereafter, weekly weight gain of the chicks was taken at the end of each week (3, 4, 5 and 6). Total weight gain was calculated as final weight minus initial weight while daily weight gain was calculated by dividing the total weight gained by number of days in the study period i.e. 28 days.

TWG=FW-IW .....(1)

ADG=TWG/NDS .....(2)

Where by:

TWG = Total Weight Gain

FW = Final live weight

IW = Initial live weight

ADG = average daily weight gain g/d (growth rate)

NDS = Number of days during the experiment (28)

Feed intake was determined by weighing the amount of feed offered less refusals in each pen (replicate) on a daily basis. Feed conversion ratio (FCR) was obtained by dividing the total feed intake with total weight gain of all birds in each pen as shown in formula 4.

Feed Intake (FI)=Feed Offered (FO)-Feed Refusals (FR) .....(3)

$$FCR = \frac{Total\ \ feed\ intake}{Total\ Weight\ gain} \quad \text{.....(4)}$$

After six weeks of age, six broilers were randomly picked from each replicate for slaughter, making a total of 96 broiler for carcass characteristics evaluation. Halal slaughtering procedure was used thereafter bleeding was facilitated by hanging them for 3 minutes. Plucking and evisceration was done properly under hygienic environmental condition. Following removal of all internal organs the carcass weight of each broiler was taken and recorded. Dressing out percentage was calculated as shown in the formula 5.

$$Dressing\% = \frac{CW}{LW} \times 100 \quad \text{.....(5)}$$

Where by:

CW = carcass weight; and LW = live weight.

Data analysis

Data on feed intake, growth rate and carcass characteristics were analysed using Statistical Analysis System (SAS, 2002) software, while cost-benefit analysis analysed using excel spread sheet (Office 2013). Data were taken and recorded in the recording books and later entered in the excel spread sheet and were processed. Thereafter data were transferred to SAS software and subjected to ANOVA procedure. General Linear Model (GLM) procedure was used to compare treatments' means. Furthermore least square means were used to show level of variation among the treatments using superscripts. Treatment (Feed) was the independent variable while feed intake, weight gain, final weight, carcass weight and feed conversion ration were dependant variables in the study. The model used in the analysis was:-

$Y_{ij}=\mu+T_i+e_{ij}$ .....(6)

Where:

Y_{ij} =Response variable

μ = General mean

T_i = Treatment effect and

e_{ij} = Random error

Results and discussion

Feed Analysis

All the experimental diets were slightly lower in terms of Metabolizable energy and crude protein (Table 1) as per Tanzania Veterinary Laboratory Agency Analysis. Energy requirement for a Broiler finisher feed is 3,000kcal/kg feed and crude protein of 18% as cited from Compounded Poultry Feeds Specification (2018) in Uganda, Similarly Tanzania Bureau of Standards (TBS), (2009) article TBS/AFDC 09 (5197) P3. Despite the lower nutritional value of the feeds, performance of the broilers offered experimental diets were in line with Cobb (2015) performance guidelines.

T3 and T4. Total feed intake was significantly higher for T1 followed by T2 and the least was T3. Best Feed Conversion Ratio revealed for the birds offered T1 diet, followed by T3, T4 and T2 was the least as observed in Table 2. Total Feed intake was significantly higher for T1 as it is in pellet form which is known to improve feed intake (Omosebi, 2016) in broilers. Diet offered to broilers in T2, the prime source of protein used ingredient was oceanic fish residue which contain sodium chloride (Nacl) has appetizing property and thus increased broiler feed intake, however the factors didn't significantly influence feed conversion ratio (Table 3).

Pellet diet does not allow the birds to easily

Table 1: Chemical analysis for the experimental broiler finisher feeds

BROILER FINISHER FEEDS	%DM	%ASH	%EE	%CF	%CP	ME (Kcal/kg)
T1	89.9	6.1	3.4	3.1	18.8	2,806
T2	89.5	11.2	6.7	3.1	18.5	2,829
T3	90.4	7.6	4.4	3.3	19.6	2,843
T4	89.9	5.3	6	2.9	18.3	2,987

DM=Dry Matter, ASH=Minerals, EE=Ether Extract, CF=Crude fibre, CP=Crude Protein and ME= Metabolizable Energy, T1=Pellet, T2=Local formulated mash feed, T3 and T4 Commercial purchased mash feeds.

Table 2: Mean values for weekly feed intake and Feed Conversion Ratio of the experimental broilers

Parameters	T1	T2	T3	T4	SEM	P-Value
WK3 (g)	800	750	725	725	0.023	0.119
WK4 (g)	975	950	900	925	0.020	0.168
WK5 (g)	1150	1050	1000	1100	0.040	0.110
WK6 (g)	875b	900c	775a	775a	0.020	0.002
TFI (kg)	3775c	3625b	3400a	3525a	0.060	0.010
TWG (g)	2008c	1646a	1626a	1750b	17.70	0.010
FCR	1.9	2.2	2.1	2.0	0.087	0.188

acb =Means in the same raw with difference superscript are different ($P<0.05$)
WK = Week, TFI = Total Feed Intake, AWG = Average Weight Gain TWG = Total Weight Gain and FCR = Feed Conversion Ratio.

Feed intake

Feed intake for the broiler under the study didn't vary during three consecutive weeks (3-5). It only showed significant difference at week six as T1 and T2 had higher feed intake than separate out the ingredients; each mouthful provides a well-balanced diet and will lead to better uniformity of growth and more economic revenue (Mamdooh 2016).

Growth performance

Table 3 displays weight gain during the entire experimental period, Total weight gain and average daily gain. For the first two weeks, there wasn't statistical difference in weight gain for the broiler offered different experimental diets. Significant statistical difference was observed from 3rd to 6th week of the experiment. There was statistical difference for total weight gain and average daily gain ($p<0.0001$). T1 had higher weight gain followed by T4 than T2 and T3.

The live weight at sixth week was higher than reported by Mutisya *et al* (2021), used Black Soldier fly larvae as protein source. Growth rate of the experimental broilers in all four treatments was optimum as per Cobb 500 management guide. The final weight at sixth week is above the one reported by Patbandha *et al* (2018) and Faki (2016) reported weight at seventh week. Feed conversion ratios of the experimental broiler diets (Table 3) comparatively above the one mentioned in Cobb 500 management guide however, it is in line with the study conducted by Foluke *et al* (2018) who replaced fish meal with Duckweed Meal, reported the FCR ranged from 1.78-2.85 for the broiler finished at eight weeks. A study conducted by Zanu *et al* (2017) in South Africa with Cobb 500 broiler breed achieved a range of 1.7-2.2 FCR for broiler finished in seven weeks. The lower FCR and higher weight gain obtained from mentioned studies attributed by higher calories and crude protein intake under highly controlled environmental conditions.

Carcass characteristics

Table 4 displays carcass characteristics of the broilers under study. Live weight, carcass weight and dressing percentage of the birds were statistically analysed at the end of sixth week of age. There were differences ($p<0.05$) on live and carcass weights and dressing percentages of the dressed carcasses.

The carcass weight (Table 4) for the experimental broilers was lower comparing to those reported by Dessie *et al* (2017) at 7 weeks. The weights are in line with results reported by Faki, (2016) for finished broilers in seven weeks of age. An average carcass weight gain of 1793g could achieve extra more 400g if the birds were slaughtered at 7th week. This justifies a total carcass weight of 2,193g/bird could be reached upon slaughtering the birds at the end of 7th week for T2, which is above all the weight reported by Faki, (2016); Dessie *et al* (2017). This achievement was probably attributed by good formulated feed and overall management. On the basis of dressing percentage results reported by Dessie *et al* (2017) were lower than the ones obtained from this study. However are on the range reported by Faki (2016).

Cost-Benefit Analysis

Table 5 shows Costs-Benefit Analysis of the experimental feeds. Amount of feed intake per treatment, price of feed per kilogram for treatments, total feed cost and total production cost for every treatment. Moreover total earnings were determined through mean carcass weight for each treatment and gross margin.

Table 3: Mean values for weight gain performance of the experimental broilers

Parameters	T1	T2	T3	T4	P-Value
WWK2 (g)	601.0±5.7	590.4±5.8	590.5±5.6	590.5±5.5	0.5273
WWK3 (g)	1048.5±9.8c	973.5±9.9b	924.3±9.7a	897.1±9.5a	<.0001
WWK4 (g)	1568.0±25.2c	1329.0±25.6b	1364.6±25.0a	1316.5±24.6a	<.0001
WWK5 (g)	2252.1±32.4c	1923.8±33.0a	1923.8±32.1a	1968.9±31.6b	<.0001
WWK6 (g)	2598.2±38.3d	2247.0±39.0b	2216.1±38.0a	2368.7±37.4c	<.0001
TWG (g)	2007.8±34.4c	1645.9±35.0a	1625.6±34.1a	1778.1±33.5b	<.0001
FNW (g)	3022.5± 38.3c	2533.8±39.5b	2358.8±42.4a	2680.0±40.2b	<.0001
ADG (g)	71.6±1.3c	58.7±1.3a	58.0±1.3a	63.5±1.2b	<.0001

abcd =Means in the same raw with difference superscript are different ($P<0.05$)

WWK = Weight of the week, TWG = Total weight gain, FNW = Final weight, and ADG = Average Daily Gain.

Table 4: Mean values for carcass characteristics of the experimental broilers

Parameters	T1	T2	T3	T4	SEM	P-Value
LW (g)	3022.5c	2533.8b	2358.8a	2680.0b	42.8	<.0001
CWT (g)	2131.2c	1793.1a	1777.2a	1803.1b	39.6	<.0001
DRP%	70.7b	70.5b	75.6c	67.8a	1.2	0.0005

acb =Means in the same raw with difference superscript are different (P<0.05);
LWT = Live weight, CWT = Carcass weight and DRP = Dressing Percentage.

Comparatively, T1 had highest gross margin followed by T2, T3 and finally T4.

On cost benefit analysis the total production cost was highest in T1 followed by T4 and T3 while T2 was the least. The cost was attributed by the amount of feed consumed per treatment and feed price. Since T1 was pellet feed, possibly the pelleting process increases cost when compared with formulated mash diets. The gross-margin of the broiler offered T1 was the highest attributed by total carcass weight of 20-22kgs above the rest treatments. However T2 was leading in gross-margin among mash formulated diets i.e. T3 and T4 on average of 25,920/=TSH.

Table Cost benefit Analysis for the experimental broilers

Parameters	Treatments			
	T1	T2	T3	T4
Chick Cost up to 2 weeks (Tsh)	186,000	186,000	186,000	186,000
Feed intake 3-6 weeks for 60 broilers (kg)	228	216	204	210
Feed price per Kilogram (Tsh)	1,200	1,000	1,160	1,160
Total Feed Cost (Tsh)	273,600	216,000	236,640	243,600
Total variable Costs (Tsh)	459,600	402,000	422,640	429,600
Average Carcass Weight k(g)	2.13	1.79	1.77	1.8
Number of Broilers	60	60	60	60
Total Carcass Weight (kg)	128	107	106	108
Selling price for 1kg Carcass (Tsh)	6,000	6,000	6,000	6,000
Total Earnings (Tsh)	766,800	644,400	637,200	648,000
Gross-Margin (Tsh)	493,200	428,400	400,560	404,400

Conclusion and recommendations

It is concluded that the control treatment (pellet feed) observed to have an outstanding performance since has passed through different treatments which improves feed intake, digestibility, absorption and finally utilization by the birds. On the other hand locally formulated feed (T2) was nutritionally in line with other commercial broiler finisher feeds used in the study. Additionally, the formula had higher profit margin and substantial carcass weight of 1.8kg in 42 days compared to other mash feeds in the study.

Therefore, it is recommended that ZALIRI could capacitate its feed mill plant to produce commercial feeds to foster poultry subsector development in Zanzibar.

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