Evaluation of Feeding and Feed Utilization of Kuchi Indigenous Chicken Ecotype of Kenya

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ABSTRACT

Kenya has a large diversity of indigenous chicken (IC) ecotypes. One of them is the Kuchi whose phenotypic attributes have made it popular in terms of high mature body weight. However, scanty information exists on the feed utilization of this IC ecotype. A study was carried out to evaluate the feed intake(FI), average daily gain(ADG) and the Feed Conversion Efficiency(FCE) of Kuchi IC growers fed with three levels energy diets: High(HE-2700MEKcal/Kg), Low(LE-2564.5MEKcal/Kg), and ground Maize Grain(MG); all managed under three feeding systems: Intensive(IS), Extensive(ES) and Extensive with Supplementation(ESS), on a two week change-over basis from week 12 to 17 of age. A Commercial ration under IS was utilized from day old to 11 weeks. A Randomized Complete Block Design (RCBD) was laid out for the experiment. Weekly growth weights on FI, ADG and FCE/Diet/System were recorded and means subjected to an ANOVA (SAS 2015) software tool. Results indicated that diets: HE (98.33g) and LE (93.88g) had significant ($p<0.05$) effect on the FI under ESS; LE (281.33g) was significant on the ADG, and the FCE (4.13) was significant under ESS on LE. It is concluded that the optimal growth of Kuchi IC is attained under a semi-intensive (ESS) and low energy ration (LE) respectively. It is therefore not economical to intensify the management of Kuchi IC ecotype. A Molecular characterization towards selection, breeding and local chicken genetic resource conservation to achieve an efficient feed utilization IC ecotype is recommended.

***Key words**: Kuchi, Indigenous Chicken, Energy Diet, Management system, Ecotype, Kenya.*

INTRODUCTION

The role of Indigenous Chicken(IC) for rural livelihoods in developing and underdeveloped countries mostly in Africa is indispensably high (Mahendra, 2016; Chesoo et al., 2016). The IC is in essence, is the animal for all as it is found within the homesteads of the well-to-do and also under scavenging conditions among the resource poor and marginalized rural communities. They form part of balanced farming system playing significant roles as source of high quality animal protein, income and socio-cultural tenets of these rural households (Chesoo et al., 2015). One of the most important positive characters of IC is their hardiness against harsh environmental condition and poor husbandry practices without much loss in production (Mahendra, 2016).

About 90% of rural communities keep IC under free-range/scavenging conditions with little or no feed supplementation (Ngeno, 2014; Kingori et al., 2010). This IC are distributed and kept in all ecological zones of developing countries. Chickens that are found in the same ecological zone are referred to as Ecotypes (Ngeno et al 2014). An example of such an ecotype is the Kuchi, whose native region is the coastal belt of Kenya, mainly the Faza Island of Lamu County. It is also found in the drier north eastern parts of Tanzania (Chesoo et al., 2014; Ngeno, 2014; Mutua, (2010), Mwanza, (2010) and Lwelamira et al., 2008).

The Kuchi ecotype has been reported to be superior in terms of mature body weight compared to other IC. The Kuchi ecotype is better in scavenging than being fed under confinement. Its mature body weight ranges from 6-9 kg and 3-6kg for males and females respectively (Figures 1-3) (Chesoo et al., 2014; Ngeno, 2014). The egg production per clutch ranges between 12 and 13, but can be as low as 8 under scavenging system (Magothe et al., 2010). However, under an On- Station management, egg production of a mature Kuchi can reach 40 eggs per clutch with an average weight of 50g (Figure 5) However, despite this attribute, a paucity of information exists regarding the general performance in regarding the optimal feed supplements and feeding requirements for Kuchi and IC under various management systems (Chesoo et al., 2016). The low production performance of IC chickens in terms of egg and meat yield may be improved through improvement in husbandry practices and supplementary feeding (Alabi et al., 2013.; Kingori et al., 2003; Roberts, 1995). There is a potential for improvement of native chicken production (Mahendra, 2016).Little research has been done on feeding and feed utilization of IC under various improved and traditional conditions have reported (Tadelle et al .,(2000).

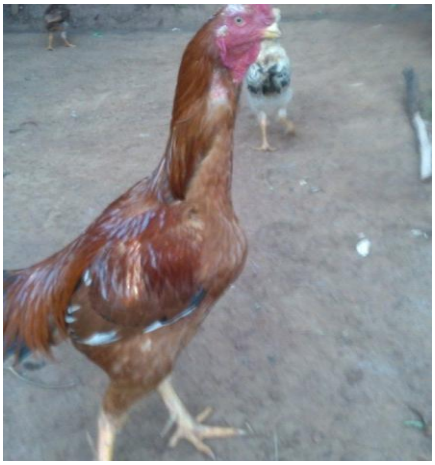


Figure .1 Kuchi Cock

Figure.2 Kuchi Pullet

Figure.3 Kuchi Hen

There is need therefore, to carry out further research on the performance of IC under various feeds and feeding management systems in order to come up with appropriate information for documentation, recommendation and adoption towards rural livelihoods improvement, not only in Kenya but also in other developing and under-developed countries.

This study was undertaken to evaluate the performance, with regard to the Average Feed Intake (FI), Average Daily Gain (ADG) and Feed Conversion Efficiency (FCE) of Kuchi IC ecotype of Kenya under three energy diets: High energy (HE), Low energy(LE) and milled Maize (MG) grain fed under three feeding systems namely: Extensive with supplementation (ESS), Extensive (ES), and Intensive(IS).

Figure.4 Kuchi cock and hen

Figure.5 Kuchi eggs (50g) average weight

MATERIALS AND METHODS

Research Site

The study was carried out at the poultry farm, Department of Animal Science of the University of Eldoret (UoE) in Uasin Gishu County, Kenya. The farm is situated at l0^{o} 31" N, Longitude 35^{o} 17" E, with an altitude of 2154 M, Above Sea Level (Kareri, 2013). The rainfall pattern is unimodal with an average of 1000mm to 1520mm per annum as been recorded for the last ten years. The rains span from late February to August and the temperatures of the site range from 23.6^{o}C day to 9.6^{o}C night (Anonymous, 2010).

Experimental Kuchi Chicken

The experimental birds were derived from one to five day old Kuchi eggs (n=209) sourced from three sites, two in Kerio Valley (Sambalat and Muskut) of Elgeyo-Marakwet County and others from pure Kuchi flock kept for the current study at the UoE farm. An artificial hatching process was carried using a commercial incubator® with due adherence to the manufacturer's recommendations. The hatched chicks were then managed in a brooder for 4 weeks, using a commercial Super Feeds® Chick mash. The Kuchi growers were then fed with a commercial Super Feeds® Grower's mash from week 5 to 10 of age before transferring them to the study site on week 11. Then 18 Kuchi growers were randomly selected, their initial weights recorded, and subjected to the experiment on week 12. All disease control protocol against common poultry diseases such as: Gumboro, Marek's, New castle, Fowl pox and Fowl typhoid diseases were strictly followed. Water was provided *ad libitum* on the experimental birds. The experiment was laid as shown in Table 3.

Experimental Feeding systems

Three feeding systems*:* Intensive (IS), where the birds were fully confined with *ad libitum* access to intensive feeding, Extensive (ES), where supplementation was provided as a free-choice from 6 a.m to 6 p.m and Extensive system with supplementation (ESS) where the birds were under confined feeding until noon(12.00Hrs) then allowed to scavenge without access to supplements.

The experiment was carried out for a period of six weeks (each taking two) ending at week 17 of the Kuchi growers. The layout procedure was arranged as shown in Table 3. Means for Daily feed intake, Daily weight Gain and Feed Conversion Efficiency per system per diet were recorded and computed.

Experimental feeds/diets

A stabilization and adjustment period of eight hours (10.00Hrs to 6.00Hrs) was subjected to the birds before the start of the experiment. Water was only provided *ad libitum* with no feeding before the start of the experiment on week 12.Then eighteen Kuchi birds were randomly located to three pens each with six birds on three formulated levels of energy diets (Tables1 and 2): High energy: 2700.5MEKcal/Kg (HE), Low energy: 2554ME Kcal /Kg (LE) and ordinary milled maize grain (MG) as a control diet, Chesoo et al. (2014). Ordinary milled Maize Grain was assumed to have an Apparent Metabolizable Energy (AMEn) of 2692±339 (Chemjor, 1998), albeit without other essential nutrients and therefore served as control. The HE and LE rations were fed to the experimental Kuchi birds from week 12 to week 17 under a Two-week Change-over feeding regime as shown in Table 3. The initial weights of the Kuchi growers were recorded and means computed. Daily/Weekly mean weights were taken for each system of management/treatment through the change -over period under each diet: (HE, LE and MG) under systems :(ESS, ES and IS), respectively.

Housing

The housing in the three systems was of floor pens of $12m^2$ as recommended by Smith (1990), with saw dust deep- litter. Scavenging areas of $49m^2$ and $30m^2$ was provided for ESS and ES groups respectively. Those in IS were intensively maintained in $12m^2$ deep litter area with *ad libitum* feeding of growers mash. The layout procedure for the three feeding systems of management is shown in Table 3.

Table1.Formulated ration for HE energy diet, 2700.5 ME kcal/kg

Ingredient	Qty(kg)
Maize Grain	30
Maize Germ	20
Wheat pollard	20
Sun flower	5
Cotton cake	11
Fish meat	5
Vegetable oil	4
Iodized salt	0.3
Limestone	0.3
Sand	0.2
Grower Premix	3

Table 2.Formulated ration for LE energy diet, 2564 ME Kcal/kg

Ingredient	Qty(kg)
Maize Grain	28
Maize Germ	20
Wheat pollard	20
Sun flower	5
Cotton cake	12
Fish meat	5
Vegetable oil	4
Iodized salt	0.3
Limestone	0.3
Sand	0.2
Grower mix	3

Table 3. Layout procedure for experimental diets: HE, LE and MG under ES, ESS and IS

	Systems		
Replications (Weeks)	**IS**	**ES**	**ESS**
Week **12 - 13** Treatments	MG	HE	LE
Week **14- 15**	LE	MG	HE
Week **16 - 17**	HE	LE	MG

RESULTS

The effects of three energy diets (HE, LE, MG) on Feed Intake/Diet/System for Kuchi growers fed under three different management systems(ESS,ES,IS) are shown in Table 3 and Figure 4. Mean feed intake of Kuchi growers fed with three energy diets(HE,LE,MG) under three systems of management (ESS,ES,IS) during two-week change-over basis from week 12-17 of age.

Table 4. Mean Feed Intake/Diet/system

System

Treatment	**ESS**	**ES**	**IS**
HE	98.88^{a}	54.38^{ab}	98.12^{ab}
LE	93.33^{a}	68.12^{b}	77.09^{b}
MG	64.64^{b}	38.83^{ac}	58.31^{c}

Treatments within column having the same superscipt letters are not significantly different (p>0.05); SEM=4.2, R2=0.49, CV=10.2, SD±7.2

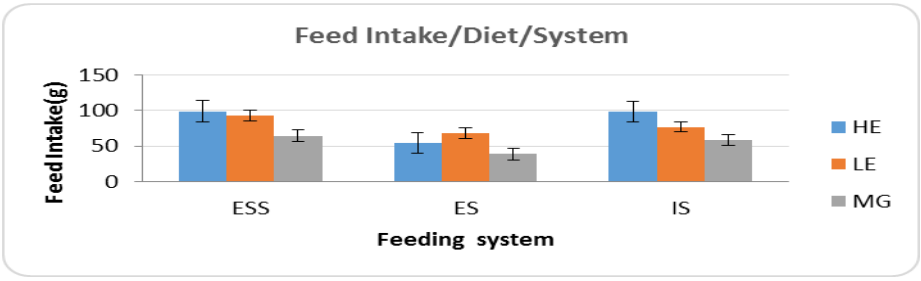


Fig.9. Mean Feed Intake/Diet/System

The daily mean feed Intake for both HE (98.88g) and LE (93.33g) were not significantly different (***p***>0.05) under ESS and ES respectively. Moreover, a slight lack of significance existed under IS. HE (54.38g) and MG (38.83g) were not significant under ES. Diet LE was significantly different with MG under all the feeding systems (ESS, ES and IS). Intake of MG under ESS (64.64g) and IS (58.32g) were both not significant, but significantly different under ES (38.83g). The intake of LE under IS (77.09g) and ES (68.12g) were not significantly different but significant under ESS (93.33 g). Furthermore, HE under IS (98.12g) and ESS (98.88g) were not significant, but significantly different from intake under ES (54.38g). Under the IS feeding system, intake of both HE (98.12g) and LE (77.09g) had slight non significance (***p***>0.05).

Table 4.ADG/diet/system

Systems

Treatments	**ESS**	**ES**	**IS**
LE	281.33^{a}	277.5^{a}	269.7^{a}
HE	190.77^{b}	172.67^{b}	150^{b}
MG	138.87^{c}	94.33^{c}	46.33^{c}

Treatments with the same superscipt letters are not significantly different (p>0.05); SEM=15.26, CV=15.134, R^2=0.86, SD±26.

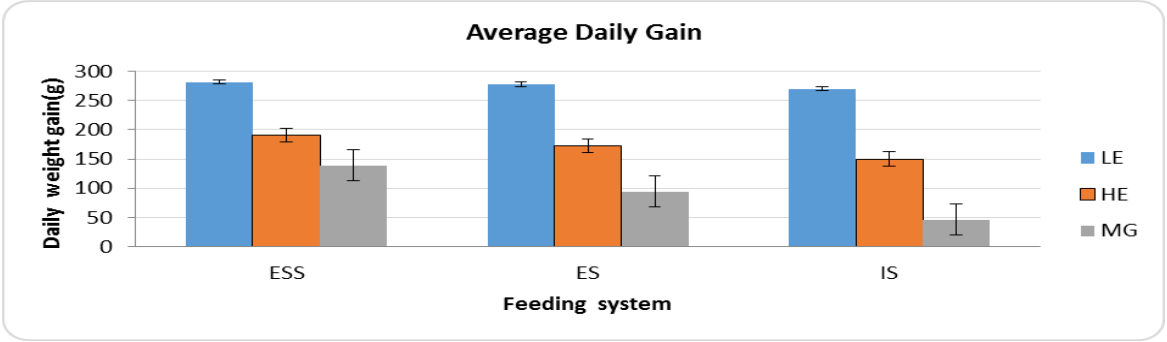


Fig.9.ADG/diet/system

The ADG/diet/system for the treatments HE, LE and MG were significantly different (p<0.05) on ADG under all feeding systems (ESS, ES and IS).
Energy diet LE under ESS (281.33g), ES (277.5g) and IS (269.7g) respectively, was highly significant (P<0.05).The ADG for MG under ESS (138.87g) and ES (94.33g) were not significant as was in IS (46.33g) and ES (94.33g). HE under ESS (190.77g) and ES (172.67g) were not significant, but significantly different under ESS (190.77g) and IS (150g), otherwise the ADG of HE under ES (172.67g) and IS (150g)was not significant(p>0.05).

Table 5.FCE/Diet/System
Treatments within the same column having same superscript letters are not significantly different (p>0.05)

	System		
Treatment	**ESS**	**ES**	**IS**
HE	1.8^{a}	2.5^{ab}	3.5^{a}
LE	4.13^{b}	3.5^{b}	1.5^{b}
MG	1.8^{ac}	1.7^{ac}	0.14^{cb}

Fig.10 Feed Conversion Efficiency /Diet/System
The treatment LE was highly significant (p<0.05) under ESS on the FCE/Diet/System**,** while HE and MG were not significant. Under ES, treatments LE and HE were not significant, while MG and HE were not significantly (p>0.05) different.

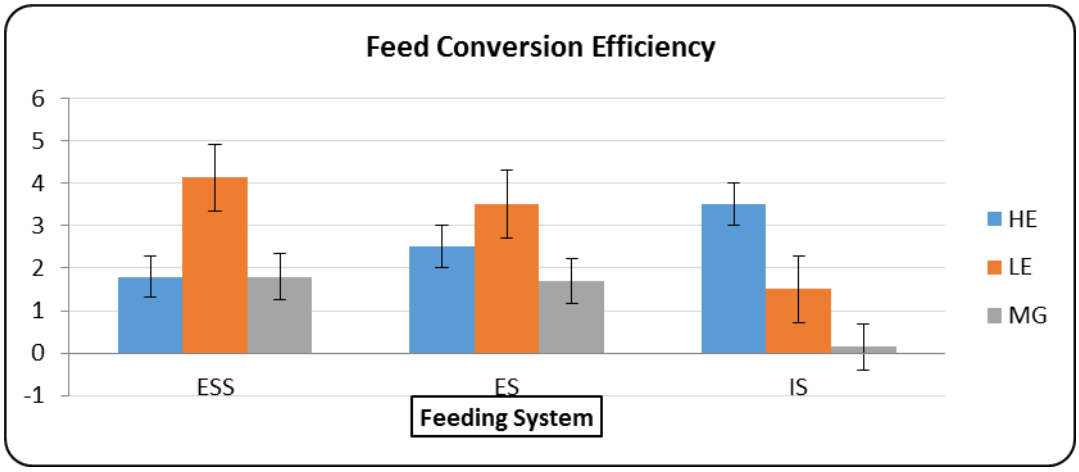
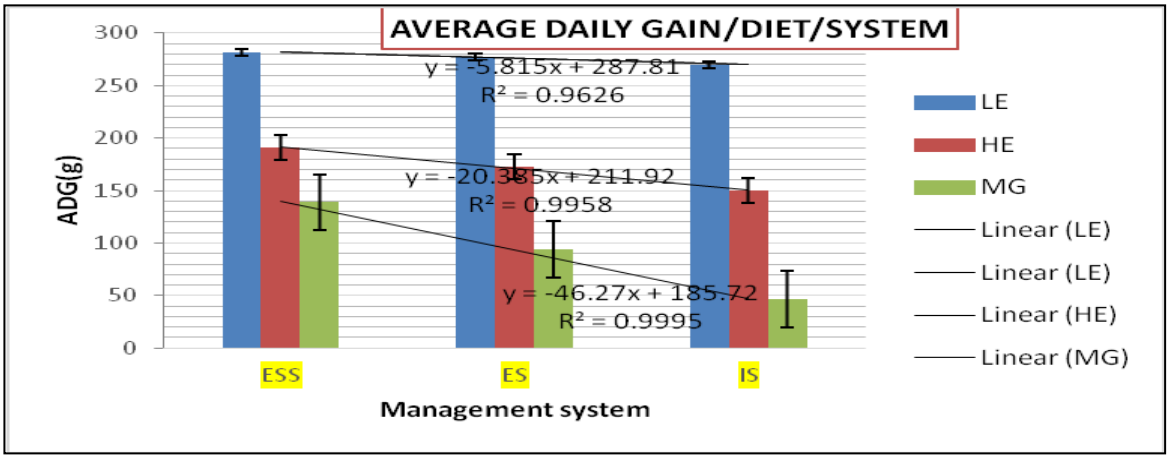


Fig.11 Regression Equations: Average Daily Gain/Diet/System

Treatment/diet/system	**MEKcal/Kg**	**Regression equation**	**Goodness of Fit**
Low energy (LE)	2564 ME Kcal/kg	**y**=-5.815x+287.8	R^2 = 0.9626
High energy (HE)	2700.5ME Kcal/kg	**y**=-20.385x+211.92	R^2 = 0.9958
Milled Maize Grain (MG)		**y**=-46.27x+185.72	R^2 = 0.9995



DISCUSSION

Feed intake/Diet/System

Diet of LE 2564 ME Kcal/Kg was better utilized by Kuchi growers in all the feeding system: Extensive System with Supplementation, ES and IS. This corroborates the findings of Chesoo et al. (2016, 2015, and 2014), that Low energy diets had significant effects on the growth performance of Kuchi IC. Kuchi IC utilizes low energy supplement than High energy. Finding from this study are consistent with reports of Roberts (1995) that the energy requirement for scavenging mature egg laying Sri Lankan village chicken is 2300 ME Kgcal/Kg and the daily free choice intake is 59.0g, which is closer to those of Kuchi growers under ES on HE (54.38g).

Kuchi growers in this study, consumed under free choice extensive system 54.34-68.12g, are consistent with reports of Chandrasiri et al., (1993) and Wickramaratne et al., (1993) for In-pen free-choice feeding of Hybrids(60.39g) and 64.64g for MG under ES. The daily feed intake of both HE and LE had an average of between 70-100g, which is within the NRC (1981c) recommendation as the consumption rates (80-100g) for chicken growers. Therefore, since both HE and LE are not significantly different, in all the feeding system (ESS, ES and IS), it is costly to feed Kuchi with high energy supplements. Any increase of energy ingredient will entail an increase on additional cost. Moreover, intake of MG and HE under ES, are not significant. It is therefore not cost-effective to feed IC with HE since LE apparently appears to be a cheaper option. Overall, the energy diet of choice for all the feeding systems (ESS, ES and IS) is LE containing 2564 ME Kcal/kg.

The growth of Kuchi IC at wk 12-17, performed significantly ($P<0.05$) when fed on an energy diet of 2564ME Kgcal/Kg. This observation is closer to what was reported by Alabi et al.(2013) of between 2500-2800MEKcal/kg and Chemjor (1998) of 2400Kcal/Kg ME for IC, as the energy requirement during the same growth period, also cited by Kingori,(2010). The finding from current study are consistent to recommendation made by Okitoi et al., (2010) that an energy diet of 2378 Kcal of ME optimizes growth performance of the scavenging IC.

Average Daily Gain/Diet/System

Diet LE had the highest ADG of 281.33g and 277.5g under ESS and ES, respectively. An Average of over 250g Daily Gain/diet/system was observed in the present study for Kuchi growers on LE diets under all the three feeding systems ESS, ES and IS. This result agrees with those of Sola-Ojo (2009) for the Fulani IC ecotype between weeks 12-16 of age. Kuchi IC in present study had an ADG of 281.33g and 277.5g with daily energy feed intake of 93.33g and 68.12g under ESS and ES respectively. The feeding of Maize grain was better utilized under supplementation in an extensive management system. However, it gave the least (negative) growth effect under an Intensive system. The R^2 statistic values (Table 6) explains Goodness-of-Fit For the diet: MG, HE and LE as 0.9995, 0.9958 and 0.9626, respectively. These regression results indicate that the regression line perfectly fits the Average Daily Gain/Diet/System data and therefore can be used to predict growth of Kuchi IC at grower stage.

Feed Conversion Efficiency/Diet/System

Diets LE had the highest (4.13 and 3.5) FCE/Diet/System under ESS and ES, respectively. However, HE was efficiently utilized under IS with a FCE of 3.5. Though the FCE for both HE and LE were not significant ($p>0.05$) under IS and ES. The findings agrees to those reported by Chickramaratne et al., (1993) for free-choice in-pen Sri Lankan village chicken and Hybrids as 4.5 and 4.1, respectively. In the current study, results shows an FCE of 4.13(LE under ESS) and 3.5 for both LE under ES and HE under IS, respectively. Similar results (3.7-4.2) were reported by Nthimo et al., (2006), on Lesotho local chicken managed under a Semi-Intensive feeding system. These FCE values of LE under ESS and ES are comparable with those recorded by Moula et al.,(2013), for local Ardennaise breed between day old and 12 weeks of age for both sexes the Silver black and Golden black breeds :4.01 and 3.99)respectively. The control energy diet, MG in this study, gave the lowest FCE of 0.14, 1.7 and 0.8 under IS, ES and ES, respectively. This means that IC utilizes a high energy feed under confined management system. The converse is true for LE and MG whose effect was negative.

CONCLUSION AND RECOMMENDATION

Kuchi chicken utilizes a low energy diet under supplementation in free-ranger management system and poorly efficient in confined system. Under a confined feeding system Maize grain is not the diet of choice. Where space is a limiting factor to IC production, it is economically viable to utilize High energy supplement. A diet specification of low energy could be used to formulate diets to be offered as supplements for scavenging chicken. Thus choosing a scavenger feed concentrate containing low to moderate energy levels is a valuable supplement for Kuchi IC and other indigenous chicken.

Energy diet for Kuchi I growers: Kuchi IC growers performed equally well in growth regardless of the management system under an energy level of 2564.5Kcal/kg.Both diets 2700.5 MEKcal/Kg and Maize Grain did not match energy level of 2564MEKcal/kg in regard to the growth effect on the Kuchi growers from 12-17 weeks of age.

Feeding system: Findings from this study indicate that the semi-intensive feeding system with a low level of energy diet is an appropriate technology for rearing indigenous chickens. Where land is not a limiting factor, it is concluded that the optimal feeding system for Kuchi IC, should be an extensive system with supplementation. However, some essential dietary requirements should be available in adequate in the ration; it is recommended that a Kuchi ration should have energy levels ranging between 2300-2564MEKcal/Kg.

Average Daily Gain: Feeding of high energy diet (HE) in a semi-intensive (ESS) and extensive (ES) feeding systems are not significant different ($p>0.05$).However, HE ADG of HE under IS and ES are significantly different. Therefore, the diet for quick economic returns on market weight is LE. Feeding of HE in ESS and ES are not significant ($p>0.05$). However, feeding of MG under ESS and is significant. Feeding of HE in ESS and ES are not significant ($p>0.05$). However, the ADG of HE under IS and ES are significantly different. The diet for quick economic returns on market weight is LE.

Indigenous chicken breeding: In order to conserve IC genetic resources, Molecular characterization and Marker Assisted Selection and breeding towards an efficient feed utilization breeds of Kuchi and other local ecotypes is recommended.

ACKNOLWEDGMENT

This study was facilitated by the Department of Animal Science and Management, School of Agriculture and Biotechnology, of the University of Eldoret. Much gratitude is owed to all those persons and institutions, especially The Iten Youth Polytechnic, who, in one way or another, made this scholarly work a success.

BIODATA

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REFERENCE

Alabi, O.J, Ng'ambi, J.W, & Norris, D. (2013). Dietary energy level for optimum productivity and carcass characteristics of indigenous Venda chickens raised in closed confinement. *South African Journal of Animal Science*, *43*(Suppl. 1), 75-80.

Chesoo, B.K., Oduho, G.W., Kios,D.K,Kitilit, J.K.,& Rachuonyo, H. A. (2015).Evaluation of Growth Performance of Kuchi Indigenous Chicken Ecotype Fed with Three Level of Energy Diets under Three Feeding Systems *African Journal of Education, Science and Technology*(AJEST).Vol.*2*(4).1-50.

Chesoo,B.K., Oduho, G.W., Kios, D.K.(2016).Characteristics And Growth performance of Kuchi Indigenous Chicken"; LAP. Germany.72-79.

Chesoo,B.K., Oduho, G.W., Kios, D.K., Kitilit,J.K, J.K& Rachuonyo, H. A. (2014).Evaluation of Three Management Systems on Growth Performance of Kuchi Indigenous Chicken Ecotype of Kenya.*African Journal of Education, Science and Technology (AJEST).Vol.1 (4).170-174.*

Kingori, A.M., A.M.Wachira & J.K. Tuitoek. (2010). Indigenous Chicken Production in Kenya: A Review. International Journal of Poultry Science 9 (4): 309-316.

Lwelamira, J.Kifaro, G.C Gwakisa P.S. (2008). *On- station and on-farm evaluation of two Tanzania chicken Ecotypes for body weight at different ages and egg production*; African Journal of Agricultural Research, Dodoma Tanzania, 843-851.

Mahendra Kumar Padhi. (2016). Importance of Indigenous Breeds of Chicken for Rural Economy and Their Improvements for Higher Production Performance,Regional Centre, ICAR-Central Avian Research Institute, Baramunda, Bhubaneswar 751003, India.

Moula N;Michaux,C;Pilippe,F.X;Antoinne-Moussiaux,N and Lerry,P(2013).Egg and Meat Production Performances or Two Varieties of the Local Ardennaise Poultry breed:Silver Black and Golden Black.Animal Genetic Resources.FAO of UN,2013;(53)57-67

Mutua, E. (2010).*Improving Nutrition through indigenous poultry*. A case of Kuchi production in Lamu District, Mombasa. Kenya. Home Economics for Rwal Development.pp18.

Mwanza, R. (2010).*Unveiling the Kuchi.* Kenya Poultry Industry USAID On-Line.htm,file://F:Down loaded on 3/2/2011.Iringa, Tanzania 1-12.

National Research Council (1981).Effect of Environment on Nutrient Requirements of Domestic Animals.

Ngeno, (2014). Development of breeding schemes for indigenous chicken for improved livelihood in Kenya. PhD thesis, Wageningen University, The Netherlands.

Nthimo, A.M.; F.W.C. Neser; W.O. Odenya & M.D. Fair (2006). A comparison of the growth performance of exotic and indigenous chickens in Lesotho. *South African Journal of Animal Science 2006, 36*, 5, Supplement 1.

Robrerts, J.A (1995).*Utilization of Poultry Feed Resources by Small Holders in Villages of Developing Countries.*

SAS (2011): *Statistical Analysis Systems*.SAS Users Guide: Inst.Inc.USA

Sola-Ojo, F.E & Ayorinde, K. L. (2009).The Fulani Ecotype Chicken.Growth and Feed Utilization Potentials. *World Journal of Applied Science and Technology*; .Vol.1 (1)

Wickramaratne, S.H.G., Gunaratne, S.P., Chanrasiri. (1993).Growth performance of village chickens under different feeding systems.*Tropical Agricultural Research, 5*,359-367.