Protein and energy requirements for indigenous guinea keets (*Numida meleagris*) in southern Ghana

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ABSTRACT

One thousand two hundred healthy unsexed unsexed keets were used in an 8-week feeding trial that aimed at determining the protein and energy requirements during the starter phase of local guinea fowls reared in coastal savanna part of Ghana. The keets were randomly allocated in a 3 X 2 factorial design to six dietary treatments (three crude protein levels and two energy levels) in a deep litter system. Each treatment had 200 keets and was replicated four times with 50 keets per replicate. The six dietary treatments were designated as follows: T1 (23% CP and 11.5 MJ ME /kg), T2 (24% CP and 11.5 MJ ME /kg), T3 (25% CP and 11.5 MJ ME /kg), T4 (23% CP and 12.5 MJ ME /kg), T5 (24% CP and 12.5 MJ ME /kg), and T6 (25% CP and 12.5 MJ ME /kg). A known daily quantity of feed was given each replicate early in the morning while water was provided *ad libitum.* The same diets were fed for the entire duration of the study. Feed intake, weight gain, feed conversion ratio, economy of gain and mortality were determined and use as indices of evaluation. The feed intake per keet per day increased with the lower energy level diets (T1, T2 and T3) ($P < 0.05$). Dietary treatments T5 and T6 had the highest ($P < 0.05$) daily weight gains of 8.61 and 8.38 g/day respectively. The feed conversion ratios of the keets were 4.18, 4.20, 4.13, 4.32, 3.46 and 3.60 for T1, T2, T3, T4, T5 and T6, respectively. T5 diet had the least ($P < 0.05$) feed costs per kg gain ($/kg gain) value of 1.63. The study indicated that protein and energy required by guinea keets during the first 8 weeks of growth could be put at 24 percent CP and 12.5 MJ ME /kg, respectively.

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Introduction

Commercial poultry farming in Ghana has been predominantly dependent on the domestic chicken than the guinea fowl (*Numida meleagris*). Guinea fowl which is indigenous to Africa has been neglected and consigned to the rural areas where it is allowed to scavenge for food. It was traditionally reared in the three northern regions (Upper East, Upper West, and Northern) of Ghana, where almost every household undertakes its production on its compound, until the recent introduction to other parts of the country (Naazie *et al*., 2007). Guinea fowl has been reported to be less susceptible to most poultry diseases, hardy and tolerant to poor management conditions (Roy and Wibberly, 1979). It is adaptive and is of cultural and socio-economic importance (Annor *et al*., 2012).

Guinea fowl meat has been reported to be tastier and firmer than that of chicken (Koney, 1993). The yield of edible meat is also higher than that of chicken due to its slender skeleton (Musundire *et al*., 2017). Their thicker egg shells give them an obvious advantage for longer storage and handling with less breakage (Petersen & Tyler, 1966). The demand for guinea fowl meat and eggs locally has been on the increase over the years because of the nutritional qualities (Teye & Adam, 2000). However, supply has been increasing but at a slower pace than the increase in demand due to many factors, including nutrition (Avornyo *et al.,* 2016). The foregoing advantages and importance of the bird has made the guinea fowl an alternative poultry. It has the potential to alleviate poverty by generating employment in the value chain, thereby, creating wealth and providing food security (Annor *et al*., 2012).

One of the major constraints on guinea fowl production in Ghana has been their feeding (Awotwi, 1987), specifically energy and protein sources and feeding standards for commercial farmers. Guinea fowls require higher protein feed than chickens, though, they are mostly fed on domestic fowl diets, household wastes and insect larvae (Naazie *et al*., 2007). Domestic fowl diets may not support their economic exploitation because nutrient requirements differ among breeds and strains (Kratzer *et al*., 1994). Recommended feeding standards for this specie have been based on environment and feedstuffs different from the study area. Avoryno *et al*., (2013) studied the effect of dietary protein on the performance of local guinea keets in the Northern Region of Ghana, which is in the guinea savanna ecological zone. This study, on the other hand, was conducted in Accra, which is in the coastal savanna zone where climatic conditions are different (Ghana Meteorological Agency, 2017). The objective of the study was, therefore, to determine the protein and energy requirements during the starter phase of local guinea fowl, using cereal-based diets in coastal savanna zone of Ghana.

Materials and method

Study location

The experiment was conducted at the Guinea Fowl Resource Center of the Council for Scientific and Industrial Research–Animal Research Institute (CSIR-ARI), Frafraha Station, Accra, Ghana. The average temperature ranged between 24.2 (June) and 28 ^{o}C (March). The relative humidity generally stood at 65 percent (mid-afternoon) and 95 percent (night time), while wind speed usually ranged between 8 and 16 km/h. The mean annual rainfall is 730 mm.

Experimental keets and design of experiment

One thousand two hundred healthy unsexed keets hatched from eggs obtained from local farmers in the Volta and the three northern regions of Ghana were used for the experiment. They were randomly allocated in a 3 X 2 factorial design to six dietary treatments; that is, three different crude protein levels and two different energy levels. Each treatment had two hundred keets and was replicated four times with fifty keets per replicate.

Feeds and feeding regime

The experimental diets had three different crude protein levels (i.e. 23, 24 and 25%) and two different metabolizable energy levels (i.e. 11.5 and 12.5 MJ ME/kg). Hence, the six dietary treatments were designated as follows: T1 (23% CP and 11.5 MJ ME/kg), T2 (24% CP and 11.5 MJ ME/kg), T3 (25% CP and 11.5 MJ ME/kg), T4 (23% CP and 12.5 MJ ME/kg), T5 (24% CP and 12.5 MJ ME/kg), and T6 (25% CP and 12.5 MJ ME/kg). The composition of the experimental diets is presented in Table 1. A known daily quantity of feed was given to each replicate early in the morning while water was provided *ad libitum.*The same diets were fed for the entire duration of the study. Weekly feed intake and body weight gain were determined and documented.

Brooding of keets

The brooder house made of concrete, wire mesh and wood was partitioned into six large compart-ments. Each compartment was further parti-tioned into four chambers. Each chamber measured 2 m X 1.5m X 2.5m for length, breadth and height, respectively, and housed a replicate. A chamber had two feeder trays and two water fountains. The stocking density was 17 birds per meter square. Before the commencement of the project, the facility was cleaned, disinfected and fresh litter (wood shavings) of 0.04 m deep spread on the floor. The guinea keets were brooded for 6 weeks with gas heaters at a temperature of 35 oC for the first week and reduced every week by 2 oC to 29 oC during the fourth week (Avoryno *et al.*, 2013). There was no provision of heat after 6 weeks. The duration of the project was 8 weeks.

TABLE 1

Composition of experimental diets

Ingredients (%)	*T1*	*T2*	*T3*	*T4*	*T5*	*T6*
Maize	57.0	55.0	53.5	62.5	62.3	60.0
Soybean meal	23.0	23.2	24.5	22.2	21.0	22.0
Wheat bran	6.00	6.04	5.55	-	-	-
Di-calcium phosphate	1.50	1.55	1.55	0.70	0.70	0.70
Limestone	2.00	2.00	1.90	0.90	0.90	0.85
Salt (NaCl)	0.20	0.15	0.15	0.15	0.15	0.10
Lysine	0.15	0.15	0.15	0.15	0.15	0.15
Methionine	0.15	0.15	0.15	0.15	0.15	0.15
Fishmeal	9.75	11.5	12.3	10.8	13.2	14.3
Vit-min. premix#	0.25	0.25	0.25	0.25	0.25	0.25
Palm oil	-	-	-	2.20	1.20	1.50
Total	100	100	100	100	100	100
Calculated composition						
Metabolizable energy (MJ/kg)	11.5	11.5	11.5	12.5	12.5	12.5
Crude protein (%)	23.0	24.0	25.0	23.0	24.0	25.0
Lysine (%)	1.30	1.38	1.45	1.32	1.39	1.46
Methionine (%)	0.52	0.55	0.57	0.54	0.57	0.59
Crude fibre (%)	2.81	2.80	2.75	2.51	2.42	2.41
Crude fat (%)	3.70	3.85	3.86	3.89	4.11	4.16
Calcium (%)	1.76	1.84	1.83	1.23	1.31	1.33
Available Phosphorus (%)	0.56	0.61	0.63	0.44	0.47	0.49
*P: E	20.0	21.0	21.7	18.4	19.2	20.0
Cost per kg ($)	0.45	0.47	0.48	0.47	0.48	0.49

#Vit-min. premix per 100kg diet: Vitamin A ($8x10^5$I.U); VitaminD3 ($1.5x10^4$ I.U); Vitamin E (250mg); Vitamin K (100mg); VitaminB2 ($2x10^2$mg); VitaminB12 (0.5mg); Folic acid (50mg); Nicotinic acid ($8x10^2$mg); Calcium panthothenate (200mg); Choline ($5x10^3$mg). Trace elements: Mg ($5x10^3$mg); Zn ($4x10^3$mg); Cu ($4.5x10^2$mg); Co (10mg); I (100mg); Se (10mg). Antioxidants: Butylate dhydroxytoluene ($1x10^3$mg). Carrier: Calcium carbonate q.s.p (0.25kg).

* P: E - Protein: energy (g protein/MJ ME)

Health

Health management schedule practices as described by Teye & Gyawu, (2002) were followed throughout the study period.

Data collection and analysis

Data collected were daily feed intake, weight gain, and mortality over the 8-week period. The following parameters were also calculated from the data collected: total feed intake, feed conversion ratio, economy of gain and protein-energy ratio of the different diets. Data on various parameters were subjected to statistical analysis using analysis of variance (ANOVA) for a completely randomized design using the Genstat Statistical Software (Genstat Statistical Package, 2008) and differences between treatment means determined by the least significant difference (LSD).

Results and discussion

Growth performance of guinea keets

Table 2 presents the growth performance data obtained during the brooding stage. The mean initial live weight of keets at 28.4 g was similar across the six dietary treatments. Guinea keets fed diets T1, T2 and T3 had higher total and mean feed intake per day compared to their counterparts fed T4, T5 and T6 diets ($P < 0.05$). The daily feed intake was higher in the keets with lower energy feeds (T1, T2 and T3), and this is because birds eat to meet their energy requirements (Gous, 2010). Metabolizable energy of 11.5 MJ/kg was low as compared to recommended energy level of 12.1-12.5 MJ/kg for guinea keets of 0–3 weeks old (Dei & Karbo, 2004). Treatment 5 recorded the highest final weight of 512 g as compared to the others at the end of the project ($P < 0.05$). The weight gain followed a similar pattern as the final weight with T5 and T6 recording the highest gains ($P < 0.05$). Tewe (1983) suggested that, for rapid growth rate of guinea keets, diet offered should contain 25–26 percent crude protein and 13 MJ/kg of energy. The high energy and high protein diets in this study, that is T5 (24% CP 12.5 MJ ME/kg) and T6 (25% CP 12.5 MJ ME/kg) had the highest weight gains ($P < 0.05$) and this is similar to the recommendation of Tewe (1983). When local guinea fowls are intensively kept, the daily weight gain ranges from 6–8g (Ayorinde, 1999). However, this study had two treatments T5 and T6, whose daily weight gains (Table 3) were higher than what has been reported by Ayorinde (1999).

TABLE 2

Growth performance of guinea keets (0–8 weeks)

Parameter	*T1*	*T2*	*T3*	*T4*	*T5*	*T6*	*SEM*	*p*
Initial weight, g	28.6	29.0	28.1	28.3	29.3	27.3	0.51	0.35
Final weight (w 8), g	447^{bc}	433^{bc}	457^{b}	414^{c}	512^{a}	497^{a}	15.3	<0.001
Weight gain, g	419^{b}	404^{bc}	429^{b}	386^{c}	482^{a}	470^{a}	15.3	<0.001
Mean live weight/day, g	7.47^{b}	7.22^{bc}	7.65^{b}	6.89^{c}	8.61^{a}	8.38^{a}	0.02	<0.001
Total feed intake, g	1749^{a}	1700^{b}	1770^{a}	1667^{b}	1668^{b}	1691^{b}	0.84	<0.001
Mean feed intake/day, g	31.2^{a}	30.4^{b}	31.6^{a}	29.8^{b}	29.8^{b}	30.2^{b}	0.02	<0.001
FCR	4.18^{a}	4.20^{a}	4.13^{a}	4.32^{a}	3.46^{b}	3.60^{b}	0.01	<0.001
Feed cost/kg gain ($/kg gain)	1.89^{b}	2.01^{a}	1.99^{a}	2.02^{a}	1.63^{c}	1.78^{b}	0.02	<0.001

ø a, b, c - Means in a row with similar or no superscript are not significantly (P>0.05) different and vice -versa

The average daily weight gain per keet per day recorded for all the treatments were higher than what was reported by Avornyo *et al*., (2013), except T4 (6.89 g) which was lower than the highest value (7.04 g) reported by them. They did not observe any differences in weight gains when different crude protein levels (22, 23, 24 and 25% CP) were assessed on the performance of local guinea keets. Also, no differences were recorded among treatments (160, 180, 200 and 220 g/kg CP) when protein requirements for growing indigenous guinea fowls in the humid tropical zone of Ghana were studied (Adjetey *et al.,* 2014). Guinea keets in this study were kept in a deep-litter floor system with saw dust used as litter as described above which is different from the use of battery cage. Saina, (2005) reported a difference in growth performance under different systems of keeping guinea fowls in the tropics.

The feed conversion ratio was improved with the high protein and high energy diets (T5 and T6) and this agrees with Naazie *et al*., (2007), who concluded that guinea fowls require high protein diets. Dei & Karbo, (2004) had suggested that the starter feed offered to guinea keets during the first 3 and 4 weeks should contain 24 percent CP. Nevertheless, under this study, one diet was offered throughout the study period. The metabolizable energy and crude protein requirements for guinea keets from 0–8 weeks have been recommended by Kari *et al*., (1978) to be 12.5 MJ ME/kg and 24 percent CP, respectively. The highest conversion of feed into flesh at the lowest cost was achieved with 24 percent CP and 12.5 MJ ME/kg, which is a protein-energy ratio of 19.2. This implies that, it was more economical to raise guinea keets on that treatment (T5).

The average final weight gain of guinea keets when fed with a diet which had this protein-energy ratio at week 8 was 421 g (Avornyo *et al*., 2013). This is slightly higher than the gain obtained in this work which was 404 g for diet T2 (24% CP and 11.5 MJ ME/kg) whose protein-energy ratio was 21. It was also observed that protein-energy ratio was inversely proportional to feed intake. Birds fed the high protein-energy ratio had lower feed intake. There was an interaction between protein and energy contents of feed fed to the guinea keets because at 11.5 MJ ME/kg, 24 percent CP gave the highest feed cost/gain while at 12.5 MJ ME/kg, the same 24 percent CP gave the lowest feed cost/gain. Summers *et al*., (1964) concluded that there was an interaction between protein and energy contents of feed fed to chickens.

The bi-weekly weight changes (Fig. 1) were similar among the treatments for the first 4 weeks. Differences in weight gains were observed from week 6 forward. Nsoso *et al*., (2006) observed a similar trend of no difference in growth rate of guinea keets during the first 4 weeks of age when they compared growth and morphological parameters of guinea fowl (*Numida meleagris*) raised on concrete and earth floors in Botswana. Generally, indigenous guinea fowls tend to grow slower weighing less than 1 kg at 8 weeks of age compared to broilers which weigh 1.5-2 kg at the same age (Ayorinde & Ayeni, 1983).

Mortality of keets (%)

Most mortality was recorded during the first 3 weeks of the project with an average mortality of 6 percent per treatment. There were no differences in the mortality rate across the different dietary treatments (Fig. 2). The major constraint of guinea fowl production reported by farmers in the northern part of Ghana is keet mortality (Teye & Adam, 2000).

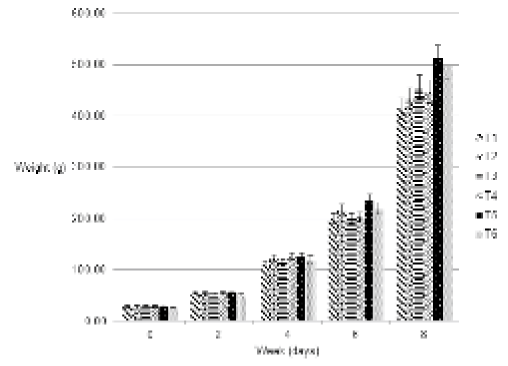

Fig. 1. Weight changes trend of guinea keets (0–8 weeks)

Guinea fowl mortality could be very high ranging from 40 percent to 100 percent with the most critical being the brooding (1–6weeks of age)/ starter phase. The major causes of death at this stage had been attributed to poor brooding management, pneumonia, dehydration, worm infestation and poor nutrition (Annor et al., 2012). The lower mortality of keets observed during this study could be attributed to the selection of healthy keets and adhering to proper management practices such as deworming, provision of enough quality drinking water, quality feed and good aeration.

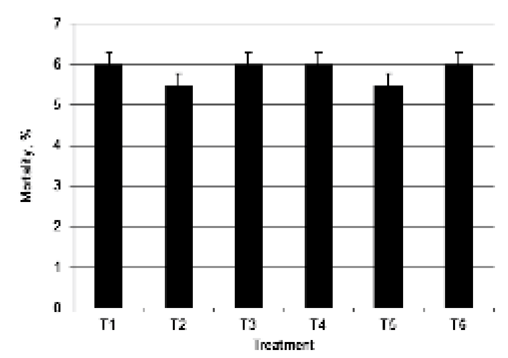

Fig. 2. Percentage mortality of guinea keets

Conclusion

The study revealed that feeding guinea keets of 0–8weeks old on diets containing 24% CP and 12.5 MJ ME/kg with a protein-to-energy ratio of 19.2 could enhance their growth performance. It is recommended that further studies be conducted to vary the metabolizable energy content over a wider range.

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