

## A COMPARISON OF SIX TREATMENTS FOR CONTROLLING MORTALITY OF KEETS IN THE WET SEASON OF THE NORTHERN REGION OF GHANA

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### Abstract

A study was conducted to assess ways of controlling guinea keet mortality in the wet season in the Northern Region of Ghana. Seven hundred and twenty day-old local guinea keets were randomly assigned to six treatments namely, antibiotics & standard diet (AS), dewormer and standard diet (DS), antibiotics, dewormer and standard diet (ADS), antibiotics and by-product diet (ABp), dewormer and by-product diet (DBp) and antibiotics, dewormer and by-product diet (ADBp), and monitored for up to 8 weeks. Statistical Analytical System 9.3 was used to analyse the data as a general linear model. Mean keet mortality was 12.6 per cent. ABp recorded the lowest mortalities (6.6%) and ADBp recorded the highest mortalities (15.7%). However, the differences were not statistically significant. Average feed intake per keet for the 8 weeks was 1.91 kg, and the corresponding mean growth rate was 7.4 g day<sup>-1</sup>. An average profit of 11 US cents was realised on each keet sold with treatment AS recording the highest profit of 21 US cents per keet sold, and ADS recording the lowest profit of -0.08 US cents per keet sold. Treatments AS and ABp were the most preferred for brooding in the wet season because they gave the highest benefits.

### Introduction

The problem of guinea keet mortality is common to guinea fowl producers all over Africa (Moreki & Radikara, 2013). In Ghana, mortality pattern is seasonal, being high in the rainy season (Teye & Adam, 2000). Hatching of guinea keets under the extensive system at the peak of the rainy season (Jun - Aug) is associated with 90 per cent to 100 per cent mortality rate (Ahaotu *et. al.*, 2013; Konlan *et. al.*, 2011). Because of this, farmers in northern Ghana have their preferred times for hatching guinea keets at the beginning of the rainy season (May) and towards the end of the rainy season (Sep-Oct) (Dankwa *et. al.*, 2000). Ironically, it is at the peak of the rainy season that guinea fowls lay a lot of eggs with good fertility (70 – 85%) and hatching rates

(80 – 90%) (Awotwi, 1972; Anamoh, 1975; Konlan & Avornyo, 2013).

The gravity of the problem of guinea fowl mortality in northern Ghana is such that it has been considered in a number of projects such as a Land Conservation and Rehabilitation Project II (LACOSREP II) in Upper East Region of Ghana, a UNICEF sponsored project in Northern Region, Agricultural Sub-Sector and Investment Project (AgSSIP) for the whole of Ghana, and an on-going Savanna Accelerated Development Authority (SADA) programme of the Government of Ghana. Moreover, less research has been conducted on the guinea fowl compared to the chicken (Nalubamba, Mudenda & Masuka, 2010). The issue of feeding will also become critical if keets have to be confined during the

period of brooding (Agbolosu *et. al.*, 2012) to prevent death caused by cold weather or by predation. The feeds normally given to keets by farmers include millet and sorghum with the occasional supply of termites (*Amitermes meridionalis*) (Dankwa *et. al.*, 2000; Teye & Adam, 2000). The demand for cereals namely millet, sorghum, maize and rice for human consumption is high making it costly to feed to poultry. There is, therefore, the need to find suitable yet cheaper sources of feed for guinea keet brooding (Boko *et. al.*, 2011; Agbolosu, Teye & Adam, 2014).

Since the guinea fowl plays a very valuable role in sustenance of the rural poor farmer, attempts at increasing its productivity may help solve the problem of food and nutrition insecurity faced by these farmers yearly (Konlan & Avornyo, 2013; Yakubu *et. al.*, 2014). The study, therefore, sought to compare six treatments in their ability to control keet mortality, enhance growth performance and reduce feed cost in guinea fowl production.

## Experimental

### *Study location and climate*

The experiment was carried out at Pong-Tamale in the Savelugu-Nanton District in the Guinea savanna zone of the Northern Region of Ghana. The climate is characterised by two seasons; the dry season from November to April and the rainy season from May to October. Maximum temperature (42 °C) is experienced during the months of March and April and minimum temperature (15°C) in December-January (peak of harmattan). The relative humidity of the area is 42 per cent between November and March and 80 per cent between June and October.

### *Collection of eggs and incubation*

A total of 1,000 local guinea fowl eggs were purchased in June from farmers in the surrounding communities of the study location. These eggs were incubated in a Pong-Tamale Veterinary College electric incubator. A total of 720 keets were hatched.

### *Preparations for the arrival of day old keets*

The brooder house was divided into three apartments, each apartment measuring 2.92 m × 3.6 m. Each apartment was further subdivided with plywood into six equal cells, with each cell measuring 1.46 m × 1.2 m × 0.6 m high. A cover was made with chicken wire mesh and wood for each cell to prevent keets from flying into other cells. Each cell was then randomly assigned to one of six treatments. Doors, windows and other openings of the brooder house were covered with polythene sheets to control temperature fluctuation in the brooder house. The rooms were pre-warmed to a temperature of 35 °C before the arrival of keets. Footbaths were provided at the entrance of the house to control the transfer of infections into the brooder house.

### *Formulation and composition of experimental diets*

Two diets were formulated namely a commercial standard diet and an agro-industrial by-product based diet. Readily available agro-industrial by-products in the locality were used in the formulation of the by-product based diet in order to assess their suitability as feed for guinea fowls. Table 1 shows the chemical composition of the feeds which were analysed in the nutrition laboratory of the Animal Science Department

TABLE I  
Composition of experimental diets

Ingredients	Inclusion rate of ingredients (g AD <sup>1</sup> kg <sup>-1</sup> )	
	Standard diet	By-product diet
Maize	500.00	140.00
Maize bran	-	70.00
Mill maize waste flour	-	177.00
Rice mill feed		90.00
Wheat bran	93.50	50.00
Sorghum spent grains	-	50.00
*30% broiler starter concentrate	390.00	-
Fish meal	-	40.00
Soya bean cake	-	250.00
Cotton seed cake	-	100.00
Common salt	4.00	3.00
Coccidiostat	2.50	2.50
Premix	-	2.50
Dicalcium phosphate	-	10.00
Oysters shell	10.00	15.00
<i>Chemical composition of experimental diets</i>		
Dry matter (g/kg AD)	894.10	904.40
Organic matter (g/kg <sup>1</sup> DM)	914.40	922.50
Protein (g/kg DM)	228.00	232.00
Ether extract (g/kg DM)	88.90	141.10
Fibre (g/kg DM)	46.40	56.90
<sup>1</sup> ME (MJ/kg DM)	11.25	11.10
Price of feed (US\$/kg)	0.45	0.39

<sup>1</sup>AD = air dry; DM = dry matter; ME = metabolizable energy

\*30% broiler concentrate (CP = 440g/kg; EE = 45 g/kg; CF = 48 g/kg; Ca = 34 g/kg; Av. P = 17 g/kg; Lys = 28 g/kg; Met = 11.5 g/kg; ME = 100.4 MJ/kg) manufactured by AGRICARE Feeds Company Ltd., Kumasi, Ghana

US\$1.00 = GH¢3.85

of University of Ghana, Legon. The chemical analysis procedures followed were those recommended by AOAC (2000).

#### Experimental design

The main factors of interest were medication and feed. Medication was at three levels and feed at two levels. These were combined to

give six treatments. The treatments were T<sub>1</sub> = antibiotics (Penstrep plus) and standard diet (AS), T<sub>2</sub> = dewormer (special guinea fowl dewormer) and standard diet (DS), T<sub>3</sub> = antibiotic, dewormer and standard diet (ADS), T<sub>4</sub> = antibiotics and by-product based diet (ABp), T<sub>5</sub> = dewormer and by-product based diet (DBp) and T<sub>6</sub> = antibiotics, dewormer and by-product based diet (ADBp). The special guinea fowl dewormer was manufactured by Laprovect. These six treatments were applied to 18 groups of unsexed guinea keets in three rooms. Each room was divided into six cells. The first room had a total number of 60-day old keets in each cell. The second room had 30-day old keets in each cell and the third room also had 30-day old keets in each cell. This translated into a stocking rate of about 34 keets m<sup>-2</sup> in the first room and 17 keets m<sup>-2</sup> in the other two rooms. The medication regimen recommended for broiler production in northern Ghana was used. Other sources of variation which were also included in the analyses were stocking rate and

cell effects.

#### Brooding of keets

The keets were brooded for 8 weeks. The room temperature was 35 °C in the 1st week and was lowered by 2 °C every subsequent week until the 4th week when the heat source was withdrawn, and room temperature of

about 29 °C was maintained up to the 8th week. The birds received 24 h of lighting each day. Wood shavings were used as litter. The day-old keets were offered water containing an anti-stress (Strexia). Keets were fed *ad lib*. Changing of water and feed as well as disinfection of feeders and waterers were done daily. The feeders used were round aluminum plates about 15 cm in diameter and 2 cm deep. The drinkers were 1.5 l round plastic fountains. Windows were gradually opened from the 3rd week during hot periods of the day to admit light so as to prevent leg deformation and increase air circulation. The remaining medications administered were; gumboro vaccine, Hitchner B1, Fowl pox vaccine, Lasota and Amprolium sulphate. The methods employed in the drug administration were water medication, feed medication and injection.

#### *Data collection, processing and analysis*

Data were collected on the following parameters: Daily feed intake, daily weight gain, manure output, mortality and cost benefit analysis. Feed conversion efficiency was computed weekly by dividing the amount of feed consumed during a particular period by the corresponding mean weight gained of the bird over that period. Mortality was recorded as it occurred.

#### *Cost-benefit analysis*

Cost of feeding, medication, litter, heating, disinfection, housing, labour, day-old keets, feeders and waterers associated with the brooding were determined. Revenue from sale of 8-week old keets and manure (droppings and spilled feed) was also computed. Total cost incurred under each treatment was then

subtracted from total revenue from treatment to estimate the profitability of using the treatment.

#### *Statistical analysis*

The data were analysed using the General Linear Model procedure of SAS 9.3 (2010) with treatment as the main effect and stocking rate, week and cell as other sources of variation. The model used to describe the effect of treatment on feed intake, weight gain, feed conversion efficiency and mortality was  $Y_{ijklm} = \mu + T_i + W_j + S_k + C_l + \epsilon_{ijklm}$  where  $Y_{ijklm}$  = response variable,  $\mu$  = overall mean,  $T_i$  = effect of treatment,  $W_j$  = effect of week,  $S_k$  = effect of stocking rate,  $C_l$  = effect of cell and  $\epsilon_{ijklm}$  = error term. Student Newman Keuls test was used to separate the means. Interaction terms between the sources of variation were also explored.

## **Results and discussion**

#### *Disease prevalence and mortality*

Observed differences in mortality rate attributable to application of treatments were not statistically significant. A high level of hygiene is usually associated with a low level of disease-induced mortality. Mortality on the average increased from 3.3 per cent in the 1st week to 12.6 per cent by the end of the 8th week (Fig. 1). Within the first 8th weeks of brooding, Boko *et. al.* (2011) have indicated that mortality rates in excess of 50 per cent are common and Ahaotu *et. al.* (2013) observed 59 per cent mortality rate for intensively reared keets, and 100 per cent for those raised under extensive system. Hien (1999) mentioned that, provision of adequate warmth, medication and feeding could control keet mortality at brooding. Under

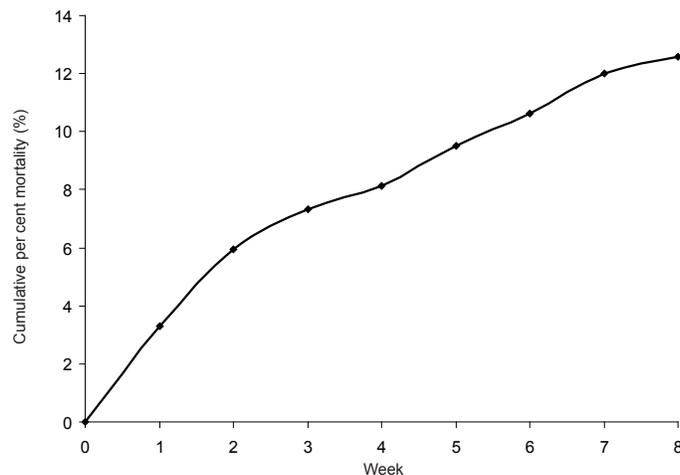


Fig. 1. Cumulative per cent guinea keet mortality curve

the intensive system of production, Teye & Gyawu (2001) obtained mortality rates of 33 per cent and 9.8 per cent, respectively, in two related studies.

Mortality rate appeared to have had a steeper incline from hatch to the 3rd week (Fig. 1), although mortality differences between weeks were not statistically significant. Avornyo *et al.* (2013) also observed higher mortality rate of keets in the first 4 weeks. It is, therefore, suggested that more attention be given to keets especially in the first 2 weeks. Post mortem records on dead keets collected from the experiment suggested bacterial infections. *Enterobacter* sp, *Salmonella* sp, *Escherichia coli* and *Streptococcus* sp. were observed. Coccidiosis, worms and viral cases were not observed. After administration of anti-stress, perhaps, antibiotics should be given for 5 to 7 consecutive days to control bacterial infection. This notwithstanding, some mortalities in the guinea fowl were

attributable to worm infestation (Agbolosu *et al.*, 2012).

There was no increase in the mortality rate of keets stocked at the higher rate of 60 keets/cell, because even keets that were stocked at the lower rate recorded slightly higher losses. This suggests that local keets may be satisfactorily brooded at 34 keets  $m^{-2}$  and brooding them in the same area up to 8 weeks. At 8 weeks, each keet weighed an average of 438.8 g. Therefore, at 8 weeks the guinea keet floor density was 14.92  $kg\ m^{-2}$  for the higher stocking rate and 7.46  $kg\ m^{-2}$  for the lower rate. Nahashon, Adefope & Wright (2011) have suggested that, a stocking rate of around 19.34  $kg\ m^{-2}$  would give the best weight gains and feed conversion in the pearl grey guinea fowl. Stocking rates in excess of this figure have been linked to leg weakness and foot dermatitis in broiler chickens (Sorensen, Su & Kestin, 2000; Buijs *et al.*, 2009). Avornyo *et al.* (2013) observed a stocking rate of 35

local keets m<sup>-2</sup> to be the most profitable rate compared to lower stocking rates.

### Feed intake

Feed intake increased significantly ( $P < 0.05$ ) from the 4th week to the 5th week because the keets had probably begun to experience rapid growth after the 3rd week. Teye & Gyawu (2001) reported that, mean feed intake increased at higher rates with increasing age until the 12th week when the rate of increase reduced or stabilised. Feed intake was highest in keets on ADS and lowest in keets on AS ( $P < 0.05$ ) (Table 2).

Generally, keets which received dewormer (DS, ADS, DBp & ADBp) consumed more feed than those which did not receive dewormers (AS & ABp) ( $P < 0.05$ ). The increase in feed intake did not translate into increase in weight gain but into increase in manure output. A keet consumed averagely 1.91 kg feed and generated 1.45 kg of manure during the 8 weeks of brooding.

Feed intake was also similarly higher in keets stocked at a higher rate than in keets stocked at a lower rate ( $P < 0.05$ ). During the study it was observed that, the birds generally exhibited allelomimetic and leadership behaviour. These could have caused an increase in feed intake as all the birds resumed feeding when one initiated the process, such that birds kept under the higher stocking rate fed more than those at lower stocking rate. Although keets on dewormer and antibiotic treatment (ADS and ADBp) consumed more feed than those on dewormer alone, which also consumed more feed than those on antibiotic alone ( $P < 0.05$ ), their feed intake appeared to be altered by the cells in which they were found. Generally cells 2, 3 and 4

TABLE 2

*Effects of observed factors on keet daily mean feed intake*

Factors	Daily mean feed intake (g d <sup>-1</sup> )	*MSE; edf; n
<i>Treatment</i>		
T <sub>1</sub> (AS)	30.87 <sup>c</sup>	
T <sub>2</sub> (DS)	32.75 <sup>bc</sup>	
T <sub>3</sub> (ADS)	35.95 <sup>a</sup>	
T <sub>4</sub> (ABp)	31.41 <sup>c</sup>	7.58;109;24
T <sub>5</sub> (DBp)	32.32 <sup>bc</sup>	
T <sub>6</sub> (ADBp)	33.82 <sup>b</sup>	
<i>Stocking rate</i>		
1	33.49 <sup>a</sup>	7.58;109; 48
2	32.51 <sup>b</sup>	7.58;109; 90
<i>Feed</i>		
1	33.19	
2	32.52	7.58;109;69
<i>Cell position</i>		
1	36.60 <sup>a</sup>	
2	30.75 <sup>c</sup>	
3	31.60 <sup>bc</sup>	
4	31.68 <sup>bc</sup>	
5	33.62 <sup>b</sup>	7.58;109;23
6	32.87 <sup>b</sup>	
<i>Medication</i>		
1	31.14 <sup>c</sup>	
2	32.54 <sup>b</sup>	
3	34.88 <sup>a</sup>	7.58;109;46

NB: Mean values with different superscript letters within a row heading are statistically different at  $P < 0.05$ ; \*MSE = mean square error; edf = error degrees of freedom; n = number of observations.

were associated with lower intakes whilst cell 1 was associated with higher intake ( $P < 0.05$ ). The standard diet was consumed slightly more than the by-product diet, however, the differences were not statistically significant.

### Keet weight gains

Fig. 2 shows the growth of the experimental keets. The daily growth rate over the 8-week brooding period was estimated at 7.4 g. This

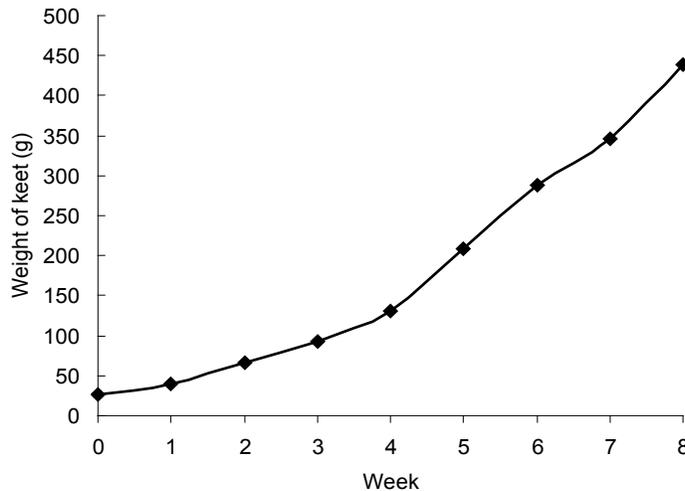


Fig. 2. Mean growth performance of experimental keets in the brooding period

growth rate was observed to be numerically higher than a maximum growth rate of 5.5 g d<sup>-1</sup> reported by Ahaotu *et al.* (2013) for guinea keets aged 0 – 8 weeks. They used a diet of 191 g CP kg<sup>-1</sup> DM and 14.6 MJ GE kg<sup>-1</sup> DM.

There was a slower growth rate in the first 3 weeks. Just before the 4th week, there was a slight increase in the growth rate. A significant increase ( $P < 0.05$ ) in growth rate was experienced from the 4th to the 5th week, and the new rate of increase was maintained to the 7th week after which there was another significant increase in growth ( $P < 0.05$ ) (Table 3). The slower growth rate observed in the first 3 weeks may be the result of environmental stress, and birds adapting to the stress. Nahashon *et al.* (2006) using Richards, Gompertz and Logistic models to describe the growth of the pearl grey guinea fowl, observed that maximum growth rate occurred around the 6th and 8th week.

Keets stocked at the higher rate exhibited a superior growth rate than those stocked at

the lower rate ( $P < 0.05$ ). The cells in which keets were confined did not influence the daily weight gains of keets in any particular way.

#### Feed conversion efficiency

Feed conversion in keets ranged from 1.88 g feed/g gain in Week 1 to 6.79 g feed/gain in Week 6. Feed conversion efficiency was better at the beginning and towards the end of the brooding period. There were some indications of better feed conversion by birds on standard feed, on antibiotics only or dewormer only, but the differences were not statistically significant. Feed conversion efficiency of guinea fowls can vary considerably even if they are on the same treatment, because the works of Agbolosu *et al.* (2012) and Avorny *et al.* (2013) could not detect significant differences between treatments in relation to feed conversion efficiency. Similarly, Teye & Gyawu (2001) observed fluctuating pattern for efficiency of gain which was not statistically significant. The local guinea

TABLE 3  
Effects of factors on keet daily weight gains

FACTORS	Mean daily weight gains (g d <sup>-1</sup> )	*MSE; edf; n
<i>Treatment</i>		
T1 (AS)	7.84	10.987; 117; 24
T2 (DS)	7.41	
T3 (ADS)	6.57	
T4 (ABp)	6.71	
T5 (DBp)	6.63	
T6 (ADBp)	6.76	
<i>Week</i>		
1	2.04 <sup>d</sup>	10.987;117;18
2	3.65 <sup>cd</sup>	
3	4.07 <sup>cd</sup>	
4	5.63 <sup>c</sup>	
5	8.39 <sup>b</sup>	
6	10.57 <sup>b</sup>	
7	8.32 <sup>b</sup>	
8	13.22 <sup>a</sup>	
<i>Stocking rate</i>		
1	8.22a	10.987;117;48
2	6.38b	10.987;117;96

NB: Mean values with different superscript letters within a row heading are statistically different at  $P < 0.05$ ; \*MSE = mean square error; edf = error degrees of freedom; n = number of observations

fowl has not undergone breed improvement for uniform growth. Keets on dewormer and antibiotics combinations appeared to be poorer converters.

#### Manure generation

The total amount of manure generated by brooding an initial number of 720 keets over an 8th week period was about 1,051kg air dry manure, ranging from 164.8 kg for keets on treatment AS to 184.7 kg for keet on treatment ADS. Agbede, Ojeniyi & Adeyemo (2008) estimated the crude protein content of poultry manure to be around 125 g kg<sup>-1</sup> DM.

#### Cost benefit analysis

Table 4 shows the profitability of guinea keet brooding. Feed cost was lower for keets on by-product diet by 16 per cent. Feed cost constituted 47 per cent of total cost. Cost of medication represented only 5 per cent of total cost. Other costs namely the cost of litter, heating, disinfection, housing, labour, day-old keets, feeders and waterers formed

TABLE 4

The cost-benefit analysis of guinea keet brooding using different treatments

Items	Amount (US\$)					
	AS	DS	ADS	ABp	DBp	ADBp
Feed cost/keet	0.78	0.79	0.80	0.63	0.66	0.69
Medication cost/keet	0.07	0.08	0.08	0.06	0.07	0.08
Other materials cost/keet	0.74	0.76	0.76	0.69	0.72	0.77
Total cost/keet	1.59	1.63	1.64	1.38	1.45	1.54
Returns from sale of keets (price per keet)	1.66	1.64	1.40	1.43	1.41	1.47
Returns from sale of manure (price per keet)	0.14	0.15	0.16	0.15	0.15	0.15
Total returns/keet	1.80	1.79	1.56	1.58	1.56	1.62
Total returns – total cost (profit)	0.21	0.16	-0.08	0.20	0.11	0.08

the remaining 48 per cent of the total cost. More expenditure was incurred on keets on treatment AS, DS and ADS.

Estimated returns were calculated based on the sale of 8-week-old keets. The results, therefore, showed that keets on ADS gave the lowest returns (US\$1.40/keet), whilst those on AS gave the highest returns (US\$1.66/keet). Keet growth rate and numbers surviving at 8 weeks had a direct effect on the quantum of the returns made.

Manure generated was sold at US\$0.09 kg<sup>-1</sup>. Returns made from manure sales ranged from US\$0.14/keet for keets on AS to US\$0.16/keet for keets on ADS. This implies that whilst keets on AS gave the highest returns on keets sold, they gave the lowest returns on manure sold. Returns made from keet sales formed 91 per cent of total returns, whilst returns from manure sales constituted nine per cent.

Estimated profits, without consideration of the value of manure, were small for treatments AS, ABp and DS, whilst ADS, DBp and ADBp made losses. When the returns from the manure were included in the estimation of the profitability of the guinea keet brooding, it showed that all treatments except ADS were profitable with treatment AS giving the highest value (US\$0.21/keet) and treatment ADS giving the lowest value (US\$0.08/keet). Ahaotu *et. al.* (2013) have indicated that guinea keet brooding enterprise may become profitable after the 5th year of production. They added that, if keet mortality rate was less than 40 per cent, it made the enterprise more likely to be profitable. Also, substituting non-conventional feedstuffs for conventional feedstuffs can increase profit margins (Chimvuramahwe, *et. al.*, 2011).

### Conclusion and recommendations

Keets should be given antibiotics for 5 to 7 continuous days starting from the 2nd day after hatch. All the treatments tested were able to control mortality at brooding to appreciable levels. Stocking local keets at 34 keets m<sup>-2</sup> from hatch to the 8th week did not have any deleterious effects on the performance of keets. Generally, keets that received both dewormers and antibiotics consumed more feed, which did not translate into faster growths but into higher outputs of manure. The cells in which the keets were confined had some effect on the rate of feed consumption, and this may be influenced by differences in the microclimate, example intensity of lighting and level of draught. The local keets would consume about 1.9 kg of feed over an 8th week period.

In terms of overall benefits, the treatments with only antibiotics (AS and ABp) were the most preferred followed by those with only dewormers (DS and DBp), before treatments which had a combination of antibiotics and dewormers. The standard diet and the by-product diet are equally recommendable since they both have their merits and demerits. More research effort is needed to lower cost of brooding.

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