Research Article

Effect of Separating Energetic Feedstuffs in the Finisher Diet on Performance of Common Guinea Fowl (Numida meleagris L.1758) Under Tropical Climate

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Abstract | Feedstuffs and high temperature are the two major constraints for tropical poultry. The Separate Energetic Feeding (SEF) was suggested as an alternative to limit the harmful effects of the high temperature on the productivity of fowls under hot climate. To check this assumption, one hundred 8 -week- old chicks Guinea fowls were distributed in two groups. Each group was divided into two replicates of 25 birds each. The first group (control; n=50) received a conventional food containing 2953. 75 Kcal/kg metabolizable energy and 17. 31% crude protein. The second group (treatment group; n= 50) was separately fed with two fractions: (1) caloric feeding with 2141.75 Kcal/kg metabolizable energy and 4. 24% of crude protein and (2) crude proteins and mineral stuffs fraction containing 812 Kcal/kg metabolizable energy and 13.07% crude protein. Feed and water were offered *ad libitum.* The mean average live weight was significantly higher (P<0. 05) in guinea fowls fed with fractioned meals. Birds receiving a SEF reached the commercial body weight (BW) one week earlier than the control group (P<0. 05). The results show that the voluntary consumption of the energy fraction increased with age of birds in both groups but was moderately higher (P<0. 05) in the treated group. This study highlighted that SEF is an alternative to limit the harmful effect of heat stress in tropical climate and may be useful for poultry production in developing countries where formulated feeds and premixes are limited.

Keywords | Guinea fowls, Free choice feeding, Live weight growth, Feed intake, Tropical poultry farming.

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INTRODUCTION

Feed is currently the most effective cost in term of expenses in poultry breeding, generally ranging between 60 to 70 %, and is one of the major obstacles in developing countries. In addition, in tropical areas, higher temperature is known to involve in lowering performance production by reducing feed intake and bodyweight and increasing mortality (Al-Nasrawi, 2016). Despite the various adjustments of feeding composition, the complete feeding stuff used *ad libitum* in tropical areas is ineffective and far to compensate the harmful effects of heat stress on the performances of poultry (Orayaga et al., 2016).

In the other hand, many studies have reported that the aptitude of birds naturally tend to select and to balance their diet in order to meet their nutritional needs (Hughes 1984; Emmans 1991; Forbes and Shariamadari, 1994). These studies also indicated that when birds are given a choice, feed intake results from a compromise between the nutritional needs of the birds and the relative palatability of the food.

Fanatico et al. (2013) defined free choice feeding as an alternative feeding method in which feed ingredients are provided in separate feeders and birds self-select energy, protein, mineral, and vitamin feedstuffs as needed. Free-choice feeding is based on the principle that poultry can adjust intake as a function of nutrient requirements. Feed selection can be specific for energy, protein, minerals, or other nutrients; so, birds can adjust intake daily to meet nutrient needs. This feeding method was used in the past in the United States, but may hold renewed potential for alternative poultry production (Fanatico et al., 2013).

Hence, the free choice feeding has also been suggested as an alternative to limit the harmful effects of the temperatures on the productivity of the poultries in hot climate. The free choice has been experimented by many researchers and has many concepts. These different concepts included: separated calcium feeding (Banga-Mboko et al., 2001; Banga-Mboko et al., 2007; Mantsanga et al., 2016), free choice feeding (Yo, 1992; Lesson and Caston, 1993; Bati, 2003; Yao et al., 2006; Cerate et al., 2007), separate energy feeding (Yo et al., 1998; Kamokini, 2012) and sequential feeding (Bouvarel et al., 2004; Arroyo et al., 2016) and cafeteria feeding (Fanatico et al., 2013).

As this study was conducted, we used the term free choice feeding based on the separation of the energy and crude protein sources. The Separated Energy feeding (SEF) can be defined as a technique which is to distribute, first, an energy food fraction in the finisher period of breeding into the first feeder, secondly, a crude proteins and mineral sources in the second feeder.

Previous studies investigated on SEF in broiler chicken and ducks but the results are not consistent (Leeson and Caston, 1993; Yo et al., 1998; Bouvarel et al., 2004; Yao et al., 2006; Cerate et al., 2007; Arroyo et al., 2016).

Although many studies have been carried out on Guinea fowls in tropical warm climates (Ayorinde et al.,1988, FAO, 1992; Dehoux et al., 1997; Alli et al., 2016), the SEF has never been experimented in Guinea fowl. As a result, there is not data available in regard to Guinea fowls that originated from Africa, and are well appreciated for their meat by local inhabitants and foreigners .

The present study was designed to check the assumption that the guinea fowl may respond positively to SEF. Therefore, the objective of this study was to evaluate performance of Guinea fowls fed with separated-energetic stuff diet under tropical climate.

MATERIAL AND METHODS

This study was conducted in the agreement to the Congolese National Regulations for Human and animal care for research purposes.

Pre-Experimental Period

The study was conducted in Brazzaville, located in the southern part of the Congo. The climate is humid tropical and the annual rainfall ranges between 1,400 – 1,600 mm. Brazzaville is dominated by two rainy seasons and two dry seasons. The annual average temperature ranges between 22°C and 29 °C , the maxima are very high and reach or exceed 32°C and the minima are never below 20 °C (Samba et al., 2008).

The experiment was conducted by a research unit on fractioned feeding located at the National Institute for Agronomy Research in Brazzaville, Congo. The pre-experiment involved two stages. During the first stage, the experiment started with 150 –one day old unsexed guinea fowls. They were housed in a single pen in the density of 10 subjects / m^2. They were fed with a starter diet containing 2,950kcal/kg; 24 % crude proteins (CP) from 1 to 14 days. In the second stage, at 15 days of age, they were transferred in a single room inside with a deep wooden litter. They were offered a grower diet containing 3,000kcal/kg and 22% CP from 3rd to 8th week.

Experimental Period

The finisher period started at 9-week age. One hundred guinea fowls were selected, and separated and put into two groups of 50 Guinea fowls each. Both the treatment and control group have an equal body weight of 822.2 ± 3 g and 820.6 ±28 g respectively. The pens were equipped with one drinker and 2 feeders (treatment group) while in the control group pen contained only one feeder and one drinker (Figure 1 and 2). Birds were placed in two different compartments with a density of 5 subjects/m^2. Each group was assigned to one treatment in a completely randomized design. Each group consisted in 2 replicates with 25 birds per replicate respectively. During the experimental period the room temperature was below 30 °C with a relative humidity maintained at 90 %.

Figure 1: Guinea fowls of the control group, the pen is equipped with one feed trough (in yellow color) and one water supply (in white).

Diets

Chicks in the control group received a conventional food

Figure 2: Guinea fowls of the treatment group, the pen contains one water supply (in white) and two feed troughs (in yellow) (Energy and crude protein) distributed in the same time.

Table 1: Diet composition and analysis of feed (control group)

Ingredients	(%)
Maize	35
Dried Brewer's grains	9
Corn	7
Cassava meal	12
Fish meal	5
Soya meal	14
Ground nut oil cake	12
Palm oil	3.5
Carbonate- calcium	2
Vitamins and amino acids mixture*	0.1
Salt	0.4
Total	100
Calculated chemical analysis	
Metabolisable Energy (Kcal/Kg)	2953.75
Crude protein (%)	17.31

* **VITAMINS:** A : 10 M UI ; D3 : 3 M UI ; E : 2500mg ; k3 :4000mg ; B1 : 5000mg ; B2 :500mg ; B6 : 2500mg ; B12 : 5mg ; C : 10000mg ; PP :2000mg ; calcium of Pantothenate: 5000mg ; Biotin : 5mg ; folic acid : 250mg. **Trace elements :** Iron ; Copper; Zinc; Manganese; Cobalt; Magnesium; iodine, Sodium chloride: 70000mg; Potassium chloride: 15000mg. **Amino acids :** Lysine ; methionine ; arginine ; glycine ; serine ; histamine ; leucine ; isoleucine ; phenylalanine ; tyrosine ; valine ; cystine ; tryptophane., Choline Chloride : 17500mg.Excipient q.s .p 100g

onto all ingredients were mixed. The composition is given in Table 1. The treatment group received a similar feed containing the same ingredients, which were separated into parts; one part constituted by stuff rich in energy, and the second fraction was composed of stuffs rich in crude proteins and ash. All feeds were distributed ad libitum and their compositions are shown in Table 2 and Table 3. The separate diet fractions were distributed simultaneously in different feeders as previously described by Bouvarel et al. (2004). The diets were given twice a day, earlier in the morning and in the afternoon.

Table 2: Composition of the energy fraction in the treatment group.

Composition	Rate (%)
Maize	35
Dried Brewer's grains	9
Corn	7
Cassava meal	12
Palm oil	3.5
Total (%)	66.5
Metabolisable Energy (Kcal/Kg)	2141.75
Crude protein (%)	4 .24

Table 3: Compositiopn of the crude protein and mineral fraction in the treatment group

Ingredients	Rate (%)
Fish meal	5
Soya bean meal	14
Ground nut oil cake	12
Carbonate- calcium	2
Vitamins and amino acids mixture	0.1
Salt	0.4
Total (%)	33.5
Metabolisable Energy (Kcal/Kg)	812
Crude protein (%)	13.07

Data Collection

Following the transfer of chicks in the experimental rooms, the Guinea fowls of each group were weighed at the beginning of the experimentation, and each week, till the age of 12 weeks. The electronic squall balance of precision was used to weigh them.

In both groups feed intake was measured daily. In the control group, the ingested energy and CP fractions were estimated by the percentage of each fraction in the mixed food intake. Likewise, the feed intake in the treatment group was measured daily. It was determined by the difference between offered quantities of each fraction (energy on the one hand and the CP and mineral on the other hand) and the refusal. Similarly, in both groups, water intake was calculated by the difference between the distributed quantity and the refusal.

Statistical Analysis

Data were analyzed by SPSS (2005) statistical software, by using a one-way ANOVA procedure. The means were compared by using student t-test. The results were considered significantly different when P<0.05.

RESULTS AND DISCUSSION

Effect of the Sef on Live Body Weight

As shown in Table 4, in both groups the live weight increased with the age of the birds. However, the mean average live weight was significantly high (P<0.05) in Guinea fowls fed with a fractioned meals. Birds receiving a SEF reached the commercial body weight (BW) one week earlier than the control group ($P < 0.05$). These results agreed with several previous studies on the fractioned feeding food (Cerrate et al., 2007). These results also indicated that the SEF contributes to shorten the breeding time in guinea fowl, which means that it will have a direct effect on the profitability on the guinea fowls.

Table 4: Effect of SEF on the body live weight of guinea fowls during the finishing period.

Age (week)	Control (g/bird)	Treatment (g/bird)
9	820.42±66 [a]	822.11±72 [b]
10	1000.10±32 [a]	1050.67±13 [b]
11	1150.75±79 [a]	1200.21±58 [b]
12	1300.96±138 [a]	1500.82±82 [b]

n=50 in each group
Means ± SD in the same line with no common superscript letter differ significantly ($P < 0.05$).

Effect of the Sef on the Feed Intake

Data on the weekly consumption of the energy fraction presented in Table 5. The results show that the consumption of the energy fraction increased with age of birds in both groups, but was significantly higher in the treatment group (P<0.05).

These results agreed with Yo (1992) and Yo et al. (1994) who reported that birds can select diets when they are confronted with various feeds of equal availability in their environment. Additionally, these results are in agreement of Bouvarel et al. (2004) who claimed that the requirement in energy is the first need to be covered by chicken. However, the data obtained on feed intake of the energetic fraction contrast with those reported by Yao et al. (2006), who observed no effect on the performances of the poultries. The explanation is that the poultry used in this study was different from other studies on the free choice feeding.

Effect of the Sef on the consumption of Crude Protein and Mineral Fraction

The results in Table 6 indicated that CP consumption increased continuously with the age in the control group while in the treatment group the feed intake increased from 9 to 10 weeks of age and then decreased till the end of the experiment. These results suggest that the ideal age to use SEF in breeding may be week 10 of age.

Table 5: Effect of the SEF on the voluntary consumption of the energy fraction of guinea fowls during the finishing period.

Age in week	Consumption of the energy fraction (g/bird)	
	Control group (n=50)	Treatment (n=50)
9	50.61± 11.35 [a]	60.01±7.7 [b]
10	62.31±6.23 [a]	65.51±10 [b]
11	62.02±9.13 [a]	71.62±17 [b]
12	74.60±8.33 [a]	117.11±89 [b]

Means ± SD in the same line with no common superscript letter differ significantly ($P < 0.05$).

Table 6: Effect of the SEF on the voluntary consumption of crude protein and mineral fractions of Guinea fowls during the finishing period.

Age in week	Consumption (g per bird)	
	Control	Treatment
9	25.50±14.28 [a]	36.24±56.59 [b]
10	31.38±5.34 [a]	57.89±6.61 [b]
11	31.24±16.01 [a]	42.96±6.61 [b]
12	37.58±10.36 [a]	36.22±4.20 [b]

n= 50 in each group
Means ± SD in the same line with no common superscript letter differ significantly ($P < 0.05$).

Effect of the Sef on the Crude Protein/ Metabolizable Energy (CP/ME) Ratio

Table 7 indicated that the ratio was maintained constantly during the whole experimental time in control group. The treatment group showed a peak at week 10 of age than decreased significantly till week 12.

These results are in accordance with many other authors who indicated that birds have the aptitude to select a diet naturally (Yo, 1992, Yo et al., 1994; Bouvarel et al., 2004; Cerrate et al., 2007). From this study, it can be understand that the requirements in crude proteins are not always the same. Its level changed according to the physiological requirement of age. It is high during the first stage of development corresponding at starting and growing diets and low at the finishing stage. Our results highlighted that the week 10 is the ideal age at which the guinea fowl should be subjected to an SEF.

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Effect of the Sef on the Water Consumption

The results presented in Table 8 indicate that water consumption increased with the age of the birds. However, it was significantly high during whole experimental period in the treatment group. These results agree with a previous study on the free choice feeding that reported over consumption of water that also found as a strategy to limit the consequences of heat stress (Banga-Mboko et al., 2007)

Table 7: Effect of SEF on the crude protein/energy ratio (CP/ME) of guinea fowl during the finishing period.

Age (week)	Control	Treatment
9	0.5	0.6
10	0.5	0.9
11	0.5	0.6
12	0.5	0.3

n= 50 in each group

Table 8: Effect of the SEF on water consumption of guinea fowls during the finishing period.

Age in week	Water intake (ml per day and per bird)	
	Control	Treatment
9	167.8±0.08 [a]	199.9±0.01 [b]
10	192.7±0.03 [a]	229.9±0.00 b
11	284.4±0.03 [a]	303.1±0.03 b
12	283.7±0.03 [a]	310.8±0.03 b

n= 50 in each group
Means ± SD in the same line with no common superscript letter differ significantly ($P < 0.05$).

CONCLUSION

This study has confirmed our hypothesis that Guinea fowls may respond positively to the SEF. It clearly appeared that the fractionation of conventional feed in energetic and crude protein increased the energetic fraction intake and adjusted the crude protein consumption during the finishing period. Chicks submitted to SEF reached one week earlier the commercial body weight. The separate energy feeding may be useful for poultry production in developing countries where formulated feeds and premixes are limited and in tropical areas where high temperatures constitute a climatic constraint.

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CONFLICT OF INTEREST

There was no conflict of interest among authors and funders.

AUTHORS CONTRIBUTION

Adzona Prudence Pitchou is an assistant professor and worked under my supervision.

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