

## **Preliminary Carcass and Meat Characteristics of Guinea Fowl (*Numidia meleagris*) Raised on Concrete and Earth Floors in Botswana**

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**Abstract:** Guinea fowls (*Numidia meleagris*) exist in the wild in large numbers in Botswana and in the South African region, therefore their domestic rearing can be exploited as an alternative to existing poultry systems. This study was conducted to determine the effects of floor finish on carcass yield and sensory characteristics of guinea fowl keets (*Numidia meleagris*) at different ages in Botswana. Over sixty keets hatched over a period of 2 days in a commercial incubator were raised together under an intensive system in a poultry house with a dwarf wall and roofing of corrugated metal sheets for four weeks. The keets were fed commercial chick starter mash and water ad lib. At week five, keets were randomly allocated to two treatments; a typical poultry house with concrete finish (n = 30) and the other group to a house with bare soil floor (n = 30). Keets in the house with concrete floor finish were raised under the deep litter system and saw dust was used as litter and was replaced every two weeks. The two groups were offered growers' mash and water ad lib until 14 of age. At weeks 10, 12 and 14, four birds were randomly picked from each treatment weighed and slaughtered according to standard abattoir procedures and thereafter re-weighed after evisceration to obtain carcass weight. From each set of birds, drumsticks (8 pieces) were obtained and cooked for one hour using the broiling system of cooking. The drumsticks were cut into pieces of about 2×5 cm tubes and meat evaluated for; colour, odour, odour intensity, juiciness, tenderness, firmness and overall acceptability by a group of 15 taste panelists. Live and carcass weights data was analysed using proc ANOVA, whereas data for taste panelists was analysed using the Proc FREQ (SAS, 2000). Carcass yield for the guinea fowl was high at about 90% for all the treatments across killing points. Meat rankings were over 60% (fair to good) for most of the parameters evaluated, showing that guinea fowl meat can be marketed successfully as one of the meat alternatives.

**Key words:** Botswana, guinea fowl, carcass/meat characteristics, concrete/soil floor

### INTRODUCTION

Guinea fowl (*Numidia meleagris*) originates from Africa where it still exists in large numbers in the wild<sup>[1,2]</sup>. Botswana, together with its neighbouring countries such as Zimbabwe, Namibia, South Africa and Zambia are well endowed with flocks of wild guinea fowl. Despite the abundance of these birds in the region, their rearing has never been widely practised whereas in other parts of the world the birds are being used as an alternative poultry system<sup>[3]</sup>. There is good demand for guinea fowl meat in the large markets and because of their wild gamey flavour, the birds are served extensively in the large prominent hotels and high priced restaurants<sup>[4]</sup>. The meat of young guineas is tender with a peculiar nice gamey flavour that distinguished it from duck, chicken and turkey meats<sup>[5]</sup>.

Guinea fowls have small skeletal frame and their carcasses yield a relatively large amount of meat<sup>[6,7]</sup>. According to CAB International<sup>[7]</sup>, guinea fowl meat contains higher proteins and low fat, at 23 and 4%, respectively, a feature that can make guinea fowl meat a good additive to the rural population's poor diet that in most studies lack nutrients, more especially proteins. Guinea fowl meat protein content averages well above the typical mammalian muscle at 19%. Furthermore, its low fat content (4%) (CAB International<sup>[7]</sup>, compared to chicken and other major meat types such as beef (21%), lamb (25%) and pork (21%)<sup>[8]</sup> can make it appeal to the health conscious especially that its white and not red meat. Guinea fowl meat attributes thus make it a bird with a great potential for providing the much needed animal protein in human diets, more especially in the developing countries<sup>[9]</sup>. The

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objective of the study was to investigate the effects of floor finish on carcass yield and sensory characteristics of guinea fowl keets at three different ages in Botswana.

## MATERIALS AND METHODS

Over sixty keets hatched over a period of two days in a commercial incubator in January 2006 were raised under an intensive system in a typical poultry house as a group for four week. The keets were fed commercial chick starter mash and water ad lib. At the beginning of week 5, keets were randomly allocated to two treatments ensuring balanced weight. The treatments were a poultry house with concrete finish and a house with bare soil floor. Keets in the house with concrete floor finish were raised under the deep litter system and saw dust was used as litter and replaced every two weeks. The two groups were offered growers' mash and water ad lib until 14 weeks of age. At weeks 10, 12 and 14, four birds were randomly picked from each treatment weighed (final weight) and slaughtered according to standard abattoir procedures and thereafter re-weighed after evisceration to obtain carcass weight. The final and carcass weights were used to determine the dressing out percentage (%) of the birds, expressed as:  $((\text{carcass weight}/\text{final weight}) \times 100)$ . The carcasses were thereafter packaged in polythene bags and kept frozen at  $-70^{\circ}\text{C}$  until a day before cooking, when they were thawed at  $5^{\circ}\text{C}$  overnight. From each set of birds, drumsticks (8 pieces) were obtained and cooked for one hour using the broiling system of cooking. Thereafter, the drumsticks were cut into pieces of about  $2 \times 5$  cm tubes and meat evaluated for; colour, odour, odour intensity, juiciness, tenderness, firmness and overall acceptability by a group of 15 untrained panelists.

**Statistical analysis:** Analysis of variances (ANOVA) were done across treatments and the data were analysed for live and carcass weight using PROC GLM model SAS<sup>[10]</sup>. For traits that were significant at 5% probability level, their means were separated using the Duncan's multiple range test. The panelists responses were analysed using the PROC FREQ<sup>[10]</sup>.

## RESULTS AND DISCUSSION

**Carcass yield (dressing out percentage):** The treatments, ages and interactions were not significantly different among treatments for all traits, indicating that the two housing systems did not affect the performance of the keets, however, the means will be presented for each house and slaughter age. Table 1 shows that guinea fowls have a relatively good carcass yield, all treatments

yielding carcasses with dressing out percentage of over 90%. The birds' dressing out percentage was relatively higher than most of the conventional meat species<sup>[8]</sup> Table 2. The guinea fowl carcass yields in this study were also high than those reported by Ayorinde<sup>[11]</sup> at 68% and Saina<sup>[12]</sup> who reported 75.4 and 71.6% for intensive and semi-intensive managements systems, respectively. The carcass yield in the present study was closer to that reported by Adeyemo and Oyejola<sup>[13]</sup> who reported 87.4%. The variation in these yields could be attributed to differences in possible birds strains, diet, birds management and carcass dressing procedures. Carcass yield is also influenced by the stage of maturity, degree of finish, breed and the intestinal contents (offals). Guinea fowls are non-ruminants and thus their offal content will be lower compared to that of ruminants. Further, CAB International<sup>[7]</sup> reported that the yield of edible guinea fowl meat after cooking is high at 80% compared to 65% of chicken, because of the slenderness of the guinea fowl skeleton. It is also evident that guinea fowls are also slow in growth since their live weight ranged from 0.946 to 1.155 kg in week 10 and 14, respectively. These weights are far much lower compared to those of broilers at about the same age; broilers reach 2 kg at 8 weeks. The slow growth of guinea fowl was also observed in studies conducted by Ayorinde and Ayeni<sup>[14,15]</sup> who reported weight of about 1 kg at about 8-12 weeks of age and Saina<sup>[2]</sup> reported live weights of 1.48 kg at 16 weeks. According to CAB International<sup>[7]</sup> and Nsoso<sup>[15]</sup>, the light weight and small body frame of guinea fowls may be a naturally selected trait meant for rapid take off (flight) and fast running as part of adaptation traits for survival in the wild.

### Sensory evaluation

**Colour:** Guinea fowl meat received an above average ranking for colour (brown to light brown) from the panelists for the two treatments and across the three slaughter points. Table 3, 4 and 5, show that more than 60% of the respondents rated the meat between brown and light brown, with light brown category receiving the highest percentage. Light brown and or tan colour is said to be ideal for cooked poultry meat<sup>[16]</sup>, based on this, guinea fowl meat can thus be cooked and marketed just like meat from broilers without much resistance from customers based on colour. According to Northcutt<sup>[17]</sup> and Killinger<sup>[18]</sup>, colour is an important selection criterion and has been used by consumers as an indicator of freshness and eating potential of the cooked product. Nonetheless, the lean has a characteristic colour appropriate for each species<sup>[8]</sup>. Poultry meat is affected by factors such as bird age, sex, strain, diet, intramuscular fat,

Table 1: Mean weights (live and carcass - kg) and dressing percentage of guinea fowls at 10, 12 and 14 weeks of age

Parameter	10 weeks		12 weeks		14 weeks	
	Concrete floor	Earth floor	Concrete floor	Earth floor	Concrete floor	Earth floor
Live weight (Kg)	0.946±0.024	1.079±0.022	1.122±0.099	1.095±0.096	1.005±0.045	1.155±0.096
Carcass weight (Kg)	0.889±0.010	0.999±0.012	1.056±0.087	1.015±0.096	0.949±0.050	1.081±0.091
Dressing Out %	93.96±1.380	92.96±0.735	94.17±0.550	92.64±0.550	94.40±0.745	93.59±0.105

Table 2: Approximate killing-out percentage for different species

Species	Killing/dressing out (%)
Sheep	50
Cattle	53
Pigs	75
Broiler chicken	72

Adapted from Warriss<sup>[6]</sup>

Table 3: Sensory evaluation of meat of guinea fowls at 10 weeks of age

Parameter	Concrete floor		Earth floor	
	Frequency	Percentage	Frequency	Percentage
Colour				
dark brown	1	6.67	1	6.67
slightly dark brown	3	20.00	4	26.67
brown	2	13.33	3	20.00
light brown	9	60.00	7	46.67
Odour (aroma)				
weak	3	20.00	2	13.33
fair	2	13.33	2	13.33
moderate	5	33.33	6	40.00
good	4	26.57	3	20.00
natural	1	6.67	2	13.33
Odour intensity				
poor	2	13.33	3	20.00
fair	9	60.00	7	46.67
excellent	4	26.67	5	33.33
Juiciness				
very dry	1	6.67	1	6.67
dry	4	26.67	3	20.00
moderate	5	33.33	4	26.67
juicy	3	20.00	4	26.67
very juicy	2	13.33	3	20.00
Tenderness				
very tough	1	6.67	1	6.67
tough	2	13.33	1	6.67
moderate	2	13.33	4	26.67
tender	8	53.33	5	33.33
very tender	2	13.33	4	26.67
Firmness				
very soft	1	6.67	1	6.67
soft	5	33.33	3	20.00
moderate	3	20.00	5	33.33
firm	4	26.67	4	26.67
very firm	2	13.33	2	13.33
Overall				
very poor	2	13.33	2	13.33
poor	3	20.00	1	6.67
fair	2	13.33	5	33.33
good	6	40.00	4	26.67
excellent	2	13.33	3	20.00

meat moisture content, pre-slaughter conditions and processing variables<sup>[17]</sup>.

**Odour (Aroma):** More than 50% of the respondents in the two treatments and across the three killing points felt that the meat has a moderate to good odour, whereas more

Table 4: Sensory evaluation of meat of guinea fowls at 12 weeks of age

Parameter	Concrete floor		Earth floor	
	Frequency	Percentage	Frequency	Percentage
Colour				
dark brown	1	6.67	1	6.67
slightly dark brown	3	20.00	2	13.33
brown	2	13.33	4	26.67
light brown	9	60.00	8	53.33
Odour (aroma)				
weak	1	6.67	2	13.33
fair	3	20.00	3	20.00
moderate	7	46.67	5	33.33
good	3	20.00	4	26.67
natural	1	6.67	1	6.67
Odour intensity				
poor	4	26.67	6	40.00
fair	7	46.67	6	40.00
excellent	4	26.67	3	20.00
Juiciness				
very dry	2	13.33	5	33.33
dry	3	20.00	4	26.67
moderate	8	53.33	4	26.67
juicy	1	6.67	1	6.67
very juicy	1	6.67	1	6.67
Tenderness				
very tough	1	6.67	1	6.67
tough	1	6.67	2	13.33
moderate	2	13.33	3	20.00
tender	5	33.33	5	33.33
very tender	6	40.00	4	26.67
Firmness				
very soft	3	20.00	2	13.33
soft	2	13.33	2	13.33
moderate	1	6.67	2	13.33
firm	5	33.33	4	26.67
very firm	4	26.67	5	33.33
Overall acceptability				
very poor	2	13.33	3	20.00
poor	1	6.67	2	13.33
fair	2	13.33	3	20.00
good	7	46.67	6	40.00
excellent	3	20.00	1	6.67

than 60% felt that the meat has a fair to excellent odour intensity (Table 3, 4 and 5). Various compounds contribute to the taste and aroma of cooked meat, amongst them are amino acids and sugar interactions, peptides, proteins and nucleotides degradation<sup>[16,17]</sup> according to Aganga<sup>[19]</sup>, aroma or smell is produced by volatile substances that are detected by olfactory receptors in the passages at the back of the nose. Such substances are mainly detected upon heating or cooking of meat, with raw meat having little aroma. Aroma comes from heating the fats present in meat, especially the phospholipids and to lesser degree the triglycerides<sup>[19]</sup>.

**Table 5: Sensory evaluation of meat of guinea fowls at 14 weeks of age**

Parameter	Concrete floor		Earth floor	
	Frequency	Percentage	Frequency	Percentage
<b>Colour</b>				
dark brown	0	6.67	1	6.67
slightly dark brown	1	20.00	4	26.67
brown	3	13.33	3	20.00
light brown	11	60.00	7	46.67
<b>Odour (aroma)</b>				
weak	0	0.00	1	6.67
fair	1	6.67	2	13.33
moderate	8	53.33	3	20.00
good	6	40.00	7	46.67
natural	0	0.00	2	13.33
<b>Odour intensity</b>				
weak	1	6.67	2	13.33
fair	10	66.67	10	66.67
excellent	4	26.67	3	20.00
<b>Juiciness</b>				
very dry	0	0.00	0	0.00
dry	1	6.67	0	0.00
moderate	7	46.67	4	26.67
juicy	7	46.67	8	53.33
very juicy	0	0.00	3	20.00
<b>Tenderness</b>				
very tough	0	0.00	2	13.33
tough	1	6.67	2	13.33
moderate	5	33.33	7	46.67
tender	8	53.33	4	26.67
very tender	1	6.67	0	0.00
<b>Firmness</b>				
very soft	0	0.00	2	13.33
soft	0	0.00	4	26.67
moderate	9	60.00	4	26.67
firm	5	33.33	2	13.33
very firm	1	6.67	3	20.00
<b>Overall acceptability</b>				
very poor	0	0.00	1	6.67
poor	0	0.00	0	0.00
fair	2	13.33	7	46.67
good	12	80.00	6	40.00
excellent	1	6.67	1	6.67

**Juiciness:** Guinea fowl meat received a good rating for juiciness, with over 66% respondents feeling that it is moderate to very juicy, with majority of the respondents going for moderate and juicy (Table 3, 4 and 5). This rating is common for all the two treatments and across all the three killing points. According to Naude<sup>[20]</sup> and Aganga<sup>[19]</sup>, juiciness is mainly affected by the Water Holding Capacity (WHC) and fat content of the meat. There is variation in juiciness of meat from different species, different animal of the same species and even the same cuts from the same animal and the major reason for the variation is the amount and distribution of the intramuscular fat referred to as marbling<sup>[20]</sup>. Meat with poor WHC loses fluid during cooking and may taste dry and lack succulence. When evaluating meat texture, some estimation of potential juiciness is made from chemical analysis of the amount of fat in the meat<sup>[19]</sup>. Since guinea

fowl meat is moderately juicy, this implies that it contains less fat, an attribute preferred by the health conscious consumers of late.

**Tenderness:** Table 3, 4 and 5 show that most of the taste panelists (over 80%) rated the meat between moderate and very tender, with the majority feeling that it is tender (~40%). The rating pattern once more was common to all the two treatments and across all the three killing points. The perception of tenderness is based on the ease of penetration of the meat by the teeth and ease of fragmentation of the meat and size of residue remaining after chewing and this is influenced amongst others by; muscle fibres, connective tissue and cooking method<sup>[8]</sup>. Cooking by boiling as was employed in the present study can tenderize meat containing large amounts of connective tissue by converting it to a more soft substance, gelatin<sup>[19,8]</sup>. Other factors affecting tenderness are; pre-rigor temperatures, rate of pH fall, ultimate pH of the meat, preservation method, sex, age and the animal species<sup>[8]</sup>. Nothcutt<sup>[17]</sup>, indicated that, after consumers buy a poultry product, they relate the quality of that product to its texture and flavour when they are eating it. Whether or not poultry meat is tender depends upon the rate and extent of the chemical and physical changes occurring in the muscle as it becomes meat.

**Firmness:** More than 60% of the panelists ranked the guinea fowl meat between moderate and very firm for the two treatments across the three killing points (Table 3, 4 and 5). Meat from the concrete floor birds killed at week 14 was ranked as moderate to very firm by 100% of respondents. The cooking method, age of the animal, the species and the purpose of the animal such as draught power do influence firmness of the meat<sup>[19]</sup>. Since guinea fowls are hardy birds, involved in fast movements and flying, it won't be surprising that their muscles (meat) yield firmer meat.

**Overall acceptability:** The overall acceptability of the guinea fowl meat from the panelists was good, with an average acceptance of ~46% respondents ranking it as good across treatments and killing points. Although there was not much difference between the two treatments and across the three killing points, a good number of respondents (80%) rated birds slaughtered at week 14 from the concrete floor as being good.

## CONCLUSION

Guinea fowls were slow growers, with a live and carcass weight of 1.155 and 1.081 kg at 14 weeks of age,

respectively. There were no significant differences between traits evaluated across treatments and killing points. This may be due to small sample numbers of meat sample presented to the panelists and also the small or lack of replication of panelists. Meat attributes of the guinea fowl received good rating from the taste panelists for the two treatments across the three killing points. Based on these results, farmers can be advised to farm the birds using the cheapest method ie. keeping them on earth floors as is the study currently in most of the homesteads with guinea fowls. More investigations on guinea fowl farming need to be carried out on issues such as economics of keeping the birds (feeding, health care and marketing) and nutritional attributes of the birds' meat. Such studies would go a long way in helping alleviate poverty and nutritional deficiencies in the country as these birds are relatively easy to keep and are abundant in the wild.

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