COMPARATIVE PERFORMANCE OF COBB 500 BROILERS FED DIETS BASED ON TWO *SORGHUM bicolor* CULTIVARS IN BOTSWANA

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ABSTRACT

A study was conducted to compare the performance of broiler birds fed diets made of two sorghum cultivars with that of birds fed commercial maize based diet in Botswana. Two hundred and ten, Cobb 500 day old broiler birds with initial body weight of 45 g were randomly allocated equally to three treatment diets (commercial, Segaolane and Phofu) according to a complete random block design. Each treatment was replicated twice. The period lasted for five weeks in which chicks, feed intake and feed refusals were weighed weekly. Feed intake of broiler chicks fed commercial diets of 5087.6±SE g was significantly (P<0.05) higher than that of birds fed Segaolane (4830.0±SE g) and Phofu (4818.3±SE g) diets, which did not differ significantly from each other. A similar trend was observed in the feed efficiency of the broiler birds used in this study, 1.13±SE, 1.76±SE and 1.97±SE g/g for commercial, Segaolane and Phofu diets, respectively. Broiler birds fed commercial diets (1918.43±SE g) had a significantly higher cumulative weight gain compared to those broiler birds fed sorghum based diets (1344.3±SE and 1186.0±SE g). However, the performance of broiler birds fed the two sorghum based diets was not significantly different from each other (P>0.05). The two sorghum cultivars reduced feed intake, feed efficiency and weight gain of broiler birds. They also had similar nutritive value and effects on broiler birds; therefore, they could be included in poultry feeds and may have fewer adverse effects on broiler birds' performance since no mortalities were recorded. Since the sorghum diets used in the study were all-mash, there might have been an influence of particle size and texture on the performance of broiler birds, hence there is need to pellet these diets so that the influence of particle size and texture could be removed.

***Keywords**: Sorghum cultivars, broiler birds, feed intake, cumulative weight gain, feed efficiency*

1.0 INTRODUCTION

Commercial poultry production systems in Botswana are characterised by flocks ranging from 200 to 4 500 birds per shed depending on the scale of production (Badubi *et al*., 2004). However, there has been poor performance recorded in broiler production

systems partly due to insufficient feed supply because of the ever-increasing feed prices in Botswana and also the quality of the feed, which has never been tested against the standards and poor management during rearing of the birds. The increasing feed prices are as a result of low production of maize in the country resulting from continued droughts and erratic rainfall. It is therefore important to evaluate other possible feed grains, which are produced under local conditions as energy sources for poultry diets, such as sorghum (*Sorghum bicolor*). Sorghum grain is lower in energy content compared to maize, but is similar in other chemical components (Faquinello *et al*., 2004; Maner, 2006). It has high protein content and essential amino acids, which include among others lysine, methionine, arginine, phenylalanine and tryptophan (National Research Council, 1994).

Although sorghum grains are similar to maize in most chemical compounds, their utilisation in non-ruminants nutrition is limited by the presence of phenolic compounds. These are divided into acidic phenolics, flavanoids and tannins (Faquinello *et al*., 2004; Garcia *et al*., 2004). When birds are fed sorghum-based diets; the presence of tannins reduces productivity in terms of inferior feed conversion, feed intake and weight gain. Tannins reduce the nutritional value of a diet, mainly due to a decrease in use of protein and a reduction in the activity of digestive enzymes (Haslam, 1981), leading to reduced nitrogen and use of amino acids due to the reduction in protein digestibility (Mitaru *et al*., 1984; Mustafa and Ez Zubeir, 1993; Elkin *et al*., 1995). It is further reported that utilisation of carbohydrates, vitamins and minerals is also reduced by the presence of tannins in sorghum grains (Mehansho *et al*., 1987; Chang and Fuller, 1993), due possibly to complex compounds formation through reaction of carbohydrates and tannins (Mahmood and Smithard, 1993). In Botswana, there is limited information on performance of broiler chickens fed sorghum grain-based diets. Sorghum is grown under local conditions and provides an alternative ingredient in non-ruminant diets. Therefore, the aim of this study was to compare the performance of broiler chicks fed diets of two sorghum cultivars with that of broilers fed commercial maize based diets.

2.0 MATERIALS AND METHODS

2.1 Location of the study

The study was conducted at the Estate Management Poultry Unit at Sebele, Gaborone (Latitude 24^{o} 34 'S and longitude 25^{o} 57), altitude of 994 m above sea level. The mean rainfall for the area is 500 mm.

2.2 Feeds

The nutritive value of the two sorghum cultivars used to formulate sorghum based treatment diets, one comprising Segaolane as a source of energy and the other Phofu as a source of energy for the chicks, are presented in Table 1. The two sorghum cultivars were selected based on their contents of tannins and nutritional composition (Badubi,

2012). Using these cultivars, farm-made starter and finisher diets were formulated to meet the chick's requirements for nutrients (NRC, 1994) (Tables 2 and 3). These diets comprised of control treatment which was a commercial maize-based diet (broiler starter and finisher) and the two sorghum cultivar based diets (broiler starter and finisher).

Table 1. The chemical composition (%) of the most common sorghum cultivars grown in Botswana.

Nutrient	**Phofu**	**Sephala**	**Mmabaitse**	**Segaolane**
Crude protein	11.5 (0.84)	10.8 (0.84)	11.7 (0.84)	11.9 (0.84)
Phosphorus	0.47 (0.14)	0.31 (0.14)	0.32 (0.14)	0.56 (0.14)
Crude fibre	4.89 (2.49)	7.40 (2.49)	6.87 (2.49)	ND
Crude fat	4.48 (2.75)	5.23 (2.25)	4.27 (2.25)	8.81 (2.25)
Dry Matter	91.42 (1.41)	91.07 (1.41)	90.95 (1.41)	91.05 (1.41)
Digestibility	95.47 (5.33)	89.7 (5.32)	89.54 (5.32)	94.16 (5.3)
Tannin	0.14 (0.07)	0.15 (0.07)	0.08 (0.07)	0.06 (0.07)

***** Source: Badubi (2012), ND = Not Determined

Table 2. The composition of the starter diets formulated using Segaolane and Phofu sorghum cultivars as energy sources for broilers.

Ingredient	**%Inclusion**
Broiler starter	
Sorghum (Phofu and Segaolane)	59
Soya bean meal	38
Sunflower cake	1.3
Limestone	1.2
Dicalcium phosphate	0.2
Salt	0.2
Vitamin & mineral premix	0.1
DL-Methionine	0.3
L-Lysine HCL	0.2
Total	**100.5**
Calculated Nutritive value	
ME (Kcal/g)	3.15
Protein	23 %
Calcium	0.5 min
Available Phosphorus	0.8 min

Table 3. The composition of finisher diets formulated using Segaolane and Phofu sorghum cultivars as energy sources for the broilers.

Ingredient	**%Inclusion**
Broiler finisher	
Sorghum (Phofu and Segaolane)	63
Soya bean meal	34
Sunflower cake	1.3
Limestone	1.2
Dicalcium phosphate	0.2
Salt	0.2
Vitamin & mineral premix	0.1
DL-Methionine	0.3
L-Lysine HCL	0.2
Total	**100.5**
Calculated Nutritive value	
ME (Kcal/g)	3.15
Protein	21 %
Calcium	0.7 min
Available Phosphorus	0.9 min

2.3 Experimental design

A total of 210 day old Cobb 500 broiler chicks bought from a local supplier were allocated in a randomized complete block design with feeding as the main effect (treatment). Each pen was a replicate with 10 chicks to give 30 chicks per block.

2.4 Management of chicks

Cobb 500 broiler chicks were managed in an all-in-all-out management system. They were vaccinated against Newcastle disease at day-old and at twenty-one days using La sota vaccine in drinking water. Any signs of illness were treated with either Sulphur 16% or oxytetracycline. Clean water and feeds were offered *ad-libitum*.

2.5 Brooding and lighting

Heating was provided by the use of spot heaters and lighting was given during the first three weeks so that chicks could locate water and feed during the night. Temperature fluctuations were monitored using a minimum and maximum thermometer. An open sided housing type usually found in tropical areas was used for housing the chicks. This housing type provides natural lighting and natural air circulation to reduce the effects of accumulation of obnoxious gases.

2.6 Parameters measured

Chicks were weighed on weekly basis to determine weight gain. Feed intake was also recorded at weekly intervals. Feeds were offered at the start of each week based on the calculated intake and at the end of the week the residual feed were weighed to

determine average intake. Weighing was done weekly to reduce the amount of stress on the chicks. The chicks were reared from 1 to 42 days of age.

2.7 Statistical analysis

The data were analysed using General Linear Models Procedure in Statistical Analysis System (SAS Institute, 2008). The reported least square means were separated using t-test. Differences were considered significant at $P<0.05$.

3.0 RESULTS AND DISCUSSION

3.1 FEED INTAKE

Feed intake was significantly higher ($P <0.05$) in Cobb 500 broiler birds fed the commercial diet compared to those on the sorghum-based diets (Table 4). This finding is consistent with that reported by Haslam (1981). The lower feed intake of birds fed the Segaolane and Phofu sorghum based diets could be due to the presence of tannins in sorghums. The tannin content of sorghum grains ranges from 0.25 to 2.5% (Garcia *et al*., 2004). In the study of Badubi (2012), the tannin content was 0.06 and 0.14% for Segaolane and Phofu respectively. Tannins at 0.5% level and above in poultry diets are reported to cause reduction in growth and available energy value of the feed, decreased availability of protein and severe mortality at higher levels (4% and above) (Haslam, 1981). Tannins are further reported to inhibit enzyme activities especially trypsin, amylase and lipase or enzyme systems (Mitaru *et al*., 1984; Mustafa and El Zubeir, 1993). It is also reported that carbohydrates are affected by tannins, possibly due to the formation of complex compounds, which are difficult to digest (Mahamood and Smithard, 1993). There are some reports that vitamins and minerals, especially those of the B complex, plus iron and calcium are all affected by the presence of tannins in the diet (Mehansho *et al*., 1987; Chang *et al*., 1993). It should, however, be pointed out that the sorghum varieties used in this study were low (0.06% and 0.14% for Segaolane and Phofu respectively) in tannin content and as such would not be expected to pose any detrimental effects on the performance of broiler birds (Table 1).

Table 4. Influence of sorghum diets on the performance of broiler chickens reared from 1-42 days of age.

	Commercial Diet	Segaolane Diet	Phofu Diet	Pooled SEM
Initial weight (g)	45	45	45	-
Average cumulative gain (g)	1918.43^{a}	1344.3^{b}	1186.0^{b}	69.4
Average feed intake (g)	5087.60^{a}	4830.0^{b}	4818.3^{b}	32.2
Average feed efficiency (g/g)	1.13^{a}	1.76^{b}	1.97^{b}	0.07

*Means in the same row with different superscripts are significantly different ($P<0.05$).

3.2 CUMULATIVE WEIGHT GAIN

Broiler birds fed commercial diets during the starter and finisher phases had a significantly higher ($P<0.05$) cumulative weight gains than those fed Segaolane and Phofu sorghum based diets (Figure 1). The poor cumulative weight gain observed in the sorghum based diets fed birds might also be due partly to the effect of anti-nutritional factors (tannins) found in sorghums. However, the results of Badubi (2012) showed that the sorghum cultivars used in this experiment were low in tannin content, hence they would not have deleterious effects on broiler birds performance (Haslam, 1981).

Secondly, feed processing or form has been shown to have an effect on performance of broiler birds (Parsons *et al*., 2006). In this study, sorghum based diets were in mash form while commercial diets were all in pellet form. Sorghum diets could not be pelleted because there was no equipment to do such processing. Different studies have looked at the influence of texture and particle size on performance of broiler chicks (Parsons *et al*., 2006 and Benedetti *et al*., 2011). These authors observed superior body weight and weight gain of young broiler chicks as a result of feed texture and particle size. However, some authors have indicated that benefits of pelleting on performance of broiler birds are evident when the integrity of the pellet is maintained to consumption (Zatari *et al*., 1990). It is apparent that when the integrity of the pellet is kept, there is a higher possibility of nutrient retention. The results shown in Figure 1 are consistent with the findings of other studies where broiler birds fed commercial pelleted diets showed increased feed intake and as a result cumulative weight gain (Zatari *et al*., 1990; Parsons *et al*., 2006). Some authors though, reported that the increased feed intake observed in birds fed coarse diets might be attributed to excessive feed wastage (Hetland *et al*., 2002). In this study, however, excessive feed wastage was not observed especially for birds fed commercial diets.

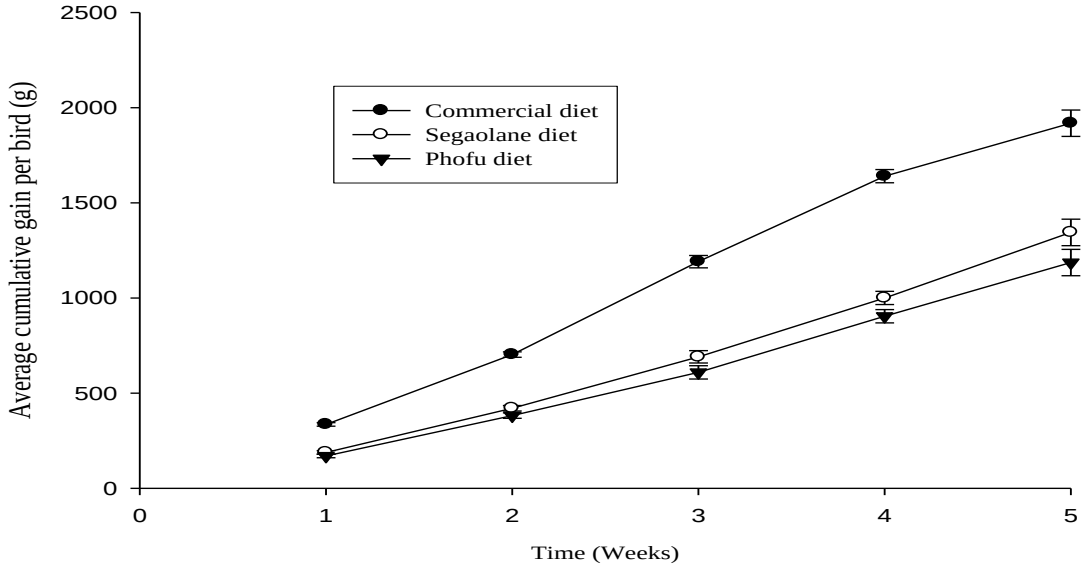

Figure 1. Comparative average cumulative weight gain of broiler birds fed commercial and sorghum based diets for 42 days.

Different studies have reported preference trends for feed particles among diets, especially if the diets are in a mash form (Parsons *et al*., 2006). It should be highlighted that if the feed preference activity takes place, there is likelihood that birds will not consume a homogenous mix of ingredients. Therefore, there is a possibility that the birds fed sorghum based diets which were in a mash form had a different nutrient profile from the one that was calculated. This is consistent with the findings of Parsons *et al*. (2006) and Benedetti *et al*. (2011) where there was a significant preference for larger particles when all mash diets were used. It is also stated that mash or crumbled feeds may affect feed intake because of the available dust particles which may cause respiratory disorders, increase water intake, feed presence in the drinkers and increase litter moisture (Benedetti *et al*., 2011). It is obvious that chicks with respiratory disorders will reduce feed intake and this may be the probable cause of lower cumulative gain observed in chicks fed mash sorghum based diets.

3.3 FEED CONVERSION EFFICIENCY

Similar to feed intake, feed conversion efficiency was higher ($P < 0.05$) in broilers fed the commercial diet compared to birds fed sorghum-based diets. The feed conversion efficiencies of the latter group were similar ($P > 0.05$) and significantly lower ($P < 0.05$) than those of the former (Table 4). These results are in agreement with the findings of Nir *et al*. (1995) and Parsons *et al*. (2006) who observed no improvement in feed efficiency of broiler birds fed all-mash sorghum based diets, but rather reported a superior feed efficiency of broiler birds fed commercial pelleted maize based diets. This might be indicative of the influence of particle size and texture of the feeds on the development of the gastrointestinal tract. These authors further argued that corn particle size improved nitrogen and lysine retention. However, Benedetti *et al*. (2011) observed a correlation between age and particle size where there was a better performance when birds were fed fine particle feeds at the age of 21 days than at the age of 42 days.

4.0 CONCLUSIONS

The sorghum based all-mash diets induced lower feed intake, feed efficiency and cumulative weight gain in Cobb 500 broiler birds than commercial diet. The performance of broiler birds fed the two sorghum cultivars was similar for all the parameters measured. It is recommended that the all-mash sorghum based diets used in this study be pelleted so that the influence of particle size and texture could be removed. Further, the two sorghum cultivars could be used in poultry feeds and may have fewer effects on broiler birds' performance since no mortalities were recorded resulting from the use of sorghum.

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