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EFFECTS OF REPLACING GROUNDNUT HAULMS WITH WHOLE COTTONSEED IN CATTLE FATTENING CONCENTRATES ON DRY MATTER INTAKES AND WEIGHT CHANGE

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ABSTRACT

Twenty five Bunaji bulls with average live weights of 230±0.4 kg were divided in to five groups and were allocated to five treatments in a completely randomized designed. The bulls were fed fattening concentrate diets in which whole cottonseed replaced groundnut haulms at 0, 25, 50, 75 and100%. Dry matter intake (DMI) of the concentrates was higher (P<0.05) in the bulls on 0 and 25% GH replacement than for those on 100%GH replacement with WCS, but was similar (p>0.05) to those on 50 and 75% GH replacement levels. Hay intake was higher (P<0.05) for the bulls on 100%GH replacement than for those on 0, 25 and 50% GH replacement, but was similar with those on 75% GH replacement level. Crude protein intake differed (p<0.01) significantly, with the highest value recorded for the bulls on 50% GH replacement and lowest value for the those on 0% GH replacement. Total live weight gain and daily weight gain was higher (p<0.05) on 0 and 25% GH replacement than on 75% GH replacement, but was similar (p>0.05) to 100% GH replacement. Total weight gain and daily weight gain tended to decreased with GH replacement with WCS. The initial live weight of the bulls on the respective treatments were improved by 30.98, 28.30, 23.16, 11.98 and 23.00% for 0, 25, 50, 75 and 100% GH replacement levels respectively. It was concluded that replacing groundnut haulms with whole cottonseed should not exceed 25% in concentrates for cattle fattening to minimize decline in weight gain.

Key words: Groundnut haulms, Whole cottonseed, Cattle fattening concentrates.

INTRODUCTION

Major constraints to livestock production include lack of improve breeds, lack of cheap quality feed, a weak livestock extension system, lack of appropriate managerial skills among many others. Of these, lack of good quality feed at affordable prices is the major problem (Safaloah, 2017). A wide range of crop residues, agro-industrial by-products and to some extent even non-conventional feed resources are available in many parts of developing countries in Latin America, Asia and Africa and their use as a feed resource may be one way to increase supply of animal protein from ruminant production in a sustainable low-cost production system (Devendra and Leng, 2011). However, farmers are often unaware of the appropriate feeding strategies for combining these resources to improve animal production.

Appropriate combination of such feed resources to supply required nitrogen and energy to ruminants is imperative, to reduce cost of animal protein production. Nsahlai *et al.,* (1999) fed oilseed noug and groundnut cake and tanniferous feeds (pods of *Acacia albida* and *Sesbania* leaves) 50: 50 to sheep and concluded that it is beneficial to feed sheep on oilseed cake following the intake of tanniferous feeds as this could support superior liveweight gain. This study was aimed at combining legume forage (groundnut haulms) and oilseed (whole cottonseed) to optimize their usage for cattle fattening.

MATERIALS AND METHODS

Experimental diets and design

The test ingredients were maize offal (MO), whole cottonseed (WCS) and groundnut haulms (GH). Maize offal was bought from local maize mills, dried and stored. Groundnut haulm was bought from local farmers and (chopped to ease weighing) and stored while whole cottonseed was bought from an oilseed mill. The treatments were derived from a fattening ration consisting of 40% groundnut haulms (GH) and 60% maize offal (MO) in which whole cottonseed (WCS) replaced 0, 25, 50, 75 and 100% of the GH(weight for weight).

The concentrate rations were:

RATION 1= 60% Maize offal and 40% GH (positive control)

2= 60% Maize offal, 30% GH 10% WCS

3= 60% Maize offal, 20% GH and 20% WCS

4= 60% Maize offal, 10% GH and 30% WCS

5= 60% Maize offal, 0% GH and 40% WCS

Maize offal and whole cottonseed were mixed in a feed mixer for 20-25 minutes, while groundnut haulms was weighed and added to the mixture at the point of feeding and mixed in a dispensing bag before offer. Diets were allocated to treatment groups in a completely randomized design.

Animals and their management

Twenty five Bunaji bulls with average live weights of 230±0.4 kg were used for the trial. The bulls were divided in to five groups balanced by weight with an animal as a replicate in a completely randomized design and were allocated to five dietary treatments. The bulls were dewormed a week to commencement of the trial with Albendazole 2500mg(Eagle Chemical Co. Ltd chungchongnamdo, Korea) and dipped in acaricides Amitix (Amitraz 12.5% by Alfasan) to control ec-toparasites. The bulls were individually penned and fed 1 kg/day of concentrate and *ad libitum* Signal grass hay for 14 days to adjust the bulls to the various diets. After the adjustment period, concentrates were fed at 2% of the animal's body weight while Signal grass hay was offered *ad-libitum* as basal diet. These were weighed before feeding. Half of the days' concentrate was offered in the morning (between 8 and 9 am) and the remaining half was offered in the afternoon (between 4 and 5 pm). Water and mineral salt block were offered *ad-libitum.* Feed remnants were weighed the following day in the morning before the day's feed was offered. The animals were weighed weekly and their feed offer adjusted accordingly. The study lasted 90 days.

Statistical Analysis

Data collected was subjected to analysis of variance (ANOVA) using the General Linear Model (GLM) Procedure of SAS, (2002), while the differences between means were separated by Duncan Multiple Range Test (Duncan, 1955) at 5 and 1% level of significance. The model used for the analysis was:

$$Yij = \mu + Ti + eij$$

Where μ = Overall means

Ti = effect of i^{th} treatment (i=1, 2, 3, 4,5)

eij= random error (The random effect assumed to be normally distributed with mean zero and equal variance σ^2 i.e. $\sum \sim N(0, \sigma_I^2)$

RESULTS

Chemical Composition of Individual ingredients and Concentrates

The chemical composition of feed ingredients is presented in Table 1. The crude protein of Whole cotton seed was the highest (27.44%) followed by groundnut haulms (12.68%) and maize offal (MO) (12.62%). The least CP content of feed ingredients was recorded for Signal grass hay (5.97%). The chemical composition of concentrates is presented in Table 2. The dry matter content of the concentrates ranged from 92.11 to 94.41%. The crude protein content of the supplemental diets increased with increased in WCS replacement of GH. The CP content of supplemental diets ranged from 14.25 to 20.00 for 0% GH replacement level and 100% GH replacement levels respectively. Acid and neutral detergent fibres content of the concentrate diets ranged from 21.02 to 27.37% for 25% and 0% GH replacement and 30.82 to 38.83 for 25% and 100% GH replacement levels respectively. Organic matter content of supplemental diets ranged from 88.35 to 90.63% for 50 and 75% GH replacement levels respectively. Metabolisable energy (MJ/Kg DM) ranged from 8.16 to 11.46 for Signal grass hay and GH for the individual feed ingredients and 10.11 to 11.45 for100 and 50%WCS replacement of GH diets.

Voluntary Nutrients Intake

Mean daily dry matter and calculated other nutrients intake of the experimental diets are presented in Table 2. Dry matter intake (DMI) of the concentrates was higher ($P<0.05$) in the bulls on 0 and 25% GH replacement than for those on 100%GH replacement with WCS, but was similar ($p>0.05$) to those on 50 and 75% GH replacement levels. It ranged from 3.16 kg/d for the bulls on 100% GH replacement level to 4.58 kg/d for those on 0% GH replacement.

Table 1: Chemical Composition (%) of Signal grass hay, Groundnut Haulms, Whole Cottonseed and Maize offal.

	Signal grass	GH	WCS	MO
Dry matter	93.82	95.23	92.17	91.74
Crude protein	5.97	12.68	27.44	12.62
Crude fibre	31.17	52.29	38.48	29.86
Ether Extract	4.76	1.42	23.61	11.59
Organic matter	88.63	90.93	88.89	88.72
Neutral detergent fibre	78.89	80.29	45.75	58.80
Acid detergent fibre	54.41	60.13	36.99	23.67
Ash	5.19	7.94	3.28	3.02
ME(MJ/kg DM)	11.14	11.46	8.16	10.39

ME = Metabolisable energy (MJ/Kg DM)

ME values of feed ingredients and experimental diets were calculated as per Alderman and Cottrill (1985) as follows:

ME (MJ/kg DM)=11.78 + 0.00654CP + $(0.000665EE)^2$ - CF(0.00414EE) – 0.0118A where DM=Dry Matter, C= Crude Protein, EE= Ether Extract, CF= Crude Fibre, A= Ash

GH =Groundnut haulms, MO = Maize offal, WCS = Whole cottonseed

Table 2: Ingredients and chemical composition of concentrates with WCS replacing GH in the fattening diets of cattle.

	Levels of replacement of GH with WCS (%)				
	T_1	T_2	T_3	T_4	T_5
Ingredients	**0**	**25**	**50**	**75**	**100**
Maize offal	60.00	60.00	60.00	60.00	60.00
Groundnut haulms	40.00	30.00	20.00	10.00	0.00
Whole cotton seed	0.00	10.00	20.00	30.00	40.00
Total	100.00	100.00	100.00	100.00	100.00
Chemical composition					
Dry matter	94.41	93.13	92.11	93.45	92.50
Crude protein	14.25	15.69	17.63	17.94	20.00
Crude fibre	18.38	18.12	15.84	15.84	15.06
Ether extract	10.19	23.07	21.09	23.07	15.51
Organic matter	89.71	88.52	88.38	90.63	88.68
Neutral detergent fibre	33.98	30.82	33.48	32.28	38.83
Acid detergent fibre	27.37	22.78	22.94	21.02	25.26
Ash	4.70	4.61	3.73	2.82	3.36
ME(MJ/kg DM)	11.19	10.63	11.45	11.31	10.11

ME =Metabolisable energy (MJ/Kg DM), ME values of feed ingredients and experimental diets were calculated as per Alderman and Cottrill (1985) as follows:

ME (MJ/kg DM)=11.78 + 0.00654CP + $(0.000665EE)^2$ - CF(0.00414EE) – 0.0118A where DM=Dry Matter, C= Crude Protein, EE= Ether Extract, CF= Crude Fibre, A= Ash

GH = Groundnut haulm, WCS= whole cottonseed

Table 3: Voluntary nutrients intake of Bunaji bulls fattened on diets containing groundnut haulms and Whole cottonseed.

	Levels of replacement of GH with WCS (%)					
	T_1	T_2	T_3	T_4	T_5	
Parameters	**0**	**25**	**50**	**75**	**100**	**SEM**
Dry matter intake (kg)						
Concentrate	4.58^{a}	4.21^{a}	3.95^{ab}	3.69^{ab}	3.16^{b}	0.43*
Signal grass hay	1.84^{b}	1.79^{b}	1.85^{b}	2.13^{ab}	2.51^{a}	0.29*
Total	6.42	6.00	5.80	5.82	5.67	0.63^{ns}
DMI (% of body weight)	2.13	2.01	2.03	2.29	2.04	0.16^{ns}
DMI (g/kgW$^{0.75}$)	106.00^{a}	102.00^{b}	98.00^{c}	98.00^{c}	96.00^{d}	0.007**
Nutrient intake/day						
Crude protein (g)	762.00^{e}	767.00^{d}	806.00^{a}	788.00^{b}	781.00^{c}	0.08**
Organic matter (kg)	6.11	5.72	5.56	5.61	5.51	0.60^{ns}
Ether extract (g)	554.00^{d}	534.00^{e}	922.00^{b}	952.00^{a}	608.00^{c}	0.08**
Neutral detergent fibre (kg)	3.01	2.71	2.78	2.87	3.21	0.32^{ns}
Acid detergent fibre (kg)	2.26	1.93	1.91	1.94	2.16	0.22^{ns}
Crude fibre (kg)	1.69^{b}	1.53^{b}	1.86^{ab}	1.91^{ab}	2.26^{a}	0.21*
Water (L)	22.05^{a}	23.45^{a}	21.41^{a}	18.02^{b}	20.13^{ab}	1.66*
Gossypol intake (%)						
Total	0.00	0.003	0.005	0.007	0.008	NA
Negative (-)	0.00	0.0016	0.0027	0.0038	0.0044	NA

^{abcde} Means with different superscripts along the row differ significantly ($p<0.05$) or ($p<0.01$), Total and negative (-) gossypol was calculated from highest values presented by
Calhoun *et al.* (1995), ns=not significant, *= $p<0.05$, **= $p<0.01$
SEM= standard error of means, NA= not analyzed
GH = Groundnut haulm, MO = Maize offal

Hay intake was higher ($P<0.05$) for the bulls on 100%GH replacement than for those on 0, 25 and 50% GH replacement, but was similar with those on 75% GH replacement level. The range of hay intake was from 1.79 kg/d for the animals on 25% GH replacement to 2.51 for those on 100% GH replacement. Significant ($p<0.05$) differences existed between treatments on concentrate and hay intake. Concentrate intake decreased with increase WCS inclusion, while hay intake increased. However, total dry matter intake and dry matter intake as percent of body weight was not significantly ($p>0.05$) affected by the diets. On metabolic weight basis, (g/kgw$^{0.75}$) DMI was highest ($p<0.01$) on 0% GH replacement and decreased to the lowest at 100% GH replacement. Crude protein intake differed ($p<0.01$) significantly, with the highest value recorded for the bulls on 50%

GH replacement and lowest value for the those on 0% GH replacement. There was no pattern in CP intake observed. The range of CP intake was from 762.00 to 806.00 g/d. Organic matter intake ranged from 5.51 kg/d for the bulls on the diet with 100% GH replacement to 6.11kg/d for the bulls on diet with 0% GH replacement level and was not affected ($p>0.05$) by replacement levels of GH. Ether extract intake differed ($p<0.01$) significantly, but in no particular pattern. It ranged from534 g/d for the bulls fed 0% GH replacement to 952 g/d for the bulls fed 75% GH replacement.

Neutral detergent fibre and acid detergent fibre intake (kg/d) were not ($P>0.05$) affected by GH replacement in the diets. NDF and ADF intakes ranged from 2.71 to 3.21 and 1.91 to 2.26 kg/d for the bulls on 25 and100% GH replacement and 50 and 0% GH replacement levels respectively. Crude fibre intake increased ($p<0.05$) with increase in WCS inclusion. It was higher ($p<0.05$) for the bulls fed 100% GH replacement than those fed 0 and 25% GH replacement. However, the value was similar to that of the bulls fed 50 and 75% GH replacement levels which were also similar ($p>0.05$) to those fed 0 and 25% GH replacement. Crude fibre intake ranged from 1.53 kg/d for the bulls fed 25% GH replacement to 2.26 kg/d for those fed 100% GH replacement. Water intake was higher ($p<0.05$) for the bulls fed 0, 25 and 50% GH replacement than those fed 75% but similar to those fed 100% GH replacement.

Liveweight, average daily gain, feed conversion ratio and body condition score.
Mean daily liveweight change, feed conversion ratio and body condition score are presented in Table 4. Total liveweight gain and daily weight gain was higher ($p<0.05$) for those on 0 and 25% GH replacement than those on 75% GH replacement, but was similar ($p>0.05$) to 100% GH replacement.

Total weight gain and daily weight gain tended to decreased with GH replacement with WCS. The decrease in liveweight gain of the bulls on the 75% GH replacement was the effect of intermittent diarrhea in one of the bulls in this treatment. Daily liveweight gain ranged from 0.31 to 0.79 Kg/d for the bulls on the diets with 75 and 0% GH replacement respectively. The initial liveweight of the bulls on the respective treatments were improved by 30.98, 28.30, 23.16, 11.98 and 23.00% for 0, 25, 50, 75 and 100% GH replacement levels respectively.

Feed conversion ratio (kg feed/kg gain)
Feed was most efficiently utilized by the bulls fed the diet in which GH was replaced at 0% by WCS. However, there were no ($P>0.05$) difference between treatment groups. Feed conversion ratio ranged from 8.12 for the bulls on diet with 0% GH replacement to 18.80 for the bulls on diet with 75% GH replacement.

Table 4: Liveweight, average daily gain, feed conversion ratio and body condition score of Bunaji bulls fattened on diets containing groundnut haulms and whole cottonseed

	Levels of replacement of GH with WCS (%)					
	T_1	T_2	T_3	T_4	T_5	
Parameters	**0**	**25**	**50**	**75**	**100**	**SEM**
Initial weight (kg)	230.40	230.40	230.60	230.20	230.40	12.07^{ns}
Final weight (kg)	301.80	295.60	284.00	257.8	283.40	22.51^{ns}
Total feed intake (kg)	6.42	6.00	5.80	5.82	5.67	0.63^{ns}
Weight change (kg)	71.40^{a}	65.20^{a}	53.40^{ab}	27.60^{b}	53.00^{ab}	13.95^{*}
Average daily gain (kg)	0.79^{a}	0.72^{a}	0.59^{ab}	0.31^{b}	0.59^{ab}	0.15^{*}
Feed conversion ratio	8.12	8.33	9.30	18.8	9.61	16.78^{ns}
Body condition score						
Initial	3.50	3.40	3.56	3.50	3.30	0.31^{ns}
Final	7.38^{a}	7.10^{a}	6.66^{ab}	5.76^{b}	6.86^{a}	0.51^{*}

[ab] Means with different superscripts along the row differ significantly ($p<0.05$)
ns= not significant, *=$P < 0.05$
SEM=Standard error of mean,
FCE = Feed conversion ratio
GH= groundnut haulms, WCS= whole cottonseed

Body condition score

Body condition score was higher ($p<0.05$) for the bulls on 0, 25 and 100%GH replacement than for those on 75% GH replacement, but was similar to those on 50% GH replacement which was also similar ($P>0.05$) to those on75% GH replacement.

DISCUSSION

The crude protein (CP) content of WCS used in this study was slightly higher than 22.5 – 23% reported by NCPA (2002) and ACP1 (2014). The difference could be due to factors that include amount of rainfall and fertilization management practices (Bertrand *et al.*, 2005; Zhongqi e*t al.*, 2013). However, the fibre content (NDF, ADF), EE and Ash were within the range reported by NCPA (2002). The crude protein content of groundnut haulms for this study was within the range reported by Savadogo *et al.* (2000) and Jadalla *et al.* (2012). The CP content of Signal grass hay was low, typical of tropical forage grasses that are reported to be of low CP at advance stage of growth (Minson, 1971). The CP content of Signal grass hay was below the minimal level (7%) critical for microbial growth and roughage intake (Warly *et al.*, 1992; Fall, 1990; Abdulrazak *et al.*, 2005). The nutrient composition of the supplemental diets were influenced by composition of the ingredients as indicated by the increased in most of the nutrient except dry matter and organic matter with increase in whole cotton seed inclusion level.

Voluntary dry matter and nutrient intake

The slight decreased in concentrate and DMI with increase in whole cottonseed inclusion in the diet was probably because cattle tend not

to eat large quantity or takes a long time to accept whole cottonseed in their diet because of the fluff nature of the seed (Coppock *et al.*, 1985). However, total dry matter intake was not different, probably due to similarity in CP content of the supplements. A similar report was given by Mendieta - Araica *et al.,* (2010) for dairy cows fed concentrate in which soybean meal was replaced by Moringa leaf meal. Similarly, diet did not influence intake of NDF and ADF. The similarity in intake of OM, NDF and ADF could be attributed to intake of DM and CP. This report is at variance with the result of higher DM, OM and NDF intake with increase in inclusion level of velvet bean hay in sheep (Mupangwa *et al.,* 2002). Differences in EE intake by the bulls on diets with 50 and 75%GH replacement as against other treatments suggest that the bulls on these treatments probably took more cottonseed and groundnut seed from the haulms than other groups as the groundnut haulm still had some few pods on it. Crude fibre intake suggested that intake was influenced by the lint content of WCS in the diets. Water intake in this study was in agreement with the report for four breeds of Nigerian cattle under fattening (Madziga *et al.,* 2013)

Liveweight changes

Low daily weight gain of the bulls on the 75% WCS replacement level as compared to the other treatments was due to the effect of intermittent diarrhea (which was treated severally) by one out of five bulls on this treatment which ended the trial with a weight loss. The cause of the diarrhea could not be ascertained, but individual reaction to gossypol toxicity could probably be the cause. Diarrhea and loss of weight are reported as some of the effects of gossypol toxicity in animals, including cattle (Hudson *et al.,* 1988; Kerr, 1989; Alexander *et al.,* 2008). It was generally observed that weight gain gradually decreased with increase in WCS inclusion in the concentrate .Weight gains in this study was in agreement with the report for weaned calves that it declined with increase in inclusion of WCS in the diet (Barje *et al.,* 2006). Feed efficiency was not affected by diets. However, the numerically higher feed efficiency of the bulls on the diets with 0 and 25% GH replacement level could be due to their higher live weight gain (Suliman and Babiker 2007). This report is in agreement with the report for sheep, that there was reduction in FC with increasing level of whole cottonseed in the diets (Absalan *et al.,* 2011; Kandylis *et al.,* 1998).Body condition score reflected body weight gain with bulls on the diets with 0 and 25% groundnut haulms replacement having numerically higher condition score than those on 50, 75 and 100% replacement levels, though it was not significantly different. Body condition score is reported to be an indication of energy reserves of beef cattle (Mekasha *et al.,* 2011).

It was concluded that replacing groundnut haulms with whole cottonseed above 25% in concentrates for cattle fattening decreased liveweight gain thus reducing the expected benefit of including whole cottonseed in fattening rations.

Feed cost per kg was 10% lower on 25% GH replacement than on 100% GH replacement and feed cost per kg gain was 47.8% lower than on the highest inclusion (100%) level.

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