

Effect of baker's yeast on crushed whole cotton seed in complete diets fed to Red Sokoto bucks

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Abstract

Whole cotton seed can substitute for forage, grain and protein within acceptable limit in ruminant ration/feed, however the presence of gossypol in free forms in whole cotton seed restricts its use. Literature has shown methods such as; mechanical and heat treatment, use of improved varieties, vitamin E, selenium and most recently, probiotic as media of alleviating gossypol toxicity in cotton by-products thereby improving their consumption and utilization. This study aimed at reducing the effect of gossypol in whole cotton seed using baker's yeast in complete diets fed to Red Sokoto buck. A total of 20 bucks weighing $12\text{kg} \pm 0.25$ were randomly assigned to five diets formulated to contain 14% crude protein in complete diets without and with yeast supplementation at varied inclusion level; 10, 15, 20 & 25% CWCS and 500g yeast (Y) across treatment groups. Bucks were fed at 4% of their body weights and water administered ad-libitum throughout the digestibility trial period in a completely randomized design. Digestibility of the diet and nitrogen balance in the bucks were studied. Results obtained showed significant difference at $P < 0.05$. Dry matter digestibility was significantly ($p < 0.05$) different across treatment where 25%CWCS + Y inclusion had the higher value with similarity to 10%CWCS and 15%CWCS + Y (90.32, 89.48 and 89.19%) respectively while 10%CWCS + Y had 88.54% and 20%CWCS + Y (86.86%). The neutral detergent fibre digestibility was best at the control (10%CWCS without yeast) 70.00% with a decline as CWCS inclusion increased. The digestibility of crude protein followed similar trend. Acid detergent fibre digestibility however, was best at 25%CWCS+Y (67.16%), while 20%CWCS had the lowest (50.40%). Nitrogen Intake was significantly ($P < 0.05$) different higher at 15%CWCS+Y (10.56%) and was lowest at 10%CWCS+Y (7.25%). Total N excreted was similar statistically at 15 and 20%CWCS+Y (8.43 and 8.36%) and the lowest was recorded at 10%CWCS+Y (6.83%). N retained as percent of intake was significantly ($P < 0.05$) different, with higher value recorded with increasing inclusion level of CWCS; 15% CWCS had higher retention (20.4%) as against the control diet (4.97%). It can be concluded from the results of this study, that the yeast supplementation influenced dry matter and acid detergent fibre digestibility, nitrogen intake and retention.

Keywords: Cottonseed, goat, digestibility, retention, yeast

Effet de la levure de boulanger sur une graine de coton entièrement écrasée dans les régimes entiers nourris à des daims de Red Sokoto



Résumé

Les graines de coton entier peuvent se substituer au fourrage, aux grains et aux protéines dans une limite acceptable dans le rationnement / alimentation des ruminants, mais la présence de gossypol sous forme libre dans des graines de coton entières restreint l'utilisation. La littérature a montré des méthodes telles que; Traitement mécanique et

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thermique, utilisation de variétés améliorées, de vitamine E, de sélénium et plus récemment, probiotique comme média de réduction de la toxicité du gossypol dans les sous-produits du coton, améliorant ainsi leur consommation et leur utilisation. Cette étude visait à réduire l'effet de Gossypol dans des semences en coton entier à l'aide de la levure de boulanger dans des régimes alimentaires complets nourris au daim de Red Sokoto. Un total de 20 daims pesant $12 \text{ kg} \pm 0,25$ ont été attribués au hasard à cinq régimes formulés pour contenir une protéine brute de 14% dans des régimes totaux sans et avec une supplémentation de levure au niveau de l'inclusion variée; 10, 15, 20 et 25% CWCS et 500 g de levure (L) sur des groupes de traitement. Les daims ont été nourris à 4% de leurs poids corporels et de l'eau administrée par AD-libitum tout au long de la période d'essai de digestibilité dans une conception complètement randomisée. La digestibilité de l'équilibre de régime et d'azote dans les mâles a été étudiée. Les résultats obtenus ont montré une différence significative à $p < 0,05$. La digestibilité de la matière sèche était significativement ($p < 0,05$) différente selon le traitement où 25% de CWCS + L inclusion avait la valeur plus élevée avec la similarité à 10% de CWCS et 15% de CWCS + L (90,32, 89,48 et 89,19%), respectivement, tandis que 10% CWCS + L avait 88,54% et 20% CWCS + L (86,86%). La digestibilité des fibres de détergent neutres a été la meilleure à la commande (10% de CWCS sans levure) 70,00% avec une baisse lorsque l'inclusion des CWCS augmentait. La digestibilité de la protéine brute a suivi une tendance similaire. La digestibilité des fibres détergentes acides a toutefois été la meilleure à 25% de CWCS + L (67,16%), tandis que 20% de CWCS avaient le plus bas (50,40%). L'apport d'azote était significativement ($p < 0,05$) différent de 15% de CWCS + L (10,56%) et était la plus faible à 10% de CWCS + L (7,25%). Total N excrété était similaire statistiquement à 15 et 20% CWCS + L (8,43 et 8,36%) et le plus bas a été enregistré à 10% de CWCS + L (6,83%). N retenus comme pour cent de l'apport était significativement ($p < 0,05$) différent, avec une valeur supérieure enregistrée avec un niveau d'inclusion croissant de CWCS; 15% des CWCS avaient une rétention plus élevée (20,4%) comme contre le régime de contrôle (4,97%). Il peut être conclu des résultats de cette étude, que la supplémentation de levure a influencé la matière sèche et la digestibilité des fibres de détergent acide, la consommation d'azote et la rétention.

Mots clés: graine de coton, chèvre, digestibilité, rétention, levure

Introduction

Whole cottonseed (WCS) is a by-product of cotton plant known to represents the chemical composition of forage, grain and protein supplement and can substitute within limits those three components Heuze, (2015), and has low competitiveness with man giving it more advantage especially in areas where cotton farming is dominant. The lint in WCS may assist in retaining the seed within the rumen fibrous mat which slows the passage rate of the seed through the fore stomach (Noftsgger *et al.*, 2000) thus reducing the effect of gossypol toxicity in the animal. Yakubu *et al.*, (2017) reported notable effect of

gossypol toxicity in the performance, immunological parameters and organ function of Red Sokoto bucks when fed beyond 10% WCS inclusion in a comparative study feeding diets containing WCS and cottonseed cake (CSC). This necessitated the need to device ways of alleviating gossypol content in WCS hence encouraging its use.

Baker's yeast is a commonly used probiotic in ruminants and known to improve productivity; increase milk yield, induce better nutrient digestion, enhance growth rate (Chaucheyras-Durand *et al.*, 2008), used as agents to detoxify mycotoxins via its ability to reduce animal stress, provide

vitamins, enzymes and protein (Baptista *et al.*, 2005) and also prevent or control health conditions such as ruminal acidosis (FAO, 2016). This study therefore, aimed at using baker's yeast to reduce the effect of gossypol contained in WCS in complete diets fed to Red Sokoto bucks.

Materials and methods

Experimental site

The research was conducted in the Teaching and Research farm, Department of Animal Science, Ahmadu Bello University Zaria. Zaria is located within the Northern Guinea Savannah Zone between latitudes 11° 12' N and longitudes 7° 33' E; at an altitude of 610m above sea level (Ovimaps, 2019). Rainfall ranges from May to September with a mean annual rainfall of 700 – 1400mm per annum. Dry season commences around the middle of October and ends in February (harmattan). This is followed by relative hot weather from March to April prior to the rain (IAR, 2019).

Experimental diets and treatments

Complete diets comprised; maize offal, brewer's dried grain, *Digitarium smutsii*, molasses, bone meal, common salt, premix, Crushed Whole Cotton Seed (CWCS) and baker's yeast inclusion. The WCS was coarsely crushed before incorporating into the diets completely with the lint, likewise *D. smutsii* hay was chopped to smaller sizes of 5-8mm and the experimental diets was formulated to contain 14% CP with varied inclusion levels of CWCS at 0, 15, 20, 25% and 500 grams of commercial baker's yeast and 10% CWCS without yeast.

Experimental design, animals and management

A completely randomized design was used for the study. Twenty (20) RSB within the ages of 8 to 12 months and weighing 12kg±0.25 were sourced from Giwa market in Giwa Local Government Area Council, Kaduna State. On arrival of the animals, they were quarantined for two (2) weeks

and vaccinated against PPR with TCRV. The animals were treated against internal and external parasites with ivermectin (ivomec®) and also Tetracycline LA was administered against bacterial infections. The bucks were weighed and randomly allocated to five dietary treatments, with four animals per group and each group was randomly assigned to one of the five dietary treatments and housed in groups in pens made of concrete floors. The bucks were adjusted to the diets for two weeks before the commencement of the study. Fresh clean water was supplied *ad libitum* throughout the experimental period and the animals were weighed forth-nightly.

Digestibility study

At the end of the growth trial, fifteen bucks with three bucks per treatment were randomly selected and housed in individual metabolism crates ideal for easy and separate faecal and urine collection, as described by Osuji *et al.* (1993).

The animals were allowed 14-day adjustment period to the conditions of the metabolism crate before the commencement of the collection period which lasted for seven days. Bucks were offered 4% of the experimental diets daily and water provided *ad libitum*. Daily faecal output was weighed and 10% of each day's faecal collection was sub-sampled and oven dried at 60°C for 48 hours for the determination of faecal dry matter voided. The faecal samples were later bulked, milled and stored in plastic containers until when required for laboratory analysis. Daily total urine output was collected over 20mL of 0.1N H₂SO₄ in plastic bucket placed under the metabolic crate and the volume recorded. A 10% aliquot of the total daily urine output was taken from each buck, bulked and stored in the refrigerator pending laboratory analysis.

Chemical analysis

Crushed WCS, experimental diets, faecal samples were analysed for dry matter (DM),

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Table 1: Ingredient composition of graded levels of crushed WCS diets supplemented with yeast

Parameters	Inclusion level of CWCS (%)				
	10	10+Y	15+Y	20+Y	25+Y
Maize offal	28.75	28.25	28.25	28.30	27.25
Crushed WCS	10.00	10.00	15.00	20.00	25.00
<i>Digitariasmutsii</i>	30.00	30.00	30.00	30.00	30.00
Brewer's dried grain	27.00	27.00	22.00	17.00	13.00
Molasses	2.00	2.00	2.00	2.00	2.00
Bone meal	1.50	1.50	1.50	1.50	1.50
Salt	0.50	0.50	0.50	0.50	0.50
Premix	0.25	0.25	0.25	0.25	0.25
Yeast (<i>S.cerevisae</i>)	-	0.50	0.50	0.50	0.50
Total	100	100	100	100	100
Proximate Analysis					
Dry Matter	92.86	93.57	93.84	93.36	88.45
Organic Matter	81.27	82.19	83.16	85.82	81.97
Crude Protein	13.75	12.53	12.8	14.21	14.54
Ether extract	1.96	1.16	1.24	1.29	1.4
ADF	32.89	39.53	38.46	41.25	28.57
NDF	32.81	30.65	25.93	28.57	25.76

Y=yeast, Whole cotton seed =WCS

crude protein (CP), crude fibre (CF), ether extract (EE), ash and nitrogen free extract (NFE), according to the method of AOAC (2005). The fibre fractions, acid detergent fibre (ADF) and neutral detergent fibre (NDF) were determined according to the method described by Goering and Van Soest (1970). Urine samples were analysed for nitrogen using the simple micro-Kjeldahl distillation method of AOAC (2005). The analysis was conducted at the Biochemistry Laboratory, Department of Animal Science Ahmadu Bello University, Zaria.

Statistical analysis

Data collected on feed intake, weight changes, nutrient digestibility, nitrogen balance, blood and serum metabolites were analysed using the GLM procedure of SAS (2002). Means with significant differences were separated using Duncan's Multiple Range (Dafaallah, 2019). The following

model was used,

$$Y_{ij} = \mu + C_i + e_{ij}$$

Where

Y_{ij} = the score of i^{th} observation on the j^{th} treatment level of varied Whole Cotton Seed

μ = Overall mean

C_j = the effect of varied level of Crushed Whole Cotton Seed

e_{ij} = random error

Results and discussion

Nutrient digestibility of crushed whole cotton seed supplemented with baker's yeast fed to growing Red Sokoto bucks

The result of nutrient digestibility is presented in Table 2. Treatment diets significantly ($p < 0.05$) affected all nutrients digestibility. Dry matter (DM) and organic matter (OM) digestibility were significantly ($p < 0.05$) lower at 20% CWCS inclusion supplemented with yeast. Crude protein

digestibility was significantly ($p < 0.05$) higher at the control group (78.29%) and 25% CWCS inclusion (76.93%) supplemented with yeast. DM, OM, CP and NDF values obtained for digestibility were higher while ADF and ether extract values were lower than those obtained by Yakubu *et al.*, (2017) in bucks fed cotton products without yeast supplementation. With the values obtained for DM, OM and CP digestibility, an improved growth performance will be expected in terms of growth rate although; several factors such as genetic, management, environment and nutrition (Seung *et al.*, 2018) could greatly affect growth. Also, the result obtained is similar to the report of Paryad and Rashidi (2009) who reported positive influence on sheep fed tomato pomace based diets with yeast inclusion against the control diet. ADF digestibility was however higher in

treatment groups; 15% + Y (51.57%) and 25% + y (67.16%) as against the control group, while values obtained for 10% + Y and 15% + Y were lower than the control group. The improve NDF digestibility observed agrees with the report of (Fadel, 2007). Treating feed with some yeast culture tends to increase the number of cellulolytic bacteria, in other instances, increases the cellulose degradation in the rumen (Miller *et al.*, 2002). Also, the higher the proportion of concentrate and neutral detergent fibre in the diet, the better the digestibility of organic matter resulting from the live yeast supplementation (Desnoyers *et al.*, 2009). The EE digestibility was higher at the control group (84.15%) as against the other treatment groups with yeast (68.8% – 82.8%). High EE digestibility may influence fat deposition in the adipose tissues.

Table 2: Nutrient digestibility of crushed whole cotton seed supplemented with baker’s yeast fed to growing Red Sokoto bucks

Parameters	Inclusion level of CWCS (%)					SEM
	10	10+Y	15+Y	20+Y	25+Y	
Dry matter	89.48 ^a	88.54 ^b	89.19 ^a	86.86 ^c	90.32 ^a	0.59*
Organic Matter	71.90 ^a	68.89 ^b	70.32 ^a	65.68 ^c	74.05 ^a	1.79*
Crude Protein	78.27 ^a	67.69 ^b	68.63 ^b	68.36 ^b	76.93 ^a	1.58*
NDF	70.00 ^a	62.65 ^b	49.94 ^c	53.44 ^c	63.31 ^b	3.36*
ADF	54.16 ^c	51.57 ^c	61.20 ^b	50.40 ^c	67.16 ^a	2.59*
Ether Extract	84.15 ^a	70.25 ^c	74.48 ^b	68.80 ^c	82.80 ^a	1.26*

^{a,b,c}Means with different super script along same row differed significantly ($P < 0.05$), SEM =Standard error of means,* significant at $P < 0.05$, NDF=neutral detergent fibre, ADF= acid detergent fibre, Y=yeast

Nitrogen balance in growing Red Sokoto bucks fed crushed whole cotton seed supplemented with baker's yeast

The result of nitrogen balance is presented in Table 4. Significant ($P < 0.05$) difference was recorded in Nitrogen intake (NI) across the dietary treatments supplemented with baker's yeast. Those fed 15 and 20% CWCS with yeast had significantly ($P < 0.05$) higher NI. Faecal N values recorded followed similar trend to NI

however, the control group (3.65g) favourably competed with treatment groups on 15%CWCS + Y (3.72g) and 25%CWCS + Y (3.68g) which were statistically different with treatment groups fed 10%CWCS + Y (3.72g) and 25%CWCS + Y (4.55g). Total N excreted and N absorbed as % intake followed similar trend, Urinary N values for control group was statistically similar ($P < 0.05$) with those on 15%CWCS + Y and 20%CWCS+ Y treatment groups

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and different from those on 10%CWCS + Y and 25% CWCS + Y treatment groups. The values obtained for N retained and N retained as % intake was lower in the control groups. High values of Nitrogen retention obtained in the baker's yeast

treatment groups as against the control agrees with Paryad and Rashidi (2009), who attributed the improvement, to rumen microbes responsible for the proteolytic and peptidolytic activities. This report also agrees with that of Cole *et al.* (1992).

Table 3: Effect of crushed whole cotton seed supplemented with baker's yeast on nitrogen balance in growing Red Sokoto bucks

Parameters(g)	Inclusion level of CWCS					SEM
	10	10+Y	15+Y	20+Y	25+Y	
Nitrogen Intake	7.76 ^c	7.25 ^c	10.56 ^a	10.06 ^a	8.94 ^b	0.27*
Feecal Nitrogen	3.65 ^b	3.72 ^b	4.55 ^a	4.41 ^a	3.68 ^b	0.17*
Urinary Nitrogen	3.84 ^a	3.11 ^c	3.87 ^a	3.95 ^a	3.75 ^b	0.06*
Total N excreted	7.49 ^b	6.83 ^c	8.43 ^a	8.36 ^a	7.44 ^b	0.18*
N absorbed	4.09 ^d	3.54 ^e	6.00 ^a	5.65 ^b	5.25 ^c	0.16*
N absorbed as % intake	52.77 ^b	48.41 ^c	56.99 ^a	56.42 ^a	58.80 ^a	1.23*
N retained	0.39 ^c	0.45 ^c	2.13 ^a	1.20 ^b	1.50 ^b	0.15*
N retained as % intake	4.97 ^c	5.98 ^c	20.40 ^a	15.88 ^b	16.70 ^b	1.27*

^{a,b,c}Means with different super script along same row differed significantly (P<0.05), SEM =Standard error of means, * significant at P<0.05, N=nitrogen, Y=yeast.

Conclusion

The inclusion of yeast caused a positive effect on dry matter and acid detergent fibre digestibility. Bucks fed 15% crushed whole cotton seed had better nitrogen intake and retention, thus the use yeast in goats fed crushed whole cotton seed-based diet is encouraged.

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