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Growth and Reproductive Performance of West African Dwarf Sheep Fed Endophyte - Infected Maize Stover Supplemented with Soybean Meal

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Abstract: An experiment was conducted to investigate the effect of feeding Endophyte-infected maize stover on growth and reproductive parameters of West African Dwarf (WAD) sheep. In a six weeks feeding trial, twenty-one individually caged growing WAD sheep were randomly alloted to three dietary treatments in a Randomized Complete Block Design. Treatment 1 (control) consists of diet with healthy maize stover without *Fusarium* inoculation while treatments 2 and 3 consist of diets with slight and high *Fusarium*-infected maize stover respectively. Results showed that the mean daily dry matter intake and metabolic dry matter intake (g/sheep) were significantly ($p<0.05$) higher in animals fed the control diet when compared with animals fed the test diets. The mean weekly weight gain of the animals fed diet 3 was significantly ($p<0.05$) lower, with the metabolic weight gain of the animals being 54.20 and 65.00% of those on diets 1 and 2, respectively. The feed conversion ratio revealed that it will take 3.76 kg of the highly-infected stover to produce the same unit weight of the meat that was produced by 2.12 kg of healthy maize stover (control diet). The mean relative kidney weight tended to decline with an increase in the level of *Fusarium* infection. The reproductive parameters examined were not significantly different among the treatments except the relative paired testes weight that was significantly ($p<0.05$) lower in animals fed diet 2 which was directly related to the live weight of the animals. The results suggest that ingestion of *Fusarium*-infected maize stover by sheep for a short time will depress dry matter intake and weight gain without adverse effect on the organ traits and reproductive potential.

Key words: Endophyte-infected maize stover · growth · reproductive performance · sheep

INTRODUCTION

Recent studies have shown that the disease status of crop stovers such as maize can have a large impact on the digestibility of crop tissues and on animal performance.

Maize particularly has been reported by Cardwell *et al.* [1] to be vulnerable to degradation by mycotoxigenic fungi, such as *Fusarium* species that is prevalent in maize worldwide especially in the humid tropics.

Fusarium species, which are ubiquitous in roots and stalks of maize and most other plants, exist as saprophytes in moribund tissues of living host or as opportunistic pathogens awaiting stress in the host [2]. It was ascertained in the same study that infection of roots and stalks by *Fusarium* spp. occurred independently and that the inoculum appeared to be disseminated primarily from above ground sources. Inoculum of *F. verticillioides* disseminated either by wind or rain [3] and spore dispersal by the corn borer [4] and Picnic beetle [5] are considerable factors in infection of stalks other than from roots. Kommedahl *et al.* [2] concluded that after anthesis, irrespective of the hybrids, most if not all stalks, are naturally infected or colonized internally by one or more species of *Fusarium* and other fungi without apparent symptoms of stalk rot and that damage from these fungi depends on the degree of stress subsequently imposed on the plant by the environment.

Since *F. verticillioides* has been reported to be predominant in both stover and grain of corn both in early and late maize growing seasons obtainable in humid

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tropics [1], it was therefore hypothesized that there should be correlation between the nutritive value of such infected stovers and degree of *Fusarium* infection, which has not been investigated. Thus far, studies have only concentrated on the effect of *Fusarium* infection on crops yield with possible interaction with other fungi, feeding infected grains to livestock with attention to fumonisin produced by the fungi and no study has been reported to determine the effect on ruminants exposed to endophyte levels reported in stovers.

The current study was therefore conducted to assess the feeding value of *Fusarium*-infected maize stover on the performance and reproductive parameters of sheep.

MATERIALS AND METHODS

Experimental site: The experiment was carried out in the ruminant unit of Livestock Research Farm of the International Livestock Research Institute (ILRI), IITA, Ibadan, Nigeria (7°30'N; 3°54'E).

Generation of infected stover: Infected stover was generated by the plant pathology team at the International Institute of Tropical Agriculture (IITA). *Fusarium verticillioides* isolate, obtained from a naturally-infected ear found in a farmer's field within Ibadan metropolis, Nigeria, was grown on acidified Potato Dextrose Agar (PDA) and microconidia were washed into a suspension with distilled water. At 10 and 15 days past mid-silk, 2 mL of *F. verticillioides* inoculum ($1x10^6$/mL) was atomized on maize stalk using tooth picks at two insertion points at first internode for slightly infected stover and four insertion points at first and third internodes for highly infected stover during the actively growing stage of the plants to generate two levels of infection for the test stovers and the control inoculated with water, thus, constituting a control (diet 1), a slightly *Fusarium*-infected maize stover (diet 2) and a highly *Fusarium*-infected maize stover (diet 3). The fungus was allowed to grow with the maize plants till maturity and the stovers harvested when dried for the feeding trial.

Feeding trial: Twenty-one West African Dwarf (WAD) sheep (18 males and 3 females) were sourced from the ILRI Farm, treated for internal and external parasites and brought indoors after the pens had been properly washed and disinfected. Animals were blocked on live weight and randomly allocated to three treatment (zero infection, slight infection and high infection) diets, each having 6 males and 1 female. The maize stovers were chopped and fed to the animals for six weeks, after a two-week physiological adjustment period. All animals were fed *ad libitum* (80 g kg^{-1} BW $^{0.75}$) daily at 0800 h and 1600 h. Basal diet for each animal was supplemented with 200 g soybean meal per day to ensure adequate protein intake. Feed refusals were collected prior to feeding every morning. The feed intake was monitored daily and animals weighed weekly for the 42 days of experimental period.

At the end of the feeding trial, 3male animals per treatment were sacrificed, dissected and their organs (kidneys, liver and testes) were carefully removed and weighed. The evaluation of the sperm storage potential of the experimental male animals involved direct haemocytometric count after 1:100 (v/v) dilutions in 0.154 M NaCl [6].

Statistical analysis: The data collected were subjected to statistical analysis using analysis of variance procedure of SAS [7]. The treatment means were compared using the Duncan procedure of the same software.

RESULTS AND DISCUSSION

Performance of sheep: The mean dry matter intake (DMI), mean weekly weight gain and feed conversion ratio are summarized in Table 1. The mean metabolic dry matter intake was significantly ($p<0.05$) influenced by the dietary treatments with the mean dry matter intake significantly ($p<0.05$) lower in animals fed *Fusarium*-infected maize stovers than the control. Weight gain and metabolic weight gain also decreased significantly ($p<0.05$) with increase in the infection levels in the stover while the feed conversion ratio increased in mean value as the levels of endophyte infection increased.

The results showed that animal fed highly infected stovers compared favourably in dry matter intake with those fed the control diet. This may probably be attributed to the reduction in the quality or nutritive value of the highly infected stover since the fungus also fed on the nutrients in the stover for its growth. The animals on highly-infected stovers tended to eat more of the diet in an attempt to meet their daily nutrient requirement. However, the dry matter intake was inversely related to the gross and metabolic weight gains, which was significantly lower in animals fed diet 3 as compared to others. The metabolic weight gain of animals on highly-infected stovers (diet 3) was 54.3 and 65.0% of those on diet 1 and 2, respectively. This result corroborates the report of Ewuola *et al.* [8] that also observed same in rabbits fed *Fusarium*-cultured diets. The feed conversion ratio revealed that it will take 3.76 kg of the highly-infected stovers to produce the same unit weight of the meat that is produced by 2.12 kg of healthy stovers (control).

Table 1: Performance of sheep fed *Fusarium*-infected maize stover

Variables	Diet 1	Diet 2	Diet 3	Root MSE
Dry matter intake (g)	383.49^a	311.42^b	368.79^a	14.980
Metabolic DMI* (g kg^{-1} BW$^{0.75}$)	39.29^a	33.90^c	36.88^b	1.427
Live weight (kg)	27.20	21.00	24.63	3.306
Weight gain (g/week)	180.72^a	143.70^a	97.98^b	118.006
Metabolic weight gain (g kg^{-1} BW$^{0.75}$)	20.33^a	16.95^b	11.04^c	12.524
Feed conversion ratio	2.12^b	2.17^b	3.76^a	0.912

$^{a-c}$: Means with different superscriptions are significantly ($p<0.05$) different, *Dry matter intake

Table 2: Organ traits of sheep fed *Fusarium*-infected maize stovers

Variables	Diet 1	Diet 2	Diet 3	Root MSE
Liver weight (g)	474.50	407.17	455.67	33.050
Relative liver weight*	17.63	18.37	18.55	1.469
Kidney weight (g)	74.88	60.32	63.44	9.755
Relative kidney weight*	2.82	2.80	2.58	0.509
Paired testes weight (g)	260.03	117.36	208.13	28.196
Relative paired testes wt.*	9.56^a	5.65^c	8.47^b	0.274

^{ab} = Means with different superscripts are significantly ($p<0.05$) different, *Relative to live weight

Table 3: Reproductive parameters of male sheep fed *Fusarium*-infected maize stovers

Variable	Diet 1	Diet 2	Diet 3	Root MSE
Weights				
Paired testes weight (g)	260.03	117.36	208.15	28.196
Relative paired testis weight*	9.56^a	5.65^c	8.47^b	0.274
Paired epididymides weight	32.04	28.93	30.89	3.040
Relative paired epididymides wt.*	1.19	1.39	1.26	0.129
Gonadal Sperm Reserves (GSR)				
GSR per testis (x10^8)	0.65	0.50	0.54	0.312
GSR per gram testis (x10^6)	0.65	0.54	0.55	0.413
Epididymal sperm reserves				
Corpus sperm reserves (x10^6)	27.67	13.63	23.17	17.715
Caudal sperm reserves (x10^6)	41.84	62.23	70.15	28.189
Daily Sperm Production (DSP)				
DSP per testis	0.19	0.14	0.15	0.090
DSP per gram testis	0.18	0.15	0.16	0.476

^{ab} = Means with different superscripts are significantly ($p<0.05$) different, *Relative to live weight

Organs traits: The average gross and relative liver, kidneys (relative to live weight) and paired testes weights are shown in Table 2. The gross and relative liver and kidney weights were not significantly influenced by the dietary treatments. However, the mean relative kidney weight (relative to live weight) tended to decrease apparently with an increase in the level of *Fusarium* infection in the stover. The mean relative paired testes weight was significantly ($p<0.05$) different among the treatments, with highest mean value (9.56) recorded in animals fed control diet.

The results show that the relative liver and kidney weights of animals that were fed test diets compared favourably with those fed control diet. This is an indication that the dietary qualities of the experimental diets promote identical organ traits among the treatments. This may probably be attributed to the concentrate supplementation of basal diets of endophyte-infected stovers.

The significant differences observed in the mean relative paired testes weight which was directly related to live weight may be attributed to dietary influence [9]. The concomitant reduction in weight gain that resulted from depressed dry matter intake may have elicited same on the testicular weight since organ development in the body is a function of dry matter intake and nutrient utilization.

Reproductive performance: The mean relative paired testicular and epididymal weights, testicular sperm reserves, daily sperm production and epididymal sperm reserves are shown in Table 3. the result shows that mean paired testes weight, testicular sperm production per testis and gram testis, paired and relative paired epididymides weights and epididymal (caput, corpus and cauda) sperm reserves were not significantly influenced by the experimental diets among the treatments. The mean value of these reproductive parameters from animals fed test diets compared favourably with those fed the control. This indicates that the diets possessed the same dietary quality that promotes identical daily sperm production and gonadal and extra-gonadal sperm reserves. The mean relative paired testes weight observed was significantly ($p<0.05$) highest (9.56) for animals fed diet 1 and least mean value (5.65) recorded for animals on diet 2, which were directly related to the live weights. Observed in this study is a confirmation of the established fact in earlier studies by Swierstra [10] and Egbunike [9] that testicular and sperm production are highly related.

This study has demonstrated that feeding highly *Fusarium*-infected maize stovers to WAD sheep solely resulted in the poor performance of the experimental animals in terms of low feed intake and weight gain because of reduction in the feeding value of the maize stovers. The study further shows that the basal diet (maize stovers) supplemented with soybean meal promoted identical organ triats and reproductive parameters in all the treatments. From the foregoing, it can be suggested that highly *Fusarium*-infected maize stovers should be avoided in sheep diet or not fed solely as this, due to feed refusal effect, will depress intake with resultant effect on weight gain without any adverse effect on organ traits and reproductive potential of sheep when fed for a short time.

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