

On-farm introduction of some dry season feeding strategies to cattle farmers on the Accra Plains of Ghana and the response of cattle to these strategies.

2. On-farm studies on the use of urea-ammoniated rice straw as a dry season feed supplement for cattle

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ABSTRACT

A feeding trial was carried out on-farm, in the Dangbe East District on the Accra Plains, to demonstrate to farmers the effect of feed supplementation on parturient cows grazing natural unimproved grasslands. A supplement of urea-ammoniated rice straw was fed to cows on four farms, with cows on four other farms serving as controls. Four cow and calf pairs were monitored on each farm. Animals were weighed monthly with a Dalton weighband. Supplemented cows lost significantly ($P < 0.05$) less weight (-0.23 vs -0.34 kg day⁻¹) than their unsupplemented counterparts. Calves of supplemented cows showed a slightly better weight gain, though not significantly different ($P > 0.05$), than calves of unsupplemented cows (0.19 vs 0.16 kg day⁻¹). Mean body condition score of cows was not significantly ($P > 0.05$) affected by supplementation. Mean cow body condition scores were 4.7 and 4.3 for supplemented and unsupplemented cows, respectively. However, there was a significant time \times treatment interaction. In February, supplemented cows had a significantly ($P < 0.05$) higher body condition score (5.0) as compared to unsupplemented cows (4.3). By the end of the project, farmers had learnt to prepare urea-ammoniated rice straw by themselves without supervision.

RÉSUMÉ

ODDOYE, E. O. K., FLEISCHER, J. E., AMANING-KWARTENG, K. & AWOTWI, E. K.: *Introduction sur le champ de quelques stratégies d'alimentation de la saison sèche aux éleveurs des bestiaux sur les plaines d'Accra du Ghana et la réaction de bestiaux à ces stratégies. 2. Etude sur le champ d'utilisation de paille du riz d'urée-ammoniac comme un supplément d'aliment de la saison sèche pour les bestiaux.* Un essai d'alimentation se déroulait sur le champ, dans le district de Dangbe East sur les plaines d'Accra pour démontrer aux éleveurs l'effet de régime complémentaire sur les vaches en parturition pâturant les herbages naturels non améliorés. Un supplément de paille du riz d'urée-ammoniac comme donné à manger aux vaches sur quatre champs, avec des vaches sur quatre autres champs servant comme des contrôles. Quatre paires de vache et veau étaient surveillés sur chaque champ. Les animaux étaient pesés mensuellement avec bande de pesage de Dalton. Les vaches de régime complémentaire perdaient considérablement ($P < 0.05$) moins de poids (-0.23 vs -0.34 kg jour⁻¹) que leurs contreparties sans régime complémentaire. Les veaux des vaches de régime complémentaire montraient un gain de poids légèrement meilleur, malgré qu'il n'était pas considérablement différent ($P > 0.05$) que les veaux des vaches sans régime complémentaire (0.19 vs 0.16 kg jour⁻¹). Le chiffre moyen de condition corporelle des vaches n'était pas considérablement ($P > 0.05$) influencé par le système complémentaire. Les chiffres moyens de condition corporelle de vache étaient 4.7 et 4.3 respectivement pour les vaches de régime complémentaire et non complémentaire. Il y avait toutefois, une interaction condérable de temps \times traitement. Dans le mois de février

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Introduction

The loss in body weight of ruminant animals, during the dry season in Ghana, is a well known phenomenon. Rose-Innes (1960) estimated that in a very severe dry season, cattle may lose up to 15 per cent of their body weight. The supplementary feeding of crop residues, in a bid to reduce the dry season weight loss, may be the answer. Crop residues are cheap and may often be a by-product of the farmer's own cropping activities. The major drawback with the feeding of crop residues is their high fibre and low crude protein content, leading to low digestibility. These short-comings may be overcome, to some extent, by urea-ammoniation which increases nitrogen (crude protein) content of the straws and also improves the digestibility of fibre. An earlier survey in the Dangbe East and Dangbe West Districts on the Accra Plains of Ghana (Oddoye *et al.*, 2002) had indicated that even though a few farmers had heard about urea-ammoniation of straw, it was not being practised; the main reason being that farmers did not know enough about it.

This study therefore aimed at the following:

1. To teach farmers how to prepare and feed urea-ammoniated rice straw to their cattle.
2. To investigate the effects of dry season feed supplementation with urea-ammoniated rice straw on cow and calf growth rates, and cow body condition score.

Materials and methods

Location of cattle farms

The study began in November 1998 and ended in March 1999 at the Sege area in the Dangbe East District on the Accra Plains.

Selection of farmers

Farmers for the project were selected from those

les vaches de régime complémentaire avaient considérablement ($P < 0.05$) un chiffre (5:0) de condition corporelle plus élevé par comparaison aux vaches sans régime complémentaire (4.3). Avant la fin du projet, les éleveurs avaient appris la préparation de paille de riz d'urée ammoniac par eux-même sans surveillance.

who had been interviewed during an earlier survey (Oddoye *et al.*, 2002). With the help of the District Veterinary Technical Officer, farmers who were most likely to accept the project were identified. The farmers were grouped into two, that is, those with their kraals towards the sea and those with their kraals towards Battor town. The farmers were then randomly chosen from the two groups, making sure as much as possible that there were equal numbers from each group. This was done because even though farmers relied on the same communal grazing lands and watering points, those towards the sea could be identified as a distinct group, with those towards Battor forming another group. It was, therefore, important to have equal representation from the two groups to ensure the success of the project.

Preparation of farmers for feeding trials

A rapid rural appraisal (RRA) was organised in the Dangbe East District before the start of the feeding trials. The idea was to sensitise farmers as to what they could expect from the dry season feeding trial, and also to find out the farmers' own perceptions of the feeding trial. The ensiling process was demonstrated. The criteria for selection of farmers for the project were then explained to the farmers after which selected farmers were introduced to the gathering. Farmers who had not been selected were encouraged to visit the selected farms to see for themselves how the project would fare.

Cattle herd management

The average size of herds was 100 with a range of 50 to 200. The Sanga (Zebu × Shorthorn) was the predominant breed, although a few Shorthorns were found in some herds. Management systems were principally agropastoralist in nature with

herdsmen in charge. Grazing was generally on natural grasslands, and owing to a shortage of forage, the herdsmen left home with the cattle between 6.00 am and 7.00 am and returned at about 6.00 pm. Grasses that were identified were those found commonly on the Accra Plains, i.e., *Andropogon* sp., *Brachiaria* sp., *Vetiveria* sp., *Panicum maximum*, *Sporobolus* sp., *Dactyloctenium* sp., *Alternanthera* sp., *Heteropogon contortus* and *Vetiveria fulvibarbis* (Fianu, 1980). A few thickets were found and herdsmen identified two species (*Jasminum dichotomum* and *Parkinsonia aculeata*) as being eaten by cattle. Cattle were watered from dams, and the animals drank once on their way to graze and once on their return.

All the farms practised natural mating, with service bulls running freely with females. Calves were weaned naturally between 6 and 9 months of age. Older calves (9 months plus) followed their dams to pasture while younger ones were isolated and penned up until their dams had gone for grazing. They were then released to graze around the homestead. Herdsmen controlled ectoparasites fortnightly by applying a mixture of acaricide and water to affected areas on the animal. Deworming was limited to calves and other animals which showed signs of heavy worm infestation. Owing to the severity of the dry season, no cows were milked.

Preparation of urea-ammoniated rice straw

A small portable silo, which could contain 25 kg of chopped rice straw, was used for ensiling. The material for the silo was a sheet of polysack material measuring 2.2 m × 2.2 m, and the silo was made by sewing together four empty sacks used for bagging wheatbran after they had been cut open. The polysack sheet was lined with a polythene sheet (1 m × 1m) to prevent seepage of the urea solution. The rice straw was chopped with a cutlass into lengths of 3 - 5 cm. Twenty-five kilograms of straw were ensiled with 1.65 kg of fertilizer-grade urea dissolved in 22 l of water to arrive at 6.5 per cent urea and 40 per cent moisture

in the ensiled material (Quarshie, 1993). The chopped rice straw was spread on the polysack sheet in layers. Successive layers of chopped rice straw were sprayed with urea solution, using a watering can, and thoroughly mixed. This process continued until all straw and urea solution were used up. The ends of the sheet were then tied together, diagonally. During the tying process, pressure was applied to the mass of chopped rice straw with the feet to expel as much air as possible. After 1 week, the silo was opened and the contents aired for a day after which it was ready for use.

Animals

Eight farms (herds) were used in the study. The target animals were parturient cows and their calves. Four cow and calf pairs were selected for monitoring on each farm.

Feeding

On four of the farms, all parturient cows were fed a supplement of urea-ammoniated rice straw on their return from grazing. Feeding was done in a group, with an allowance of about 1.5 kg of urea-ammoniated straw per cow. The supplement was offered in a feed trough which also contained a salt lick. Initially, that is, during the adjustment phase of 2 months, cows were enticed to eat urea-ammoniated rice straw by mixing it with sun-dried cassava peels and salt. By the end of the adjustment phase, cows had gotten used to the urea-ammoniated rice straw and the use of these materials was therefore discontinued. The supplement was available throughout the night until grazing time the next morning. On the other four farms, which served as controls, no supplement was offered. However, the animals on the control farms were also supplied with salt lick. Feeding was from November 1998 to March 1999, with measurements being made from January 1999 to March 1999.

Parameters studied

The measurements made were initial weights

of cow and calf, monthly weights of cow and calf for 3 months (January, February and March), initial body condition score of cow, and monthly body condition score of cow also for 3 months. All the weights were estimated with the Dalton weighband (Dalton Supplies Ltd, England). The body condition score of cows was estimated with the 9-point scale developed at the International Livestock Centre for Africa (Nicolson & Butterworth, 1986).

Chemical analysis

Samples of untreated rice straw and urea-ammoniated rice straw were analysed for nitrogen (AOAC, 1984) and detergent fibres (NDF, ADF, ADL) (Goering & Van Soest, 1970). Organic matter was determined as the weight loss after ignition in a furnace at 550°C for 3 h. Hemicellulose was calculated as the difference between NDF and ADF, and cellulose as the difference between ADF and ADL. Samples of urea-ammoniated rice straw prepared by farmers were also analysed and compared with that made by the researchers.

Statistical procedures

The GLM procedure of the Statistical Analysis Systems Institute (SAS, 1987) was used to analyze the data. The regression of monthly cow and calf weights on time (month) was used to estimate growth rate of cow and calf, respectively. The analysis of variance for repeated measures was used to assess the change in cow body condition score with treatment and time (month).

Results

Table 1 shows the chemical analyses of untreated rice straw and urea-ammoniated rice straw. It also shows a comparison of the chemical analyses of samples of urea-ammoniated rice straw from the various farms, prepared by the farmers themselves, and that prepared by the researchers. The results, though not statistically tested, indicated that what farmers made themselves were comparable to what the researchers had made. The results also showed that generally urea-ammoniation increased the crude protein content in all treated rice straws by over 100 per cent.

TABLE 1

Chemical Composition of Untreated Rice Straw and Urea-Ammoniated Rice Straw Prepared by Farmers and Researchers

| <i>Parameter</i> | <i>Untreated rice straw</i> | <i>UTS1</i> | <i>UTS2</i> | <i>UTS3</i> | <i>UTS4</i> | <i>UTS5</i> |
|----------------------------------|-----------------------------|-------------|-------------|-------------|-------------|-------------|
| Dry matter (g kg ⁻¹) | 891 | 875 | 847 | 853 | 864 | 860 |
| <i>g kg⁻¹ DM</i> | | | | | | |
| Organic matter | 818 | 797 | 830 | 835 | 816 | 820 |
| NDF | 775 | 727 | 705 | 730 | 729 | 725 |
| ADF | 584 | 626 | 570 | 618 | 622 | 612 |
| ADL | 67 | 57 | 79 | 67 | 62 | 66 |
| Hemicellulose | 191 | 101 | 135 | 112 | 107 | 113 |
| Cellulose | 517 | 469 | 491 | 551 | 560 | 546 |
| Nitrogen × 6.25 | 44.9 | 92.9 | 99.3 | 90.0 | 91.4 | 93.4 |

UTS1 - Urea-ammoniated rice straw prepared by researchers

UTS2 - Urea-ammoniated rice straw prepared by Farmer 1

UTS3 - Urea-ammoniated rice straw prepared by Farmer 2

UTS4 - Urea-ammoniated rice straw prepared by Farmer 3

UTS5 - Urea-ammoniated rice straw prepared by Farmer 4

TABLE 2

LS Means and Standard Errors for Effect of Treatment on Cow and Calf Growth Rate

| Treatment | Growth rate (kg day ⁻¹) | |
|------------------|-------------------------------------|--------------|
| | Cow | Calf |
| Supplemented | -0.23 ± 0.009 ^a | 0.19 ± 0.300 |
| Not supplemented | -0.34 ± 0.010 ^b | 0.16 ± 0.320 |

Means within an effect with common or no postscripts are not significantly different ($P>0.05$)

TABLE 3

LS Means of Cow Body Condition Score as Affected by Treatment and Month

| | Supplemented | Not supplemented | SED | P value |
|--------------|--------------|------------------|------|---------|
| Minimum | 4.0 | 3.0 | | |
| Maximum | 5.0 | 6.0 | | |
| Mean | 4.7 | 4.3 | 0.47 | NS |
| <i>Month</i> | | | | |
| January | 5.0 | 5.3 | 0.50 | NS |
| February | 5.0 | 4.3 | 0.50 | * |
| March | 4.0 | 3.5 | 0.58 | NS |

SED - Standard error of the difference between two means

Table 2 shows cow and calf growth rates. There was a significant difference ($P<0.05$) between supplemented and unsupplemented cows in weight loss. However, this was not reflected in calf growth rates which were not significantly different ($P>0.05$), even though calves from supplemented cows showed a better growth rate. Table 3 shows cow body condition scores for the experimental period. There was a significant interaction ($P<0.05$) between month of observation and treatment. In the 2nd month (February 1999), supplemented cows showed a significantly superior ($P<0.05$) body condition score as compared to their unsupplemented counterparts.

Discussion

Increase in nitrogen/crude protein content is one

of the advantages of urea-ammoniation of straw. The values for this study are higher than the 84 g kg⁻¹ reported by Quarshie (1993) for rice straw treated with 6.5 per cent urea at 40 per cent moisture, incubated for 14 days, and aired for 24 h. On the contrary, the values reported by Sottie (1994) for both untreated rice straw, i.e., 5.74 per cent and urea-ammoniated rice straw (treated at 6.5 per cent urea and 40 per cent moisture), i.e., 10.45 per cent, are higher than those reported here.

The increase in crude protein content, relative to the crude protein level of the untreated material, was 106.9 per cent in this study as compared to 82.05 per cent reported by Sottie (1994). These differences may be accounted for by the different types of silos used and the length of the ensiling period. Sottie (1994) ensiled his material in a concrete silo for 21 days while the polysack silo was used in this study with an ensiling period of only 7 days. The differences in the varieties of rice straw used in the various experiments may also be a cause of the variation.

In this study, the effect of the urea-ammoniated rice straw supplement on weight gain in cattle was a reduced weight loss in cows and increased weight gain in calves.

Wharton *et al.* (1967) reported similar results in an experiment where urea was fed as a supplement to cattle at Pong-Tamale in northern Ghana. They reported that animals that received the urea supplement did not lose as much weight as control animals during the dry season.

In their studies with sheep, in which they fed rice straw supplemented with urea as a dry season supplement, Attah-Krah (1972) and Rhule (1973) also observed that at the end of the experimental period, test animals were healthier and had gained more weight as compared to the control. A similar observation was made by Larsen & Amaning-Kwarteng (1976) when they fed urea-supplemented diets to cattle during the dry season. On the contrary, Oddoye *et al.* (1996) reported no apparent advantage when calves, grazing natural pasture, were supplemented with

chopped *Panicum maximum* straw and poultry manure. These authors concluded that the calves did not eat enough of the supplement for it to make a difference. Daily dry matter intake of *P. maximum* straw was 0.25 ± 0.03 kg. Dagbui (1993) also reported a 6.8 per cent increase in milk yield for animals being supplemented with urea-ammoniated *P. maximum* straw as compared to those on natural grazing only. However, this difference was not significant ($P > 0.05$). Daily dry matter intake of urea-ammoniated *P. maximum* per cow was 0.75 kg.

The reduction in weight loss by supplemented cows which was not passed onto their calves may be explained by the fact that the partitioning of nutrients in lactating animals is a very complex issue, controlled by other factors; and it is possible that under the severe dry season conditions, the maintenance of body weight to ensure survival was more important than increased milk production. It is also possible that under the prevailing conditions, increasing protein intake, as a result of supplementation with urea-ammoniated rice straw, increased the overall digestibility of the cow's feed and its total dry matter intake. The increased energy intake would counterbalance energy release from tissue, thus reducing net tissue mobilisation or liveweight loss.

Weight gain in calves, at this stage of their life, is mainly a function of their intake of milk. It was impossible to measure milk yield, but from the results obtained and the explanations given above, milk yield would probably not differ much between the two groups of cows; hence, the similar growth rates observed in their calves.

Feed intake for the group of animals on urea-ammoniated rice straw supplement was not measured because farmers fed the supplement to all their paturient cows as the dry season was very severe. It was originally intended to have a supplemented group and a control group on each farm. However, it was observed during monitoring visits to the project sites that farmers had added on more cows after realizing the usefulness of the supplement. The number of cows eating the

supplementation increased with each visit. This made the calculation of feed intake very difficult. This behaviour or attitude of farmers will have to be considered in future on-farm work. It was intended to provide about 1.5 kg of urea-ammoniated rice straw per animal per day. This was to provide about a quarter of the potential dry matter intake of a 250-kg (Tropical Livestock Unit/TLU) weight cow (2.5 % of body weight - 6.25 kg). This figure was probably not attained for the reasons stated above. The low intake could therefore be one of the factors that led to a less than expected performance from supplemented animals.

Cameron (1970) reported that cattle did not readily accept supplemental feed because they were not used to supplementation, and restricting them in kraals to allow them to consume the supplement may also contribute to their low intake. Oddoye *et al.* (1996) also reported similar problems. In this study, however, apart from initial problems during the first 2 months, cows ate the supplement readily. This may be partly attributed to the salt and cassava peels used to entice the animals, the severity of the dry season, and also farmer interest in the project.

Farmers participated actively during the project, and this is very important to ensure the success of any on-farm project. The study had aimed at teaching farmers how to prepare urea-ammoniated rice straw by themselves. Farmers did participate, and by the end of February, they could carry out the process unaided. While teaching the farmers, it was realised that four wheatbran sacks, very well packed with chopped straw, weighed about 25 kg. The farmers also provided an empty margarine container which could contain about 0.55 kg of urea. Three measures of this container would provide enough urea (1.65 kg) for ensiling 25 kg of straw. Farmers also had an aluminium container which they used to fetch water for domestic chores. It was also realised that this container, when filled to the brim with water, was about 22 l.

At the end of the whole project, there was a

wrap-up farmers' forum at which farmers who had participated in the project shared their experiences with their colleagues. This was also a way of finding out if the farmers had learnt anything at all from the project. The farmers demonstrated how to chop rice straw and then prepare urea-ammoniated rice straw. It was evident during the forum that farmers viewed the success of the project in other terms. For example, the fact that calves on the farms where the supplement was fed looked healthier and stronger, and were more likely to survive the dry season was considered highly important. A premium is placed on calves, especially heifer calves, and calf survival means continued growth of the herd. During the study, cows which were not given the supplement would often "go down" and would have to be sold. Animals would then be so thin that farmers got very little from the sale. This did not happen on farms where cows were fed the supplement.

Conclusion

A supplement of urea-ammoniated rice straw can help reduce dry season weight losses in cattle. Owing to some problems stated in this study, the exact amount to feed is still not clear. However, feeding should at least aim at keeping cows at maintenance. For the best results, the feeding of agro-industrial by products, especially those generated by the farmers themselves (e.g., cassava peels and leaves), should be encouraged, as their feeding will help ensure an optimum environment in the rumen for the digestion of the very fibrous material that the cows have to depend on during the dry season. The technology needed for the urea-ammoniation of rice straw has been transferred to a few farmers in the Sege Area of the Dangbe East District of the Greater Accra Region. The use of simple dry season feeding strategies, with emphasis on the use of locally available materials, and with the active participation of farmers, may be a step in the right direction.

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