Effect of Soaked and Urea Treated Wheat Straw Based Diets on Live Weight of Wether Sheep

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***Abstract*—** nine bales of about 300 kg of chopped (10-15cm) wheat straw were distributed manually into 18 polyester silo bags that were individually placed inside galvanized mesh rings. A 2 x 3 factorial design, in triplicate, was used to apply different urea and water levels to prepare treated wheat straws as follows. Water to represent 2water (soaking) to straw ratios (0.15:1 and 0.50:1) and 3 urea levels (0, 2.5 and 5% of straw) were sprayed onto these straws in bags which were compressed to exclude air, sealed and left outdoors for ten weeks. An animal trial was conducted to compare the effect of feeding these straws on the live weight of 6 similar groups of wether sheep but individually housed over 6 weeks. The wethers were offered ad-libtum the above mentioned straws after their mixing in small batches daily with 3% molasses for the first two weeks as an adaptation period, and then for another 6 weeks to observe the weekly live-weights (LW) of these wethers. The wethers were also fed daily 200g of a concentrate plus 20g of a vitamin-mineral premix per head to meet their nutrient requirements refrence, [1]. The data were statistically analysed by using the Analysis of Variance in Minitab software to compare the effects of soaking, urea and soaking x urea interactions on the weekly live weight of these wethers at $P<0.05$. Feeding of urea treated straw at both levels (2.5 and 5%) caused almost no change ($P>0.05$) in LW of wethers for 35 days, but from 35 to 42 days of the trial the LW of the sheep was improved at both urea levels. On all occasions, the live-weights of wethers fed with high soaked wheat straw (0.50:1) were greater than those fed with the low soaked treated straw (0.15:1).

***Keywords*—** wheat straw, live weight, soaking, urea, Wethers

I. Introduction

THEAT straw forms an important component of livestock rations in many countries such Libya. References [2] and [3] reported that advanced maturity in cereal straws is associated with high contents of detergent fibers, lignin and detergent insoluble N content and low N, which cumulatively depress feed intake.

While urea treatments have been known to improve the chemical utilisation of straws for ruminants, the extent of such improvement depended upon the amount of urea, method of its application and the type of a straw.

The alkali improves nutrient digestibility of low quality roughages through solubilisation of silica and weakening of bonds between lignin and cellulose [4]. The variability in the composition and digestibility of straw could be due to both varietals and environmental factors [5]. This study tested the effect of treating wheat straw with different amounts of water (soaking) alone and with different urea levels on the live weights of wether sheep consuming these treated straws together with fixed amounts of a concentrate.

II. Material and Methods

A. Experimental design

A 2 x 3 factorial design, in triplicate, was used to apply different urea and water levels to prepare treated wheat straws as follows. Water to represent 2water (soaking) to straw ratios (0.15:1 and 0.50:1) and 3 urea levels (0, 2.5 and 5% of straw). The feed grade urea contained 42 % nitrogen. Each treatment involved three identical silos.

B. Preparation of urea solutions

Low soaking ratio (0.15:1)

A: 0 urea +15 litres of water + 100kg straw= 0 urea + 27 litres of water +180kg straw.

B: 2.5kg urea+15 litres of water + 100kg straw = 4.5kg urea + 27 litres of water +180kg straw.

C: 5kg urea + 15 litres of water + 100 kg straw= 9kg urea +27 litres of water + 180kg straw.

High soaking ratio (0.50:1)

D: 0 urea + 50 litres of water + 100kg straw = 0 urea + 90 litres of water + 180kg straw.

E: 2.5kg urea + 50 litres of waters +100kg straw = 4.5kg urea + 90 litres of water + 180kg straw.

F: 5kg urea + 50 litres of water + 100kg straw = 9kg urea + 90 litres of water + 180kg straw.

The above mentioned amounts of 0, 4.5 and 9kg urea were mixed with either 27 litres of warm water for soaking (low soaking ratio), or with 90 litres of water for soaking 2 (high soaking ratio) and then the solutions were sprayed on 180kg wheat straw. Each concentration of urea solution was prepared separately in 100 litre plastic bins. The urea being used in this trial was urea prills of animal feed grade which were procured from *Chance & Hunt Limited* (*Alexander House, Crown Gate, Runcorn, Cheshire WA7 2UP*). The urea was accurately weighed in order to achieve the desired concentration of each treatment by using a digital scale. It

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was then transferred into plastic bins before a mixture of warm tap water was added and thoroughly mixed until the urea was totally dissolved. The purpose of the application of the warm water was to accelerate the dissolving of the urea.

C. Application of urea and storage of urea treated straw

The silos (black polyethylene bags) were placed in the galvanized welded metal mesh rings and the wheat straw was manually loaded from the truck into the silos (bags) by using fork. After certain amount of chopped straw was placed in the bags the water and the relevant urea solutions were sprayed, mixed with straw and compressed by feet to exclude air from the bag, (this process was repeated until the bags were fully filled). Once filled, all the treated bags were sealed by plastic clips and then several used car tyres were placed on the top of each silo. These tyres were used to provide protection and stability to the rings containing the treated straws against wind and predators. Samples of untreated wheat straw (untreated control) were taken for chemical analysis particularly for pH and dry matter content. The silos were stored for 10 weeks when the outdoor temperature remained around 12-15˚C. After a 10 week period, samples of wheat straw were collected from each silo for chemical analysis and sensory evaluation (colour, smell, and texture and mould growth). The fermentation characteristics of the material in the silos were also determined.

D. Animal housing and experimental design

Thirty six one year old Suffolk x Mule wethers were brought to Cockle Park farm. They were checked for general appearance and health, and treated with anthelemintic as described later. They were housed in the shed at the sheep unit in individual pens bedded with sawdust. The sheep were dewormed prior to the commencement of the experiment by injecting 1 ml of Ivomec subcutaneously. The Ivomec super (ivermectin and colorsuton) contained 1% w/v ivermectin and 10% w/v colorsulon. in a sterile solution (*Merial Animal Health Ltd P. O. Box 327. Sandringham House, Harlow Business Park. Harlow, Essex C M19 5T G, Batch No NB580400*). The shed was cleaned and cleansed by using disinfection prior to bedding and wether housing. The wethers were weighed and divided into six balanced groups according to their initial live-weights, and the animals were then allocated to the individual pens bedded with sawdust. Each treatment group was allocated into two different sides of the shed to ensure that all treatments were equally represented on the exposed and sheltered parts of the building, so no bias was introduced because of location in the building.

E. Feeding programme

The wethers were fed ad-libtum on treated straws for the first two weeks as an adaptation period, and then molasses (sugar cane) was introduced at 3% of dry matter of the treated straws for the rest of the trial to reduce dustiness and improve palatability of straws and to provide the wethers with extra source of energy. Sufficient quantities of the treated wheat straws were transferred by hand from the silos into big plastic barrels and then thoroughly mixed with molasses by fork, before these were offered to the sheep. Subsequently the straws were weighed in small tubs by using the digital scale and then placed in a big strong plastic container and thoroughly mixed with molasses by using a fork for 2 minutes until the straw and molasses were well mixed before, these were offered to the sheep. In-addition to the forage component of the diet. The wethers were fed 200g of concentrate and 20g mineral vitamin supplements, which comprised of 75% Ca, 5% P, 8% Na, 30mg/kg Se (Sodium selenite), 2,000 mg/kg Mn (as Manganous oxide), 175 mg/kg Co (as Cobalt carbonate), 200mg/kg I (as Calcium iodate), 3000 mg/kg Zn (as Zinc oxide), 300.000 IU/kg vitamin A, 60.000 IU/kg vitamin D3, 1.000 IU/kg vitamin E (as alpha Tocopherol acetate) and 2mcg/kg vitamin B12. The supplement contained no added copper and it was obtained from *Scotmin Nutrition Limited,* (*13 Whitfield Drive, Heathfield Industrial, Estate, Ayr*. *Product code: SZ1001*). The concentrates and mineral vitamin supplements were offered to the wethers twice a day where one portion of 110g (100g concentrate plus 10g vitamin mineral supplements) at 9 am and the other portion of 110g at 4 pm were offered to sheep for this trial period. The amount of concentrate which was offered to each wether was calculated to be sufficient to match its daily requirement. During the adaptation period the diet was monitored and some alteration was made due to large refusals of straw, therefore, the quantity of straw was reduced and compensated by a slight increase of concentrate to 200g. Thus the sheep received daily basal diet comprising of free choice of treated straws, molasses, 200g/head/day of concentrate plus 20g vitamin mineral supplements. The daily requirements for each wether were estimated according to the equations proposed by reference [1] and Pearson square to meet the requirements of a 40kg adult sheep. The individual pens were provided with holders for water buckets. The water buckets were emptied daily, brushed, rinsed, and refilled with fresh drinking water every morning and replenished again every afternoon.

F. Collection of straw samples and their refusals and spillage

Fresh samples of straw were collected when the silos were opened and immediately prepared for fermentation profiles study. Additional samples of straw and their refusals were collected daily and stored in labelled plastic bags for each week. In addition to that spillages were also collected daily from the bedding of the individual pens by hand. These spilled samples were sieved to remove faeces and sawdust before being stored in the labelled bags. At the end of each week the refusals and spillages were weighed together, recorded and 10% of the pooled weights were sub-sampled and oven dried at 60°C for 24h then subsequently ground through (2mm sieve) hammer mill and stored in labelled self sealed plastic bags for later analysis. For this purpose a random sample of each treated wheat straw was taken every day from each batch for six days and placed in labelled plastic self seal bags and kept in the refrigerator, pooled then thoroughly mixed, sub-sampled and dried in the oven at 60˚C for 24h then subsequently passed through (2mm sieve) hammer mill and stored in labelled air tight plastic bags to be used for chemical analyses.

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G. Live weight

Each wether was weighed and condition scored every week for six weeks of the trial according to the Meat and Live-stock Commission's guidelines (MLC).

H. Chemical analysis

The concentrates and wheat straw, faeces and refusals were analysed in duplicate for DM, OM, CP and EE according to the standard procedures [6]. ADF, NDF and ADL were analysed as described by references [7, 8] later modified by reference [9] omitting sodium sulphate and α amylase and the result were expressed inclusive of residual ash only for NDF analysis. Hemicellulose and cellulose were calculated from the data of NDF and ADF as suggested by reference [2]. Faecal and refusal samples were excluded from EE analysis. CP was determined by using LECO FP 428 Nitrogen determinator and the nitrogen content was converted by multiplying N by factor 6.25. Ammonia nitrogen (AN) analysis was conducted on the treated and untreated wheat straw and RF according to Cobas Mira clinical analyzer. VFAs of straws were estimated by using gas chromatography

I. Calculations

Total live weight gain (TLWG) = Final weight (kg) – Initial weight (kg)

Daily weight gain was obtained in two ways:

$$\text{Daily weight gain (DWG) g} = \frac{Total\ weight\ gain\,(g)}{No\,of\ days}$$

J. Statistical analysis

Calculations and statistical analyses were carried out for live weight gain by using Microsoft Excel (spreadsheet) and the Min-tab soft-ware package respectively. Analysis of variance was used to measure the effect of the treatments on live weight gain of sheep. Preliminary analysis of data by using general linear model. Normality test was applied on all data residual: All variables (soaking, urea and period) passed this test (*P>0.1*).

III. Results

Only the main effect of urea and soaking treatments on the mean weekly live-weights per weather are shown in figure 1 and 2 respectively. The graphs give an immediate impression of these treatments.

Feeding of urea treated straw at both levels (2.5 and 5%) caused almost no change (*P>0.05*) in LW of wethers for 35 days, but from 35 to 42 days of the trial the LW of the sheep was improved at both urea levels as shown in Figure 1. On all occasions, the live-weights of wethers fed with high soaked wheat straw (0.50:1) were greater than those fed with the low soaked treated straw (0.15:1). The differences between treatments for live-weights at different days were never statistically significant (*P>0.05*) during the 42 days of the trial. There was no significant interaction between soaking and urea in terms of live-weight of sheep during the 42 days of this trial (*P>0.05*).

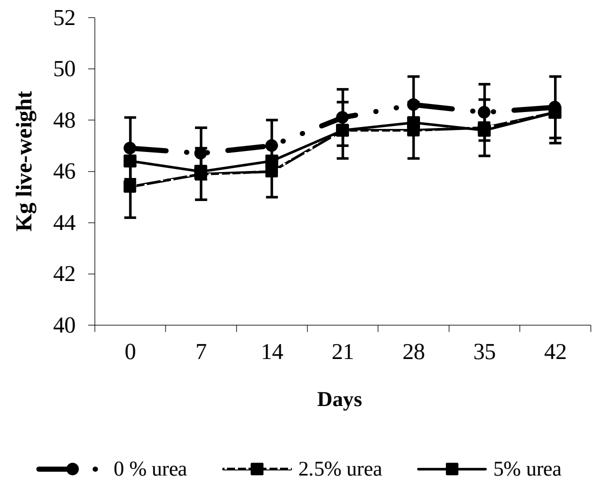

Fig. 1 Effect of urea levels on weekly live weight

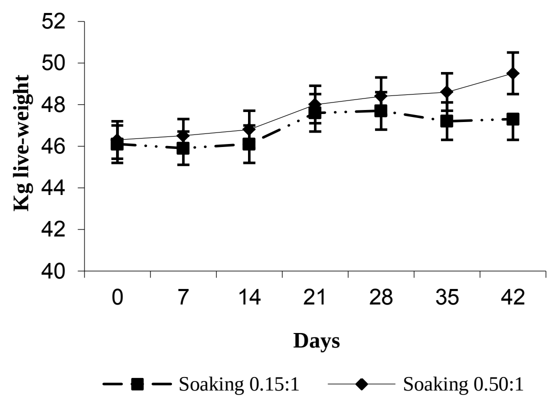

Fig. 2 Effect of soaking on weekly live weight

IV. Discussion

Urea treated straw at both levels (2.5 and 5%) showed a slight decreases in live-weight of the sheep during the 42 days of the trial, but they were not statistically significant. This result was perhaps expected, because of the initial size and maturity of the sheep. The sheep in the present study were well built, healthy, strong and perhaps had sufficient stores in their bodies, and therefore, sheep maintained their live weight even if they lost their appetite during the three middle weeks. The low feed intake may also be attributed to the presence of incompletely hydrolysed urea, which may had unpleasant affect on straw taste and so had undesirable effect on straw intakes by sheep as revealed by references [10]. The variable increase in dry matter intake of urea treated straws in this study during the three middle weeks was similar to other studies [11-14]. This may be due to the higher levels of ADF in urea treated straws which might have reduced their utilization by sheep in this study. The live weights of sheep in this study were insignificantly increased with high soaking during last two weeks of this study. Although there was slight response for high soaking ratio treatment, sheep maintained their live weight within the acceptable range and they were

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healthy and very strong appearance as shown with urea treated straws. . This could be related to the fibre fractions in the consumed soaked straw, which showed insignificant differences for both soaking ratios of the wheat straw and consequently were equally degraded and utilized by sheep, especially when sheep were offered equal amount of compensatory concentrates during the last two weeks, before they were slaughtered. Despite the lower total straw intake and slight increases of the live weight of high soaking ratio, the greater daily body weight gain of these sheep were perhaps an indication that these straws were better utilized by these sheep. Also this may be due to the phenomenon that the lower nutritive value feed has more efficiency of conversion as reported by reference [15].

V. Conclusion

Urea treatment could not significantly modify live-weight when the sheep were fed either with 2.5 or 5% urea treated straw during the 42 days of the trial. However, the live-weight of the wethers fed with high soaked straw (0.50:1) was slightly increased during 42 days of the trial. To optimise the combinations of urea treatment and soaking levels further studies are needed especially under warmer conditions. It would also help if relatively younger and but growing lambs are used over a much longer period (12 to 14 weeks) to observe the real benefit of similar treatments.

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