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**Research Article**

# Effect of Concentrate Supplementation on Urea Treated Wheat Straw Based Diets on Feed Intake, Weight Gain & Carcass Characteristics of Yearling Arsi-Bale Sheep

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**ABSTRACT**

The study was conducted on forty-eight male Arsi-Bale ram lambs having initial body weight of 18.85 kg body weight for 90 days to investigate the effect of different dietary treatments on growth performance and carcass characteristics of Arsi-Bale sheep breed. The treatments were (1) UTS (Urea treated straw) + 300g, (2) UTS + 400g, (3) UTS + 500g, (4) US + 100g, (5) US + 400g and (6) US + 500g of Concentrate supplement. All ram lambs were fed UTS and US adlibitum and supplemented with wheat middling and nougcake 1:1 ratio at different levels. Four lambs from each treatment groups were randomly selected and slaughtered for carcass evaluation. Total Dry matter (DM) intake was higher for urea treated straw compared to untreated straw fed group. The DM intake of urea treated straw and untreated straw excessively decreased ($p<0.001$) with increase in the level of supplementation. Treatment 3 had significant ($p<0.005$) effect on body weight, total weight gain, overall average daily gain. Treatment 3 had significantly ($p<0.05$) higher average daily weight gain (g) 101 than T1, T2, T4 and T5, but T3 had no significant ($p>0.05$) difference from T6. There were significant differences among treatments in hot carcass, thin cut, rib, hindquarter and foreleg, shoulder and neck. While loin, fore quarter, fat thickness, rib eye muscle area did not ($p>0.05$) differ among dietary treatments. In general, form the current study it was observed that as concentrate supplementation level increases daily weight gain also increase whether the basal diet was UTS or US. Findings from this experiment indicated that treatment of wheat straw was not statistically improved ($p>0.05$) the feeding value of wheat straw when it is delivered with 300 and 400 g supplementation of concentrate. In conclusion, supplementation of treated wheat straw (TWS) with a noug cake and wheat middling based concentrate at the rate of 300-400 gram for three months had no positive effect on the performances of Arsi-Bale sheep. Therefore, supplementation of urea treated wheat straw and supplementation of 500 g of wheat middling and noug cake concentrate have positive effect on the fattening performances of Aris-Bale ram lambs.

**Key words:** Urea treated straw, Arsi Bale lamb, weight gain, carcass characteristics

## INTRODUCTION

Livestock production is an integral part of the subsistence crop-livestock mixed farming systems of Ethiopian highlands, where crop & livestock production are closely integrated & complement each other (Gryseels and Anderson, 1983). The most important contribution of livestock to the farming system is not only as a source of draught power, manure & means of transportation to support the crop sector, but it is also diversifying household income sources through sales of meat and milk. Moreover, they serve as a capital asset, while crops provide livestock with feed in the form of crop residues & agro-industrial by products.

Crop residues are the major sources of ruminant feed in the high land crop-livestock mixed farming systems. In such systems, the grazing areas are limited because of expansion of cropping land for increased cereal crop production to feed the fast-growing human population. As more and more land is put under crop production, livestock feed becomes scarce and crop residues particularly cereal straws remain the major feed source for livestock, particularly during the dry seasons, providing about 40-50% of the annual livestock feed requirement (reference).

A total of 12-13 million tons of crop residues are estimated to be produced annually in Ethiopia (Seyoum & Zinash, 1998). Cereal straws & other crop residues have low nutrient content (crude protein, vitamins & minerals)

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and high crude fiber (40-45%). Cereal straws contain very low crude protein (4-5%) which is below the critical level of 7% dietary protein required for acceptable voluntary feed intake. As a result, intake is low (1-1.25 kg dry matter/100 kg live weight), digestibility is poor of the order of 30-45%, and low level of performance, (Smith, 1993).

There are a number of methods by which feeding values of straws can be enhanced: physical, chemical, biological treatments, supplementation, or the combination of 2 or more of the above. Different alkali treatments are being used to improve the nutritional value of crop residues at farm and industrial levels.

In recent years, considerable interest has been shown regarding the use of urea treatment. Improving nutritional value of straw through wet ensiling (for 10-30 days) with urea (4-5%) has been found applicable for practical use at present. Urea treatment is relatively easy to apply, simple and is effective with relatively lower cost. Furthermore, urea is non-toxic to animals when used at a dose 5% of DM of the ration, or lower. Apart from providing supplemental nitrogen, urea treatment increases the digestible energy & feed intakes by the animal.

Supplementation with agro-industrial by-products (oilseed cakes, wheat bran) rich in protein, energy, and minerals could be another option of improving the nutritional value of crop residues. The principal objective of supplementing cereal straws is either to optimize animal productivity through improved utilization of the straws by the animal or to meet requirements of the animal for production. The amount of supplement is generally small, and is intended to provide by-pass protein and to establish favorable rumen environment in order to optimize microbial growth for efficient fiber digestion.

Because of economic implications, limited supplementation of fibrous residue diets utilizing local feed ingredients is now considered as appropriate technology of feeding ruminants in the tropics.

Any method of improving crop residues must be economically viable to be acceptable to the farmer i.e. enhanced animal productivity resulting from the improvement in straw quality must be reliable and must justify the cost of treatment.

**Objectives:**

- To measure the voluntary intake of urea-treated (UT) wheat straw
- To measure the body weight performance of lambs on a high or low concentrate mixture fed along with UT wheat straw, respectively
- To measure the carcass performance of lambs fed a high or low concentrate mixture along with UT wheat straw, respectively.

## MATERIALS AND METHODS

**Animal and feeding management:** A total of 48 yearling Arsi-Bale male lambs with an average weight of 18.9 kg were purchased from the local market around Asella. All sheep were ear-tagged and treated against internal & external parasites before the start of the experiment. The sheep were stratified in to 6 groups based on their body weight & randomly assigned in to one of the six treatment combinations.

**Treatment Diets:** Three hundred grams, 400g and 500g noug cake and wheat middling were supplemented on both treated and untreated straw fed groups. Eight sheep were assigned in an individual pen.

All experimental sheep were kept in-door & experimental diets were offered twice daily in individual feeding pen throughout the feeding period. Concentrate mixture were offered prior to straw feeding and all sheep have access to fresh water ad libitum. The experiment had two weeks of acclimatization period and an actual feeding period of 90 days.

A concentrate mixture made up of wheat bran & noug cake was prepared in equal (1:1) proportion. Straw was treated with a urea solution prepared from 40 g of urea per kg of air-dried straw (Ibrahim and Schiere, 1989) dissolving it in one litter of water. The straw was treated, well trampled, compacted and airtight until end of treatment period (21 days). Then straw was taken off the plastic bag, ventilated and fed to sheep daily. Wheat straw that was used as a basal diet was purchased after wheat harvest at Kulumsa.

**Data collection and analysis:** Feed refusals were weighed, recorded, and subtracted from feed offered to establish total feed intake. Animals were weighed at the beginning, at the end, and fortnightly (at 7-day interval) after overnight fasting for at least 12 hours. At the end of the feeding period, half of the animals in each treatment group were slaughtered for carcass evaluation after an overnight fasting for at least 12 hours & the rest were sold in the nearby market.

Feed samples (urea treated and concentrate mixture) were collected weekly (every 7 days) before feeding the animals and composited for each ration before analysis.

**Carcass evaluation:** Four animals from each treatment groups were randomly selected and slaughtered for carcass evaluation at the end of experimental period. The animals were slaughtered following the standard procedures of USDA (1982). The bodies were skinned; the heads and feet were removed. The carcasses were eviscerated and the internal organs and tissues were weighed. All body components such as head and tongue, feet with hooves, tail, skin, kidneys, liver with bile, heart, lungs and trachea, spleen, testicles, full and empty gut were weighed. Kidneys fat, abdominal fat were also weighed using sensitive balance. Full live weight, empty live weight, hot carcass weight, and hot dressing percentage were determined.

The carcass was cut between $12^{th}$ and $13^{th}$ ribs to measure rib eye area (REA) with calibrated waterproof paper. The thickness of fat along the surface of rib eye area was measured using ruler. Dressing percentage was calculated according to hot carcass weight and pre-slaughter live weight.

The data were subjected to analysis of variance procedures for complete randomized design CRD (Steele and Torrie, 1980). Least Significant Difference (LSD) was used to determine differences between means using R software.

**Feed sample analysis:** The chemical composition of treated and untreated wheat straw as well as the concentrate diet was analyzed. Representative feed samples were collected each time and prepared for analysis at the end of the experiment. Chemical analysis was conducted by the National Veterinary Institute (NVI), Debrezeit, Ethiopia. Crude fiber, Dry matter, Nutrient free extract, Ether extract and Ash were determined using proximate procedures (Mueller 2004). Nitrogen was determined according to Kjeldhal procedure and crude protein calculated as N x 6.25.

**Composition of experimental feed:** Chemical compositions of untreated and urea treated wheat straw samples are indicated in Table 1. Urea treatment increased the CP and CF content of the straw from 6.53% to 9.29% and from 36.37% to 37.53%, respectively. The C fat and ash content increased from 1.12% to 1.23% and from 8.75% to 10.03% respectively.

## RESULTS AND DISCUSSION

**Weight gain, feed intake and feed conversion efficiency:** In the current study the responses in body weight gain, intake and feed efficiency to treated straw and levels of supplementation were not significant ($p<0.05$). The sheep which received the urea treated straw with 1:1ratio of 500g noug cake and wheat middling of supplement were judged to be a little fattened for slaughter than sheep fed un treated straw with same level of supplement but results were not statistically significant than the control group. In literature, the use of UTS as a ruminant feed has been performed with ruminants in many research reports (Firew et al. 2005) sheep fed with sole urea treated wheat straw consumed greater (566 g/day) and gained body weight of 10.7 g/day also recorded positive weight gain of 14 g/day in sheep fed urea treated wheat straw. Joy et al. (1992) has reported that different treatments caused an increase in total nitrogen content and a decrease in neutral detergent fiber content as well as a significant effect on the digestibility of the organic matter (DOM) in the straw. The differences in intake of UTS and US might have been expected to be greater, however from the present result no significant difference ($p>0.05$) was observed in intake between treated and untreated straw. Supplementation with low level (300g/d) of concentrate promoted more intake of urea treated and untreated wheat straw. However, supplementation of high level (500g/d) concentrate decreased the DM intake of treated and untreated wheat straw but it increases the total dry matter intake. Thus, greater body weight gains in the high level of concentrate-supplemented group might be related to more nutrient supply from both the basal diet and supplement (Table 3).

On the other hand, Hadjipanayiotou et al. (1993) stated that even if animals depend on urea treated crop residues perform better than those on untreated crop residues, animals continued to be on negative nutrient balance. Likewise, Abebe (2008) reported that sheep fed only urea treated rice straw lost 4.3 g body weight per day. Animut et al. (2002) reported that supplementation of urea to wheat straw and plus casein to ammoniated WS did not result in intake of DM and OM in a diet based on urea+NaOH in goats.

The highest ($p<0.05$) FCE (0.11 and 0.10) was recorded for sheep supplemented with high level of concentrate 500g supplementation as compared to other treatment groups. The increased feed conversion efficiency for highly supplemented group could be partly contributed by better CP intake. As indicated by Pond et al. (1995), the improved feed conversion efficiency may also be due to the relatively higher nutrient consequent increase in body weight gain showing that diets that promote a high rate of gain will usually result in a greater efficiency than diets that do not allow rapid gain, since the rapidly gaining animals utilize less of the total feed intake for maintenance and more of it for live weight gain.

**Carcass characteristics:** The carcass parameters of Arsi bale sheep as obtained in the present study are presented in (Table 4). In the current study the responses in carcass parameters to treated straw and to levels of supplement were not statistically significant ($p>0.05$). However, Sheep fed urea treated straw with 300g, 400g and 500g of noug cake and wheat middling mix supplementation has higher values of hot carcass weight and dressing percentage than sheep fed untreated straw with 300g, 400g and 500g of noug cake and wheat middling mix supplementation. The hot carcass weight and dressing percentage increase with increasing level of concentrate mix supplementation. In agreement with the current study, both Michael and Yayneshet (2014) and Gemeda et al. (2007) reported higher carcass parameters obtained for treatments under the highest level of feeding (250 and 400 g/day concentrate mix) of Tigray highland and Horro sheep compared to those treated under lower feeding levels, respectively. However, no significant difference was observed between sheep fed treated and untreated wheat straw with same level of concentrate supplementation in all carcass parameters. No significant ($p>0.05$) difference was observed on fat thickness, rib eye-muscle area among all treatment groups.

Feeding of Arsi-Bale male young sheep with treated wheat straw and supplementation of higher levels of concentrate (500 g/h/d) had better carcass, gain (total and daily) and dressing percentage compared to animals from treatment 4 and 5 (feeding of Arsi-Bale sheep with untreated wheat straw with supplementation of low to medium levels of concentrate (300 and 400 g/h/d).

The effect of experimental diets on the carcass cuts of sheep is shown in (Table 5). There were no ($p>0.05$) significant differences in weight yield of wholesale cuts sheep fed treated and untreated wheat straw with equal amount of concentrates supplementation. However, there were significant differences ($p<0.05$) among treatments 4 and 3 in thin cut, ribs, foreleg shoulder neck. Loin and leg weight were not significantly different ($p<0.05$) among all treatment groups.

**Non-edible offal:** There is no significant difference at $p<0.05$ in fore-feet, hind-feet, lung and trachea viscera full spleen, among treatments, however, treatment 3 has significant higher skin weight than treatment 6 at $p<0.05$ and higher spleen weight were recorded in treatments 5, 6 and 2 than treatments 1, 3 and 4.the result is described in (Table 6).

**Conclusion:** This study was conducted to determine the effect of urea treated wheat straw with different levels of concentrate on body weight change and carcass characteristics of Arsi bale sheep. Results of this study suggested that supplementation of urea treated wheat straw with Noug cake and Wheat middling of higher amount (500 g) had significant effect on most parameters like final body weight, carcass weight, dressing percentage, intakes and

**Table 1:** Treatment combinations and ingredients used

| Ingredients | Treatment groups | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| Treated straw | ad libitum | ad libitum | ad libitum | - | - | - |
| Untreated straw | - | - | - | ad libitum | ad libitum | ad libitum |
| Concentrate supplement, g/day | 300 | 400 | 500 | 300 | 400 | 500 |

**Table 2:** Nutritional analysis of dietary groups

| Type of sample | DM% | MM% | CF% | CP% | CFat% |
|---|---|---|---|---|---|
| Concentrate feed | 90.75 | 5.64 | 6.18 | 32.13 | 7.78 |
| Treated straw | 70.47 | 10.03 | 37.53 | 9.29 | 1.23 |
| Untreated straw | 97.12 | 8.75 | 36.37 | 6.53 | 1.12 |

CP= crude protein; DM= dry matter; CF= Crude fiber; CFat= Crude fat

**Table 3:** Least square means of performance and intake of Arsi Bale sheep fed experimental diets

| Item | Diet | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| Average initial weight (kg) | $18.85^{a}$ | $18.87^{a}$ | $18.91^{a}$ | $18.91^{a}$ | $18.91^{a}$ | $18.91^{a}$ |
| Average final weight (kg) | $26.82^{ab}$ | $27.1^{ab}$ | $28.35^{a}$ | $25.94^{b}$ | $25.7^{b}$ | $26.82^{ab}$ |
| Average live daily gain (g) | $78.6^{bc}$ | $90.4^{b}$ | $101.8^{a}$ | $68.2^{c}$ | $76.5^{bc}$ | $86.5^{ab}$ |
| Total live weight gain (Kg) | $7.07^{bc}$ | $8.14^{ab}$ | $9.16^{a}$ | $6.13^{c}$ | $6.88^{bc}$ | $7.78^{ab}$ |
| Straw intake (gm) | $353.86^{a}$ | $281.19^{abc}$ | $251.51^{bc}$ | $316.69^{ab}$ | $223^{bc}$ | $219^{c}$ |
| Concentrated intake (gm) | $299.77^{d}$ | $299.3^{c}$ | $499.4^{a}$ | $299.9^{d}$ | $399.3^{c}$ | $496^{b}$ |
| Total | $652.72^{a}$ | 680ab$^{abc}$ | $750^{a}$ | $616.69^{c}$ | $622.31^{bc}$ | $715^{ab}$ |
| FCE | $0.092^{bc}$ | $0.095^{b}$ | $0.11^{a}$ | $0.074^{c}$ | $0.099^{ab}$ | $0.10^{ab}$ |
| Hot carcass weight (kg) | $10.67^{ab}$ | $11.1^{ab}$ | $11.72^{a}$ | $9.76^{bc}$ | $10.02^{bc}$ | $10.47^{ab}$ |
| Dressing percentage (%) | $39.7^{abc}$ | $40.9^{ab}$ | $41.28^{ab}$ | $37.63^{c}$ | $38.8^{bc}$ | $39.09^{bc}$ |

$^{abc}$ = means with different superscripts in a rows are significantly different; 1= Tstraw+300 concentrate, 2= Tstraw+400 concentrate, 3= Tstraw+500 concentrate, 4= UT straw+ 300 concentrate, 5= UTstraw+400 concentrate, 6= UTstraw+500 concentrate

**Table 4:** Least square means of carcass parameter of Arsi Bale sheep fed experimental diets

| Item | Diet | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| Heart (g) | $115^{ab}$ | $122.5^{ab}$ | $140^{a}$ | $120^{ab}$ | $102.5^{b}$ | $127.5^{ab}$ |
| Liver (g) | $328.75^{abc}$ | $360^{ab}$ | $355^{abc}$ | $295^{bc}$ | $276.25^{c}$ | $310^{abc}$ |
| Kidney (g) | $62.5^{ab}$ | $58.8^{ab}$ | $62.5^{ab}$ | $57^{b}$ | $55^{b}$ | $62.5^{ab}$ |
| V-empty (kg) | $0.65^{a}$ | $0.7^{a}$ | $0.70^{a}$ | $0.71^{a}$ | $0.64^{a}$ | $0.75^{a}$ |
| Tail weight (g) | $615^{ab}$ | $471.3^{b}$ | $763.8^{a}$ | $579^{ab}$ | $486.3^{b}$ | $767.5^{a}$ |
| Abdominal fat (g) | $108.8^{a}$ | $77.5^{a}$ | $92.5^{ab}$ | $66^{ab}$ | $46.3^{ab}$ | $70^{ab}$ |
| Kidney fat (g) | $20^{a}$ | $35^{a}$ | $43.75^{a}$ | $32^{a}$ | $26.25^{a}$ | $32.5^{a}$ |
| Head and tongue (kg) | $3.56^{ab}$ | $1.82^{a}$ | $1.85^{a}$ | $1.6^{ab}$ | $1.63^{ab}$ | $1.68^{a}$ |
| Fat thickness left (cm) | $0.5^{ab}$ | $0.6^{a}$ | $0.47^{ab}$ | $0.5^{ab}$ | $0.35^{ab}$ | $0.55^{ab}$ |
| Fat thickness righ(cm) | $0.55^{ab}$ | $0.75^{ab}$ | $0.37^{ab}$ | $0.5^{ab}$ | $0.45^{ab}$ | $0.62^{a}$ |
| Rib_Eye_muscle area, left (mm) | $111.75^{a}$ | $103.75^{a}$ | $119.5^{a}$ | $98.8^{a}$ | $109.5^{a}$ | $106.3^{a}$ |
| Rib eye muscle area, right (mm) | $110.5^{a}$ | $115.3^{a}$ | $119.5^{a}$ | $97.2^{a}$ | $95.25^{a}$ | $104.25^{a}$ |

$^{abc}$ = means with different superscripts in a rows are significantly different; diet 1= Tstraw+300 concentrate, 2= Tstraw+400 concentrate, 3= Tstraw+500 concentrate, 4= UT straw+ 300 concentrate, 5= UTstraw+400 concentrate, 6= UTstraw+500 concentrate

**Table 5:** Least square means of carcass cuts of sheep fed experimental diets

| Item | Diet | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| Thin cut (g) | $540^{abc}$ | $596.25^{ab}$ | $635^{a}$ | $494^{bc}$ | $470^{bc}$ | $603.75^{ab}$ |
| Rib (kg) | $2.1^{ab}$ | $2.25^{ab}$ | $2.27^{a}$ | $1.92^{b}$ | $2^{ab}$ | $2.1^{ab}$ |
| Lion (kg) | $772.5^{a}$ | $795^{a}$ | $783^{a}$ | $692^{ab}$ | $713.75^{ab}$ | $758.75^{a}$ |
| Leg (kg) | $3.57^{ab}$ | $3.72^{a}$ | $3.77^{a}$ | $3.32^{ab}$ | $3.45^{ab}$ | $3.35^{ab}$ |
| F_Leg_Sholder_& neck | $3.28^{bc}$ | $3.6^{ab}$ | $3.87^{a}$ | $3.18^{bc}$ | $3.3^{ab}$ | $3.2^{bc}$ |

$^{abc}$ = means with different superscripts in a rows are significantly different;diet 1= Tstraw+300 concentrate, 2= Tstraw+400 concentrate, 3= Tstraw+500 concentrate, 4= UT straw+ 300 concentrate, 5= UTstraw+400 concentrate, 6= UTstraw+500 concentrate

**Table 6:** Least square means of non-edible offal parts of Arsi Bale sheep fed experimental diets

| Item | Diets | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| Fore-feet | $285^{a}$ | $265^{a}$ | $292.5^{a}$ | $258^{a}$ | $255^{a}$ | $252.5^{a}$ |
| Hind-feet | $252.5^{a}$ | $280^{a}$ | $272.5^{a}$ | $260^{a}$ | $252.5^{a}$ | $252.5^{a}$ |
| Testicles | $245^{bc}$ | $337.5^{a}$ | $312.5^{ab}$ | $248^{bc}$ | $272.5^{ab}$ | $332.5^{a}$ |
| Skin weight | $2.2^{ab}$ | $2.1^{abc}$ | $2.2^{a}$ | $1.96^{abc}$ | $2.05^{abc}$ | $1.9^{bc}$ |
| Lung and trachea | $353.75^{a}$ | $307.5^{a}$ | $391.3^{a}$ | $324^{a}$ | $312.5^{a}$ | $317.5^{a}$ |
| Spleen | $40^{b}$ | $50^{ab}$ | $45^{ab}$ | $45^{ab}$ | $56.3^{a}$ | $53.3^{ab}$ |
| Viscera full | $4.17^{a}$ | $4.42^{ab}$ | $4.42^{ab}$ | $4.6^{ab}$ | $4.87^{a}$ | $5.07^{a}$ |

$^{abc}$ = means with Different superscripts in a rows are significantly different; diet 1= Tstraw+300 concentrate, 2= Tstraw+400 concentrate, 3= Tstraw+500 concentrate, 4= UT straw+ 300 concentrate, 5= UTstraw+400 concentrate, 6= UTstraw+500 concentrate feed conversion efficiency over sheep fed on untreated wheat straw (300 and 400 g) concentrate supplementation. However, there is no different effect on the sheep fed untreated wheat straw supplemented with high level of concentrate (500 g). The results of the present study suggest that the urea treatment of straws is simple, but it was attractive when it was given with higher amount (500g) of concentrate supplementation.

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