Global Veterinaria 13 (1): 75-82, 2014
ISSN 1992-6197

DOI: 10.5829/idosi.gv.2014.13.01.84235

# Nutritional Evaluation of Some Halophytic Plants by Range Animals (Sheep and Goats)

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**Abstract:** *Acacia saligna* and *Brassica nigra* hay (Leaves and stems) were evaluated for nutritive potential (Chemical composition and digestibility characteristics) using eighteen adult animals (9 mature male local sheep averaged 40 kg weight and 9 mature male Baladi goats averaged 30 kg weight) which were divided according to experimental rations into three groups within animal species. Animals of group R1 were fed on berseem hay (BH) with barley grains as control, the animals in group R2 and group R3 fed on *Acacia saligna* hay (ASH) or *Brassica nigra* hay (BNH) with barley grains, respectively. Berseem hay was used for comparison and barley grains were offered to cover 50% of maintenance requirements for sheep and goats, while the tested experimental plants hay were offered *ad lib*. The results showed that values of CP for shrub species tested plants were 13.46 and 12.85%, while CF and ADL were 35.25, 12.59 and 30.45, 6.40% for *A. saligna* and *B. nigra*, respectively compared with 11.80, 34.89 and 11.25% for berseem hay, respectively. Phytochemical screening (Anti-nutritional factors) of the three tested plants showed that *A. saligna* had higher contents of most of the anti-nutritional factors (Saponins, alkaloids, flavonoids, tannins and coumarins) than those detected in both berseem hay and *B. nigra* hay. The average daily DM intake for sheep and goats from tested plants only were 17.28 and 20.78 g/kg w $^{0.75}$, respectively compared with 31.98 for those fed berseem hay. Nutrients digestibility of brassica hay ration was better ( $P< 0.01$) than the other two rations containing berseem hay and acacia hay. These results reflected the nutritive values of all rations, therefore the brassica hay recorded higher DCP and TDN values than acacia hay and nearly similar values with berseem hay. All rations by sheep and goats recorded positive N. balance, sheep and goats those were fed brassica hay recorded the highest ($P< 0.01$) nitrogen balance value followed by those fed acacia hay then those fed berseem hay. The results indicated that sheep and goats fed *Acacia saligna* recorded the lowest values for pH, ammonia nitrogen and total volatile fatty acids compared with those fed berseem hay and *Brassica nigra*, respectively. It can be concluded that *A. saligna* and *B. nigra* hay supplemented with barley grains can be successfully used in feeding both sheep and goats.

**Key words:** *Acacia saligna* · *Brassica nigra* · Berseem Hay · Chemical Composition · Anti-Nutritional Factors · Digestibility · Nutritive Value · Sheep and Goats

## INTRODUCTION

Dry regions in Egypt suffer from a chronic shortage of fodder crops production due to several environmental factors, particularly salinity stress in soils and ground water. Bedouins spend a considerable amount of money to buy and transport other feed ingredients from the Nile valley region, which puts an additional burden on the economic situation of Bedouins and have an impact on the feed gab in the new valley area. The vegetative yields of halophytes and other salt-tolerant plants species could have great potentialities particularly as sources of livestock fodders [1].

Feeding halophytes is a feasible solution to minimizing the problem of feed shortage in developing countries, where desert represent high percentage of the total area, therefore, proper range management and utilization of halophytes as an animal feed should have

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the priority of the development plan. Efforts have been directed to identify the most critical problems of livestock nutrition in native range lands and the prospects for better solution [2].

A major advantage of browses over herbaceous legumes and grasses is their higher crude protein content. However, due to the presence of secondary plant metabolites (particularly tannins) in browse, digestibility of protein and organic matter in these feeds is low [3].

The objective of this work is to evocate the performance of sheep and goats fed some halophytic plants (*Acacia saligna* and *Brassica nigra*) comparison with berseem hay.

## MATERIALS AND METHODS

This study was conducted at Nubaria Experimental Farm, El-Bostan, Behaira Governorate and Laboratories of Animal Production Department, National Research Center, Giza, Egypt.

**Halophytic Plants and Hay Making:** Succulent twigs of *Brassica nigra* and *Acacia saligna* shrubs naturally grown in Nubaria desert area were used in this study. Hay made by chopping succulent parts (Leaves and stems) of the two plants which were air dried separately on thin plastic sheet to avoid mechanical losses or sand contamination.

**Experimental Animals and Management:** Nine mature male local sheep (40 kg) and 9 mature male Baladi goats (30 kg) were divided according to experimental rations into three groups within animal species (3 animals of each). They used to evaluate nutrients digestibility, feeding value, nitrogen utilization and some ruminal parameters of *Brassica nigra* and *Acacia saligna* hay and berseem hay (*Trifolium alexandrinum*) (BH) rations. The BH was used as control roughage. Crushed barley grains were offered to cover 50% of the maintenance requirements for sheep [4] and goats [5], while tested forages were offered *ad-lib*. Drinking fresh water was available for all experimental animals.

Animals were kept in pens and fed on their rations for three weeks as adaptation period. During this period, the animals were fed gradually to avoid any adverse effect, then they were kept individually in wooden metabolic crates for 15 days as a preliminary period followed by 7 days for total faeces and urine collection. Faeces and urine were collected once daily at 07:00. The animals were usually offered their diet once daily at 08:00. Residual rations if any were daily weighed and represented samples of rations offered and residues were taken for DM determination. At the end of each digestion trial, rumen liquor samples were taken from each animal before feeding (zero) and 4 hrs. Post feeding, then filtrated. Values of ruminal pH were immediately measured after sampling by the digital combination electrode pH meter.

**Chemical Analysis:** Proximate analysis for feed ingredients, faeces and urine was determined according to AOAC [6] methods. The cell wall constituents (Neutral detergent fiber, NDF; acid detergent fiber, ADF and acid detergent lignin, ADL) were estimated according to the method of Goering and Van Soest [7]. Hemicellulose and cellulose values were calculated by difference. The qualitative phytochemical screening of some anti-nutritional factors in different tested hay was carried out and expressed by signs as negative (-), weakly positive (+), positive (++) or strongly positive (+++). Tannins and alkaloids were detected according to Wall *et al*. [8], glycosides according to Vogel [9], sterols and/or triterpens according to Schmidt [10] and flavonoids according to Willstartter [11].

The concentration of ammonia-nitrogen and total volatile fatty acids in the rumen liquor were determined according to Conway and O"Malley [12] and Warner [13].

**Statistical Analysis:** The obtained data from this study was statistically analyzed using SAS [14]. Differences among means were examined using multiple range tests according to Duncan [15].

## RESULTS AND DISCUSSION

**Chemical Analysis:** The chemical composition and cell wall constituents of the two tested range plants compared to berseem hay are presented in Table (1). The data showed that *Acacia saligna* hay and *Brassica nigra* hay were comparable in CP content (13.46 and 12.85%), respectively. These values were higher than berseem hay (11.80%). The herein results agreed with the findings of Wardeh *et al*. [16], who found that the preferred plant species of the desert range contained 8.54 to 14.89% crude protein, such a high protein content would satisfy most of the protein requirement of consuming animals to performer their physiological function. The CF content in *A. saligna* was higher (35.25%) than that found in *B. nigra* (30.45%), while berseem hay contained 34.89% which were similarly with found in *A. saligna*. These results agreed with that obtained by Abd

Table 1: Chemical analysis and cell wall constituents of berseem hay, acacia hay, brassica hay and barley grains.

| | Experimental plants | | | |
|---|---|---|---|---|
| Item | BH | ASH | BNH | BG |
| Chemical analysis (%) on DM basis: | | | | |
| Organic matter | 88.14 | 84.30 | 87.25 | 96.90 |
| Crude protein | 11.80 | 13.46 | 12.85 | 10.50 |
| Crude fiber | 34.89 | 35.25 | 30.45 | 9.80 |
| Ether extract | 4.07 | 4.65 | 3.28 | 2.50 |
| Nitrogen free extract | 37.38 | 30.94 | 40.67 | 74.10 |
| Ash | 11.86 | 15.70 | 12.75 | 3.10 |
| Cell wall constituents (%) on DM basis: | | | | |
| NDF | 38.47 | 49.48 | 40.57 | 26.60 |
| ADF | 20.50 | 30.45 | 26.25 | 8.10 |
| ADL | 11.25 | 12.59 | 6.45 | 2.30 |
| Hemicellulose* | 17.97 | 19.03 | 14.32 | 18.50 |
| Cellulose** | 9.25 | 17.86 | 19.80 | 5.80 |

BH = Berseem hay ASH = Acacia hay BNH = Brassica hay BG = Barley grains

* Hemicellulose = NDF - ADF

** Cellulose = ADF – ADL

Table 2: Phytochemical screening (Anti-nutritional factors) of the experimental plants

| | Experimental plants | | |
|---|---|---|---|
| Item | Berseem hay | Acacia hay | Brassica hay |
| Saponins | - | + | - |
| Alkaloids | - | + | + |
| Flavonoids | - | ++ | - |
| Sterols | ++ | + | - |
| Tannins | - | +++ | - |
| Coumarins | + | ++ | - |

- Not detected + slightly ++ moderate intense +++ high intense

El-Rahman *et al*. [2], who found that the desert plants contained fluctuation values of CF which ranged between 14.05 and 37.9%. The tested plants showed moderate content of ether extract (EE). The desert plants contain moderate values of EE which ranged from 1.5 to 4.4% as reported by Abd El-Rahman *et al*. [2]. The two tested plants showed highest values of ash content compared with berseem hay. The high content of ash might be due to their high content of salt which could be predicted from the high Na and Cl contents [17, 18]. All desert shrubs had Na concentration significantly different among species [2].

The tested plants also contained fluctuated values of NDF, ADF and ADL, however, *B. nigra* contained the lowest value of ADL (6.45%) compared with other plants, while the highest value was found in *A. saligna* (12.95%). In this connection, Abd El-Rahman *et al*. [2] found that the values of ADL in different range plants ranged between 3.5 and 12.0%.

**Phytochemical Screening (Anti-nutritional Factors):** Results of qualitative phytochemical screening (Anti-nutritional factors) are presented in Table 2. Qualitative analysis could be a reliable indicator to the presence and concentration of these secondary metabolites. Anti-nutritional factors expressed by (-, +, ++ and +++) signs, it indicated that *B. nigra* and berseem (*Trifolium alexandrinum*) hay showed lowest detected contents expressed as (- and +) signs. Meanwhile, *A. saligna* showed the different contents ranged from + to +++ signs. The herein findings are in line with the cited literature [2, 19, 20]. In addition, the results indicated that *A. saligna* contained highly intense of tannins, however, the berseem hay and *B. nigra* hay were free. Tannins reduce voluntary feed intake and digestibility of protein and carbohydrate by inhibiting digestive enzymes and by altering the permeability of the gut wall [21]. Also, tannins may reduce bacterial enzymes and/or forming indigestible complex with cell wall carbohydrates [22]. While, the other two tested plants showed lowest detected contents expressed as - and + signs.

**Feed Intake:** The dry matter consumed of both whole rations and hay alone by the different animal species are illustrated in Table 3. The mean values of dry matter intake (DM) by sheep and goats were 24.02 and 22.67 g/kg $w^{0,75}$, respectively.

Regardless to animal species, the DM intake from berseem hay in ration or alone was higher than the two tested plants. The DM intake of tested plants varied within 17.28 to 20.78 g/kg $w^{0,75}$. However, *A. saligna* hay showed the lowest DM intake compared with the other plants which might be due to high content of tannins (+++), which caused reduce of voluntary feed intake [21, 23], who found that high level of tannins depress feed intake, digestibility of protein and carbohydrates and animal performance. Also, *A. saligna* contained other some anti-nutritional factors like saponins, alkaloids, flavonoids, sterols and coumarins. On the other hand, some researchers showed that there is a significant negative correlation usually exists between anti-nutritional factors and forage lignin contents and either DM intake or nutrients utilization [24-28]. In the present study *A. saligna* hay showed higher ADL content than *B. nigra* hay.

**Digestion Coefficients and Nutritive Values:** The results of digestion coefficients and nutritive values of the experimental rations are presented in Table 4. The average

Table 3: Daily dry matter intake of the experimental rations for sheep and goats.

| Item | Experimental rations | | | Mean±SD |
|---|---|---|---|---|
| | Berseem hay (R1) | Acacia hay (R2) | Brassica hay (R3) | |
| | Dry matter intake (g/head/day) | | | |
| Hay | | | | |
| Sheep | 489.32±35.16 | 300.55±42.01 | 355.80±26.25 | 381.89±89.34 |
| Goats | 425.53±21.03 | 200.85±21.79 | 245.61±5.89 | 290.66±136.07 |
| Mean±SD | 457.43 [a] ±25.92 | 250.70 [c] ±62.33 | 300.71 [b] ±63.00 | |
| Sig. | | | | ** |
| | | Barley | | |
| Sheep | 282.61 | 282.61 | 282.61 | 282.61 |
| Goats | 236.15 | 236.15 | 236.15 | 236.15 |
| Mean±SD | 259.38± | 259.38 | 259.38 | |
| Sig. | | | | - |
| Total | | | | |
| Sheep | 771.93±28.16 | 583.16±35.01 | 638.41±38.34 | 664.50±89.06 |
| Goats | 661.68±19.94 | 437.00±17.94 | 481.76±33.72 | 526.81±137.70 |
| Mean±SD | 716.81 [a] ±32.89 | 510.08 [c] ±84.05 | 560.09 [b] ±91.94 | |
| Sig. | | | | ** |
| | Dry matter intake (g/kg w $^{0.75}$) | | | |
| Hay | | | | |
| Sheep | 30.76±2.21 | 18.89±2.64 | 22.40±1.88 | 24.02±5.62 |
| Goats | 33.19±1.64 | 15.67±1.70 | 19.16±0.46 | 22.67±10.63 |
| Mean±SD | 31.98 [a] ±4.49 | 17.28 [c] ±2.66 | 20.78 [b] ±2.22 | |
| Sig. | | | | ** |
| | | Barley | | |
| Sheep | 17.76 | 17.76 | 17.76 | 17.76 |
| Goats | 18.42 | 18.42 | 18.42 | 18.42 |
| Mean±SD | 18.09 | 18.09 | 18.09 | NS |
| Sig. | | | | - |
| Total | | | | |
| Sheep | 48.52±1.77 | 36.65±2.20 | 40.16±2.41 | 41.78±5.60 |
| Goats | 51.61±1.55 | 34.09±1.40 | 37.58±2.63 | 41.09±1069 |
| Mean±SD | 50.07 [a] ±4.72 | 35.37 [c] ±2.17 | 38.8 [b] 7±2.66 | |
| Sig. | | | | ** |

a, b and c: Means at the same row with different letters are significantly (P<0.01) different.

NS: Non significant.

**: Significant at 1% level of probability.

values of DM digestibility by the two animal species regardless to rations were 66.55 and 67.23% for sheep and goats, respectively. Regardless of animal species, the results showed that *B. nigra* recorded the highest (P<0.01) DM digestibility than the other tested plants. The DM digestibility of the tested rations ranged between 56.97 to 74.54% for acacia hay and brassica hay, respectively, compared with 69.16% for berseem hay.

The OM digestibility was taken the same trend of DM digestibility. The crude protein digestibility (CPD) of rations by the two animal species showed that goats recorded the highest (P<0.05) value than sheep (61.19% vs. 58.89%), respectively. Regardless of animal species, acacia hay recorded lowest (P<0.01) value (49.48%) than the other tested rations (63.39 and 67.24% for berseem hay and brassica hay, respectively). The low CPD of acacia hay might be due to the *Acacia saligna* had high tannins content than the other two tested plants (Table 2). High content of tannins depress feed intake and digestibility of protein and carbohydrates and animal performance [23].

Concerning crude fiber digestibility (CFD), the results showed that regardless to rations, the average values of CFD by sheep and goats were nearly the same. These results agreed with those obtained by Abd El-Rahman *et al*. [29], who found that CFD by sheep and goats fed the different desert forages were nearly the same.

Table 4: Digestion coefficients and nutritive value of the experimental rations fed for sheep and goats

| Item | Experimental rations | | | Mean±SD |
|---|---|---|---|---|
| | Berseem hay (R1) | Acacia hay (R2) | Brassica hay (R3) | |
| | Apparent digestibility (%): | | | |
| DM | | | | |
| Sheep | 67.71±0.53 | 56.62±5.20 | 75.31±73.53 | 66.55±6.51 |
| Goats | 70.60±2.35 | 57.31±1.16 | 73.77±1.24 | 67.23±8.25 |
| Mean±SD | 69.16 [b] ±2.20 | 56.97 [c] ±3.66 | 74.54 [a] ±1.73 | |
| Sig. | | | | ** |
| OM | | | | |
| Sheep | 68.41±1.09 | 57.07±1.14 | 74.13±1.07 | 66.54±7.58 |
| Goats | 70.96±1.39 | 58.75±0.8 | 76.23±1.73 | 68.65±7.85 |
| Mean±SD | 69.69[b]±1.79 | 57.91[c]±1.23 | 75.18[a]±1.73 | |
| Sig. | | | | ** |
| CP | | | | |
| Sheep | 62.54±0.71 | 48.84±0.23 | 65.29±1.16 | 58.89±7.66 |
| Goats | 64.25±1.40 | 50.13±1.78 | 69.20±1.54 | 61.19±8.68 |
| Mean±SD | 63.40[b]±1.36 | 49.48[c]±1.34 | 67.24[a]±2.46 | |
| Sig. | | | | ** |
| CF | | | | |
| Sheep | 60.25±1.1 | 61.78±1.37 | 59.28±1.32 | 60.44±1.55 |
| Goats | 61.73±1.47 | 61.58±1.27 | 60.72±0.93 | 61.34±1.18 |
| Mean±SD | 60.99[ab]±1.42 | 61.68[a]±1.19 | 60.00[b]±1.29 | |
| Sig. | | | | NS |
| EE | | | | |
| Sheep | 65.83±1.38 | 61.92±1.83 | 64.63±1.11 | 64.13±2.15 |
| Goats | 67.65±1.35 | 62.95±0.15 | 68.61±0.86 | 66.40±2.02 |
| Mean±SD | 66.74±2.47 | 62.44±1.29 | 66.62±2.33 | |
| Sig. | | | | NS |
| NFE | | | | |
| Sheep | 71.58±0.92 | 65.47±1.08 | 73.21±1.71 | 70.09±3.70 |
| Goats | 78.47±0.87 | 68.55±0.85 | 75.47±0.72 | 74.16±4.46 |
| Mean±SD | 75.02[a]±3.86 | 67.01[b]±1.90 | 74.34[a]±1.71 | |
| Sig. | | | | ** |
| | Nutritive value (DM basis,%): | | | |
| TDN | | | | |
| Sheep | 64.07±0.70 | 59.69±0.52 | 64.45±1.22 | 62.73±2.42 |
| Goats | 68.11±1.22 | 61.77±1.01 | 66.74±0.41 | 65.54±3.00 |
| Mean±SD | 66.09[a]±2.37 | 60.73[b]±1.37 | 65.59[a]±1.49 | |
| Sig. | | | | ** |
| DCP | | | | |
| Sheep | 7.10±0.31 | 5.68±0.37 | 7.89±0.34 | 6.89±1.01 |
| Goats | 7.35±0.27 | 5.83±0.32 | 0.43± | 8.03 7.07±1.14 |
| Mean±SD | 7.23[a]±0.28 | 5.76[b]±0.32 | 7.96[a]±0.43 | |
| Sig. | | | | ** |

a, b and c: Means at the same row with different letters are significantly (P<0.01) different.

NS: Non significant.

**: Significant at 1% level of probability.

Data of ether extract digestibility (EED) showed that the average values of EED for the rations fed by the two animal species ranged between 62.44 to 66.74%. Regardless to plant species, the average values of EED for sheep and goats were 64.13 and 66.40%, respectively. Regardless of animal species, data of EED of the experimental rations indicated that *B. nigra* rations recorded nearly similar value of berseem hay ration and both rations had higher values than acacia hay ration. These results disagree with those obtained by Wardeh [30] who found that desert forages have high EE content owing to their high wax and essential oil content,

Table 5: Nitrogen utilization for sheep and goats fed the experimental rations

| Item | Experimental rations | | | Mean±SD |
|---|---|---|---|---|
| | Berseem hay (R1) | Acacia hay (R2) | Brassica hay (R3) | |
| | Nitrogen, mg/kg w $^{0.75}$ | | | |
| Nitrogen intake: | | | | |
| Sheep | 881.12±8.62 | 682.57±3.02 | 776.21±1.94 | 779.97±86.14 |
| Goats | 937.24±4.91 | 634.15±2.46 | 726.35±2.25 | 765.91±105.51 |
| Mean±SD | 909.18$^{a}$±31.37 | 658.36$^{c}$±139.50 | 751.28$^{b}$±27.40 | |
| Sig. | | | | ** |
| | Fecal nitrogen: | | | |
| Sheep | 515.51±5.26 | 286.40±2.75 | 419.53±2.72 | 407.15±87.89 |
| Goats | 510.55±3.8 | 273.11±2.86 | 416.09±2.59 | 399.92±111.75 |
| Mean±SD | 513.03$^{a}$±25.0 | 279.76$^{c}$±7.70 | 417.81$^{b}$±3.03 | |
| Sig. | | | | ** |
| | Urinary nitrogen: | | | |
| Sheep | 305.61±3.09 | 315.40±1.8 | 247.60±3.15 | 289.54±39.99 |
| Goats | 295.15±4.45 | 255.10±3.05 | 198.78±2.52 | 249.68±50.50 |
| Mean±SD | 300.38$^{a}$±11.72 | 285.25 $^{b}$ ±33.10 | 223.19$^{c}$±26.88 | |
| Sig. | | | | ** |
| | Nitrogen balance: | | | |
| Sheep | 60.00±1.65 | 80.77±2.27 | 109.08±3.38 | 83.28±21.45 |
| Goats | 91.54±1.66 | 105.94±3.74 | 111.46±2.26 | 102.98±9.21 |
| Mean±SD | 75.77$^{c}$±17.33 | 93.36$^{b}$±14.06 | 110.27$^{a}$±2.88 | |
| Sig. | | | | ** |

a, b and c: Means at the same row with different letters are significantly (P<0.01) different.

**: Significant at 1% level of probability.

therefore, it have low EE digestibility. Goats recorded highest (P<0.05) value of nitrogen free extract digestibility (NFED) was 74.16% vs. 70.09% for sheep. Regardless animal species, berseem hay rations recorded the highest (P<0.01) NFE digestibility followed by *B. nigra* hay rations.

Data of the nutritive values expressed as TDN and DCP are presented in Table 4. Most nutrients digestibility of *B. nigra* ration were higher (P<0.01) than the other rations containing berseem and acacia. These results reflected on the nutritive values, so the *B.nigra* hay recorded significant higher values than acacia hay and insignificant higher values than berseem hay.

**Nitrogen Utilization:** Data of nitrogen utilization expressed for sheep and goats are presented in Table 5. The mean values of N intake recorded for two animal species were 779.97 and 765.91 mg/kg w$^{0.75}$ for sheep and goats, respectively. The highest (P< 0.01) values of N intake regardless to animal species were recorded with berseem hay ration followed by *B. nigra* hay ration, while, the lowest value recorded with *A. saligna* hay ration. The high N intake which was recorded with berseem hay might be due to the high protein content and high DM intake of berseem hay. There was no significant difference among animal species in fecal nitrogen, however, sheep exerted more fecal N than goats (407 vs. 400 mg/kg w$^{0.75}$, respectively). Also, goats showed the lower value of urinary nitrogen than sheep (250 vs. 290 mg/kg w $^{0.75}$, respectively). The mean values of daily nitrogen retention were 83.28 and 102.98 mg/kg w$^{0.75}$ for sheep and goats, respectively. These results indicated that goats can utilize the desert plants better than sheep. These results were in agreement with those obtained by Abd El-Rahman *et al*. [29] and Abd El-Rahman [31] who found that goats can utilize the halophytic plants better than sheep. Regardless to animal species, animals fed the two desert plants hay had higher (P<0.01) N retention than those fed berseem hay.

**Rumen Liquor Parameters:** Results in Table 6 showed that the lowest ruminal pH values recorded for animals fed acacia either before feeding or at 4 hrs post feeding compared with those fed the other two rations. Sheep had lower values than goats at the two sampling times. These results agreed with those reported by Abd El-Rahman *et al*. [29] who found that goats showed higher pH values than sheep when given halophytic plants.

Concerning the concentration of ruminal ammonia-N, goats showed higher values either at zero time or 4 hrs post feeding compared with sheep. Regardless of animal species the highest values were recorded with berseem

Table 6: Rumen liquor parameters of sheep and goats fed the experimental rations

| | Experimental rations | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Before feeding | | | | 4 hrs post feeding | | | |
| Item | BH (R1) | ASH (R2) | BNH (R3) | Mean±SD | BH (R1) | ASH (R2) | BNH (R3) | Mean±SD |
| | | | | pH: | | | | |
| Sheep | 6.53±0.3 | 5.52±0.21 | 5.53±0.38 | 5.86±0.57 | 6.10±0.24 | 5.87±0.42 | 6.75±0.50 | 1.406.24± |
| Goats | 6.70±0.2 | 5.86±0.26 | 6.95±0.03 | 6.50±0.52 | 6.82±0.36 | 5.95±0.06 | 6.97±0.03 | 6.58±0.51 |
| Mean±SD | $6.62^{b}$±0.25 | $5.69^{c}$±0.28 | $6.24^{a}$±0.81 | | $6.46^{a}$±0.17 | $5.91^{b}$±0.27 | $6.86^{a}$±0.33 | |
| Sig. | | | | ** | | | | ** |
| | | | | NH3(mg/100ml): | | | | |
| Sheep | 16.10±0.25 | 11.24±0.23 | 17.25±0.30 | 14.86±2.77 | 23.68±0.93 | 17.40±0.15 | 23.35±0.20 | 21.48±3.10 |
| Goats | 17.24±0.46 | 13.76±0.51 | 18.10±0.35 | 16.37±2.03 | 25.12±0.23 | 20.17±0.52 | 24.85±0.90 | 23.38±2.47 |
| Mean±SD | $16.67^{b}$±0.71 | | $12.50^{c}$±1.42 | $17.68^{a}$±0.55 | | $24.40^{a}$±0.99 | $18.79^{b}$±1.55 | $24.10^{a}$±1.00 |
| Sig. | | | | ** | | | | ** |
| | | | | TVFA·s (meq/100ml): | | | | |
| Sheep | 5.55±0.30 | 4.97±0.13 | 7.20±0.35 | 5.91±1.03 | 11.15±0.30 | 9.85±0.58 | 14.15±0.40 | 11.72±1.95 |
| Goats | 7.25±0.10 | 5.48±0.33 | 8.10±0.45 | 6.94±1.19 | 11.63±0.38 | 10.27±0.28 | 16.55±0.40 | 12.82±2.88 |
| Mean±SD | $6.40^{b}$±0.95 | $5.23^{c}$±0.35 | $7.65^{a}$±0.61 | | $11.39^{b}$±0.40 | $10.06^{c}$±0.46 | $15.35^{a}$±1.36 | |
| Sig. | | | | ** | | | | ** |

a, b and c: Means at the same row with different letters are significantly (P<0.01) different.

**: Significant at 1% level of probability.

hay and *B. nigra* hay rations at the two sampling times compared with *A. saligna* hay ration. These results may be related to lower CP digestibility recorded for *A. saligna* hay ration compared with the other two rations (Table 4).

The mean values of ruminal TVFA's were 5.91and 6.94 ml eq./100 ml before feeding for sheep and goats, respectively then reach to 11.72 and 12.82 ml eq./100 ml at 4 hrs post feeding, respectively. Similar results have been reported by Mohamed [17] and Abd El-Rahman *et al*. [29] who found that goats recorded high values of ruminal TVFA's than sheep when received desert plants. Bhattia and Ghosal [32] found that TVFA's production is related to many factors such as physical characteristics, chemical composition of feed, feeding frequency, watering and climatic conditions.

Regardless of animal species, animals fed *B. nigra* hay ration recorded highest TVFA's values compared with those given other rations.

The depression in ammonia-N and TVFA's in acacia ration, may be due to the high content of tannins and other anti-nutritional factors compared with brassica and berseem hay (Table 2). In this connection, Reed [23] stated that high content of tannins depress feed intake and digestibility of protein and carbohydrates. This explanation show clearly in feed intake (Table 3), protein and other nutrients digestibility (Table 4) and in nitrogen balance (Table 5).

From these results, it is recommended that to improve the native range species as well as to cultivate some of high potential shrubs, making hay of succulent parts of less palatable species with other feed ingredients will increase the quality and quantity of feed resources.

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