Research Article

# Effect of Alfalfa Hay Replacement with giant reed on Growth Performance, Nutrient Digestibility and Blood Metabolites of Ardi goats in Arid Subtropics

**Shaker B. Al Suwaiegh**

*Animal and Fish Production Department, Agriculture and Food Sciences College, King Faisal University, Al-Hassa, KSA.*

**Abstract** | Nutritional ingredients have been known to effect on ruminant animal performances. The present study aimed to investigate the effects of replacement alfalfa hay with giant reed on nutrients digestibility and growth performances and serum biochemistry of goats in arid subtropics. Twenty-four goats average 29.70 ± 1.17 kg body weight (BW) were randomly distributed over four groups. The goats were fed four diets composed of 50.0% concentrates and 50.0% forages. The four diets formulated according to replacement of alfalfa hay with giant reed were control alfalfa hay diet (T1; 50.0% alfalfa hay) and giant reed rations (T2 20.0% alfalfa hay and 30.0% giant reed; T3 10.0% alfalfa hay and 40.0% giant reed; T4 50.0% giant reed). Nutrients digestibility, body weight, physiological parameters and serum metabolites were investigated during the study. The results indicated that the diets with high percentage of giant reed (40.0 & 50.0%) were decreased (P<0.05) the most recorded parameters compared to the control and 30.0% giant reed diets under subtropical condition. In conclusion, replacement of alfalfa hay with 30.0% giant reed could be promising of Ardi goat growth performances, feed efficiency and serum metabolites.

**Keywords** | Giant reed, Digestibility, Growth, Metabolites

**Received** | August 28, 2023; **Accepted** | September 20, 2023; **Published** | October 12, 2023
***Correspondence** | Shaker B. Al Suwaiegh, Animal and Fish Production Department, Agriculture and Food Sciences College, King Faisal University, Al-Hassa, KSA; **Email:** shaker@kfu.edu.sa
**Citation** | Al Suwaiegh SB (2023). Effect of alfalfa hay replacement with giant reed on growth performance, nutrient digestibility and blood metabolites of ardi goats in arid subtropics. Adv. Anim. Vet. Sci. 11(10): 1751-1756.
**DOI** | http://dx.doi.org/10.17582/journal.aavs/2023/11.10.1751.1756
**ISSN (Online)** | 2307-8316



## INTRODUCTION

Meat and milk production is necessitated for 3rd world countries and their economic prosperity. Hence, feeding ruminant animal requirements and supplements are significant for maintaining meat and milk production and animal health (Al-Suwaiegh 2023; Mohammed and Al Suwaiegh 2016, 2023), especially the countries suffer from the problem of lack of rangeland (Mohammed et al., 2021; Ali et al., 2021; Al-Mufarji et al., 2022, 2023; Al-Mufarji and Mohammed 2022; Vasmara et al., 2023). Country of KSA is considered one of the countries that suffer from the scarcity of animal feed. In 2018, the KSA Minister Council prevented cultivation of green fodder to conserve groundwater resources. Hence, finding novel green fodder that can give the nutrient animal requirements would maintain meat and milk production and animal health.

Alfalfa hay is one of the world's most popular forages and is characterized by its high palatability and high nutritional value (Al Suwaiegh, 2023). For small livestock breeders, feeding alfalfa hay is economically costly because of the fluctuations of its prices during the seasons of the year,

which poses a challenge for animal breeders to buy these feed. Traditional feeds are widely used by animal production projects, while many small animal breeders have difficulty to buy traditional feeds because of the high prices of the feed. Thus, incorporating non-traditional feed ingredients can offer various benefits in terms of nutrition, sustainability, and cost-effectiveness and will enhance the continuity of animal production projects and reduce the costs of animal feeding. One of these unconventional plants is common reed (giant reed), a large perennial rhizomatous grass, which grows in large quantities in drains in many countries of the world.

Common reed is characterized by rapid growth and growing in wide range of environmental conditions. The plant is about 2 to 4 m tall and it is widely distributed in drains, brackish and alkaline waters (Marks et al., 1994). Majchrzak (1992) and Sun et al. (2008) showed that common reed is a good quality forage when consumed in the beginning of the growth for livestock, goats and horses. Alfalfa hay could be partially replaced by common reed for ruminants (Baran et al., 2002). Therefore, the aims of this study were to investigate the effects of replacement alfalfa hay with giant reed on nutrient digestibility, physiological and serum metabolite parameters for Ardi goats in subtropics.

## MATERIALS AND METHODS

The present study procedures were approved by the ethical committee of King Faisal University [KFU – REC-2023-MAR-EA0100]. The current study was conducted at Training and Research Station at KFU in Al-Ahsa, Saudi Arabia from March to May, 2023 with an average 29.0 °C temperature and 36.0% relative humidity.

### Harvesting Common Reeds And Analysis

The common reed was harvested from water drains spread around farms of Al-Ahaa Governorate in the Kingdom of Saudi Arabia. The CR was transferred to a farm and sun-dried. After drying was completed, the plant was cut to 1-2 cm length. The common reeds were dried at 65.0°C for 24:0h, ground and milled to 1.0 mm. The composite common reeds samples were dried for 3:0h at 105.0°C. The chemical analysis of crude protein, crude fiber, acid detergent fiber (ADF) and neutral detergent fiber (NDF), and ash (A.O.A.C.-994.10) were determined according to procedures of A.O.A.C. (1995).

### Experimental Design And Animals

Ardi goats (twenty-four) with an average weight of 29.7 ± 1.17 kg body weight (BW) kg and 3-5M of age were selected and distributed to four groups for the study. The chemical compositions of common reed (CR) and the diets of experiment were determined before starting the experiment. The control and CR diets were isocaloric and isonitrogenous and formulated according to NRC (2007). The animals were fed rations consisted of 50.0% forages and 50.0% concentrates (Table 1). All feed ingredients involve the concentrates and forages in each treatment were mixed thoroughly and the experimental diets were transferred to a pelleting machine to form pellet feeds. The diameter of the pellets ranged between 4-6 millimeters. The prepared pellet was sun dried for three-days and stored before starting of the trial. The chemical compositions of the CR, alfalfa hay and experimental rations are presented in Table 2. All goats were vaccinated against the main diseases and deworming as of Veterinary Sector Guidance before the starting of the experiment to ensure that they were free of diseases.

### Growth Trial

A total of twenty-four growing goats were assigned randomly to four treatments. Animals were placed and fed in individual metabolic crate and the trial lasted 12 weeks. The control group received a diet containing 50% alfalfa hay and 50% concentrate feed. Goats in-group 2 fed a diet containing 30% CR and 50% concentrate feed while groups 3 and 4, 40% and 50% of CR were substituted by alfalfa hay, respectively, and the concentrate feed was 50%. All groups fed diet once a day at 7 a.m. in the morning and the feed refusal were weighted every day before feeding the animals to determine intake of dry matter. Daily feed intake for each animal was recorded during the study, as the difference between the offered and refused ration.

### Blood Samples' Collection And Analyses

Samples of blood (3) were collected monthly from the control and the three giant reed groups. Blood serum were obtained upon centrifugation of obtaining blood samples and analyzed through chemistry analyzer (Skyla VB1). The obtained parameters of serum include total protein, albumin, globulin, glucose, urea, minerals and enzymes (Al-Mufarji et al., 2023).

### Physiological Parameters

Rectal temperatures, pulse rate, oxygen partial pressure were measured as thermal responses using digital thermometer (Citizen CTA-303), pulse oximeter and heart rate apparatus (CMS60D) (Mohammed et al., 2023).

### Statistical Analysis

Values of diets chemical composition, nutrient digestibility physiological and serum chemistry parameters of control (50.0% alfalfa hay) and giant reed treated goats (30.0, 40.0 & 50.0% giant reed) are shown as mean. The values of control and giant reed groups were analyzed using the General Linear Model (G.L.M.) procedure of S.A.S. (2008) according to the model: Yij = μ + Ti+ Eij; Yij=Observation,

**Table 1:** Ingredients of experimental ration

| Parameters | Treatments | | | |
|---|---|---|---|---|
| | T1 | T2 | T3 | T4 |
| Alfalfa hay | 50 | 20 | 10 | 0 |
| Common Reed | 0 | 30 | 40 | 50 |
| Wheat bran | 3.2 | 17.9 | 18.2 | 30.8 |
| Barley | 41.2 | 26.6 | 25.2 | 12.6 |
| Soybean meal | 1.9 | 1.83 | 2.9 | 2.9 |
| Dicalcium phosphate | 2.0 | 2.0 | 2.0 | 2.0 |
| Limestone | 1.0 | 1.0 | 1.0 | 1.0 |
| Salt | 0.6 | 0.6 | 0.6 | 0.6 |
| Vit and Min Premix | 0.1 | 0.1 | 0.1 | 0.1 |

T1; 50% Alfalfa hay
T3; 20% Alfalfa hay, 30% giant reed
T2; 10% Alfalfa hay, 40% giant reed
T4; 50% giant reed

**Table 2:** Chemical composition of ingredients used during the study

| Parameters | Treatments | | | |
|---|---|---|---|---|
| | T1 | T2 | T3 | T4 |
| Dry matter | 88.77 | 90.26 | 90.76 | 91.24 |
| Crude protein | 14.50 | 14.23 | 14.38 | 14.76 |
| Total digestible nutrients | 65.30 | 65.00 | 65.62 | 64.81 |
| Fat | 2.19 | 2.67 | 2.74 | 3.09 |
| Ash | 6.12 | 7.60 | 7.95 | 8.79 |
| Crude fiber | 18.05 | 18.95 | 18.69 | 19.19 |
| Neutral detergent fiber | 35.15 | 43.56 | 45.19 | 50.22 |
| Acid detergent fiber | 22.64 | 23.51 | 23.48 | 24.43 |
| Calcium | 1.43 | 1.65 | 1.48 | 1.56 |
| Phosphorus | 0.65 | 0.78 | 0.69 | 0.72 |

T1; 50% Alfalfa hay
T3; 20% Alfalfa hay, 30% giant reed
T2; 10% Alfalfa hay, 40% giant reed
T4; 50% giant reed

**Table 3:** Effect of giant reed feeding on digestibility coefficient of different nutrients and nutritive values of Ardi goats

| Item | Treatments | | | | | |
|---|---|---|---|---|---|---|
| | T1 | T2 | T3 | T4 | SEM | P Value |
| No. animals | 6 | 6 | 6 | 6 | | |
| Initial BW, (kg) | 29.8 | 29.4 | 30.0 | 29.7 | 1.17 | 0.95 |
| Final BW, (kg) | 40.08$^{a}$ | 39.26$^{a}$ | 38.34$^{ab}$ | 37.66$^{b}$ | 1.48 | 0.95 |
| Nutrients digestibility coefficient, % | | | | | | |
| DM | 73.08$^{a}$ | 67.67$^{b}$ | 60.43$^{c}$ | 57.77$^{c}$ | 1.85 | 0.05 |
| OM | 77.32$^{a}$ | 71.56$^{b}$ | 65.42$^{c}$ | 62.03$^{c}$ | 1.79 | 0.04 |
| CP | 74.01$^{a}$ | 70.76$^{ab}$ | 68.83$^{b}$ | 66.10$^{b}$ | 1.07 | 0.05 |
| CF | 68.58$^{a}$ | 57.87$^{b}$ | 53.48$^{b}$ | 48.95$^{c}$ | 2.23 | 0.02 |
| NDF | 74.13$^{a}$ | 66.89$^{b}$ | 53.31$^{c}$ | 49.53$^{c}$ | 3.03 | 0.01 |
| ADF | 81.57$^{a}$ | 59.44$^{b}$ | 50.22$^{c}$ | 48.08$^{c}$ | 3.72 | 0.03 |
| EE | 71.85 | 70.06 | 72.16 | 72.76 | 0.41 | 0.93 |

| | | | | | | |
|---|---|---|---|---|---|---|
| NFE | 85.04 | 80.60 | 85.20 | 84.73 | 0.65 | 0.93 |
| Nutritive values, % | | | | | | |
| TDN | 74.38[a] | 68.33[b] | 62.12[c] | 59.31[c] | 1.78 | 0.03 |
| DCP | 10.73[a] | 10.05[b] | 9.91[b] | 9.72[b] | 0.14 | 0.02 |

[a, b, c]; Values with the different superscripts in the same row differ at P<0.05.
T1= 50% Alfalfa hay; T2 = Mixture of 20% Alfalfa hay and 30% Giant Reed; T3= Mixture of 10% Alfalfa hay and 40% Giant Reed; T4 = 50% Giant Reed
DM dry matter, OM organic matter, CP crude protein, CF crude fiber, NDF neutral detergent fiber, ADF acid detergent fiber, EE ether extract, NFE none free extract, Ca calcium, P phosphorus.

**Table 4:** Effect of giant reed on physiological and serum parameters of Ardi goats

| Item | Treatments | | | | | |
|---|---|---|---|---|---|---|
| | T1 | T2 | T3 | T4 | SEM | P Value |
| No. animals | 6 | 6 | 6 | 6 | | |
| Physiological parameters | | | | | | |
| Pulse rate/min | 138.0 | 134.33 | 133.0 | 137.67 | 4.43 | 0.03 |
| Partial pressure of oxygen, SPO2 | 95.67[a] | 94.00[a] | 91.00[ab] | 89.67[b] | 1.62 | 0.03 |
| Rectal temperature, °C | 39.37 | 39.33 | 39.40 | 39.30 | 0.12 | 0.10 |
| Serum parameters | | | | | | |
| Total protein, g/dl | 7.60 | 7.60 | 7.60 | 7.50 | 0.16 | 0.08 |
| Albumin g/dl | 3.80 | 3.73 | 3.83 | 3.77 | 0.03 | 0.06 |
| Globulin g/dl | 3.80 | 3.87 | 3.77 | 3.73 | 0.16 | 0.07 |
| Glucose mg/dl | 66.33[a] | 53.67[b] | 54.0[b] | 42.0[c] | 2.36 | 0.02 |
| Blood urea nitrogen, mg/dl | 16.97[d] | 18.97[c] | 21.13[b] | 24.10[a] | 1.09 | 0.01 |
| Urea, mg/dL | 36.30[d] | 40.60[c] | 45.23[b] | 51.57[a] | 2.35 | 0.001 |
| Creatinine, mg/dL | 0.96[c] | 1.08[b] | 1.09[b] | 1.15[a] | 0.046 | 0.001 |
| Calcium, mg/dl | 8.97[b] | 9.80[a] | 9.37[a] | 9.30[a] | 0.14 | 0.02 |
| Phosphorus, mg/dl | 11.33 | 11.43 | 11.67 | 11.70 | 0.48 | 0.93 |
| Sodium, mmol/L | 143.67 | 149.67 | 148.0 | 145.33 | 1.48 | 0.02 |

[a, b, c, d]; Values with the different superscripts in the same row differ at P<0.05.
T1= 50% Alfalfa hay; T2 = Mixture of 20% Alfalfa hay and 30% Giant Reed; T3= Mixture of 10% Alfalfa hay and 40% Giant Reed; T4 = 50% Giant Reed

μ = Mean, Ti = Treatment effects, Eij= Standard error. Duncan's multiple range test was used to compare between means of the control and giant reed groups for statistical significance (P<0.05).

## RESULTS AND DISCUSSION

The current study shown chemical composition of giant reed and its feeding effects on digestibility coefficient, growth performance, and serum metabolites of Ardi goats in subtropical conditions (Figure 1 & Tables 1-4). Giant reed compared to alfalfa hay contains protein (13.0 & 16.54%), crude fiber (29.2 & 29.7%), ether extract (2.1 & 2.8%), none free extract (40.86 & 42.4%) and ash (3.89%) (Figure 1) as indicated in other studies (Baran et al., 2002; Sun et al., 2008; Al Suwaiegh et al., 2023; Mohammed et al., 2023). This composition of giant reed might support nutrient digestibility, growth performance, and body health.

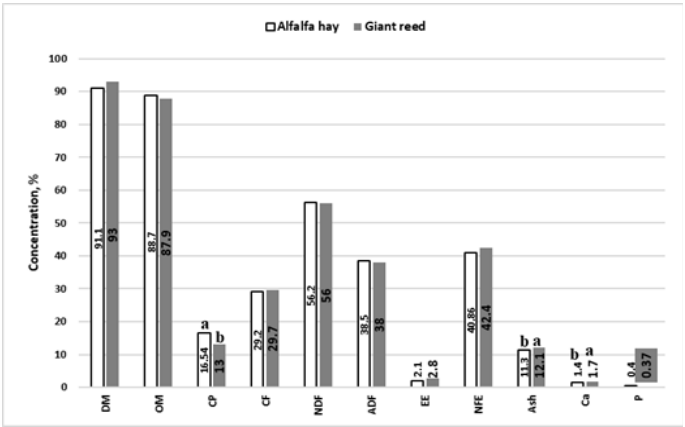


**Figure 1:** Chemical composition of alfalfa hay and giant reed
DM dry matter, OM organic matter, CP crude protein, CF crude fiber, NDF neutral detergent fiber, ADF acid detergent fiber, EE ether extract, NFE none free extract, Ca calcium, P phosphorus. [a,b] Significant (P < 0.05).

### Digestibility Coefficient And Body Weight Gain

The ingredients and chemical compositions of rations fed during the current study were shown isocaloric and isonitrogenous (Table 1 & 2). The effects of feeding giant reed diets (T2, T3 & T4) compared to alfalfa hay control diet (T1) on digestibility coefficient and body weight are shown in Table (3). The dry matter, organic matter and nutritive values were highest ($P < 0.05$) in T1 control group (50.0% alfalfa hay) followed by T2 (20.0 alfalfa hay & 30.0% giant reed), T3 (10.0 alfalfa hay & 40.0% giant reed) and T4 (50.0% giant reed) groups, respectively (Table 3). The same trend was found in final BW (Table 4). The effects of giant reed on feed utilization and digestibility coefficient and body weight gain were obtained in previous studies (Baran et al., 2002; Sun et al., 2008). The increasing negative effects of giant reed (30.0, 40.0 & 50.0%) on nutritive digestibility coefficients and nutritive values could be owing to low protein content, calcium and phosphorus imbalances compared to alfalfa hay (Figure 1). Such negative effects of giant reed on nutritive digestibility coefficients and nutritive values and body weight gain might be elevated upon increasing the replacement level (≤ 30.0%) in the diet in addition to increasing the plant age.

### Physiological Parameters And Serum Biochemistry Profiles

Physiological parameters (PR, SPO2 & RT) and serum profiles of control and giant reed groups are shown in Table (4). The PR and RT parameters were not differed between control and giant reed groups whereas SPO2 parameter decreased ($P < 0.05$) in T4 compared to other groups. The values of serum fell within the normal range for healthy goats (Mohammed and Kassab 2015; Al Suwaiegh, 2023). In addition, the results indicated unchanged of total protein, albumin globulin, phosphorus and sodium among groups. On the other hand, glucose values were deceased ($P < 0.05$) whereas blood urea nitrogen, urea, creatinine and calcium values were increased in groups of giant reed compared to control group.

Physiological parameters, serum metabolite and mineral values are an indicative of body health in ruminant animals. The negative effects ($P < 0.05$) of giant reed on PO2, glucose, blood urea nitrogen, urea, creatinine and calcium values might be due to factors as low percentage of protein and minerals imbalances (Figure 1), low nutrient digestibility coefficient and nutritive values (Table 3) compared to alfalfa hay. In addition, the calcium values were higher in giant reed groups when compared to control alfalfa hay group due to high content of calcium in giant reed (Figure 1). Collectively, decreasing the level of giant reed replacement (≤) in the diet leads to an improvement in the function of the digestive tract and liver resulting to increase in nutrient digestibility, growth performance, and serum biochemistry of Ardi goat in subtropical conditions.

## CONCLUSIONS

The chemical composition properties of giant reed in the current study showed low protein level and calcium and phosphorus imbalances. Furthermore, this study showed that ≤ 30.0% giant reed daily feeding to Ardi goats resulted in comparable results with 50.0% alfalfa hay feeding on feed utilization through modulating serum biochemistry and physiological parameters. Moreover, further studies could be recommended on less than 30.0% giant reed feeding of growing stages to authenticate their possible application on body function and metabolism.

## ACKNOWLEDGEMENTS

This work was supported by the Deanship of Scientific Research, Vice Presidency for Graduate Studies and Scientific Research, King Faisal University, Saudi Arabia [Grant No. 4248]

## CONFLICT OF INTEREST

No conflict of interest to declare for author.

## NOVELTY STATEMENT

Replacement of alfalfa hay with giant reed (≤ 30.0%) could supply nutrient requirements to growing Ardi goats.

## AUTHOR'S CONTRIBUTION

The author designed the experiment, wrote, prepared tables and figures and submit MS.

## REFERENCES

Al Mufarji A, Al Suwaiegh S, Mohammed AA (2023). Influence of Organic Moringa oleifera leaves Supplemented during Gestation and Lactation periods: Modulation of Production Efficiency, Blood and Metabolic Parameters of Ewes and Lambs in Subtropics. Adv. Anim. Vet. Sci., 7(1): 385-393. https://doi.org/10.17582/journal.aavs/2023/11.3.385.393

Al-Mufarji A, Mohammed AA (2022). Organic Moringa oleifera leaves chemical composition and fatty acid profiles and its effect on modulation of blood and plasma parameters of ewes in subtropics. Adv. Anim. Vet. Sci., 10(6): 1227-1232 https://doi.org/10.17582/journal.aavs/2022/10.6.1227.1232

Al-Mufarji A, Mohammed AA, Al-Masruri H, Al-Zeidi R (2022). Effects of dietary microalgae supplementation on mammals' production and health. Adv. Anim. Vet. Sci., 10(8):1718-1724. https://doi.org/10.17582/journal.aavs/2022/10.8.1718.1724

AL-Suwaiegh S (2023). Effect of Feeding Green Microalgae and *Bacillus subtilis* on Growth Performance, Blood Metabolites and Nutrient Digestibility of Beef Bulls in Arid Subtropics. Ind. J. Anim. Res., 57(7): 882-888. https://doi.org/10.18805/IJAR.BF-1605

Ali MA, Alshaheen T, Senosy W, Kassab A, Mohammed AA (2021). Effects of feeding green microalgae and Nigella sativa on productive performance and metabolic profile of Boer goats during peripartum period in subtropics. Fresen. Environ. Bull., 30(07): 8203-8212.

A.O.A.C. (1995). Official Methods of theAssociation Official Analytical Chemists,Washington DC.

Baran M, Váradyová Z, Krácmar S, Hedbávny J (2002). The common reed (Phragmites australis) as a source of roughage in ruminant nutrition. Acta Vet. Brno., 71: 445-449. https://doi.org/10.2754/avb200271040445

Duncan DB (1955). Multiple range and multiple Ftest. Biometrics, 11: 1. https://doi.org/10.2307/3001478

Majchrzak Y (1992). Evolution des communautés végétales de marais tourbeux soumises au pâturage de bovins et d'équins. Application pour la gestion conservatoire d'une zone humide, le marais de Lavours (Ain, France). PhD Thesis, Grenoble I university, France.

Marks M, Lapin B, Randall J (1994). Phragmites australis (P. communis): threats, management, and monitoring. Nat. Area. J., 14: 285-294.

Mohammed AA (2022). Effects of copper and green algae supplementation on ovarian function, blood and metabolic profiles of boer goats grazing copper-deficient alfalfa in arid subtropics. Fresen. Environ. Bull., 31(6): 6424.

Mohammed AA, Al-Suwaiegh S (2023). Impacts of Nigella sativa Inclusion during gestation and lactation on ovarian follicle development, milk composition as well as the blood and metabolic profiles of ardi goat in subtropics. Agriculture, 13(3): 674. https://doi.org/10.3390/agriculture13030674

Mohammed AA, Al-Suwaiegh SB (2016). Effects of Nigella sativa on Mammals' Health and Production. Adv. Anim. Vet. Sci., 4 (12), 630-636.

Mohammed AA, Al-Hizab F, Al-Suwaiegh S, Alshaheen T, Kassab A, Hamdon H, Waleed Senosy W (2021). Effects of propylene glycol on ovarian Restoration, reproductive performance, Metabolic status and milk production of Farafra ewes in subtropics. Fresen. Environ. Bull., 30(7): 8192-8202.

Mohammed AA, Kassab A (2015). Metabolic changes in blood and ovarian follicular fluid in Baladi goats as affected by storage time duration. Egypt. J. Anim. Prod., 52(1): 47-54. https://doi.org/10.21608/ejap.2015.93638

NRC (2007). National Research Council (US). Nutrient Requirements of goats. Seventh Revised Edition: Update 2007. The National Academy of Washington DC.

Prince D, Bartholic J, Selegean J (2005). Assessing Sediment Loading from Agricultural Croplands in the Great Lakes Basin. J. Am. Sci., 1(2): 14-21.

SAS (2008). SAS user's guide: Basics. Statistical Analysis System Institute, Inc., Cary, NC, USA.

Sun Z, Zhou D, Ferreira LMM, Zhong Q, Lou Y (2008). Diet composition, herbage intake and digestibility in Inner Mongolian Cashmere goats grazing on native Leymus chinensis plant communities. Livest. Sci., 116: 146-155. https://doi.org/10.1016/j.livsci.2007.09.018

Vasmara C, Cianchetta S, Marchetti R, Ceotto E, Galletti S (2023). Co-digestion of pig slurry and KOH pre-treated giant reed (Arundo donax L.) enhances methane yield and digestate characteristics. Environ. Technol. & Innov., 31: 103204. https://doi.org/10.1016/j.eti.2023.103204

Zhang D, Cheng J (2005). Assessing Sediment Loading from Agricultural Croplands in the Great Lakes Basin. J. Am. Sci., 1(2): 14-21.