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FRESHWATER COMMON REED GRASS *(Phragmites australis)* AS UN-CONVENTIONAL SUMMER FORAGE IN COMPARATIVE FEEDING STUDIES AMONG CAMEL, SHEEP AND GOAT.

EL-Talty, Y.I.; M. H. Abd EL-Gawad and A.E.M. Deif
Animal Production Department, Faculty of Agriculture, Cairo University.

ABSTRACT

Four direct metabolism trials were carried out using four mature males of Sudanese camels; *Camelius dromedaries*, Osimi rams and Zaribi bucks. Common reed, *Phragmitis australis* were offered as green (RG), silage supplemented with 5% molasses (RS) and hay (RH) comparing to clover hay (CH) as the common summer roughage used in Egypt.

Results obtained indicated that crude protein and cellulose (DM basis) of all reed grass forms are comparable to those of clover hay, while the hemi-cellulose was remarkably higher than the clover hay. Reed silage quality was nearby to that of corn silage quality in term of pH, ammonia, lactic cid and short chain fatty acids. Most of nutrients digestibility, TDN and DCP (g/Kg $W^{0.75}$) were significantly ($p<0.05$) higher for animals fed green or silage reed compared to those fed the control roughage (CH). Sheep showed the highest values for digestibility coefficients and nutritive value when fed RG and RS roughages. Goats were superior for CF digestion for all forms of that compared to other species. Regarding rumen parameters, however values were erratic and there is no definite trend observed, all animals fed RG and RS showed a very comparable value to those measured with CH roughage. Acetate / propionate ratio indicated a good fermentation pattern of the tested roughages, especially with RG and RS. Although dry matter intake of all tested roughages including CH is less than the maintenance requirements for all species, body weight change and nitrogen retention as well were positive, except camels and goats fed RH. Economic evaluation of the tested roughages compared to the control one indicated that the maintenance feeding cost and price of 1 Kg as fed or DM of the CH is almost 4 times more than that of different reed forms. It could be concluded that, common reed, *phragmitis australis*, is a good and cheap un-conventional summer feed resource for ruminant nutrition especially as green and silage as well to cover the maintenance requirements or to be added as a blend with other common roughages to widen the summer feed gap.

Keywords: *Common reed, un-conventional feed, nutritive value, ruminants*

INTRODUCTION

Both quality and cost of feeds and their availability affect ruminant production, especially in summer time where green forages are scarce. At Egypt there is a gap between the available quantity 52.34 million tons of green forage (general statistics, year book, 2005) plus 9 million tons of concentrate mixture (sector of animal wealth 2005). In addition, there are about 4.37 million heads of cattle, 3.845 million heads of buffaloes, 5 million heads of sheep, 3.87 million heads of goats and 129 thousand heads of camels (statistics of ministry agriculture 2006) that are mainly fed berseem during winter, which occupying 1.67 million acre (general statistics, year book, 2005). El-Tambadawy, 1990 said that "animal production is a get of berseem". However, feeding in summer depends mainly on a variety of poor quality field crop residues, which are nutritionally imbalanced and do not cover the requirements of the animal either in protein or in energy. In addition, cottonseed meal, which is the main source of protein in concentrate feed mixtures in the country, is in short supply.

Improved feeding systems based on adding locally available feed resources will enhance milk and meat production at a considerably low cost. Moreover, partially fill the gap in protein and energy shortage. Almost two-thirds of this gap could be fulfilled by redistributing the presently consumed feeds over the entire year to provide animals with a well-balanced ration during both winter and summer. Also introducing un-conventional feed resources to be exploited as animal fodder consider another important path and should given more attention. Huge amount of the aquatic weed (*phragmites australis*) is found on the Nile River, lakes banks and salt marches that found at Alexandria governorate entrance as well. Common reed (*phragmites australis*) is a large perennial rhizomatous grass, or reed especially common in alkaline and brackish environment (Haslam, 1972).

Because the majority of aquatic plants have little, if any, value as human food, a practical use and utilization of this resource, could be as fodder for ruminant feeding. There is an extensive literature on the use of aquatic plants as fodder (FAO, 1968) and little work has been done on utilization of aquatic plants/weeds as alternative feed resource added to the ruminant feedstuff Cortes. Common reed has been examined *in vitro* (Baran *et al*. 2002) and *in vivo* (Baran *et al*. 2004) for ruminant's nutrition.

The objective of the present study is to answer the following questions; is it appropriate to administrate the reed as fresh, hay or silage?, which animal can be effectively and economically fed it?, What is the feeding value of freshwater common reed as a summer un-conventional feed resource for camel, sheep and goats?

MATERIAL AND METHODS

The present study was carried out at the Experimental Station of Animal Production Department, Faculty of Agriculture, Cairo University, Giza, Egypt, to determine the feeding value of, (green, hay and silage) Fresh water Common Reed "*phragmetis australis*" in ruminant nutrition in comparison with clover hay as a regular for ruminant's nutrition. The experiments lasted for four months (April till July, 2006).

Voluntary intake and direct digestibility trials were carried out using four mature male, of camels "*Camelius dromedaries*", Osimi Rams, and Zaribi bucks, with average body weight of 388 kg, 50 Kg and 27 Kg respectively. All animals were dulled in individual cages during whole study period. The tested roughages were fresh water reed in three different forms (green, silage supplemented with 5 % molasses on DM bases and hay) versus clover hay (*Trifolium alexandrinum)* as a control diet. Preliminary period was 21-days to adapt animals for the new consumed feed ,then followed by 7-days as a collection period.

At the end of each collection period rumen liquor samples were withdrawn just before morning feeding, three and six hours post feeding. Rumen liquor samples were collected through rubber stomach tube attached to electric suction pump. Samples of rumen liquor were strained through two layers of cheescloth and its pH was recorded immediately after collection with Beckman pH meter. Strained rumen liquor (SRL) samples were acidified with 0.1N hydrochloric acid and concentrated orthphosphoric acid and freezed for determination of total volatile fatty acids (TVFA's). Strained rumen liquor (SRL) samples were preserved with metaphsphoric acid 25% and centrifuged at 3.000 rpm for 5 minutes and stored at -18 Cº for later to determine the volatile fatty acids fractions (FVFA's).

Common reed (height of 1.5. to 2.00 m) was chopped into 5-7 cm at two successive days and mixed with 5% of molasses on dry matter basis and kept inside over ground silo with dimension of $4\times 3 \times 1.5$ m length, width and high, respectively. Walls of the silo and the top as well were covered with polyethylene sheet (1.0 mm). Clay layer of approximately 20 cm thickness was spread over the polyethylene sheet after entitled air has been evacuated by pressing. After 6 weeks the silo was opened from one side. Silage was taken out by cutting it vertically then it was offered to experimental animals. The silo was kept covered throughout the entire experimental period.

Silage quality (pH, ammonia and lactic acid) was tested before feeding according to Waldo and Schultz, 1956.

Chemical analyses:

Feeds and feces were analyzed for proximate analyses (A.O.A.C., 1990). Nitrogen free extract was calculated by difference. Fiber fractions were analyzed according to Van Soest and Wine 1967. Ammonia nitrogen in rumen liquor was determined as followed by Conway 1957, while the concentration of total VFA's in rumen liquor were determined according to Warner, 1964. Strained rumen liquor samples were prepared for FVFA's determination following the procedures of Erwin *et al.,* 1961.

Gross energy (GE), metabolizable energy (ME), and net energy for lactation (NE_l) were estimated according to DLG equations (1982) as follows;
GE (MJ/kg DM) = 0.0242 CP + 0.0366 EE + 0.0209 CF + 0.0170 NFE(g).
ME(MJ/kg DM) = 0.0152 DCP+ 0.0342 DEE+ 0.0128 DCF+ 0.0159DNFE (g).
NE_l (MJ/kg DM) = 0.60[1+0.004(q-57)] ME (MJ).Where, q = (ME/GE)*100.
Energy value was divided by 4.18 to be converted into M cal/Kg DM.

Statistical analyses

Data were analyzed using the general liner model procedure of SAS (1996). One way ANOVA procedure used to analyze the intake, digestibility, and N-retention data following the next model; $y_{ij} = \mu + T_{ij} + E_{ij}$
Were: μ is the overall mean of y_{ij} ; T_{ij} is the treatment and species effect; E_{ij} is the experimental error.

Two way ANOVA procedure was used to analyze the rumen parameters measurements, following the model; $y_{ij} = \mu + T_i + S_j + TS_{ij} + E_{ij}$

Were: y_{ij} ; T_i ; Sj; TS_{ij} is the treatment or species effect and effect of interaction; E_{ij} is the experimental error.

The differences among means were separated according to Duncan's New Multiple Range Test (Duncan's 1955).

RESULTS AND DISCUSSION

Chemical composition:

The Chemical composition of the different tested forms of common reed "*phragmetis australis*" as green (RG), silage (RS) and hay (RH) and the control diet, clover hay (CH) is presented in Table (1). The results indicated that RG content of DM, OM, CP, CF, EE, NFE and ash was similar to that reported by shehata *et al*. (1988) and Gaber *et al*. (1999). Dry matter content of reed green (35.00%) was higher than sorghum (13.90%), but slightly higher than that of berseem (31.48%), as reported by El-kholany *et al*., 1998 and Tagel-Din *et al*., 1985, respectively. In addition, reed silage DM is considerably high, which might be due to slight welting as the green reed was harvested and cut on two consecutive days and then more moisture could be evaporated. Reed green (RG) contained (11.94 %) crude protein, which close to that obtained by El- kholany *et al*., 1998 and Tagel-Din *et al*. (1988). However, reed hay (RH) contained 33.97% CF, which was higher than reed green (31.72%) as shown in Table 1, while reed silage contained 26.02% CF, compared to clover hay (28.86 %), that might be due to the conversion process of reed to silage where cell wall content was decreased or the energy loss occurred through the ensiling process. Ash contents of reed were 12.41%, 15.00% and 13.58% in RG, RS and RH, respectively. Which is similar with the findings of Zedew and Asuren., 1982. The neutral detergent fiber (NDF) was higher in forms of reed than clover hay by 23.21 %, however, the acid detergent fiber (ADF) was lower in reed by 14.67 than clover hay.

Table 1: Chemical composition of the tested forms of common reed versus clover hay (DM basis).

Nutrients	Clover hay (CH)	Reed green (RG)	Reed silage (RS)	Reed hay (RH)
DM	91.06	35.00	62.00	92.54
OM	87.23	88.59	85.00	86.42
CP	13.40	11.94	12.62	10.05
CF	28.86	31.72	26.02	33.97
EE	2.06	2.21	2.81	2.07
NFE	42.91	42.72	43.55	40.33
Ash	12.77	11.41	15.00	13.58
NDF	52.11	68.74	53.59	68.86
ADF	39.14	38.77	32.82	37.92
ADL	6.69	7.88	8.15	8.13
Cellulose	32.45	30.89	24.67	29.79
Hemicelluloses	12.97	29.97	20.77	30.94

Acid detergent lignin (ADL) was nearly similar in both reed forms and clover hay. Generally fiber content in reed silage was lower than that of other treatments. As shown in Table 1, the fiber structure of the different reed forms is tended to be higher in hemicellulose than clover hay, indicating a potential of the common reed as a good fermenTable fibrous matter. McDonald *et al.* (1972) stated that the chemical composition of forage are very variable, depending on the age of plant, soil nature, type and level of fertilization, species, verities, weather and cutting interval.

Common reed silage quality:

The physical characteristics of reed silage including pleasant aroma, color, appearance and texture are considerably good and including a successful ensiling and fermentation process. Palatability and animal performance are indicated by high dry matter intake. On the other hand, the chemical characteristics of reed silage including pH value, lactic acid, Acetic acid, propionic acid, butyric acid and isobutyric acid concentrations were acceptable in relevance to corn silage as an external reference representing as shown in Table 2. Chemical analysis indicating quality was within the normal values of the good corn silage intern of pH, ammonia-N, lactic acid, and short chain volatile fatty acids concentration. These results indicated a good fermentative quality of reed silage which agreed with Ahmed *et al*., 2002.

Table 2: Chemical characteristics of prepared reed silage (DM basis).

Item	Reed silage	Good silage standard values	Reference
pH value	4.2	3.9-4.8	Longston (1958)
Ammonia-N	2.01	1.02-2.87	Longston (1958)
Lactic acid	12.32	3.03-13.76	Longston (1958)
Acetic acid	1.68	< 2.19	Kleinschmit *et al*. (2005)
Propionic acid	0.18	0.03	Kleinschmit *et al*. (2005)
Isobutyric acid	0.03	____	
Butyric acid	0.16	< 0.4	Helleberge (1963)
Isovaleric acid	0.10	____	
Valeric acid	0.48	____	

Digestion coefficients and nutritive values:

Digestion coefficients and nutritive values of the tested showed in Table 3. As a major trend sheep and goat were significantly ($P < 0.05$) higher in DM digestibility (76.06 and 75.93) and OM (77.03 and 77.73), when fed RG compared with other treatments, which confirmed by Shehata *et al*., 2006. The improved DM and OM digestibility is attributed to crude fiber digestibility (80.19%, 83.44%, respectively) due to improving cellulose digestibility ranged (82.42 and 84.22). In this respect Baran *et al*., 2002 found that common reed dry matter digestibility (41.8%) ranged within the dry matter digestibility of wheat straw (36.6%) and meadow hay (50.2%).

Worthy, it was noticed that goat had the highest value of CF digestibility with CH, RG, and RS, RH; being 54.86, 83.44, 70.20 and 73.97, respectively. That might be due to the nature of rumen microflora and selectivity of goats to the wilted parts from green, silage and not woody parts from hay. The highest nutritive values expressed as TDN, ME, NE_l was obtained by sheep and goat when fed RG, that could be resulted in improving nutrients digestibility especially EE (73.70 and 74.08) and CF (80.19 and 83.44). On the other hand DCP yielded was significantly ($P < 0.05$) higher in sheep fed RS (9.41 %), CH (8.94%) and RG (8.58 %). Similar results were obtained by Gaber *et al*., 1999 who reported that the nutritive value expressed as TDN was not significantly different among tested diets (sorghum plus reeds, reeds and sorghum alone) and DCP values tended to be increase. In concern with metabolisable energy; ME and net energy for lactation; NE_l , the present results indicated that the reed green (RG) treatment was significantly ($P < 0.05$) the highest among all treatments, specially for both sheep and goats; being 2.10, 2.50 M cal /Kg DM and 1.52 and 1.43 M cal/Kg DM, for sheep and goats, respectively. These values reflect the potential of reed green (RG) as alternative forage for milk production. Those values of ME or NE_l are higher than those of Tagel-Din *et al*., 1988 when fed sheep on a diet contained 50 % or 25 % of reed hay, being; 2.02 and 2.12 M cal ME, 1.2 and 1.3 M cal NE_l , respectively.

Feed intake:

Results relevant to treatment and species interaction effect on daily intakes of tested roughages are summarized in Table (4). Dry matter intake expressed as DMI g / $W^{0.75}$ was significantly ($P < 0.05$) higher in camels fed reed silage (85.40 g) compared with other treatments and species. On the other hand, reed hay intake was significantly ($P < 0.05$) lower among all treatments and species, especially goats, being 28.17 g/ Kg $W^{0.75}$. Dry matter intake (Kg/100 Kg BW) was significantly ($P < 0.05$) higher with clover hay by goat than that by camel and sheep (2.09, 1.14 and 1.13, respectively), which may indicated that legume hays are more readily consumed than grass hays of similar quality (Kearal, 1982). Reed silage intakes were obviously higher for all species compared with other treatments. Total digestible nutrients and digestible crude protein intake (g/ $KgW^{0.75}$ or g/100 kg BW) were highly significant ($P < 0.05$) for camel and sheep consumed reed silage and reed green compared the other species fed clover hay and reed hay, except camel which recorded high consumption of reed green (12.61 g DCP/ $KgW^{0.75}$). Overall, reed green and reed silage represented the highest values of DM, TDN, and DCP intake.

Retained nitrogen generally was highly significant ($P< 0.05$) with sheep and goats fed CH, RG and RS than camel, which indicates that sheep and goat are more efficient in nitrogen metabolism than camels, especially with available dietary protein levels (Tagel-Din *et al*., 1982).

T3-4

Rumen parameters:

Rumen liquor parameters of the experimental tested roughages are summarized in Tables 5. Most of ruminal parameter measured was affected by different types accepTable with the normal range of rumen parameters parameter. Ruminal pH recorded the highest values with sheep and goats fed clover hay at zero time. The gradual decrease in pH value over time after feeding was synchronized with gradual increase in ruminal total volatile fatty acids concentration at the same times. Similar results were obtained by Gaber *et al*., 1999, who found that the maximum ruminal pH was recorded at pre-feeding without significant differences among tested roughages (reed, sorghum or both). Feeding on different roughages resulted in insignificant pH values among dietary treatments with the same breed, except goats fed CH, sheep fed RS and camel fed RH. After 6 hrs. it was found that sheep fed RH recorded highly significant ($P < 0.05$) pH value, followed by camel fed RS, CH and RH being the same value (6.83) expect camel fed RG (6.3). While goat and sheep fed RG resulted in significantly ($P < 0.05$) lower pH values (5.46, 5.66). In this respect Abdel-Rahman *et al*., 2003, found that the ruminal pH values of four animal species (camels, bulls, sheep and goats) before feeding were 7.5, 6.8, 6.95 and 6.95, respectively, and all pH values after feeding were lower than those before feeding, being 6.78, 6.45, 6.77 and 6.64, respectively.

Ammonia is one of the most important products of protein break down in the rumen. Ruminal ammonia concentration at zero time was highly significant ($p < 0.05$) with goats fed RS (17.5), followed by camel fed RG and RH (14.63, 14.01), while the lowest concentration recorded with sheep fed CH (8.2). At three hours post-feeding, ammonia concentration was significantly higher with sheep and goats fed RG (23.67, 22.32), and camel fed RS (23.34), while significantly lower with sheep fed RH (9.77). Ammonia concentration at 6 hrs post-feeding was significantly ($p < 0.05$) higher with camel fed RS, while significantly lower with sheep fed CH. Abdel-Rahman *et al*., 2003 found that ammonia concentration in camels were lower than those reported in bulls, sheep and goats, either before feeding (13.3, 16.10, 16.30 and 15.80 mg/ Id, respectively) or at 5 hrs. after feeding (10.0, 19.3, 20.2 and 18.0, respectively). The beneficial effect of high level of ammonia might be in part due to increasing the amount of substrate available for microbial protein synthesis in the rumen (Church 1988).

Total volatile fatty acids concentration showed highly significant ($p < 0.05$) values at 3 hrs post feeding with camel fed RS (6.10) and goat fed CH (5.63), while the lower value was recorded with sheep fed RH. In comparison, TVFA's production at six hours post feeding was highly significant with goat fed CH, camel and sheep fed RS and camel fed RH, being 4.47, 4.55, 4.03 and 4.18, respectively. Gaber *et al*., 1999, found that the TVFA's concentrations tended to decrease in the rumen of dairy goats fed ration containing reed grass (50% CFM plus reed forage *ad lib*) compared with their mate fed sorghum rations.

Fractions of volatile fatty acids as shown in Table 6 indicated no obvious trend with sheep fed the different tested roughages, there was a tendency for having high FVFA's concentration over pre and post feeding time, it was noticed that there is no consistent trend for decreasing or increasing of both acetic acid and propionic acid, however, butyric acid tended to increases as time post-feeding increases.

T5-6

In contrary, isobutyric acid showed a reverse pattern compared to that of butyric acid. Acetate / propionate ratio recorded the highest values with sheep fed RG at 3 and 6 hrs. post-feeding (1.95 and 2.22) and goats fed RH pre-feeding (2.00). Baran *et al*. 2002 found that common reed *P. australis* gave high acetate: propionate ratio (4.4) compared to other substrates (meadow hay, wheat straw, barley, amorphous cellulose and glucose). This finding leads to speculate that, green reed could be utilized as a source of green forage for lactating animals where high production of acetate / propionate is demanded.

Economic Evaluation of tested roughages:

All tested roughages compared with the control one "clover hay", are presented in Table 7. The clover hay common market price was "760 LE/Ton" and reed price was estimated as 140 LE/Ton for RG, 240 LE/Ton for RS, and 120 LE/Ton for RH. Reed price included the following costs (harvest cost; 60 LE/Ton, transportation; 50 LE/Ton and chopping; 30 LE /Ton, and additional cost; 100 LE/Ton for molasses and plastic sheets which used for silage making). Maintenance DMI, DCPI and TDNI for camel were calculated according to Wardeh, 1997, whereas for both sheep and goats according to NRC, 1985. Results indicated that the price of tested roughages as fed or even per one Kg DM were considerably very low in comparison with the control roughage "clover hay". It was almost 1.9, 1.3 and 8.5 times more for all species fed CH comparing with those fed RG, RS and RH, respectively.

Maintenance feeding cost for all species fed different reed grass forms and expressed as DM intake, Kg was very low compared to those fed clover hay (CH). In addition maintenance DM feeding cost was two times higher in camel, sheep and goats fed on CH versus those fed RG or RS, while four times than those fed on RH. Nutrients unit cost of DCP and TDN, expressed as LE/unit/ton indicated that the most expensive unit price was recorded with CH, followed by RG, RS, and RH, for all species. Dry matter intake as percent of required DM for maintenance indicated that camel covered their maintenance requirements from RG and RS, while failed to cover it's maintenance from both CH and RH. On the other hand, sheep response to cover their maintenance DM requirements was better than goats for most treatments.

Conclusion:

The present results indicated that common reed "*Phragmites australis*" has a potential as un-conventional summer forage for ruminants feeding. Therefore, it could be exploited as an economic alternative to cover most of the maintenance requirements or as a portion of the total nutrients required. Common reed as green forage or preserved as silage with 5% molasses supplementation showed highly palaTable and accepTable from camel, sheep and goats. In addition, common reed could be considered a very low price forage "gotten for granted" if harvested and utilized in an intensive way.

T7

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حشيشة غاب المياه العذبة (*Phragmites australis*) كعلف صيفي غير تقليدي فى دراسة غذائية مقارنه بين الإبل والأغنام والماعز

يحيى إبراهيم التلتي، محمد حسن عبد الجواد وعادل عيد محمد ضيف
قسم الإنتاج الحيواني- كلية الزراعة– جامعة القاهرة

أجريت أربع تجارب هضم مباشرة باستخدام أربعة ذكور بالغة من الإبل السودانية (388 كجم) والكباش الأوسيمي (50 كجم) وذكور الماعز الزريبي (27 كجم). تم تسكين الحيوانات فرديا بصناديق الهضم والتمثيل الغذائي لمدة ٢٨ يوما مقسمةً إلى ٢١ يوما كفترة تمهيدية و٧ أيام لجمع العينات. قدم للحيوانات ثلاثة أشكال مختلفة من نبات غاب المياه العذبة، وهى الأخضر (RG) سيلاج مضاف إليه ٥% مولاس (RS) ودريس (RH)، وذلك بالمقارنة بمجموعة الكنترول والتي يمثلها دريس البرسيم (CH) كعلف خشن شائع الاستخدام صيفا.

أوضحت النتائج أن نسبة البروتين الخام والسيليلوز (على أساس المادة الجافة تماما) لكل أشكال نبات الغاب كانت متقاربة مع نظيرتها في دريس البرسيم، في حين كانت نسبة الهيميسيليلوز أعلى بدرجه ملحوظة عن دريس البرسيم. وكانت جودة سيلاج نبات الغاب قريبة إلى حد كبير من جودة سيلاج نبات الذرة، سواء في درجة الحموضة، أو تركيز الأمونيا وحمض اللاكتيك والأحماض الدهنية قصيرة السلسلة. زادت معظم معاملات الهضم والمأكول من المادة الجافة والمركبات المهضومة الكلية والبروتين الخام المهضوم بالجرام/كجم حيز جسم تمثيلي بدرجة معنوية (P< 0.05) للحيوانات التي غذيت على الغاب الأخضر أو سيلاج الغاب مقارنة بمجموعة الكنترول. أظهرت الأغنام أعلى قيم لمعاملات الهضم والقيمة الغذائية عندما غذيت على الغاب الأخضر أو سيلاج الغاب. كانت الماعز أكثر تفوقا في هضم الألياف الخام لكل المعاملات مقارنة بباقي الأنواع. فيما يتعلق بخصائص ببيئة الكرش، في حين كانت النتائج متفاوتة ولم يكن هناك اتجاه محدد، إلا أن الحيوانات التي غذيت على الغاب الأخضر أو سيلاج الغاب أظهرت قيما متقاربة جدا بتلك التي غذيت على دريس البرسيم.

دلت نسبة الأسيتات/بروبيونات على حدوث درجة جيدة من التخمر للمعاملات المختلفة مقارنة مع مجموعة دريس البرسيم، وخاصة مع الغاب الأخضر وسيلاج الغاب. وبالرغم من انخفاض المادة الجافة المأكولة من كل الأعلاف الخشنة المختبرة، متضمنة دريس البرسيم عن احتياجات حفظ الحياة لكل الحيوانات المستخدمة، فإن التغير في وزن الجسم وميزان الأزوت كان موجبا فيما عدا الإبل والماعز التي غذيت على دريس الغاب. أوضح التقييم الاقتصادي للأعلاف الخشنة المختبرة مقارنة بدريس البرسيم أن تكاليف التغذية لحفظ الحياة، وأيضا سعر تكلفة واحد كيلوجرام من العلف المأكول على صورته أو كمادة جافة من دريس البرسيم يبلغ أربعة أمثال الأعلاف الأخرى المختبرة من نبات الغاب.

يستنتج من هذه الدراسة أن نبات الغاب يعتبر مصدرًا جيدًا ورخيصًا كعلف خشن صيفي غير تقليدي لتغذية المجترات، خاصة في صورته الخضراء أو كسيلاج لتغطية احتياجات حفظ الحياة أو إضافته مع مخاليط أعلاف خشنة أخرى شائعة الاستخدام لتقليل الفجوة الغذائية صيفًا.

Table 3: Nutrients digestibility and nutritive values of the tested form of common reed (DM basis).

Item	Clover Hay (CH)			Reed Green (RG)			Reed Silage (RS)			Reed Hay(RH)			±SE
	Camel	Sheep	Goat	Camel	Sheep	Goat	Camel	Sheep	Goat	Camel	Sheep	Goat	
Digestibility (%):													
DM	55.21^{de}	57.72^{de}	58.33^{d}	63.83^{bc}	76.06^{a}	75.93^{a}	58.74^{d}	72.23^{a}	65.73^{b}	52.51^{e}	66.77^{b}	53.21^{de}	1.79
OM	50.17^{cd}	59.69^{cd}	60.45^{cd}	67.62^{b}	77.03^{a}	77.73^{a}	63.33^{bc}	73.52^{a}	67.87^{b}	54.40^{e}	61.87^{cde}	54.34^{e}	1.56
CP	54.00^{c}	66.73^{bcd}	57.64^{c}	54.55^{c}	71.88^{ab}	70.15^{ab}	55.63^{c}	74.57^{a}	56.94^{c}	47.31^{d}	60.20^{c}	54.94^{c}	2.32
EE	56.21^{c}	63.84^{b}	60.43^{bc}	73.57^{a}	73.70^{a}	74.08^{a}	78.90^{a}	77.80^{a}	76.85^{a}	55.63^{c}	59.96^{bc}	65.22^{b}	2.17
CF	54.78^{e}	52.79^{e}	54.86^{e}	67.86^{b}	80.19^{a}	83.44^{a}	63.43^{d}	65.46^{cd}	70.20^{bc}	65.08^{e}	61.96^{d}	73.97^{b}	1.93
NFE	73.63^{ab}	65.13^{cd}	55.69^{e}	55.62^{e}	76.55^{a}	68.59^{bc}	67.33^{bc}	76.90^{a}	68.25^{bc}	54.69^{e}	59.10^{ed}	55.32^{e}	2.12
NDF	54.02^{e}	58.42^{ef}	53.17^{e}	67.13^{bc}	79.41^{a}	79.68^{a}	60.67^{fg}	65.13^{cd}	66.63^{bc}	55.52^{ef}	60.63^{de}	70.82^{b}	1.69
ADF	51.63^{c}	55.57^{c}	55.77^{c}	56.66^{b}	78.06^{a}	66.80^{b}	51.61^{d}	59.30^{b}	67.58^{b}	48.09^{d}	52.10^{d}	62.13^{b}	1.82
Cellulose	70.93^{ed}	72.58^{cde}	75.85^{bcd}	67.56^{ef}	82.42^{ab}	84.22^{ab}	63.25^{fg}	68.74^{ef}	77.72^{b}	54.52^{h}	59.69^{g}	67.19^{ef}	1.77
Hemi-cellulose	55.38^{e}	57.57^{e}	60.33^{e}	77.69^{bc}	79.75^{ab}	83.68^{a}	77.15^{bc}	74.09^{c}	77.57^{bc}	67.66^{d}	78.68^{abc}	76.97^{bc}	1.68
Nutritive value:													
TDN, %	59.83^{bc}	55.80^{cd}	52.40^{d}	58.19^{bc}	69.62^{a}	67.16^{a}	58.13^{bc}	65.13^{a}	60.48^{b}	51.56^{d}	57.33^{c}	50.03^{e}	1.57
DCP, %	7.24^{d}	8.94^{bcd}	7.72^{ab}	6.51^{cd}	8.58^{bcd}	8.37^{bcd}	7.02^{cd}	9.41^{a}	7.18^{bcd}	4.75^{e}	6.05^{e}	5.52^{e}	0.26
ME, (M cal/kg DM)	2.04^{c}	1.90^{d}	1.77^{d}	2.10^{bc}	2.50^{a}	2.38^{a}	2.05^{c}	2.23^{b}	2.13^{bc}	1.57^{e}	1.51^{e}	1.34^{f}	0.19
NE_l, (Mcal/kg DM)	0.98^{cd}	1.10^{d}	1.01^{d}	1.23^{c}	1.52^{a}	1.43^{a}	1.20^{c}	1.33^{b}	1.25^{bc}	0.87^{e}	0.83^{e}	0.74^{f}	0.13

$^{a,b,c...}$ **Means in the same row with different superscripts are significantly different (P<0.05).**

Table 4: Feed intake (DM, TDN and DCP) and nitrogen retention (NR) of the tested forms of common reed versus clover hay.

Item	Clover Hay (CH)			Reed Green(RG)			Reed Silage(RS)			Reed Hay(RH)			±SE
	Camel	Sheep	Goat	Camel	Sheep	Goat	Camel	Sheep	Goat	Camel	Sheep	Goat	
Dry matter Intake(DMI):													
Kg/h/d	4.45	0.57	0.57	4.86	0.43	0.41	7.47	0.98	0.55	3.29	0.55	0.33	
g/Kg $W^{0.75}$	50.76^{bc}	30.23^{e}	47.90^{bcd}	52.18^{bc}	55.6^{b}	34.25^{dec}	85.4^{a}	52.2^{bc}	45.78^{bcd}	37.76^{dec}	29.58^{e}	28.17^{e}	4.89
Kg/100kgBW	1.14^{cd}	1.13^{cd}	2.09^{a}	1.25^{cd}	0.86^{d}	1.49^{bc}	1.92^{ab}	1.96^{ab}	2.00^{ab}	0.85^{d}	1.15^{cd}	1.23^{cd}	0.18
Total Digestible Nutrient(TDN):													
Kg/h/d	2.69	0.35	0.32	2.82	0.34	0.28	4.36	0.27	0.33	1.70	0.19	0.17	
g/ $KgW^{0.75}$	27.35^{de}	18.35^{f}	27.24^{d}	32.38^{c}	18.00^{f}	25.63^{d}	49.83^{a}	35.46^{b}	27.69^{d}	22.72^{e}	9.96^{h}	14.12^{g}	0.94
Kg/100Kg BW	0.69^{c}	0.69^{c}	1.19^{ab}	0.74^{bcd}	0.67^{c}	1.13^{ab}	1.12^{ab}	1.28^{a}	1.21^{ab}	0.44^{d}	0.37^{d}	0.62^{c}	0.04
Digestible Crude Protein(DCP):													
g/h/d	414	54.68	55	1100	99	92	1553	201	116	389	27.67	19.50	
Kg/ $KgW^{0.75}$	4.73^{ef}	2.89^{fg}	4.57^{ef}	12.61^{b}	5.19^{e}	7.72^{d}	17.71^{a}	10.68^{c}	9.74^{c}	4.45^{ef}	1.46^{g}	1.63^{g}	0.67
Kg/100Kg BW	1.06^{e}	1.08^{e}	2.00^{d}	2.85^{c}	1.94^{d}	3.38^{bc}	4.00^{ab}	4.00^{ab}	4.25^{a}	1.00^{e}	0.55^{e}	0.71^{e}	0.23
Nitrogen retention (NR):													
g/h/d	15.77	3.82	4.30	20.28	2.99	2.09	48.99	6.30	2.04	-11.74	1.25	-2.27	
% N-Intake	16.54^{f}	31.27^{b}	35.18^{a}	21.84^{d}	36.43^{a}	26.69^{c}	32.49^{b}	31.86^{b}	18.37^{e}	-21.93^{h}	14.15^{g}	-42.83^{i}	0.57

$^{a,b,c....}$ **Means in the same row with different superscripts are significantly different (P<0.05).**

Absolute intake of DM, TDN, DCP and NR were not statistically tested for mean separation since they are related to different body weights.

Table 7: Economic evaluation of the tested forms of common reed versus clover hay.

Item	Clover Hay (CH)			Reed Green (RG)			Reed Silage (RS)			Reed Hay (RH)		
	Camel	Sheep	Goats	Camel	Sheep	Goats	Camel	Sheep	Goats	Camel	Sheep	Goats
Average BW	390	50.44	27.30	388	50	27.5	389	51	27.5	387	47.8	26.8
Feed intake:												
As fed, Kg/h/d	4.89	0.625	0.625	13.88	1.23	1.17	12.05	1.58	0.889	3.55	0.594	0.356
DMI, Kg/h/d	4.45	0.57	0.57	4.86	0.43	0.41	7.47	0.98	0.55	3.29	0.55	0.33
DMI, % BW	1.14	1.13	2.08	1.25	0.86	1.46	1.92	1.92	1.96	0.85	1.14	1.22
DMI, % of maintenance req.	٩٥	٥٦	٩٣	١٠٥	٤٣	٦٧	١٦٠	٩٦	٩٠	٧٦	٥٧	٥٦
Feed cost:												
1 Kg as feed	0.76			0.14			0.24			0.19		
1 Kg as DM	0.83			0.40			0.38			0.21		
Total Kg DMI, LE/h/d	3.69	0.47	0.47	1.94	0.17	0.16	2.91	0.38	0.21	0.69	0.12	0.07
Maintenance feed cost:												
DM, LE/h/d	3.87	0.83	0.50	1.86	0.38	0.23	1.46	0.40	0.23	0.98	0.20	0.12
Nutrients unit cost, LE/Ton:												
DCP	114.7	92.9	107.5	61.4	46.6	47.8	54.1	40.4	52.9	44.2	34.7	38.1
TDN	13.90	14.9	15.8	6.9	5.8	6.0	6.5	5.8	6.3	4.1	3.7	4.2

Dry matter, TDN and DCP calculation for body weight maintenance was calculated as 1.20 % from BW, (29g and 2.7g) TDN and DCP/KgW$^{0.75}$ for camel (Whardeh, 1997), 2.0% from BW, (550 and 50) TDN and DCP g/day, for sheep (NRC, 1985) and 2.2 % DM from BW, (365, 35) TDN and DCP g/day, for goats (NRC, 1985).

Table 5: Rumen parameters of the tested forms of common reed versus clover hay.

Item	Clover Hay			Reed Green			Reed Silage			Reed Hay			±SE
	Camel	Sheep	Goats	Camel	Sheep	Goats	Camel	Sheep	Goats	Camel	Sheep	Goats	
Rumen pH:													
Zero time	6.90^{bc}	6.93^{ab}	7. 00^{a}	6.90^{bc}	6.90^{bc}	6.90	6.9^{bc}	6.83^{cd}	6.93^{ab}	6.80^{d}	6.90^{bc}	6.90^{bc}	0.06
3 hrs.	6.60^{a}	6.80^{a}	5.10^{e}	5.77^{d}	5.18^{e}	5.69^{d}	6.70^{ab}	6.50^{abc}	6.50^{abc}	6.50^{abc}	6.70^{ab}	6.33^{bc}	0.19
6 hrs.	6.83^{bc}	7.00^{a}	6.50^{cd}	6.30^{d}	5.66^{e}	5.46^{f}	6.83^{bc}	6.66^{bc}	6.73^{bc}	6.83^{ab}	7.00^{a}	6.50^{cd}	0.08
Rumen ammonia concentration (mg %):													
Zero time	11.93^{de}	8.20^{f}	10.61^{e}	14.63^{b}	12.70^{cd}	11.10^{de}	10.69^{e}	10.53^{e}	17.50^{a}	14.01^{bc}	10.21^{e}	10.37^{e}	0.54
3 hrs	14.51^{d}	11.64^{e}	14.72^{d}	17.74^{c}	23.67^{a}	22.32^{a}	23.34^{a}	20.27^{b}	17.49^{c}	21.86^{ab}	9.77^{e}	14.13^{d}	0.64
6 hrs.	12.60^{cde}	8.68^{f}	11.22^{e}	16.38^{b}	13.55^{c}	11.95^{de}	20.53^{a}	12.91^{cd}	13.52^{c}	12.77^{cd}	7.96^{f}	12.42^{cde}	0.45
Rumen total volatile fatty acids concentration (mEq/100ml RL):													
Zero time	3.21^{b}	3.00^{bcd}	3.40^{b}	2.11^{f}	2.50^{e}	2.58^{de}	3.26^{b}	2.60^{de}	2.57^{e}	4.03^{a}	2.80^{cde}	3.07^{bc}	0.13
3 hrs.	4.58^{bc}	4.47^{bcd}	5.63^{a}	4.18^{bcd}	3.77^{ed}	4.10^{d}	6.10^{a}	4.83^{b}	4.20^{bcd}	4.73^{bc}	3.32^{e}	4.35^{bcd}	0.21
6 hrs.	3.65^{bc}	3.60^{bc}	4.47^{a}	3.14^{cd}	2.95^{d}	3.00^{d}	4.55^{a}	4.03^{ab}	3.40^{cd}	4.18^{a}	3.00^{d}	3.63^{bc}	0.17

[a,b,c…] **Means in the same row with different superscripts are significantly different ($P<0.05$).**

Table 6: Rumen fraction volatile fatty acids concentration (%) of the tested forms of common reed versus clover hay.

Item	Clover Hay (CH)			Reed Green(RG)			Reed Silage(RS)			Reed Hay(RH)			±SE
	Camel	Sheep	Goats	Camel	Sheep	Goats	Camel	Sheep	Goats	Camel	Sheep	Goats	
Acetic acid													
Zero time	57.89^{a}	45.10^{cde}	45.98^{cde}	51.03^{abcd}	41.16^{e}	51.60^{abcd}	46.69^{cde}	45.03^{cde}	43.83^{ed}	52.95^{abc}	49.40^{bcde}	56.02^{ab}	2.52
3 hrs.	58.17^{a}	51.21^{bcd}	52.83^{b}	49.97^{d}	58.21^{a}	52.83^{b}	52.09^{bc}	45.21^{e}	45.21^{e}	50.47^{cd}	52.26^{bc}	52.26^{bc}	0.57
6 hrs.	50.49^{abc}	46.25^{bc}	48.20^{bc}	47.47^{bc}	58.99^{a}	47.45^{bc}	48.79^{bc}	48.28^{bc}	43.42^{c}	51.73^{abc}	56.02^{ab}	50.18^{abc}	3.11
Propionic acid													
Zero time	32.77^{ab}	28.52^{efg}	30.12^{cde}	30.80^{bcd}	34.01^{a}	31.52^{bc}	27.53^{fg}	28.30^{efg}	26.50^{g}	29.07^{def}	29.00^{edf}	27.43^{fg}	0.64
3 hrs.	30.38^{e}	35.21^{b}	30.38^{e}	32.30^{c}	29.86^{e}	37.18^{a}	32.21^{cd}	34.60^{b}	29.16^{e}	30.53^{de}	35.21^{b}	34.70^{b}	0.57
6 hrs.	29.88^{ab}	27.60^{cd}	31.88^{a}	28.00^{bc}	26.57^{cde}	26.81^{cd}	30.27^{a}	25.50^{ed}	27.88^{bc}	24.48^{e}	26.88^{cd}	30.64^{a}	0.70
Butyric acid													
Zero time	10.97^{h}	17.78^{bc}	15.26^{ed}	12.27^{fgh}	20.34^{a}	11.83^{gh}	16.87^{cd}	19.83^{ab}	19.12^{ab}	14.20^{ef}	13.85^{efg}	13.33^{efg}	0.71

3 hrs.	5.30^{h}	10.94^{ef}	14.16^{cd}	15.59^{bc}	6.38^{g}	7.08^{g}	12.45^{ed}	19.55^{a}	16.55^{b}	12.71^{d}	10.31^{f}	9.81^{f}	0.56
6 hrs.	18.21^{c}	23.05^{b}	18.57^{c}	21.38^{b}	22.65^{b}	26.50^{a}	18.61^{c}	20.89^{b}	20.81^{b}	22.56^{b}	12.43^{d}	11.45^{d}	0.70
Isobutyric acid													
Zero time	5.02^{ab}	6.00^{a}	4.44^{ab}	3.18^{b}	4.77^{ab}	3.89^{b}	6.00^{a}	4.11^{ab}	6.02^{a}	3.77^{b}	4.68^{ab}	3.37^{b}	0.62
3 hrs.	3.57^{ab}	0.29^{d}	0.75^{d}	0.45^{d}	2.30^{c}	2.83^{ab}	0.66^{d}	0.44^{d}	0.05^{d}	4.30^{a}	2.20^{c}	4.31^{a}	0.41
6 hrs.	0.64^{e}	3.06^{abc}	0.61^{e}	3.13^{abc}	0.65^{e}	1.22^{de}	2.56^{bcd}	4.08^{abc}	4.13^{ab}	2.20^{cde}	4.66^{a}	3.77^{abc}	0.57
Acetate : propionate ratio													
Zero time	1.76^{abc}	1.58^{cd}	1.53^{d}	1.65^{bcd}	1.21^{e}	1.63^{bcd}	1.7^{bcd}	1.59^{cd}	1.65^{bcd}	1.82^{ab}	1.7^{bcd}	2.00^{a}	0.06
3 hrs.	1.92^{a}	1.45^{fg}	1.74^{b}	1.54^{d}	1.95^{a}	1.42^{g}	1.62^{c}	1.30^{h}	1.55^{d}	1.65^{c}	1.48^{ef}	1.05^{e}	0.01
6 hrs.	1.69^{cd}	1.68^{cd}	1.51^{d}	1.69^{cd}	2.22^{a}	1.77^{bcd}	1.61^{cd}	1.89^{abc}	1.56^{cd}	2.11^{ab}	2.08^{ab}	1.64^{cd}	0.10

[a,b,c…] **Means in the same row with different superscripts are significantly different (P<0.05).**