Effect of Ensiling and Urea Treatment of Wild Reed *Phragmites communis* on Productive Performance of Awassi Lambs

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Abstract

This study was conducted using 24 Awassi male lambs at 4-6 months of age and mean initial weight of 20.59 kg, to investigate the effect of ensiling of wild reed and level of urea (0, 1 or 2%) on productive performance of lambs. Results revealed that lambs fed reed consumed higher (P<0.01) amounts of of all nutrients except digestible DM. Whereas, intake of roughage and total nitrogen (N) and total digestible N were affected (P<0.01) by urea treatment. Intake of all nutrients was significantly affected by interaction between ensiling and urea treatment as well. Final weight, total and daily gain were not affected by ensiling and level of urea, corresponding values were, 25.93, 78.86 and 5.52 for lambs fed reed silage vs. 27.18 kg, 86.83 g/day and 6.07 kg for reed respectively. Final weight gain was not affected by interaction between ensiling and level of urea, whereas, lambs fed reed treated with low level of urea gained higher average final and daily gain. Ensiling was significantly superior in feed conversion ratio (FCR) estimated on basis of DM intake (7.74 vs, 8.86). Better (P<0.05) FCR was associated with lower level of urea. Lambs fed untreated reed silage recorded better FCR in comparison with other lambs. Ensiling improved digestibility coefficients of most nutrients, whereas, it decreased (P<0.05) CP digestibility, 67.03 and 69.59% for silage and reed, respectively. Digestibility was also affected by urea treatment, where, better values were generally achieved with 1% of urea except those of fiber components, in which, 2% level of urea was superior (P<0.01) in hemicellulose digestibility.

Key word: Wild reed, weight gain, feed conversion ratio, ensiling, urea

الخلاصة

اجريت الدراسة باستخدام 24 حمل عواسي ذكري بعمر 4- 6 شهر وبمتوسط وزن ابتدائي بلغ 20.59 كغم للتحري عن تاثير سيلجة القصب البري ومستوى اليوريا (0 , 1 او 2%) في الأداء الانتاجي للحملان. اشارت النتائج الى تفوق (P<0.01) الحملان المغذاة على القصب في التناول من جميع العناصر الغذائية باستثناء التناول من المادة الجافة المهضومة. فيما تاثر (P<0.01) التناول من النتروجين للعلف الخشن والنتروجين الكلي والنتروجين الكلي المهضوم بمستوى المعاملة باليوريا. كما تاثر التناول من العناصر معنويا بالتداخل بين السيلجة ومستوى اليوريا. ولم يتاثر الوزن النهائي ومعدل الزيادتين اليومية والكلية معنويا بالسيلجة ومستوى اليوريا, اذ بلغت القيم 25.93 و78.86 و5.52 للحملان المغذاة على السايلج مقابل 27.18 كغم و86.83 غم/يوم و 6.07 كغم للقصب على التوالي. ولم يؤثر التداخل بين السيلجة ومستوى اليوريا في الوزن النهائي فيما سجلت الحملان المغذاة على القصب المعامل بالمستوى المنخفض من اليوريا اعلى معدل زيادة وزنية كلية ويومية. وكان للسيلجة افضلية معنوية في معدل التحويل الغذائي المحسوب على اساس التناول من المادة الجافة (7.74 مقابل 8.86). كما ارتبط افضل (P<0.05) معدل تحويل غذائي بالمستوى المنخفض من اليوريا. وسجلت الحملان المغذاة على السايلج غير المعامل باليوريا افضل معدل تحويل غذائي مقارنة ببقية الحملان. وقد ادت السيلجة الى تحسين معظم هضم العناصر الغذائية فيما ادت الى خفض (P<0.05) هضم البروتين الخام (67.03 و 69.59% للسايلج والقصب على التوالي). كما تاثر الهضم بالمعاملة باليوريا, اذ تحققت افضل القيم عند استخدام المستوى 1% باستثناء هضم المكونات الليفية, اذ تفوق المستوى 2% معنويا (P<0.01) في هضم الهيميسليلوز.

الكلمات المفتاحية: القصب البري, الزيادة الوزنية, معدل التحويل الغذائي, السيلجة, اليوريا

Introduction

Roughages are considered the main ruminant's diet. Ruminants were expected to be more dependable on roughages as a result of increase population and competition on concentrates. High cell wall components and low crude protein (CP) content of most roughage is the main restriction factor for its use in feeding due to its negative effect on digestibility and palatability (Hassan, *et al.,* 1998). Since ruminants have limited ability to utilize roughages efficiently, improve its performance depending on these materials required increase rate of utilization (Chaudhry, 2008). Sakhawat (2011) reported that producing good quality and healthy diets is a very important factor affecting quality of animal products and its economic value.

Reed is the most abundant plants. It grows in arable and semarable areas and it invasively, separated in rivers and irrigation canals. Availability and adequate CP content of reed, especially in green tops which may reach 9.5% (Al-Saady, 2009) encouraged researchers to study feeding value of this plant and increase available ruminants dietary sources.

Ensiling is a way to preserve excess crops and saving diets to use it as animal diets in time where pastures and good forages are scared. Silage is juged high quality feed in many regions. In Europian countries like Holland, Germany and Danmark, about 90% of forage crops are preserved as silage, and even in temperate countries like France and Italy, where there is suitable climate for hay making, 50% of forges were ensiled (Wilkinson, *et al.,* 1996). Saeed (2015) demonstrated that more palatable feed can be produced by ensiling. Moreover, ensiling may participate in reducing cost of feeding through lowering concentrate levels (Bendary and Younis, 1997).

With respect to constrained role of nitrogen (N) in low quality roughages, Non protein nitrpgen (NPN) sources were used to meet requirements of rumen microbes. Urea is the most important NPN utilized to improve utilization of roughages and crop residues; rendering it an attractive N source as compared with relative expensive CP sources (Hamad, et. al., 2010). Consequently, the objective of the current study was to investigate the effect of ensiling reed with different level of urea on productive performance of male Awassi lambs.

Materials and Methods

Preparing of silages

Reed was collected from nearby areas to Animal field of Animal Production Department-College of Agriculture. In order to prepared three silages, whole reed plant was chopped into 3-5 cm and treated with solutions prepared by addition of dates honey at rate of 10% and three levels of urea, 0, 1 or 2% on dry matter (DM) basis. Treatment solutions were diluted with enough water to reduce DM content of reed to about 40%. Treated reed was packed in 3 pit silos, covered with plastic sheet, compacted with tractor and left filled up with soil for 60 days.

Experimental diets

Wheat bran, barley, yellow corn and soybean meal were mixed at ratios that ensure a content of about 12.76% CP in a produced concentrate diet. As well as securing the standard ratio of rumen degradable nitrogen (RDN) to metabolizable energy (ME) of 1.34 g RDN/MJ of ME. Concentrate was offered at 2% of live body weight. Roughaes (fresh reed and silage) were offered ad libitum. Samples were daily collected to determine DM content and DM intake. Table (1) shows chemical composition of experimental diets and their ingredients.

Table 1- Chemical composition of concentrate, roughage diets and their ingredients

Diets and ingredients	reed pre ensiling	silage			Reed pre feeding	reed			concentrates	Dates honey
		0% urea	1% urea	2% urea		0% urea	1% urea	2% urea		
DM	43.40	38.99	41.23	36.51	45.21	50.67	44.13	46.70	91.09	63.04
OM	83.73	81.50	83.91	83.89	78.98	78.52	78.51	78.82	92.90	97.43
CP	5.82	5.84	7.60	8.58	5.98	6.15	9.08	11.62	12.76	2.10
CF	53.84	50.23	51.37	51.35	50.77	51.47	50.50	51.32	13.98	0.79
EE	3.30	4.35	3.91	4.36	4.39	4.17	4.44	4.88	4.67	0.93
NFE	20.77	21.08	21.03	19.60	17.84	16.73	14.49	11.00	61.49	93.71
NDF	80.47	79.54	79.47	79.03	65.94	64.91	66.41	66.73	54.48	-
ADF	73.22	71.66	71.08	70.42	54.39	54.52	54.47	54.24	16.43	-
Cellu.	26.97	25.52	25.14	24.07	20.48	20.63	20.84	20.16	5.94	-
Hcell.	7.25	7.88	8.39	8.61	11.55	10.39	11.94	12.49	38.05	-
lignin	46.25	46.14	45.94	46.35	33.91	33.89	33.63	34.08	10.49	-
ME,MJ /100g	0.73	0.75	0.76	0.77	0.71	0.70	0.70	0.70	1.23	1.37

ME (MJ/ kg DM) = 0.012 CP +0.031 EE+0.005 CF +0.014 NFE (MAFF, 1975)

Experimental animals

Twenty four male Awassi lambs at 4-6 months of age and initial body weight of about 20.59 kg were randomly allocated into 6 equall groups, three were offered either fresh reed treated with urea at rate of 0 (FR0), 1 (FR1) or 2% (FR2). The corresponded reed silage, SR0, SR1 or RS2, respectively were offered to the other three groups. Lambs were individually housed in 1×1.5 m^2 pens supplied with feed, water containers and salt cubes. Experiment lasted 70 days with a 14 days adaptation period.

Digestion trail

Digestion trial was conducted to determine nutrients digestibility of experimental diets. Hand made sacs were used to collect faeces excreted by lambs. Sacs were designed in a suitable way to separate faeces and urine without limiting animal movement. Collection period extended for 7 days, where, daily feces excreted by each lamb were weighed and samples were preserved by freezing. During this period consumed feeds were accurately recorded.

Chemical analysis

Representative samples were dried at 60ºC in a forced-air oven for 48 h. After drying silage samples were ground through a 1 mm screen. Chemical analysis was performed in duplicate according to methods described by AOAC (2005). DM was analyzed by drying the samples at 105ºC overnight. Organic matter (OM) content was determined by ashing in a muffle furnace at 500 ºC for 4 h. Ether extract (EE) content was determined by hexane extraction using Soxhlet method. CP content was determined as N × 6.25 by S4 Kjeltec System using Kjeldahl method. Cell wall components (cellulose, hemicellulose and lignin) were determined according to Goering and Van Soest (1970) using Dosi-fiber and cellulose extractor.

Silage fermentation and quality

Sensory characteristics including color, odor, texture and existence of fugi were performed as described by Saeed (2015). Water extract of silage samples was prepared according to method described by Levital, et. al., (2009). pH was immediately determined in water extract. Concentrations of ammonia N (NH_3-N) and total volatile fatty acid (TVFA) were determined according to AOAC (2005) and Markham (1942) respectively. DM loss was estimated on basis of weight of samples and DM content before and after ensiling (Nishino and Touno, 2005). Fleig point (Fp) was calculated according to equation used by Kilic (1986), depending on pH values and its content of DM: Fp = 220 + (2 × DM5% - 15) – 40 × pH. Silage quality index for Fp is as follows: 80-100, very good; 60-80, good; 40-60, moderate; 25-40, satisfying and <25 points, worthless. Aerobic stability was determined on basis on time passed before temperature was raised with 2 Cº above ambient temperature (Levital, et. al., 2009). Buffering capacity was determined using method described by Playne and McDonald (1966).

Statistic analysis

Data were statistically analyzed according to factorial experiment 2×3 in CRD design using statistical analysis system (SAS, 2010). Means were separated using Duncan (1955) multiple range test.

Results and discussion

Sensory characteristics of sialge

After ensiling silos were opened, it was shown that SR0 and RS1 were colored with yellowish green, whereas, RS2 samples were colored with dark brown. Similar result was obtained by Caluya (1995). This may attributed to breakdown of chlorophil during ensiling (Catchpool and Henzell, 1971). RS0 samples were characterized with fruity vineger odor; this may refere to the completeness of fermentation and increase lactic acid concentration (Ostling and Lindgren, 1993). RS1 and RS2 samples showed a smell of diluted and concentrated date's vinegar respectively. This may due to existence of organic acids produced from anaerobic oxidation (Catchpool and Henzell, 1971).

RS0 samples were somewhat loosly connected, whereas, RS1 and RS2 samples were moderate and firmly connected respectively. This may associated with nature of fermentation and end products, as well as, compation level practiced in preparing silages. No moulding was observed in RS2 samples, with very little and little moulding in RS1 and RS0 respectively. Due their anti fungal activity, urea and ammonia released from its degradation during ensiling may participate in protection silage from moulding activity (Kung, *et al.*, 2000).

Silage fermentation and quality characteristics

Silage fermentation and quality characteristics are shown in table 2. Results revealed that RS0 had lower pH ($P<0.01$) than RS1 and RS2. Values were increased ($P<0.01$) with increasing urea level. This may due to insufficient effect of water soluble carbohydretes (WSC) (Shahsavan, 2009), and its role to stimulate silage fermentation (McDonald, *et al.,* 1991). Higher values were associated with ammonia concentration released from degradation of urea during ensiling (Saeed, 2012). Similarly, NH_3-N concentrations were increased ($P<0.01$) with each increase in the level of urea; values were 12.31, 20.99 and 33.83% of total N in RS0, RS1 and RS2, respectively. In addition to degradation of urea, presence of mmonia in silage is a result of protelolysis naturally accurring during ensiling (Abarghoei, *et al.*, 2011), attributed to activity of plant enzymes (Heron, *et al.,* 1986). Higher ($P<0.01$) total volatile fatty acids (TVFA) values were determined in RS0 and RS2, respectively (11.30 vs. 17.52% % of DM). Increased TVFA concentrations in RS1 and RS2 may be attributed to improve digestion of cell wall components (table 7). Improve digestion of structural carbohydrates of reed silage due to addition of urea may provide additional amounts of soluble carbohydrates and consequently, increase TVFA concentration resulted from anaerobic bacterial fermentation of sugars (Azim, *et al.,* 1992).

Table 2- Silage fermentation and quality characteristics

Fermentation parameters	RS0	RS1	RS2	Significant effect and SE	
pH	3.75^{c}	4.30^{b}	6.70^{a}	**	± 0.03
NH_3-N, % TN	12.31^{c}	20.99^{b}	33.83^{a}	**	± 0.37
TVFA, % DM	11.30^{c}	14.43^{b}	17.52^{a}	**	± 0.21
DM loss, %	17.73^{b}	14.05^{c}	22.80^{a}	**	± 0.14
Fp	132.98^{a}	115.46^{a}	$<25^{b}$	**	± 11.97
AS, hours	31.5^{b}	38.5^{a}	39.5^{a}	**	± 0.56

Fp, Fleig points, AS, aerobic stability; Means with horizontly different letters are differed significantly; * ($P<0.05$) ** ($P<0.01$) NS=non-significant

Results also revealed that lower ($P<0.01$) DM loss was estimated with RS1, whereas, higher ($P<0.01$) loss was estimated with RS2, where, values were 14.05 and 22.80% respectively. Similar results were obtained by Saeed (2015), who reported a significant decrease ($P<0.01$) in DM loss of reed silage prepared with addition of soybean as compared with urea. This may attribute to delying or imbedding silage fermentation as affected by ammonia released from breakdown of urea. Tapia, *et al.*, (2004) demonstrated that recovering higher levels of nutrients in silage was associated with time required for completeness of fermentation.

Regarding Fleig points (Fp), it was noticed that better values ($P<0.01$) were estimated in RS0. Yilmaz and Gürsoy (2004) indicated that addition of molasses improved fermentation and increase Fp. However, addition of urea in a current study decreased ($P<0.01$) Fp values to be less than 25 at the high level of urea. This finding agreed with those observed by Saeed (2012, 2015), in which there was a descending changes of Fp values with increasing level of urea. Similar trend for aerobic stability (AS) were also shown. Oude Elferink, et. al., (1999) confirmed previous results that addition of urea or ammonia improved AS due to its anti fungal growth effect (Kung, *et al.,* 2000). Lower ($P<0.01$) values were observed in RS0 samples. Muck and Kung (1977) pointed out that ensuring anaerobic condition during ensiling and rapid production of acid through homofermentation of lactic acid can be harmfull to aerobic stability. This is because lactic acid per se is not active agent against fungi (Moon, 1983). In addition, lactic acid can be metabolized by yeasts when silo is opened and silage is exposed to air (Kung and Ranjit, 2001).

Voluntary intake of diets

Intake data is shown in Table 3. Lambs consumed higher ($P<0.01$) DM of fresh reed (DMI) and total DM (TDMI) as compared with reed silage. Values were 333.19 and 752.76 g vs. 217.51 and 609.20 g/day for fresh reed and silage respectively. However, there was no significant difference in digestible DMI (DDMI). This agreed with results obtained by Taha and Ghazi (1993), which revealed that ewes consumed higher DM of reed hay and straw than reed silage. Priority of fresh reed may attribute to presence of organic acids. Robin (2005) reffered to decline palatability of silage due to high concentration of acetic and butyric acids, this in turn may decrease intake of silage. Silage NH_3-N concentration was proved to be negatively correlated with intake of silage. Cushnahan, *et al.,* (1995) indicated that increase ammonia and butyric acid concentratios decreased intake of silage. Moreovr, intake of silage can be highly affected by low silage pH, because this may lower rumen pH and decrease intake due to reduction of cellulolytic activity (Huhtanen, *et al.,* 2002).

Table 3- Effect of ensiling and level of urea on intake of diets (g/day)

Intake g/day	Ensiling (A)		Urea levels (B)			Significant effect		
	silage	reed	0	1	2	SE	A	B
RDMI	217.51[b]	333.19[a]	238.04	285.25	302.77	±16.89	**	NS
TDMI	609.20[b]	752.76[a]	624.89	707.46	710.59	±25.68	**	NS
DDMI	406.93	467.97	394.26	460.21	457.88	±16.24	NS	NS
RNI	2.62[b]	4.81[a]	2.30[c]	3.88[b]	4.97[a]	±0.36	**	**
TNI	10.62[b]	13.37[a]	10.19[b]	12.50[a]	13.30[a]	±0.53	**	**
DNI	7.13[b]	9.35 [a]	6.72[b]	8.70[a]	9.30[a]	±0.42	**	**

RDM, roughage dry matter intake, TDMI, total dry matter intake, DDMI, digestible dry matter intake, RNI, roughage nitrogen intake, TNI, total nitrogen intake, DNI, digestible nitrogen intake
Means with horizontly different letters are differed significantly; * (P<0.05) ** (P<0.01) NS=non-significant

Regarding effect of urea level, lambs consumed higher DM and TDMI due to addition of higher level of urea, 302.77 and 710.59 vs. 285.25 and 707.46 g/day for high and low level respectively, whereas, slightly higher TDMI was assosaited with low urea level (460.21 vs. 457.88 g/day respectively). Lower DMI, TDMI and DDMI of FR0 were noticed, 238.04, 624.89 and 394.26, respectively. Similar results were obtained by Al-Mashhadany (2000), where, average DMI, TDMI of reed were improved due to urea treatment. Hassan, *et al.,* (1998) reported that urea treatment increased N content and stimulated breakdown linkages between cellulose and hemicellulose and with lignin, then higher amounts of structural carbohydrates may expose to microbial activity leading to increase intake of treated reed.

Results also revealed that lambs consumed higher (P<0.01) quantity of N (all forms) as compared with silage, 4.81, 13.37 and 9.35 vs. 2.62, 10.62 and 7.13 g N from roughage, total N (TN) and digestible N (TN), respectively. Urea treatment increased (P<0.01) roughage N intake. As expected, roughage N intake was increased with increasing urea level, 2.30, 3.88 and 4.97 g/day for 0, 1 and 2% level of urea respectively.

Interaction effect between ensiling and urea levels is shown in table 4. Results revealed that higher (P<0.05) DM was consumed by lambs fed fresh reed regardless to urea levels and urea treated reed silage as compared with reed silage prepared without urea. FR1 recorded higher DMI, TDMIand DDMI, whereas, FS0 recorded the lower value, 352.01, 789.09 and 487.18 vs. 166.25, 537.47 and 346.50 g/day respectively. As expected, higher (P<0.05) RNI was consumed by lambs fed urea treated fresh reed as ompared with other groups. However, higher (P<0.05) TNI and DNI were consumed by lombs fed FR2, FR1 and RS2.

Table 4- Effect of interaction between ensiling and urea level on intake of diets (g/day)

Roughage, R	Reed silage			Fresh reed			Sigbificant level & SE	
Urea level, %	0	1	2	0	1	2		
RDMI	166.25[c]	218.50[bc]	267.80[ab]	309.83[a]	352.01[a]	337.74[a]	±16.89	*
TDMI	537.47[b]	625.84[ab]	664.30[ab]	712.31[a]	789.09[a]	756.88[a]	±25.68	*
DDMI	346.50[b]	433.24[ab]	441.05[ab]	442.02[ab]	487.18[a]	474.72[a]	±16.24	*
RNI	1.55[c]	2.65[bc]	3.67[b]	3.04[b]	5.11[a]	6.27[a]	±0.36	*
TNI	9.12[c]	10.97[bc]	11.78[abc]	11.26[bc]	14.03[ab]	14.83[a]	±0.53	*
DNI	5.99[c]	7.63[bc]	7.78[bc]	7.46[bc]	9.78[ab]	10.83[a]	±0.42	*

RDM, roughage dry matter intake, TDMI, total dry matter intake, DDMI, digestible dry matter intake, RNI, roughage nitrogen intake, TNI, total nitrogen intake, DNI, digestible nitrogen intake;
Means with horizontly different letters are differed significantly; * (P<0.05) ** (P<0.01) NS=non-significant

Weight gain and feed conversion ratio

Results shown in table (5) revealed that there were no significant differences among lambs in final weight, however, lambs fed fresh reed recorded highr final weight as compared with lambs fed reed silage (27.18 vs. 25.93 kg, respectively). Similar results were obtained by Hassan, *et al.,* (2009) and Al-Saady (2009), where reed silage was ascendingly introduced in lambs diet instead of alfalfa hay without affecting final weight and total and daily weight gains. This difference may attribute to the effect of adaptation period that the current study began with. Higher final weight of lambs fed fresh reed may due to lower silage intake as compared with reed (table 3).

Table 5- Effect of ensiling and level of urea on average weight gain and feed conversion ratio

Items	Ensiling (A)		Urea levels (B)			Significant effect		
	silage	reed	0	1	2	SE	A	B
Initial weight, kg	20.41	21.10	20.75	21.09	20.42	± 0.64	NS	NS
Final weight, kg	25.93	27.18	26.55	27.23	25.88	±.71	NS	NS
Total weight gain, kg	5.52	6.08	5.80	6.14	5.46	± 20	NS	NS
Average daily gain, g/day	78.86	86.86	82.85	87.71	78.00	± 2.86	NS	NS
FCR, g DM/g ADG	7.73[b]	8.86[a]	7.53[b]	8.21[ab]	9.16[a]	± 0.29	*	*
FCR, g DDM/g ADG	5.17	5.52	4.75[b]	5.39[ab]	5.90[a]	± 0.20	NS	*

FCR, Feed conversion ratio; ADG, average daily gain
Means with horizontly different letters are differed significantly; * (P<0.05)

Regarding effect of urea level, higher final weight was observed at 1% as compared with 2% levels (27.23 vs. 25.88 kg, respectively). This may associated with palatability chracteristics. Al-Mashhadany (2000) attributed increase final weight of lambs fed ground urea-molasses treated reed to the appetite of animals and adaptation of rumen microbes to the diet.

Total gain of lambs was not significantly affected by ensiling though slight priority of reed in comparison with silage (6.08 vs. 5.52 kg, respectively). Taha, *et al.,* (1992) and Ahmad, *et al.,* (2009) reported similar trend. Total gain was not affected by level of urea; however, higher gain was recorded at lower level (6.14 kg) as compared with high level (5.46 kg). Similar results were obtained by Al-Mashhadany (2000).

Average daily gain (ADG) was not significantly affected by ensiling, though lambs fed fresh reed gained higher ADG than those fed silage, 86.86 vs. 78.86 g/day. Similar results were obtained by Hassan, *et al.,* (2009) and Ahmed, *et al.,* (2000). But Taha and Ghazy (1993) reported that ADG by lambs fed silage was significantly lower than those fed straw or reed hay. Insignificant differences in final and daily gain due to ensiling and urea levels in a current study may indicate that both varialbes were not negatively affected nitrogen retention and their positive effect on digestion of nutrients (table 7).

Results also reveled that lambs fed low level of urea gained higher mathematical ADG than those fed high level, 87.71 and 78 g/day respectively. This may be a result of negative effect of urea on palatability and its positive effect on digestion. Munthali, *et al.,* (1992) reported that improve weight gain of urea fed animals depends on utilization rate of the non protein nitrogen source which is affected by level of energy intake.

Regarding feed conversion ratio (FCR), results showed that ensiling improved ($P<0.05$) FCR, 8.86 vs. 7.74 g DM/g ADG. Ahmed, *et al.,* (2009) referred to the priority of lambs fed reed silage as compared with those fed reed. This can be explained by the significant ($P<0.01$) increase in reed intake in comparison with reed (table 3), in association with slight differenvce in ADG (table 5). Addition of urea seemed to had negative effect on FCR, where, lambs fed silage or reed without addition of urea consumed its diets more efficiently ($P<0.05$) than those fed diets treated with high level of urea (7.53 vs. 9.16 g DM/ g ADG). Similar results werer obtained by Elias and Fulpagare (2015) with silage of urea treated corn stover.

FCR estimated according to DDMI was not significantly affected by ensiling, though, there was slight priority toward lambs fed reed silage as compared with those fed reed (5.17 vs. 5.52 g DDM/g ADG). This may due to improve nutrients digestion as affecred by ensiling (table 7). FCR estimated on basis of DDMI showed that lambs were efficiently ($P<0.05$) consumed urea-untreated diets as compared with high urea-treated diets (4.75 vs. 5.90 g DDM/ g ADG). This may due to higher DDM consumed as affected by urea treatment (table 3). Correlation between FCR and intake of diet is cofirmned by Fouda (2005).

Regarding interaction between ensiling and urea levels, results shown in table 6 revealed higher final body weight was recorded by lambs fed FR1 as compared with those fed RS2 (28.16 vs. 25.30 kg). This difference may attribute to lower intake of urea-treated silage by lambs as affected by unpleasant odor of ammonia. Results also revealed that lambs fed FR1 gained higher ($P<0.05$) total and ADG as compared with lambs fed FR2 and RS1 with differences of 1.62, 76.42 and 1.67 kg, 75.71 g/day respectively.

FCR was also affected by interaction between ensiling and urea level. Lower ($P<0.05$) FCR was achieved by lambs fed RS0 as compared with lambs FR2, 6.62 vs. 9.94 g DM/ g ADG. Smiliarly, lambs fed RS0 lower ($P<0.05$) FCR estimated on basis of DDMI.

Table 6- Effect of interaction between ensiling and level of urea on weight gain and feed conversion ratio

Roughage, R	Reed silage			Fresh reed			Sigbificant level & SE	
Urea level, %	0	1	2	0	1	2		
Initial weight, kg	20.50	21.00	19.74	21.00	21.18	21.12	± 0.64	*
Final weight, kg	26.18	26.30	25.30	26.91	28.15	26.47	±.71	*
Total weight gain, kg	5.68[ab]	5.30[b]	5.56[ab]	5.91[ab]	6.97[a]	5.35[b]	± 20	*
Average daily gain, g/day	81.14[ab]	75.71[b]	79.42[ab]	84.43[ab]	99.57[a]	76.42[b]	± 2.86	*
FCR, g DM/g ADG	6.62[b]	8.27[ab]	8.40[ab]	8.50[ab]	8.16[ab]	9.94[a]	± 0.29	*
FCR, g DDM/g ADG	4.27[b]	5.73[a]	5.57[ab]	5.27[ab]	5.06[ab]	6.24[a]	± 0.20	*

FCR, Feed conversion ratio; ADG, average daily gain
Means with horizontly different letters are differed significantly; * (P<0.05) ** (P<0.01) NS=non-significant

Digestibility of nutrients

Effect of ensiling and urea levels on digestibility coefficients on dietary nutrients is shown in table 7. Ensiling improved (P<0.01) dry matter digestibility (DMD), 66.61 vs. 62.19% for reed silage and fresh reed, respectively. El-Talyt, et. al., (2015) observed similar results. This may due to improve digestion of plant cell wall components during ensiling. Saeed (2012) reported that a partial degradation of cell wall component was involved in ensiling as a result of silage microbes activity.

Although DM digestibility was not affected by level of urea, higher coefficients were associated with 1%, there was a 2.36% increase as compared with 0 level. Organic matter digestibility (OMD) responded to ensiling in the same way as DMD. Values were 70.01 and 64.10% for silage and fresh reed respectively. This can be explained by higher digestibility of OM components due to ensiling. Urea treatment had no effect on OMD; higher values were associated with 1% (68.31%) as compared with other levels, with slight difference between them (66.51 and 66.34% for 0 and 2% urea level respectively). Hassan, *et al.,* (1998) reffered to improvment of reed OMD due to urea treatment.

Results revealed that crude protein digestibility (CPD) was 2.56% higher (P<0.05) in fresh reed as compared with reed silage. CPD was highly (P<0.01) affected by urea level, coefficients were 69.60, 69.57 and 65.77% for 1, 2 and 0% urea levels, respectively. Improve CPD in urea-treated reed (silage or fresh) may attribute to providing ruminal microbes with additional N (Merchen and Satter, 1983). Degradation of urea during ensiling and partial attachment with reed may participate in this finding.

Table 7- Effect of ensiling and level of urea on nutrient digestibility

Items	Ensiling (A)		Urea levels (B)			Significant effect		
	silage	reed	0	1	2	SE	A	B
DMD	66.61[a]	62.10[b]	63.05	65.41	64.62	± 0.87	**	NS
OMD	70.01[a]	64.10[b]	66.51	68.31	66.34	± 0.82	**	NS
CPD	67.03[b]	69.59[a]	65.77[b]	69.57[a]	69.60[a]	± 0.72	*	**
EED	63.05[a]	56.38[b]	61.41[a]	60.42[ab]	57.31[b]	± 0.97	**	*
Cell-D	49.05[a]	43.07[b]	43.77	46.87	47.54	± 1.14	**	NS
Hcell-D	63.92	63.29	60.05[b]	61.15[b]	69.62[a]	± 1.35	NS	**

DMD, OMD, CPD, EED, Cell-D, Hcell-D, represent digestibility coefficients of dry matter, organic matter, crude protein, ether extract, cellulose and hemicellulose respectively.
Means with horizontly different letters are differed significantly; * (P<0.05) ** (P<0.01) NS=non-significant

Digestibility of ether extract (EED) was also affected (P<0.01) by ensiling. EED increased from 56.38 to 63.05%. This may due to role of silage microbes in metabolizing soluble sugar into VFA (Saeed and Mohammad, Unpublished data). Increasing urea level decreased (P<0.05) EED, this may attribute to basic effect of ammonia (table 2) released form breakdown of urea during ensiling that proved to slow rate or imbed fermentation.

Results also revealed that cellulose digestibility (Cell-D) was afeected (P<0.01) by ensiling. Cell-D coefficents were 49.05 and 43.07% for reed silage and fresh reed, respectively. Cellulolytic activity of silge microbes during ensiling may be responsible for that improvement in Cell-D (Saeed, 2012). Though, Cell-D was not significantly affected by urea level, higher coefficients were associated with higher levels, 47.54, 46.87 and 43.77% for 2, 1 and 0%, respectively. Conversely, hemicellulose digestibility (Hcell-D) was not affected by ensiling but highly (P<0.01) affected by urea treatment. Hcell-D coefficients were 60.05, 61.15 and 69.62% for 0, 1 and 2% levels of urea, respectively. This can be explained by enhancing growth of ruminal cellulolytic bacteria as affeced by ammonia (Alikhani, et. al., 2005). Though, there was no difference in Hcell-D due to ensiling in a current study, other studies referred to higher digestibility of this structural carbohydrate in silage by rams (Marei, 2007) and by lambs (Shwerab, *et al.*, 2010).

Table (8)- Effect of interaction between ensiling and urea level on nutrient digestibility

Roughage, R	Reed silage			Fresh reed			Sigbificant level & SE	
Urea level, %	0	1	2	0	1	2		
DMD	64.23^{ab}	69.20^{a}	66.42^{ab}	61.87^{b}	61.63^{b}	62.81^{b}	± 0.87	*
OMD	67.66^{bc}	72.39^{a}	69.98^{ab}	65.36^{cd}	64.24^{cd}	62.71^{d}	± 0.82	*
CPD	65.31^{c}	69.58^{ab}	66.20^{bc}	66.24^{bc}	69.56^{ab}	72.99^{a}	± 0.72	*
EED	63.82^{a}	63.91^{a}	61.44^{ab}	59.01^{ab}	56.94^{bc}	53.19^{c}	± 0.97	*
Cell-D	44.97^{abc}	50.32^{ab}	51.86^{a}	42.57^{c}	43.43^{bc}	43.22^{bc}	± 1.14	*
Hcell-D	63.03^{bc}	57.96^{c}	70.78^{a}	57.07^{c}	64.34^{abc}	68.46^{ab}	± 1.35	*

DMD, OMD, CPD, EED, Cell-D, Hcell-D, represent digestibility coefficients of dry matter, organic matter, crude protein, ether extract, cellulose and hemicellulose respectively.
Means with horizontly different letters are differed significantly; * (P<0.05) ** (P<0.01) NS=non-significant

On the other hand, results revealed that all digestibility coefficients were significantly (P<0.05) affected by interaction between ensiling and urea levels (table 8). Higher (P<0.05) DMD was achieved by lambs fed RS1 (69.20%). lower DMD was associated with fresh reed; coefficients were 61.87, 61.63% and 62.81% for FR0, FR1 and FR3 respectively. Rapid breakdown of urea by urease activity during ensiling (Saeed and Latif, 2008) may be a probable reason for improve DMD. Klopfenstein (1978) observed breakdown lignin-cellulose and hemicellulose linkages due to exposure of ensiled material to the effect of fermentation products (ammonia in particular). Moreover, poteantial relationship between increase digestion and decrease fiber content of silage was confirmed by Heron and Owen (1991).

Higher (P<0.05) OMD was achieved by lambs fed RS1 (72.39%) as compared with lower value of 62.71% recorded in FR2. However, higher CPD was observed (P<0.05) in FR2 as compared with other diets. Lambs fed RS1 diet digested ether extract with higher (P<0.05) coefficient (63.91%), whereas, lower EED was noticed in FR2 (53.19%). Higher EED of silage may refer to concentration of fatty acids and its availability to ruminal microbes. Arbabi and Ghoorchi (2008) pointed out to the presence of VFA as a result of anaerobic oxidation of soluble sugars during ensiling.

As expected, higher cellulose digestibility (Cell-D) was associated with silage and high level of urea. Higher and lower coefficients were 51.86 and 42.57% for RS2 and FR0 respectively. Although, there were no significant differences in Cell-D among reed silages regardless to urea level, it was increased with increasing urea level. Similar trend was noted in other study (Shwerab, et. al., 2010). Hemicellulose digestibility (Hcell-D) was affected ($P<0.05$) by interaction between ensiling and urea level. Higher coefficient was achieved by lambs fed RS2 diet as compared with those fed FR0 diet (70.78 vs. 57.07%).

Results of digestion in a current study clearly clarify priority of silage in comparison with fresh reed in digestibility of cell wall components. This can be explained by changes occurred during ensiling.

Conclusion

As shown, good quality silage can be prepared using whole reed plant (not green tops only) with addition of 10% dates honey and 1% urea, as evidenced by low pH, Fleig points and ammonia nitrogen. Higher urea level may require higher than 10% of this source of soluble sugars.

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