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Research Article

Feed Value of Cactus and Cactus Silage

Mustafa ÇÜREK
Institute of Science, Akdeniz University, Antalya - TURKEY
Nihat ÖZEN
Department of Animal Science, Faculty of Agriculture, Akdeniz University, Antalya - TURKEY

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Abstract: The nutrient composition, and feed value of cactus were evaluated through total collection and nylon bag techniques. In the first trial conducted with 3 Chios rams, digestion coefficients of dry matter, organic matter, crude protein, ether extracts, crude fiber and nitrogen-free extracts of cactus leaves (cladodes) and cactus silage were found to be 57.57, 79.20, 72.69, 79.13, 27.95 and 84.14%; 57.32, 69.40, 33.21, 90.10, 13.08 and 78.45%, respectively. The contents of digestible protein, ether exctracts, fiber and nitrogen-free extracts (dry matter basis) were as 3.55, 1.61, 6.77 and 63.33%; 2.14, 1.78, 7.71 and 52.35%, respectively. Depending upon the data above, starch unit (SU) and total digestible nutrients (TDN) of the same feeds were calculated (dry matter basis) as 58.10 and 42.80%; 61.20 and 46.37%, respectively. Dry matter degradation data of newly emerged leaves (named as young cladodes) and leaves ripened (named as old cladodes) and the silage of their mixture determined by means of nylon bag technique at 4, 8, 16, 24, 48, 72, 96 h following the rumen incubation with 3 cannulated Merino rams were 50.39, 56.36, 78.35, 77.78, 84.88, 84.95 and 82.01%; 43.58, 47.77, 50.26, 63.22, 66.23, 64.18 and 63.13%; 38.63, 39.99, 45.97, 57.58, 64.35, 67.91 and 71.77%, respectively. The in situ rumen dry matter degradation rates of young cladodes were significantly higher than those of the old ones and the silage at 4, 8, 16, 24 and 72 h at $P < 0.01$ and at 48 and 96 h at $P < 0.05$ levels. During the whole year, each months, old and young cladodes and their mixed silages were analysed in order to determine variations in their nutrient compositions. Statistical analyses indicated significant differences in nutrient compositions in terms of both young/old cladodes and months ($P < 0.01$). pH and organic acid determinations carried out after sensorial tests proved that old cladodes had better silage quality scores of old cladodes compared to the young cladodes. The results of this research indicated that cactus and cactus silage can be utilised efficiently as an alternative roughage in ruminant nutrition.

Key Words: Cactus, cactus silage, cladode, digestibility, dry matter degradation, nylon bag technique.

Kaktüs ve Kaktüs Silajının Yem Değeri

Özet: Kaktüslerin yem değerini saptamak amacıyla yapılan bu çalışma 2 bölüm halinde yürütülmüştür. 3 Sakız toklusuyla klasik sindirim denemesi şeklinde yürütülen ilk denemede, kaktüs yaprakları (kladotları) olduğu gibi ve silaj formunda incelenmiştir. Elde edilen verilerden yeşil kaktüste kuru madde, organik madde, ham protein, ham yağ, ham sellüloz ve azotsuz öz maddelerin sindirilme dereceleri, sırasıyla % 57.57, 79.20, 72.69, 79.13, 27.95 ve 85.14; silajında ise % 57.32, 69.40, 33.21, 90.10, 13.08 ve 78.45; kuru madde üzerinden sindirilebilir ham protein, ham yağ, ham sellüloz ve azotsuz öz madde içerikleri ise % 3.55, 1.61, 6.77, 63.33 ve % 2.14, 1.78, 7.71, 52.35 olarak bulunmuştur. Bu değerlerden de yeşil kaktüsün toplam sindirilebilir besin maddeleri (TSBM) değeri % 8.65 (KM üzerinden % 61.20) silajınınki ise % 9.27 (KM üzerinden % 46.37); nişasta birimi (NB) değerleri, yeşil kaktüste % 8.22 (KM üzerinden % 58.10) silajında % 8.63 (KM üzerinden % 42.80) olarak hesaplanmıştır. İn situ naylon torba tekniği ile yürütülen ikinci denemede kaktüsün, aynı yıla ait (genç) ve bir önceki yıla ait (eski) kladotları ile bunların karışık silajı, rumende kuru madde parçalanabilirliği bakımından ayrı ayrı incelenmiştir. Parçalanabilirlik 4, 8, 16, 24, 48, 72 ve 96. saatler için naylon keselerde rumen inkübasyonu ile belirlenmiştir. Genç sürgünlerin yukarıdaki süreler için kuru madde parçalanabilirlikleri, sırasıyla % 50.39, 56.36, 78.35, 77.78, 84.88, 84.95 ve 82.01; eski sürgünlerinki, % 43.58, 47.77, 50.26, 63.22, 66.23, 64.18 ve 63.13; silajınki % 38.63, 39.99, 45.97, 57.58, 64.35, 67.91 ve 71.77 olarak saptanmıştır. Genç sürgünlerin 4, 8, 16, 24 ve 72. saatlerde kuru madde parçalanabilirlikleri $P < 0.01$ ihtimal sınırında, 48 ve 96. saatlerde parçalanabilirlikleri ise $P < 0.05$ sınırında eski kladotlardan ve silajdan önemli derecede yüksek bulunmuştur. Bir yıl boyunca, her ay toplanan eski ve yeni sürgünlerle, bunların ayrı ayrı yapılmış silajları analiz edilerek, besin madde içeriklerindeki olası değişmeler incelenmiştir. Analizler hem eski ve yeni sürgünler arasında hem de aylara göre, önemli farklılıklar bulunduğunu ortaya koymuştur ($P < 0.01$). Aylık olarak toplanan yapraklardan hazırlanan silajlarda gerçekleştirilen duyusal değerlendirmelere ek olarak yapılan pH ölçümleri ve organik asit tayinleri, eski sürgünlerde silaj kalitesinin genç sürgünlerden daha iyi olduğunu göstermiştir.

Anahtar Sözcükler: Kaktüs, kaktüs silajı, kladot, kuru madde sindirilebilirliği, naylon torba tekniği.

Introduction

There is a serious shortfall in roughage production both quantitatively and qualitatively in Turkey, since many ranches and pastures have been transformed in to croplands. Most of the ranches and pastures remaining are common land belonging to villages rather than to individual families. As a result, most of these grassland areas have become very poor, due to insufficient management and lack of good care such as seeding, fertilization and irrigation (1). The shortfall is more severe during fall and winter, because silage making is not widespread. Artificial ranches and pastures do not exist. Therefore, low quality dry roughages such as wheat straw and chaff are still the main winter feeds.

Cactus seems at this point to be a good alternative roughage in some regions of Turkey and as well as all over the world for winter and fall (2). More than a million ha of cactus plantation exist in the world, and it is cultivated in many places such as Italy, Spain, the USA, South America, Israel, Turkey and the whole of Africa (3). It can grow easily even on the poorest land and is resistant to drought. Cactus leaves (cladodes) are utilized as feed in many countries such as Tunisia, Mexico, South Africa and the USA (Texas).

In the west and south coastal region of Turkey it grows widely and the fruit (cactus pear or prickley pear) is utilized as fresh food or in the jelly industry.

This experiment was conducted in order to determine the crude and digestible nutrient compositions, total digestible nutrients (TDN), and starch unit (SU) of fresh cladodes and their silage collected from cactus plants grown in the Antalya region through laboratory analysis, digestion trials and the *in situ* nylon bag technique, and also the qualitative characteristics of the silages through physical and sensorial evaluation tests.

Materials and Methods

Digestion trials

Three digestion trials were conducted: the first with alfalfa hay alone, the second with cactus cladodes in a ration containing 50% alfalfa hay and 50% cladodes, and the third with cactus silage, again, with a ration composed of 50% alfalfa hay and 50% silage.

Each diet was tested on 3 adult Chios rams for 30 days. Cactus cladodes were collected from 156 roots, chopped into 1 to 2 cm diameter cubes, and wilted under sunlight until achieving 35% dry matter (DM), before ensiling. Feces samples were collected during the last 10 days of each experiment. The material was ensiled in 100 kg barrels. In the experiment, all feeds and feces collected were analyzed for their nutrient compositions (4). Digestion coefficients and feed value as TDN and SU of both cladodes and the silage were calculated from the data obtained.

Both cladodes and the silage were evaluated through the *in situ* nylon bag technique on 3 fistulated adult Merino rams. Dry matter degradation rates at 4, 8, 16, 24, 48, 72, 96 h following rumen incubation were determined as explained by Mehrez and Orskov (5). In addition to digestive experiments, monthly evaluations were carried out. For this purpose, every month young and old cladodes were collected and ensiled in 2 l jars, separately. Both cladodes and silages were analyzed for nutrient contents, in order to determine if any change occurred during the year. In addition, the silages were scored through physical and sensorial tests, organic acid analysis and, pH measurements (Flieg method) (6,7).

Furthermore, statistical analysis was carried out through analysis of variance (8,9), and Duncan's Multiple Range test (10).

Results

Comparable data related to crude and digestible nutrient composition, and the feed value of cladodes and the silages (Table 1) indicated a remarkable decrease with ensiling in terms of all digestible organic materials such as crude protein (CP), ether extracts (EE) and N-free extracts (NFE) feed value (TDN and SU).

Dry matter degradation data collected with the nylon bag technique (Table 2) showed that the rumen degradation rate of young cladodes at 24, 48 and 72 h was significantly higher than that of the old ones; and the ensiling of young cladodes caused a significant decrease in degradability at all times. However, the effect of ensiling on the degradability of old cladodes at any time was not significant ($P > 0.05$).

Similiarly; it can be seen in Table 3 that washing losses (WL) in young cladodes were higher than those in both old cladodes and the silage.

According to the results of qualitative evaluation of silages prepared monthly, old cladode silages were always of better quality than the young cladode silages, except

Table 1. Crude and Digestible Nutrient Composition, Digestibility Coefficients of Nutrients and Feed Value of Cactus and Cactus Silage Determined by Digestion Trials (Moisture Free).

Nutr. and feed value	Cactus			Cactus silage		
	C. nutr., %	Digestib. %	Dig. nutr., %	C. nutr., %	Digestib. %	Dig. nutr., %
DM	14.15	57.57	8.15	20.00	57.32	11.46
OM	75.26	79.20	59.60	63.98	69.40	44.40
CP	3.55	72.69	2.58	2.14	33.21	0.71
CF	6.77	27.95	1.89	7.71	13.07	1.00
EE	1.61	79.13	1.27	1.78	90.10	1.60
Ash	24.74	-	-	36.02	-	-
NFE	63.33	85.14	53.92	52.35	78.47	41.08
TDN, %		61.20			46.37	
SU, g/kg		581			428	

Table 2. Potential Dry Matter Degradability of Cactus Cladodes and Cactus Silages (%).

Inc. time, h	Young cladodes	Old cladodes	Mixed silage
4	50.39 ± 1.85 a	43.58 ± 1.98 ab	38.63 ± 0.86 b
8	56.36 ± 1.55 a	47.77 ± 1.77 ab	39.99 ± 0.95 b
16	78.35 ± 6.19 a	50.26 ± 4.77 ab	45.97 ± 2.55 b
24	77.78 ± 2.55 a	63.22 ± 0.92 b	57.58 ± 1.34 b
48	84.88 ± 5.30 c	66.23 ± 0.26 d	64.35 ± 3.38 d
72	84.97 ± 0.33 a	64.18 ± 1.98 b	67.91 ± 1.20 b
96	82.01 ± 1.58 c	63.13 ± 1.33 cd	71.77 ± 5.99 d

Means with different letters at the same line differ significantly: a, b: $P < 0.01$; c, d: $P < 0.05$

Table 3. Washing Losses (WL), Potential Degradability (a + b), Degradation Rate Constant (c) and Residue Standard Deviation (RSD) Data of Cactus Cladodes and Cactus Silage (as is).

	WL %	(a+b) %	c faction/h	RSD
Young cladodes	37.70	84.10	0.104	3.59
Old cladodes	34.00	65.00	0.067	3.51
Mixed silage	31.70	72.88	0.033	2.48

for in January (Table 4). Both silages remained at at least "satisfactory" or "good" quality levels during the whole year except for the Flieg score of young cladodes in October (Tables 5 and 6).

Chemical analysis of cladodes collected each month indicated that the DM content of young cladodes was lower than that of old cladodes in all months except October (Table 7), while, DM showed a similiar tendency in silages for only 5 months, between June and December (Table 8). CP and NFE were higher in young cladodes than in old ones during the whole year (Table 7); however, CP contents of young silages were lower than those of old ones in August and April; in contrast, NFE figures of young silages were higher than those of old ones only for July, August and January (Table 8). EE (except June) and CF contents (except June, July and October) of the old cladodes were higher than those of young ones (Table 7); the young silages were superior to the old ones during the whole year in terms of CF and EE (Table 8).

Young cladodes were richer than the old ones, in terms of calcium (Ca), (except August and January), and phosphorus (P), even though the young ones were lower in ash content (Table 9).

The pH values of old cladode silages were lower than those of young ones in all months except November, indicating a better silage quality (Table 10).

Table 4. Monthly Evaluation of Cactus Silages through Sensorial Tests.

Month	Young cladodes		Old cladodes	
	Score	Quality	Score	Quality
Jun	17	Very good	14	Very good
Jul	18	Very good	18	Very good
Aug	14	Satisfactory	19	Very good
Sep	15	Satisfactory	20	Satisfactory
Oct	13	Satisfactory	13	Very good
Nov	16	Very good	17	Very good
Dec	14	Satisfactory	18	Satisfactory
Jan	17	Very good	13	Satisfactory
Feb	13	Satisfactory	14	Very good
Mar	15	Satisfactory	17	Very good
Apr	17	Very good	18	Very good
May	14	Satisfactory	15	Satisfactory
Mean	15.25	Satisfactory	16.33	Very good

Table 5. Monthly Evaluations of Cactus Silages by Flieg Scoring.

Month	Young cladodes		Old cladodes	
	Flieg s.	Quality	Flieg s.	Quality
Jun	100	Very good	99	Very good
Jul	69	Good	99	Very good
Aug	87	Very good	100	Very good
Sep	74	Good	95	Very good
Oct	53	Fair	73	Good
Nov	97	Very good	88	Very good
Dec	100	Very good	100	Very good
Jan	82	Very good	83	Very good
Feb	76	Good	75	Good
Mar	75	Good	85	Very good
Apr	83	Very good	100	Very good
May	80	Good	80	Good
Mean	81.33	Very good	89.75	Very good

Table 6. Monthly Variations in Organic Acid Contents of Cactus Silages, %.

Months	Young cladodes					Old cladodes				
	Lac. a. %	Ace. a. %	But. a. %	Score	Quality	Lac. a. %	Ace. a. %	But. a. %	Score	Quality
Jun	2.80	1.20	0.30	70	Good	3.13	1.90	0.60	70	Good
Jul	2.34	1.52	0.33	70	Good	2.48	2.67	0.44	70	Good
Aug	2.14	1.70	0.40	70	Good	3.01	1.50	0.30	70	Good
Sep	2.96	1.40	0.45	70	Good	2.71	0.83	0.30	70	Good
Oct	2.54	1.58	0.20	70	Good	3.25	1.47	0.24	70	Good
Nov	2.48	1.35	0.50	70	Good	3.25	1.67	0.12	70	Good
Dec	2.56	1.80	0.30	70	Good	3.56	1.06	0.30	70	Good
Jan	2.69	1.57	0.40	70	Good	3.47	0.90	0.40	70	Good
Feb	2.98	1.84	0.30	70	Good	3.14	1.32	0.24	70	Good
Mar	2.87	1.32	0.24	70	Good	3.98	1.62	0.31	70	Good
Apr	2.34	1.67	0.40	70	Good	3.37	1.09	0.33	70	Good
May	2.85	1.42	0.30	70	Good	3.09	1.71	0.15	70	Good
Mean	2.59	1.53	0.34	70	Good	3.20	1.52	0.31	70	Good

Table 7. Monthly Variations in Nutrient Composition of the Young and Old Cladodes (DM basis %).

Month	DM			CP			CF			EE			NFE		
	Young	Old	M	Young	Old	M	Young	Old	M	Young	Old	M	Young	Old	M
Jun	10.21	12.01	11.11 c	5.55	4.62	5.08 c	6.31	5.55	5.93 i	1.91	1.37	1.64 i	64.82	60.00	62.41 d
Jul	10.43	15.13	12.78 a	7.22	4.07	5.64 a	6.91	6.55	6.73 e	1.73	2.15	1.94 g	66.22	57.57	61.90 c
Aug	11.04	14.39	12.71 a	4.68	4.05	4.36 e	4.78	4.90	4.84 j	1.08	2.11	1.59 j	65.86	61.60	63.73 a
Sep	7.97	9.13	8.55 k	6.67	4.23	5.45 b	6.52	6.94	6.73 e	1.56	2.54	2.05 f	60.08	57.84	58.96 g
Oct	11.83	11.22	11.52 b	4.67	3.83	4.02 f	7.66	7.06	7.36 c	2.04	3.33	2.71 a	61.48	58.30	59.89 f
Nov	8.61	9.02	8.81 j	4.58	3.07	3.82 g	5.32	7.34	6.33 g	1.36	2.56	1.96 g	55.28	60.57	62.97 b
Dec	8.36	10.53	9.44 h	3.78	3.03	3.40 h	6.21	8.60	7.41 b	1.57	2.28	1.92 g	60.29	56.26	58.27 i
Jan	9.07	11.51	10.29 e	3.95	2.96	3.45 h	7.50	7.93	7.71 a	1.96	2.82	2.39 c	62.44	60.05	61.24 e
Feb	7.60	11.53	9.57 g	5.32	4.05	4.68 d	6.33	7.78	7.05 d	2.07	3.01	2.54 b	55.19	51.68	53.43 j
Mar	9.31	10.57	9.94 f	4.62	2.15	3.38 h	5.46	6.62	6.04 h	1.54	2.13	1.84 h	64.73	62.66	63.70 a
Apr	8.64	9.75	9.19 i	3.22	2.81	3.01 i	6.53	8.33	7.43 b	1.24	2.95	2.09 e	63.72	53.52	58.62 h
May	9.71	11.32	10.51 d	4.12	3.75	3.93 gf	5.30	7.81	6.55 f	1.82	2.64	2.23 d	66.55	59.38	62.97 b
Mean	9.39	11.34	10.36	4.86	3.55	4.18	6.23	7.11	6.67	1.65	2.49	2.07	59.72	58.28	60.67

Means with different letters at the same column differ significantly ($P < 0.01$).

Table 8. Monthly Variations in Nutrient Composition of the Young and Old Cladode Silages (DM basis %).

Months	DM			CP			CF			EE			NFE		
	Young	Old	Mean	Young	Old	Mean	Young	Old	Mean	Young	Old	Mean	Young	Old	Mean
Jun	31.22	25.64	28.93 b	4.26	3.43	3.85 b	7.10	6.25	6.67 g	2.14	2.01	2.08 d	57.20	68.51	62.86 d
Jul	15.35	23.52	19.43 g	3.76	3.70	3.73cb	8.51	7.23	7.87 a	2.35	2.11	2.23 cb	62.64	58.75	60.70 b
Aug	15.34	23.82	19.58 f	3.33	3.83	3.58 cde	6.91	5.84	6.37 h	2.87	1.96	2.42 a	62.13	61.60	61.86 c
Sep	12.63	16.67	14.65 j	4.60	3.60	4.10 a	7.33	6.52	6.92 f	1.95	1.51	1.73 g	57.36	58.15	57.76 f
Oct	14.06	14.11	14.08 k	4.01	3.20	3.60 cd	8.73	7.05	7.89 a	2.02	1.74	1.88 f	51.08	57.63	54.35 i
Nov	26.64	27.81	27.22 c	3.06	2.93	3.00 f	7.73	6.23	6.98 e	2.04	1.83	1.93 e	61.96	64.20	63.08 a
De	35.42	23.62	29.52 a	3.60	2.40	3.00 f	8.93	6.75	7.84 a	2.56	1.93	2.24 b	57.34	57.79	57.56 f
Jan	16.40	9.94	13.17 l	2.89	2.53	2.71 g	8.11	6.73	7.42 d	2.37	2.01	2.19 c	57.47	57.00	57.23 g
Feb	17.94	12.36	15.15 i	4.09	3.50	3.79 cb	9.01	5.87	7.44 d	2.74	2.12	2.43 a	47.53	54.06	50.79 j
Mar	20.12	19.31	19.71 e	3.57	3.23	3.40 de	8.50	6.74	7.62 c	1.93	1.43	1.68 h	57.38	62.63	60.00 e
Apr	23.42	21.64	22.53 d	3.36	3.40	3.38 e	7.93	5.33	6.63 g	2.40	1.76	2.08 d	58.74	60.97	59.86 e
May	18.50	17.85	18.17 h	3.70	3.13	3.41 de	8.11	7.23	7.67 b	2.64	2.14	2.39 a	54.32	56.93	55.63 h
Mean	20.59	19.69	20.18	3.68	3.24	3.46	8.07	6.48	7.28	2.33	1.87	2.11	57.09	59.85	58.47

Means with different letters at the same column differ significantly ($P < 0.01$).

Table 9. Monthly Changes in Ash, Ca and P Contents of Young and Old Cladodes (DM basis, %).

Months	Young cladodes			Old cladodes			Mean		
	Ash	Ca	P	Ash	Ca	P	Ash	Ca	P
Jun	21.40	6.20	0.56	28.45	4.80	0.33	24.93	5.5	0.44
Jul	17.90	10.41	0.62	29.64	8.62	0.40	23.77	9.5	0.51
Aug	23.59	3.93	0.39	27.33	5.95	0.31	25.46	4.9	0.35
Sep	25.15	9.06	0.70	28.44	7.06	0.64	26.79	8.06	0.67
Oct	24.14	7.33	0.59	27.87	6.53	0.49	26.00	6.93	0.54
Nov	23.45	10.56	0.74	26.34	5.21	0.68	24.89	7.88	0.71
Dec	28.14	7.91	0.48	29.81	7.85	0.44	28.97	7.8	0.46
Jan	24.14	6.22	0.64	26.23	7.96	0.57	25.18	7.0	0.60
Feb	31.08	8.63	0.55	33.47	7.97	0.43	32.28	8.3	0.49
Mar	23.63	7.68	0.82	26.42	4.75	0.74	25.02	6.2	0.78
Apr	25.28	7.36	0.73	32.37	6.25	0.61	28.83	6.8	0.67
May	22.19	7.39	0.46	26.40	5.78	0.38	24.30	6.5	0.42
Mean	24.17	7.72	0.60	28.56	6.56	0.50	26.36	7.11	0.55

Table 10. Monthly Changes in pH of Young and Old Cladode Silages.

Months	PH		
	Young clad. silages	Old clad. silages	Mean
Jun	4.06	3.94	4.00
Jul	4.18	3.81	3.99
Aug	3.71	3.65	3.68
Sep	3.90	3.58	3.74
Oct	4.50	4.00	4.25
Nov	4.03	4.30	4.16
Dec	4.10	3.76	3.93
Jan	3.89	3.54	3.71
Feb	4.12	3.87	3.99
Mar	4.25	3.96	4.10
Apr	4.23	3.58	3.90
May	4.05	4.01	4.03
Mean	4.08	3.83	3.95

Discussion

The decrase with ensiling in terms of organic materials and feed value (TDN and SU) could be attributed to the nutrient losses that occurred during ensiling. It was reported in the literature that cactus is comparable to mid quality grass hay in terms of its digestible energy (1), and to legume grass hays (11); however, cactus silage is somewhere between grass hays and straws (11). Dry matter degradation rates and WL, (a+b), c and RSD data presented in Tables 2 and 3 show that potential degradability (a+b) and degradation rate constant (c) of young cladodes during the whole incubation period were also higher than the others also indicating that the young cladodes have the highest consumption rate. Residue standard deviation (RSD)

values around 3 (or even less than 3), confirm that the data obtained from this experiment could be utilized in the evaluation of feed value of the material tested.

The chemical analysis presented in Tables 7 and 8 supported the findings of Nefzaoui and Ben Salem (1) in terms of dry matter content; again, Nefzaoui and Ben Salem (1), Anonymous (11) and Felker (2) in crude protein; Nefzaoui and Ben Salem (1), Anonymous (11) and Saenz -Hernandez (12) in ether extracts and N-free extracts; while, contradicted the reports of Anonymous (11) and Teles et. al. (13) in dry matter; Gregory and Felker (14) in crude protein; Nefzaoui and Ben Salem (1), Anonymous (11) and Saenz-Hernandez (12) in crude fiber.

The ash data optained from this experiment were higher than those reported by Anonymous (11) and Gregory and Felker (14). Similiarly, phosphorus data were also higher than those given in the same report and calcium data reported by Felker (2). However, the calcium figures were found to be comparable to those reported by Nefzaoui and Ben Salem (1) and Anonymous (11), ash content to data reported by Nefzaoui and Ben Salem (1).

The good quality of cactus silages in all aspects, despite the high ash content, could be attributed to high NFE levels.

Variations in all nutrient contents of both young and old cladodes and silages were neither consistent nor attributable to seasonal climatic conditions.

In summary, a comparison of cactus cladodes and cactus silage with some common feeds utilized in animal nutrition (Table 11) indicates that both cactus cladodes and cactus silage are lower particularly in DM and CP than most of the others. They are not very suitable for use as the only roughage in ruminant diets. However, they could be a good alternative feed if utilized together with roughages high in DM, protein and even energy; thus, they can be helpful in preventing green feed shortages, especially during the winter; some digestive disturbances such as constipation and probably colitis related to excessive dry feeds can also be prevented.

Table 11. Comparison of Cactus Cladodes and Cactus Silage with Some Common Feeds.

Feeds	DM %	CP %	TDN %	SU g/kg
Cactus	14.1	3.55	61	581
Cactus silage	20	2.1	46	428
Beet, common	11	13.2	86	687
Sugar beet pulp	10	9.0	75	607
Corn silage	26	6.1	61	603
Wheat straw	90	3.6	38	340
Sugar beet molasses	77	8.7	75	661
Grass hay	91	8.1	56	370

Kılıç (7); Anonymous (11); Ozen (15); Işık (16).

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