SHORT NOTE

The nutritive value and antinutritional factors in mesquite (*Prosopis chilensis* L.) leaves

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Mesquite (*Prosopis chilensis* L.) is a leguminous browse tolerant to harsh environments and was introduced into the Sudan in afforestation programmes and as animal feed (Elamin, 1990). It is now widely distributed in central, eastern and western regions of the Sudan (Elamin, 1990) and is a hazard in irrigated schemes. Pods and leaves have high CP (Ibrahim and Gaili, 1983; Elimam and Babiker, 2000). Pods are highly palatable and leaves are generally unpalatable except *P. sprigera* (Abdelgabar, 1986) and dried leaves are partially palatable. Enhancing leaves consumption provides a valuable animal feed and is an effective tool for controlling mesquite. However, there is no available information on improving mesquite leaves palatability. Consequently, the effects of drying, boiling and pods syrup addition on mesquite leaves nutritive value, condensed tannins, alkaloids, palatability and degradation in the rumen of goats were studied.

The studies described below were conducted in the premises of the Goat Research Centre in Elneshasheba farm in Wad Medani, Gezira State, Sudan, during 2002.

In the first experiment mesquite leaves proximate analysis, antinutritional factors and goat preference were determined. Mesquite fresh leaves and dry mature pods were collected from different sites in Elneshasheba Farm in Wad Medani in the Gezira State, Sudan. Fresh leaves were divided into equal parts and were sun cured for 24 hrs, dried in an oven at 100^0C for 24 or 48 hrs, boiled in equal weights of water for 30 minutes, 1 or 2 hrs or left as control. Mature pods were boiled for 2 hrs in an equal weight of water and the syrup was added to one half of fresh and treated leaves and thoroughly mixed. Samples of fresh and treated mesquite leaves were stored and used for proximate analysis and tannins and alkaloids analysis. The Preference of fresh and treated mesquite leaves was studied in Nubian goats in a cafeteria test.

Eight Nubian goats about 3-4 years old and weighing on average 35-40 kg were used in this experiment. Four animals were familiar with mesquite leaves and pods and the others were not familiar with it. The animals were not fed overnight and the experimental diets were offered in a cafeteria test at 9.0 am. Three hundred grams of fresh and treated mesquite leaves were placed on paper on the floor in front of each animal. The animals were observed and intake was recorded.

In the second experiment, the degradation of fresh and treated mesquite leaves was determined in three rumen fistulated female Nubian goats using artificial fibre bags as described by Orskov *et al.*

(1980). They were about 3 years old and weighing on average 35kg. They were bought from Wad Medani livestock market.

Samples of fresh and treated mesquite leaves were used for proximate analysis as described by AOAC (1984). Fresh and treated leaves were also analyzed for condensed tannins according to Le Feuvre and Jones (1998). Alkaloids were extracted and determined using thin layer chromatography as described by Harris and Wilson (1988). Residues in the bags for each incubation time in the three animals were mixed for each leaves preparation and used for CP, CF and ash analysis as described before. The proximate analysis and alkaloids in fresh and treated mesquite leaves are shown in Table 1. There were variations in the proximate analysis of fresh and treated mesquite leaves. Crude protein increased by drying for 24hrs and boiling, especially for 1hr. Syrup addition increased CP in fresh and treated leaves and the effect was least at 48 hrs drying and highest at 30 min boiling. Crude fibre and EE decreased by drying, boiling and syrup addition. Ash increased by drying and syrup addition and decreased by boiling. Crude protein was close to that reported by Abdelgabar (1986) and
lower than in mature leaves (Elimam and Babiker, 2000). Ether extract was higher than that in the Gezira (Elimam and Babiker, 2000) and Khartoum (Abdelgabar, 1986). Crude fibre was very high compared to that in the Gezira (Elimam and Babiker, 2000) and was higher than in Khartoum (Abdelgabar, 1986). Ash was higher than in the Gezira (Elimam and Babiker, 2000) and lower than in Khartoum (Abdelgabar, 1986). The variations between locations could be environmental and /or due to strains.

Table 1. The proximate analysis (%) and alkaloids in fresh and treated mesquite (*P. chelensis*) leaves in the Gezira State, Sudan.

Treatments	DM	CP	EE	CF	Ash	NFE	Alkaloids
F	53.2	14.0	4.8	28.1	09.3	43.8	+++
D:24 hr	98.1	17.5	4.2	21.6	12.0	44.7	++
:48 hr	97.1	14.0	3.9	21.1	11.5	49.5	+
B:30 min	98.1	17.5	4.8	24.5	10.0	43.2	++
:1.0 hr	97.9	21.0	3.5	27.7	09.0	38.8	+
:2.0 hr	97.6	17.5	3.0	26.1	07.5	45.9	+
F + S	98.8	17.5	3.9	20.6	13.7	44.8	+
D +S:24hr	97.8	17.5	4.8	21.3	12..9	43.5	+
:48hr	89.5	14.5	4.8	20.8	11.2	49.1	+
B+S:30min	98.2	22.8	4.5	25.3	10.0	37.4	++
:1.0hr	98.7	18.7	3.4	25.5	07.3	45.1	+
:2.0 hr	98.5	17.5	3.5	23.1	09.0	46.9	+

DM= Dry matter. CP= Crude protein. CF = Crude fibre. EE= Ether extract.
NFE = Nitrogen free extract. F= Fresh. D= dried. B= Boiled. S= Syrup.
+ = Very low alkaloids, ++ = Low alkaloids and +++ = Medium alkaloids.

The treatments affected fresh leaves proximate analysis. Sun curing for 24 hrs improved CP and reduced alkaloids and boiling increased CP, especially for 1hr. The increased CP in leaves could be due to destruction of some cell components and N in alkaloids. The decreased EE with drying and boiling could be due to loss of soluble and volatile substances. The decreased CF by drying and boiling

could be due to extraction of soluble constituents in fibres. The effects of drying were larger than boiling and time had little effects.

Condensed tannins were not detected in fresh and treated leaves. Alkaloids in leaves decreased by drying and boiling for 30 min and increased by boiling for 2hrs. Syrup addition had no effects on alkaloids in fresh leaves and decreased it in leaves boiled for 1 and 2 hrs. Goats not familiar with mesquite leaves did not consume fresh or treated leaves and those familiar with mesquite consumed some dried leaves and green pods in the fence.

Table 2 shows mean rumen degradation of fresh and treated mesquite leaves in the rumen of Nubian goats. Degradation generally increased with increasing incubation times. There were variations in DM, CP, CF and OM degradation and it was generally highest for CP and least for CF. Degradation was highest for CP, DM and OM in fresh leaves with syrup and least for CF in leaves boiled for 30 min. Degradation of fresh and treated leaves increased by syrup addition and decreased by drying and boiling.

Syrup addition substantially increased CP degradation in fresh and treated leaves and it was decreased at 24hrs drying. Boiling decreased CP degradation and the effect was higher without syrup. The degradation of OM in fresh leaves increased with syrup addition and generally decreased by drying. Crude fibre degradation in fresh leaves was not affected by syrup addition and was depressed by drying and boiling. Syrup addition decreased CF degradation in dried leaves, especially at 48 hrs.

The reduced degradation of leaves by drying and boiling with no effects on palatability indicated that other factors are involved in mesquite leaves palatability in goats. However, it is generally accepted that feeds palatability is not important for goats (Devendra and Mc Leroy, 1982). Alkaloids depressed feed intake and nutritive value (Van Soest, 1982; Mukisira *et al.*, 1995). The results provided interesting information on feed intake control in goats and more research is required to understand factors affecting feeds palatability.

Table 2. Mean degradation (%) of fresh and treated mesquite leaves in the rumen of Nubian goats in the Gezira State, Sudan.

Treatment	Incubation period (hrs)	DM	CP	OM
Fresh leaves	6	40.3 ± 4.03	76.2 ± 2.19	66.7 ± 2.25
	18	41.9 ± 4.65	77.0 ± 1.7	67.5 ± 3.12
	30	50.1 ± 2.29	70.0 ± 1.4	72.6 ± 1.32
	48	51.1 ± 3.69	70.8 ± 2.70	73.7 ± 1.89
Dried: 24hr	6	16.4 ± 2.52	26.0 ± 2.12	17.8 ± 2.43
	18	23.2 ± 4.22	54.8 ± 2.48	20.2 ± 4.39
	30	28.4 ± 0.21	50.7 ± 0.15	25.8 ± 0.17
	48	32.3 ± 4.12	52.9 ±2.85	31.4 ± 4.26
: 48hr	6	19.2 ± 1.59	11.4 ± 1.70	15.8 ± 1.59
	18	18.8 ± 2.24	13.7 ± 4.35	17.1 ± 4.20
	30	26.7 ± 1.44	19.6 ± 1.57	24.5 ± 1.32
	48	30.8 ± 3.43	24.2 ± 3.79	29.4 ± 3.54
Boiled: 30 min	6	10.3 ± 4.31	47.2 ± 2.48	9.2 ± 4.34
	18	22.5 ± 9.12	31.3 ± 8.14	21.6 ± 9.24
	30	14.6 ± 5.62	16.3 ± 5.49	10.3 ± 5.90
	48	23.7 ± 1.87	40.1 ± 1.53	24.3 ± 1.87
:1hr	6	7.1 ± 1.30	9.0 ± 1.35	7.5 ± 1.30
	18	10.6 ± 1.55	1.3 ± 1.69	11.6 ± 1.49
	30	16.9 ± 0.91	18.6 ± 0.87	15.9 ± 0.91
	48	18.4 ± 0.99	10.4 ± 1.86	19.2 ± 0.99
: 2hr	6	12.2 ± 1.24	22.6 ± 1.14	10.7 ± 1.30
	18	17.8 ± 0.76	43.6 ± 0.55	17.6 ± 0.78
	30	19.1 ± 3.26	44.5 ± 2.25	18.9 ± 3.32
	48	19.5 ± 5.07	29.1 ± 4.49	20.5 ± 5.01

Table 2.Continued.

Fresh + syrup	6	77.4 ± 0.82	84.3 ± 0.55	75.9 ± 0.87
	18	79.8 ± 0.99	84.0 ± 2.45	78.0 ± 1.10
	30	79.6 ± 0.44	85.8 ± 0.32	78.0 ± 0.49
	48	83.2 ± 1.06	90.0 ± 0.66	82.1 ± 1.16
Dried: 24hr+ syrup	6	33.9 ± 1.65	53.8 ± 1.15	31.0 ± 1.65
	18	34.0 ± 7.42	17.1 ± 9.31	31.9 ± 7.71
	30	42.9 ± 1.67	28.3 ± 2.2	41.5 ± 1.80
	48	49.3 ± 4.96	29.5 ± 6.96	47.6 ± 5.16
Dried: 48hr+ syrup	6	25.4 ± 1.08	02.2 ± 1.39	21.4 ± 1.12
	18	27.8 ± 2.76	14.1 ± 1.31	24.9 ± 2.91
	30	29.8 ± 10.2	33.8 ± 4.86	24.3 ± 11.0
	48	35.2 ± 2.12	38.4 ± 2.02	30.3 ± 2.29
Boiled:30min+ syrup	6	16.7 ± 2.46	55.8 ± 1.48	15.5 ± 2.48
	18	23.2 ± 2.89	24.6 ± 2.78	21.2 ± 2.98
	30	25.1 ± 2.61	37.7 ± 2.17	20.8 ± 2.78
	48	27.3 ± 0.17	45.2 ± 0.12	25.1 ± 0.15
Boiled :1hr+syrup	6	16.7 ±8.93	17.7 ±8.81	16.0± 9.02
	18	29.5 ±0.73	14.9 ±0.89	28.0 ±0.78
	30	33.3 ±0.21	04.9± 0.32	30.3 ±0.21
	48	35.3 ±1.08	29.3± 1.19	33.4 ±1.15
Boiled: 2hr+syrup	6	15.8 ±1.11	25.1± 1.01	13.1 ±1.15
	18	20.7 ±0.91	13.9 ±1.00	20.2 ±0.90
	30	24.9 ±1.15	03.6 ±1.51	20.4 ±1.25
	48	29.4±1.25	30.5±1.25	30.5±1.25

DM = Dry matter. CP = Crude protein. OM= Organic matter.

Table 3 shows the degradation characteristics of fresh and treated mesquite leaves in the rumen of Nubian goats. There were variations in degradation characteristics of fresh and treated leaves. The degradation of the soluble fraction was higher in fresh leaves and generally decreased by drying and boiling. Syrup addition increased the soluble fraction in fresh and treated leaves. The part degradable with time (b) was depressed by syrup addition to fresh leaves and generally increased by different treatments. There were great variations in degradation rates and were
generally increased with syrup addition and decreased by drying and boiling and the effects increased with time.

Fresh leaves soluble fraction was very high (35.5%) than that reported by Elimam and Babiker (2000) and could be genetic and/or due to stages of maturity. The decreased soluble fraction by drying and boiling could be exploited to modify browses degradation. Syrup increased the soluble fraction (a) and decreased the part degraded with time (b) in fresh leaves because it was high in soluble carbohydrates and the higher degradation of fresh leaves with and without syrup was mainly due to their higher soluble fractions compared to other treatments.

Leaves degradation rates were higher than those of leaves and pods in the Gezira (Elimam and Babiker, 2000). The generally decreased degradation rates with boiling and drying were probably due to changes in composition and degradation characteristics. Variations in DM degradation characteristics of browses were reflected in DMI and growth rates in goats (Kibon and Orskov, 1993).

Table 3. The degradation characteristics of fresh and treated mesquite (*P.chelensis*) leaves in the rumen of Nubian goats in the Gezira State, Sudan.

Samples	DM				CP				OM			
	a	b	p	c	a	b	p	c	a	b	p	c
Fresh	35.5	16.0	51.5	0.048	68.0	10.0	78.0	0.058	63.5	13.0	76.5	0.025
D 24hrs	15.0	16.0	31.0	0.031	18.0	26.0	44.0	0.028	14.5	15.0	29.5	0.038
D 48hrs	14.5	18.0	32.5	0.030	08.5	21.0	30.0	0.025	11.5	19.5	31.5	0.028
B 30 min	07.0	17.5	24.5	0.025	10.5	26.0	36.5	0.028	06.0	16.5	22.5	0.027
B 1hrs	04.5	20.0	24.5	0.028	-05.0	25.5	20.5	0.032	04.5	18.5	23.0	0.029
B 2hrs	06.0	18.0	24.0	0.042	17.0	25.5	42.5	0.036	05.5	16.0	21.5	0.041
Fresh +S	72.0	09.0	81.0	0.068	82.5	06.5	89.0	0.061	74.5	05.5	80.0	0.064
D24hrs+S	24.5	25.5	50.0	0.028	03.0	31.0	34.0	0.030	22.5	25.0	47.5	0.029
D48hrs+S	21.0	14.5	35.5	0.039	08.0	35.5	40.5	0.034	15.0	17.5	32.5	0.031
B30min+S	07.5	20.0	27.5	0.054	17.0	29.5	46.5	0.038	05.0	21.0	26.0	0.045
B 1hrs+S	11.0	24.5	35.0	0.066	02.5	24.0	26.5	0.061	11.5	23.5	35.0	0.054
B 2hrs+S	12.5	17.5	39.0	0.034	30.0	24.0	54.0	0.048	13.0	15.5	28.0	0.035

D = Dried. B = Boiled. S = Syrup. DM = Dry matter. CP = Crude protein. OM = Organic matter.
a = Soluble fraction (%). b = Part degraded with time (%). p = Degradability (%). c = Degradation rate.

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القيمة الغذائية والعوامل الغذائية المضادة في أوراق المسكيت

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الخلاصة

تم قياس القيمة الغذائية والعوامل الغذائية المضادة في أوراق المسكيت الطازجة والمعاملة في ولاية الجزيرة بالسودان. جففت الأوراق لمدة 24 أو 48 ساعة أو غليت لمدة 2/1، 1 أو 2 ساعة وأضيف عسل الثمار الناضجة إلى نصف كل معاملة. لم يوجد تانين مكثف في أوراق المسكيت الطازجة والمعاملة. أثر التجفيف والغلي وإضافة العسل على التحليل التقريبي وخفض القلويدات في الأوراق. كانت الأوراق غير مستساغة ولم تتحسن الإستساغة بالتجفيف أو الغلي أو العسل. لم ترتبط الإستساغة بالتانين المكثف وربما إرتبطت بالقلويدات في الأوراق الطازجة. ربما كان إنخفاض إستساغة الأوراق المجففة لإنخفاض القلويدات بالمعاملة. زاد تكسر الأراق الطازجة والمعاملة بزيادة مدة الحضانة في الكرش وكانت أعلى نسبيا للبروتين الخام وأقل للألياف الخام. زاد التكسر في الكرش بإضافة العسل وإنخفض بالتجفيف والغلي. تباينت سرعة التكسر كثيرا في الأوراق الطازجة والمعاملة وكان الجزء الذائب أعلى في الأوراق الطازجة.