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Rumen Degradation and Nutritive Value of Fruit Flesh Seed Cake, Leaves and Green Shoots of Sidder (*Ziziphus Spina-Christi*) Trees

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Abstract: **Oil cakes of fruit seed, Leaves and tender branches were analyzed to determine the chemical composition, dry matter and crude protein degradability. Nylon bag technique was employed using three steers; samples of each part were incubated in the rumen for 0, 6, 12, 24, 36, 48 and 72 hours. The data obtained were subjected to one way analysis of variance. The results showed that the following ranges of nutrient contents: (96.59% and 94.61%), (10.03% and 2.62%), (1.12and 0. 3%), (14.77% and 8.03) and (32.46 and 12.72%) for dry matter, ash, crude fat, crude protein and crude fiber respectively. Effective degradability of DM decreased with the fast ruminal outflow rate (0.08/ hr) ranging from a low of 28.50% (k=0.08) to 53.04% (k=0.02) in the leaves and 17.52% at (k=0.085) to 25.07% at (k=0.02) in the green shoots. Potentially the degradability of CP in the green shoot, leaves, fruits flesh and seed cakes and was 64.62 ,41.33 , 88.23 and 71.95 respectively. Crude protein disappearance rate post-incubation for 48 hrs was 34.65%, 62.55%, 24.45&, and 51.25%, in the green shoots , leaves , fruits flesh and seed cake respectively .The ED at the slow outflow rate (k=0.02) of CP was 67.52%, 78.50%, 100.00% and 100.00%, while at the fast outflow rate (k=0.08) was 61.07%, 53.03% ,74.37%, and 72.31% in the green shoot, leaves ,fruits flesh and seed cakes respectively.It is concluded that, the highest value of crude protein and fat were recorded in the leaves.**

Keywords: **Insitu DM and CP degradation, Ziziphus spinachristi**

1. INTRODUCTION

The use of shrubs and tree fodder as livestock feed has been increasingly indicated (FAO, 1997). Research that had been conducted for evaluation of nutritional value of tree has shown that tree leaves have potential nutritive value in ruminants nutrition (Gutteridge *et al*., 1990; Ikhimioyal *et al*., 2005 and Topps .,1992) . *Ziziphus spina-christi* tree (Sidder) and its fruit (Nabag) indicate the importance of this plant as food. Rural population in Sudan rely on this wild growing tree species to fulfill some of some food need. Gebauer (2005) reported that *Z. spina-christi* is the most abundant wild fruit tree used in home gardens in El Obeid, the capital of North Kordofan state in central Sudan. However, little research has been conducted on the rich nutritional content of its fruits and leaves (Nour *et al*. 1987; Berry-Koch *et al*. 1990). Moreover, limited information is available on the use of sidder tree as animal feed.

So the general objective of this work is aimed to incorporate unexplored ,unconventional locally available cheap feed stuff in ruminants feeds to fill the gap in animals feed due to seasonal nutritional deficiencies and the specific objective of this work is intended to evaluate *Z. spina-christi* seed cake, leaves and tender branches as feed for ruminant.

2. MATERIALS AND METHODS

Collection of samples:

The Sidder fruits, leaves, and tender stem were collected from the different area in Sinnar and Blue Nile State-Sudan.The seed cake was prepared after removal of the fruit pulp, by mechanical extraction of the oil of the seeds..

Animals and feeding:

Three castrated steers agedof the local breed, 3 - 3½ years, were fitted with rumen cannulae as described by Brown *et al*., (1968) were used. They were maintained on a well balanced ration of concentrates and roughage, and were fed twice daily. water and salt licks were available all the time.

Chemical analysis:

Chemical analysis of collected sampleswas determined using Kjeldahl method (AOAC, 1990).

***In situ* trial:**

Polyester bag technique of Mehrez and Ørskov, (1977) was used. The bags were prepared from nylon material of 35-40 µm pore size and weighing 2 - 3g. Five grammes of samples were put in each bag were introduced inside the rumen. The bags (2 bags/animal/period/ treatment) were incubated for 6, 12, 24, 36, 48 and 72 hours each. The DM and CP contents of the four samples before incubation and of the residues after incubation were determined as described by AOAC, (1990).

Calculation of the ruminal (DM, CP) degradability: Degraded dry matter and crude protein percentage was calculated by the formula:

$$\frac{\text{Weight of sample incubated} - \text{Weight of residue after incubation} \times 100}{\text{Weight of sample incubated}}$$

The degradation kinetics of the cake s was described by curve-linear relationship of DM and CP loss from the bags with time by the equation of Ørskov and McDonald (1979).

$$P = a + b\,(1 - \exp^{-ct})$$

Where,

P = potential degradability (percentage)

a= the soluble fraction (percentage).

b= the potentially degradable fraction (percentage).

c= the rate of degradation of b.

t=time (hour).

The effective degradability of samples was calculated using the equation of Ørskov and McDonald (1979)., at three rumen fractional outflow rates ,of 0.020. ,0.05 and 0.08 h–1., where the relationship is;

Pe= a+ bc/c+k

Statistical analysis:-

All of data were analyzed by Statistical Analyze Software (SAS) (1999). ANOVA was carried out for the comparison of in situ kinetics and dry matter degradation value. Significant differences were assessed using the Least Significant Differences (LSD) test according to Gomez and Gomez, (1984). Mean differences were considered significant at $P < 0.05$.

3. RESULTS AND DISCUSSION

Nutritive values:

The chemical composition of the different parts of Ziziphus spina- christi is shown in table (1).

The dry matter (DM) varied significantly ($p<0.05$) among the different parts. The highest DM content was observed in the green shoots while the flesh showed the lowest DM content. The DM content *Ziziphus spina christi* leaves is higher than that reported in the leaves of *Acacia mellifera* (285.7g/kg), *and Zizyphus abyssinica* (753g/kg) (Elamin and Babiker., 2000) ,*Adansonia digitata* (936.5g/kg), (Ikhimioyal *et al* 2005).

The crude protein (CP) content were variable significantly ($p<0.05$). A high CP content (14.77%) was found in the leaves, followed by the flesh, and the lowest CP was observed in the green shoots. which is far higher than the CP of *Ziziphus spina christi* (1.4 g/kg),reported by Guinand and lemessa, (2002). Lower CP than of the present study were reported in Sudan browse trees leaves *Acacia mellifera*. (Elamin and Babiker .,2000), Acacia Senegal and Acacia nilotica (Mahala and Assad, 2007).

The crude fibre (CF) content was highest in the seed cakes while the flesh showed the lowest value.

Crude fat (EE) content varied significantly ($p<0.05$) among the different parts. The highest content was observed in the leaves and the lowest content in the green shoots.

The ash content was highest in the green shoots while the flesh showed the lowest value. *Ziziphus spina christi* leaves have a very low ash contents especially when compared with that of Ficus sp (110g/kg), *Acacia mellifera* (50g/kg), *Zizyphus*

abyssinica (70g/kg) (Elamin and Babiker .,2000), and with the ash content in the leaves of Almond tree (8.8%), *Cherry tree* (9.3%) and *Apricot tree* (15%), (Nahand *etal* ,2012).

The nitrogen free extract) NFE) content was significantly ($p<0.05$) highest in the flesh while the seed cakes showed the lowest value. The variation in the chemical composition of the present work and that of other researchers may be attributed to species differences, the plant parts, the age of plant,(Norton 1994); climatic conditions , the state of hydration (fresh wilted or dry) (Palmer and schlink,1992) and drying procedure used (Dzowela *et al*., 1995).

Table (1). Approximate analysis of the different parts of *Ziziphus spina christi* (means ±SD)

Part	DM%	EE%	CP%	CF%	Ash%	NFE%
Green shoots	96.59 ±0.01^{b}	0.3±0.00^{c}	8.03±0.15^{b}	14.21±0.012^{b}	10.03±0.07^{a}	67.43±0.30^{b}
Leaves	96.15±0.005^{a}	1.12±0.07^{a}	14.77±0.23^{a}	12.72±0.015^{c}	8.47±0.12^{b}	62.92±0.22^{b}
Flesh	94.61±0.015^{c}	0.94±0.015^{b}	10.55±0.07^{b}	13.50±0.015^{b}	2.62 ±0.01^{c}	72.39±0.03^{a}
Seed cake	94.63±0.015^{c}	1.09±0.01^{a}	8.65±0.087^{c}	32.46±0.015^{a}	3.12±0.015^{c}	54.68±0.47^{c}
SEM	3.19	0.15	1.32	1.89	1.62	2.202.202.20
Sig	*	*	*	*	*	*

Rumen dry matter degradation of different parts of *Ziziphus spina christi*:

In situ Dry matter disappearance (%) of Green shoots, leaves, flesh, and seed cakes at different incubation periods in the rumen is presented in table (2) and table (3).

There was a steady increase in DM disappearance of the different parts of *Ziziphus spina christ* up to ninety six hours.Flesh exhibited the highest DM disappearance at all the incubation times followed by leaves and the lowest value was in green shoots. Effective Degradability (ED) of the examined nutrient components were calculated using the outflow rates of 0.02, 0.05 and 0.08/h, according to Ørskov *et al*. (1980), model: Pe = a+[bc/(c+k)] . Effective Degradability (ED) of DM was decreased with increase in outflow rates. Mupangwa *et al*. (1997) observed that as general ,effective degradability ED of DM to decrease as the outflow rate increase. The immediately soluble fraction 'a' ranged from 3.19% in flesh to 12.83% in leaves. The insoluble but rumen degradable fraction 'b' was least in green shoots (23.09%). This is a reflection of the fact that its DM component was most readily soluble. With a similar slowest rate of degradation 'c' per hour of the rumen degradable fraction in green shoots and leaves, these leaves appear to be potential sources of energy for use by microorganisms in the rumen. Green shoots and leaves had less than 50% DM loss during 24 hours as compared to the over 60% value obtained for flesh. However, beyond 72 hrs incubation, all the leaves, flesh and seed cake had DM disappearance values above 60%. This information provides an insight into the level of rumen undegradable DM post incubation for 96 hrs. The rate of DM degradability of leaves of *Ziziphus spina christi* degradation was comparable with that reported by Ikhimioyal *et al* (2005) in *Ficus exasperate* leaves. While Elamin and Babiker (2000) and Ikhimioyal *et al* (2005) found to be high of value for fraction a, b, a+b and c respectively from *Ficus sp*, *Acacia mellifera* and *Zizyphus sp* leaves and in *Tectonia grandus*, *Terminolia catappa* and *Spondias monbin* respectively . The relatively high soluble DM values in these tree leaves reveals the potential of their being good sources of nutrients for microbial growth (Clark *et al*. 1992).

The low Pe (k=0.05) of the DM of the green shoots and leaves,this may have resulted from high cell wall content, despite high contents (Van Soest, 1983),. The DM degradability of *Ziziphus spina christi* cake at different times of incubation in this study, increased from 6hrs incubation period to 36 hrs and slowed up to 72 hrs. This result was similar to that obtained by Mohamed (2008) and (Aplang ,.2008).in groundnut cake and sesame cake respectively .

The rate of degradation characteristics of *Ziziphus spina christi* cake are comparable with that reported by (Ahmed, 2003), in *Fehderbia albida* pods . While (Zinn and Oen 1983),(Nidaa 2008) and (Aplang 2008) higher values for fraction a, b, a+b and c respectively from Sesame meal, Groundnut cake and Sesame cake respectively, lower values than of the present work are reported by Mahala and Assad, (2007). in Sesame seed cake.

Table (2). Dry matter disappearance (%) of Green shoots, leaves, flesh, and seed cakes at different incubation periods in the rumen (Mean ± Sd)

	Different Parts of *Ziziphus spina christi*				
Incubation time (h)	**Green shoots**	**leaves**	**flesh**	**seed cake**	**S. level**
Zero	6.56±.51 [b]	3.94±.17 [a]	3.93±.58 [a]	4.04±1.03 [a]	*
3	13.32±5.29 [c]	19.32±6.34 [b c]	48.41±14.50[a]	39.08±4.84 [a]	*
6	16.24±5.53 [d]	27.30±6.23[c]	70.93±4.18[a]	49.21±4.73[b]	*
12	24.16±4.13[c]	38.86±1.64 [c]	76.96±4.49[a]	52.24±1.22[b]	*
24	26.45±1.89 [d]	49.54±3.82 [c]	78.45±13.79[a]	54.43±3.62[b c]	*
48	28.75±2.32 [d]	60.22±4.99 [b]	79.93±3.87[a]	56.63±2.50 [c]	*
72	30.54±3.03 [d]	68.64±9.70 [b c]	86.21±.84[a]	55.39±3.02 [c]	*
96	33.96±2.24 [d]	85.27±10.16 [a]	85.75±.97 [a]	62.27±3.41 [c]	*

a, b ,c and d : means within the same row followed by different superscripts are significantly (p< 0.05) different .

* : significant at (p<o.05) .

Zero time= washing loss.

Table (3): Dry matter degradation characteristics and effective degradability of of Green shoots, leaves, flesh, and seed cakes from fitted model (Mean ± Sd)

	Different Parts of *Ziziphus spina christi*				
Fitted values	**Green shoots**	**leaves**	**flesh**	**seed cake**	**S. level**
a.	9.79[b]	12.83[a]	3.19[c]	4.18[c]	*
b	23.09[d]	47.30[b]	75.55[a]	50.75[c]	*
c	0.04	.020	0.35	0.40	NS
Pd	32.92[d]	60.15[b]	78.29[a]	55.23[c]	*
ED (0.02)	25.07[d]	53.04[b]	74.38[a]	52.31[c]	*
ED (0.05)	20.04[c]	35.19[d]	68.75[a]	48.89[b]	*
ED (0.08)	17.52[c]	28.50[c]	64.00[a]	45.94[b]	*

a ,b Means in the same rows with different superscripts differ significantly (p 0.05)

a = water soluble faction

b = water in soluble faction

Pd =potential degradability

c = rate of degrade

ED= effective degradability at there levels of rumen out flow rate 0.02, 0.05 and 0.08

***In situ* crude protein disappearance (%) for Different Parts of *Ziziphus spina christi*:.**

Table (5) Shows the CP disappearance of the studied green shoots, leaves, flesh, and seed cakes at different incubaton periods . The CP disappearance increased with the increase in the incubation time. Significant differences were observed among the different parts. Leaves showed the highest washing loss followed by green shoots and the lowest value was found in flesh.

Degradation of protein in the rumen is an important factor as it determines the supply of nitrogen for rumen microbes and protein available for digestion in the small intestine (Chalupa, 1975). the lowest value of shooting branches accords with the value of Sadeghi and Shawrang (2006) in soybeans meal.Higher values than of GNC and SSC are reported in GNC (Turki *et al* 2010) and SSC (Sehu *et al* 2010) respectively.

The potentially degradable fraction (b) of sidder seed cakes was higher than the finding of Khan *et al* (1998) in sesame seed cake. The (b) value of GNC and TSC are close; higher (b) values were found in GNC by Turki *et al*.,(2010), and in CSC by Sahoo *et al.*, (1993).

Moreever, sidder seed cakes showed the highest (a+b) value which is comparable to the values obtained by Khan *et al* (1998), and Shamseldein, *et al* .,(2010). Kamalak *et al.*, (2005) have reported 84.7% and 82.5% in soybean meal and hazelnut meal which are higher than the (a+b) values of seed cakes..The effective degradability of sidder cakes at 0.05 and 0.08 are close to rate reported by Sehu *et al*,(2010). A variation in the plant species and variety may influence ruminal protein degradation (Sehu *et al* 2010).

Table 4 : Protein degradability (%) in the Different Parts of Zizyphus Spin Christi Tree

	Different Parts of *Ziziphus spina christi*				
Incubation time (h)	**Green shoots**	**leaves**	**flesh**	**seed cake**	**S. level**
Zero	26.53± 0.51c	55.42± 0.17a	19.27± 0.58d	40.70± 1.03bb	*
3	27.43± 5.29c	56.54± 6.34ba	19.27± 14.50d	44.28± 4.84b	*
6	27.43± 5.53c	60.92± 6,23a	21.15± 4.18c	44.32 ± 4.73b	*
12	34.44 ± 4.13^{c}	60.15 ± 1.64^{a}	21.27 ± 4.49^{d}	44.45 ± 1.22^{b}	*
24	34.40 ± 10.89^{c}	60.17 ± 3.82^{a}	22.77 ± 13.79^{d}	$49.52\pm 3.62b^{b}$	*
48	34.65 ± 2.32^{d}	62.55 ± 4.99^{a}	24.45 ± 3.87^{d}	51.25 ± 2.50^{b}	*

a, b ,c and d : means within the same rows followed by different superscripts are significantly ($p< 0.05$) different .

* : significant at ($p<o.05$) .

Zero time: washing loss.

Table 5: Crude protein degradation characteristics and effective degradability of green shoots, leaves, flesh, and seed cakes from fitted model (Mean ± Sd)

	Different Parts of *Ziziphus spina christi*				
Fitted values	**Green shoots**	**leaves**	**flesh**	**seed cake**	**S. level**
a.	24.37^{b}	41.54^{a}	15.37^{c}	18.51^{c}	*
b	40.19^{c}	$.21^{d}$	73.83^{a}	$53.44.^{b}$	*
c	0.0036	0.065	0.13	0.0039	NS
Pd	64.62^{c}	41.33^{d}	88.23^{a}	71.95^{b}	*
ED (0.02)	67.52^{c}	78.50^{b}	100.00^{a}	100.00^{a}	*
ED (0.05)	65.04^{b}	65.19^{b}	98.75^{a}	95.89^{a}	*
ED (0.08)	61.07^{b}	53.03^{c}	74.37^{a}	72.31^{a}	*

a, b ,c and d : means within the same rows followed by different superscripts are significantly ($p< 0.05$) different .

a = water soluble faction

b = water in soluble faction

Pd =potential degradability

c = rate of degrade

ED= effective degradability at there levels of rumen out flow rate 0.02, 0.05 and 0.08

4. CONCLUSION AND RECOMMENDATION

It was concluded that there were significant variations in chemical composition and rumen degradation characteristics of *Ziziphus spina* Christi shoots, leaves fruit and seed cake studied in this experiment, This study has shown that there are potentially many sources of fodder for ruminants in the form of *Ziziphus spina christi* leaves which are not, as yet, being utilized to the maximum possible extent , but more experiments are needed for accurate determination of nutritional values of these resource.

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