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Nutritional and Digestibility Values of Six Varieties of *Gleditsia Triacanthos* L. Pods

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Abstract: In order to improve the usage of forage feeds for cattle some nutritive parameters of *Gleditsia* pods from 6 varieties were determined in wethers maintained in individual cages. Results showed dry matter (DM) digestibility values varying from 41-59% with a nutritional value between dry forage and concentrated feed. Softer pods tend to be more digestible. Transit time of pods throughout the digestive tract is likely to be inversely proportional to the amount of ingested feed. *Gleditsia* pods may be used as an alternative feed complement for cattle.

Key words: *Gleditsia*, digestibility, feed supplementation, forage, cattle

INTRODUCTION

The differences between animal nutrition under pasture and caged conditions have been studied (Chávez *et al*., 1979; Fierro, 1980; Holechek *et al*., 1982; Ramirez *et al*., 1997). These authors emphasize the need to determine the quality of cattle diet under the prevailing conditions of each region and the availability of plants species, particularly leguminosae shrubs and nitrogen fixing trees.

The genus *Gleditsia* contains a dozen species in the tropics (Detwiler, 1947), trees of rapid growth under adverse climatic conditions, adapting well to drought and low temperatures due to their flexible radical system (Fioc, 1986).

The foliar and fruit biomass is high. Browsing by animals poses no danger to these trees as their mature pods fall on the ground and are thus easily available to the cattle. The production potential is left, therefore, intact.

The whole pods of *Gleditsia triacanthos* L. are quite palatable toxin free and rich in sugar and protein, but nonetheless, deficient in N. Their nutritional value value is quite similar to that of barley, but low if compared with concentrated diets (Auge and Allemand, 1973).

Digestibility of ground pods protein is low when compared with that of whole pods (Mostert and Donaldson, 1960; Foroughbakhch, 1993).

A study was undertaken with the purpose of improving the use of G. *triacanthos* as forage, by preventing the loss of nitrogen and energy. First, the nutritive value and digestibility in ruminants was assessed.

MATERIALS AND METHODS

A feeding trial was conducted on 6, 2 year old wethers (castrated males) of 42 kg average weight maintained in individual handling cages. The wethers received daily rations of 1350 g dry pods, 380 g of dehydrated alfalfa and 50 g of mineral supplement. After 17 days of acclimatization phase the experiment was divided into 6 measurement periods on a weekly basis. Each week a different pod variety was given to the animals. Varieties were named according to their origin: MIL (South); TOT (North); VFM (South-east), SUM (West); VPO (North-west), ADV (East) of Montpellier, France.

The measurements included daily registry of distributed and rejected feed for each animal; subsamples were analysed for dry matter, organic matter (furnace 575°C, 9 h) and nitrogen content by Kjeldahl (AOAC, 1997).

The number of seeds in faeces was recorded distinguishing intact from swollen seeds. A 100 g subsample of the weekly faeces was retained for this operation. Seeds were separated from the excrement by mechanical shaking of the sample in water for 24 h and filtration through a 3 mm sieve. To make sure that such a subsample was representative a second measurement was also taken.

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From these measurements budgets for dry matter, organic matter and nitrogen content was computed for each animal and each week (i.e., each pod variety) and the *in vivo* digestibility of the ration was deduced. Since, the *in vivo* digestibility of the dehydrated alfalfa is well known we could deduce the *in vivo* digestibility of the honeylocust pods.

Coefficients of digestibility were deduced from the following equation:

CD = (Ingested – Faeces) / Ingested

Where,

Ingested	=	Swallowed – Spat (during rumination).
Swallowed	=	Distributed – Not eaten.
Not eaten	=	Refused + Fallen out of reach.
Faeces	=	Metabolized + Unmetabolized.
Unmetabolized	=	Intact seeds + Swollen seeds (in the faeces).

The same equation applies to calculate a coefficient of digestibility for any particular part of the ratio. For example, two coefficients were calculated for honeylocust seeds on a dry matter basis from the following equations:

CD. 1= (Ingested-Faeces) / Ingested
CD.2 = (Ingested-Faeces) / (Ingested -Unmetabolized)

The second coefficient applies to the seeds attacked by the digestive process, while the first one applies to all the seeds ingested and gives a lower result since a significant part of the seeds travel unbroken through the animal.

A budget of the number of digested seeds was also computed from the following equations:

Ingested seeds	=	Distributed seeds- seeds in pods not eaten by animal during rumination
Digested seeds	=	Ingested seeds – seeds in faeces
Seeds in the faeces	=	Intact seeds + Swollen seeds.

RESULTS AND DISCUSSION

The coefficient of digestibility of the feed ration was deduced from the measurements made. On the other hand, digestibility characteristics of alfalfa supplement has well known values: Dry matter 60%, organic matter 60% and raw protein 68%. Thus, we then deduced from the digestibility of the whole ration those values corresponding to the ingested pods (Table 1).

Table 1: Coefficients of digestibility of pod varieties of *Gleditsia triacanthos*

Variety[1]	DM	OM	ADF	NDF
MIL	58.3±8.5a	60.8±8.4a	34.5±17.3a	51.8±14.7a
TOT	58.7±7.6a	61.0±8.1a	37.7±10.6a	51.5±12.4a
VFM	54.0±5.4b	55.9±5.1ab	25.8±8.6b	38.5±9.3b
SUM	48.6±4.5b	50.1±5.9b	8.6±4.5d	45.8±10.6ab
VPO	44.5±1.9bc	45.2±4.7bc	10.8±3.1c	36.2±8.4b
ADV	41.8±3.7c	43.6±1.8c	9.7±2.9d	45.9±11.2ab

[1]Varieties origin: MIL (South); TOT (North); VFM (South-east), SUM (West); VPO (North-west), ADV (East) of Montpellier, France. DM = Dry matter, OM= Organic matter, ADF = Acid detergent fiber, NDF = Neuter detergent fiber Values followed by the same letters are not significantly different at the 5% level (standard deviation)

Table 2: *In vivo* coefficients of digestibility of raw protein from *Gleditsia triacanthos* pods for caged wethers

Pod variety	Ingested Raw protein (g)	Raw protein coeff. Of digest.
MIL	147.6±7.0a	37.3±5.3a
TOT	121.0±16.5a	34.5±6.9a
VFM	120.8±12.7a	20.2±8.2b
SUM	136.0±18.7a	16.9±6.1b
VPO	131.2±12.4a	14.3±3.8c
ADV	127.6±8.9a	11.7±5.5cd

[1]Varieties origin: MIL (South); TOT (North); VFM (South-east), SUM (West); VPO (North-west), ADV (East) of Montpellier, France. Values followed by the same letters are not significantly different at the 5% level (standard deviation)

Table 3: Calculated versus measured coefficients of digestibility of raw protein from Gleditsia triacanthos L. pods

Variety	Giger´s CPD	*In vivo* CPD Average	Best
MIL	0.43	0.37 a *	0.56
TOT	0.38	0.21 b	0.55
VFM	0.35	0.21 b	0.51
SUM	0.34	0.17 c	0.38
VPO	0.31	0.18 c	0.39
ADV	0.30	0.16 c	0.33

*Values followed by the same letters are not significantly different at the 5% level

Dry matter digestibility resulted high, ranging form 41-59%, according to the variety and/or the animal and it was much higher than the values obtained in this investigation for crude protein digestibility (Table 1).

One of the animals spat most of the seeds while ruminating resulting in striking differences between animals. However unaffected results in the ingestion of crude protein were obtained since no significant differences appeared between the 6 varieties (Table 2).

The digestibility of the pods seems to be inversely correlated with pod intake. Animals that ate fewer pods showed higher coefficients of digestibility than those who ate more quantities. This suggests that honeylocust pods should not be given as a sole feed. More research is needed to clarify this point.

Raw protein digestibility can be calculated according to Giger´s formula (INRA, 1981):

$$CPD = 33.5 - 0.532*NDF + 1.14*ADF - 1.73*ADL + 1.75*MAT$$

Table 4: Gleditsia triacanthos seeds budget during the feeding trial

Variety	1	2	3	4	5	6
MIL	447	35.5±18.5d	411±18ab	51±25d	361±20a	6.2
TOT	558	126.8±53.6b	431±53ab	92±42b	339±40ab	36.2
VFM	422	74.3±41.3c	347±41b	137±39a	211±37b	31.8
SUM	665	182.2±75.5a	482±75a	157±49a	325±43ab	32.4
VPO	461	135.6±40.2b	325±15bc	88±13b	237±32ab	N.A
ADV	412	113.8±18.4bc	298±21c	72±18c	226±45b	N.A

*Values followed by the same letters are not significantly different at the 5% level (standard deviation). N.D = Not determined, (1) Number of seeds in the ration distributed to animals, (2) Number of seeds not swallowed + number of seeds spat during rumination, (3) Number of seeds taken down the rumen, (4) Number of seeds in the faeces, (5) Number of seeds absorbed in the intestine, (6) % of spat seeds as compared to absorbed seeds

Where,

CPD = Crude Protein Digestibility.
NDF = Neutral Detergent Fibre.
ADF = Acid Detergent Fibre.
MAT = Total Nitrogenous Matter.

We compared the values deduced from this formula and the values measured on the animals under trial conditions. A more balanced ration, with lesser quantity of pods and a rougher feed could lead to different results (Table 3).

The tremendous difference between the varieties could not be deduced from Giger´s formula. Direct measurements showed that *in vivo* digestibility of raw protein is less effective than what could be inferred from the Van Soest (1987) profile. Given these results, we can state that the pod varieties tested offer only 37 g (MIL) of digestible protein per kg of dry matter.

A budget of the number of digested seeds is shown in Table 4. Seventy six percent of consumed seeds were processed and absorbed in the digestive tract. The seeds are protected by their teguments which are broken by the teeth only during rumination. It can be deduced from the results shown in Table 4 that the teguments of the different varieties vary in hardness. Mil and Tot varieties seem to have the softer tegument, which is confirmed by the ratio of swollen to intact seeds in the faeces. A variety with soft tegument would therefore be of a high interest for feed complement.

On the other way, a strong relationship is observed between the percentage of swollen seeds in the faeces and the raw protein digestibility of the pods. We suggest looking for a simple mechanical way of measuring tegument hardness in order to rank varieties on the basis of this factor. A test that would be easy to perform could be applied to many sources of seeds. Such a vast screening could hopefully lead to identifying trees with soft tegument seeds.

CONCLUSION

We believe there is still scarce information on *Gleditsia triacanthos* and that its nutritional properties have not been evaluated thoroughly. Its tremendous widespread utilization in ruminant diets tends to improve the conservation and expansion of this species and thus favor its stability under local ecological conditions.

On the basis pod digestibility, it was clearly observed that the transit time of the ingested pods throughout the digestive tract varies among animals. An animal which ingests large amounts of pods digests them in minor proportion and vice versa.

The coefficient of digestive utilization and nutritional value determined in our study indicate that dry *Gleditsia* pods have an intermediate value between dry forage and concentrated diets.

The limited scope of breeding techniques of forage indicates that *Gleditsia triacanthos* is a viable and valuable alternative as cattle forage.

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