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The Effect of The Mechanical Treatments on The Nutritive Value of Egyptian Hay

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THE EFFECT of mechanical treatment of clover hay in Egypt on its digestibility and feeding value when fed to sheep was investigated. Hay was fed in three forms: long, chopped (5-7cm) and finely ground to Rahmany sheep. The curd fibre and N-free extract, were replaced by lignin and carbohydrates as a better analytical method. The carbohydrates were also devided into cellulose, pentosans and carbohydrates.

Results indicated that, feeding ground hay, significantly decreased all nutrients digestibilities (except NFE), when compared with either long or chopped hay with a result of producting the lowest feeding value standards. Highest digestibilities were observed with chepped hay in the majority of nutrients producing the highest feeding value standards. The highest digestibilities of DM, CP, EE and other carbohydrates and DCP were observed with long hay.

The overall result of mechanical treatments appeared to be infavour of chopping. Grinding appeared to be disfavourable decreasing the feeding value and increasing processing cost.

A great deal of research is directed to make full use of roughages and agricultural residues using several methods, recently attention was directed to the mechanical treatments to increase their feeding values.

With hay, some investigators mentioned that grinding hay reduced digestibilities (Meyer *et al.*, 1959; keith *et al.*, 1961 and Johnson *et al.*, 1964). But Meyer *et al.* (1959) and Woods and Rodes (1962) indicated that better utilization of feed constituents was achieved when rations were finely ground despite lower digestibilities. Blaxter and Graham (1956) indicated that processing a roughage increases its nutritive value by reducing energy losses as heat and methane. Processing hay also influences its intake, digestibilities and nutrative value (Meyer *et al.*, 1959; Johson *et al.*, 1964 and Cottyn *et al.*, 1970). On the other hand, Buchanan *et al.* (1968) reported that processing did not affect the digestibility of any component by sheep. But Orskov *et al.* (1968) mentioned that the composition, particle size of the diet and the feed intake were the principal factors affecting fermentation in the rumen.

Therefore, an intensive study was carried out on the effect of grinding and chopping of hay on its digestibility using sheep in metabolism trials.

Material and Methods

Clover hay from *Trifolium Alexandrinum*, having the International Ref. No., 1-01-340 (Harris *et al.*, 1968) was prepared in three forms : long, chopped (5 - 7 cm) and finely ground (2 mm).

The same triplicate rams were used in comparative studies to avoid sources of variation among individuals. The preliminary period was 15 days, collection period being seven days. Metabolic cages were as those described by Ghoneim (1964) and Maynard and Loosli (1969).

Hay was fed alone in every trial. Each animal received 0.5 kg of every form twice daily at 9 a.m. and 4 p.m. Both feces and urine were collected once daily at 9 a.m. during the collection period.

The methods of A.O.A.C. (1970) were used for the proximate analyses. Lignin was determined using the method of Moon and Abou-Raya (1966) slightly modified by Abou-Raya and Galal (1966) cellulose and pentosans were determined after Galal (1969). The calor. (the calorific value) was determined directly by using the non-adiabatic Veb bomb calorimeter.

Results and Discussion

Nutritive analyses

The data concerning hay composition are presented in Table 1.

TABLE 1. The nutritive of hay.

Item	Analysis as fed			Average analysis on dry matter basis
	Long hay	Chopped hay	Ground hay	
Analysis %				
Moisture	12.00	10.00	8.43	0.00
Ash	11.47	11.73	11.93	13.03
OM	76.53	78.27	79.64	86.97
CP	11.66	11.93	12.13	13.25
EE	1.00	1.03	1.04	1.14
CF	35.42	36.23	36.86	40.25
NFE	28.45	29.10	29.60	32.33
Suggested fractions of CC % :				
Lignin	4.13	4.22	4.30	4.69
Carbohydrates	59.74	61.65	63.14	67.89
Detailed fractions of carbohydrates % :				
Cellulose	23.97	24.51	24.94	27.24
Pentosans	12.52	12.80	13.03	14.23
Other carbohyds.	23.25	24.34	25.17	26.42
GE Kcal/g.	3.94	4.03	4.10	4.48

The nutrients content of the used hay were within the wide range of analysed hay samples in Egypt.

The lignin content was lower than published by El-Talty (1970) and (1973) but contained higher cellulose and slightly lower pentosans.

	Suggested method		Detailed Carbohydrates		
	Lignin	Carbo-hydrates	Cellulose	Pentosans	Other carbohydrates
El-Talty (2 samples)	5.3-5.5	58.6-59.1	17.7-19.2	8.5-8.6	30.9-32.8
Guedas *et al.* (1970) (4 samples)	8.9-10.9	—	34.5-37.8	—	—

Effect of hay physical form on digestibility and feeding value

Results in Table 2, indicated that, the digestibilities of the major nutrients in the three forms of the hay were within the wide range of digestibilities found in Egypt.

When comparing the digestibility of the major nutrients within the three forms of hay, it was clear that, there was no significant difference between long and chopped hay in DM or OM digestibility. While the differences between long and ground hay and between chopped and ground hay was highly significant.

It was clear that, grinding reduced both DM and OM digestibility. The same occurred with energy digestibility, being the highest with chopped hay (60.33 %), followed by that of long hay (59.72 %) and, being the lowest with ground hay (55.72 %), Results are in harmony with those of Sandev and Dardshonov (1973) and Zerebeov and Vrakin (1970). It was also noticeable that energy digestibility could be predicted from that of OM using the prediction equation of Abou-Raya *et al.* (1972) :

" Energy digestibility % = 1.098 + 0.946 OM digestibility %. It was found to be 60.36 %.

The CP digestibilities were descendingly with chopped, ground and long hay being correspondingly 57.81, 63.23 and 65.49%. These results agreed with those of king *et al* (1962) and Zerebcov and Vrakin (1970).

The digestibility of EE was the maximum (35.33 %) in long hay and decreased ($P < 0.1$) to 26.83 and 27.84 in both chopped and ground hay, respectively.

Regarding CF, the digestibility in chopped hay was 55.18%, being 53.94% in long hay, without significant difference. Ground hay digestibility (42.87 %) was distinctly lower ($P<0.5$) than with both long and chopped hay. These results were in harmony with those rocorded by Johnson *et al.* (1964) and Sandev and Dardzyhonov (1973)

TABLE 2. Effect of the Physical form of clover hay on nutrients digestibility and feeding value.

	Long hay (LH)	Chopped (CH)	Ground (GH)
Digestibilities %			
DM	59.30± 2.09	58.89± 3.31	53.42± 11.30e,f
OM	60.75± 1.24	62.83± 8.64	57.33± 10.87b,c
CP	65.49± 6.81	57.81± 1.93a,c	63.23± 11.61
EE	35.23± 8.63	26.83± 1.97d	27.84± 4.08b
CF	53.94± 6.98	55.18± 2.45	42.87± 16.78b,c
NFE	73.86± 8.90	75.67±14.17	74.42± 14.87
Energy	59.72± 0.18	60.33± 0.12	55.72± 1.38
Suggested CC % Lignin			
Carbohydrotcs	18.84± 8.25	23.18± 2.18	10.64± 5.43e,f
Detailed carbohydrates %	63.14± 0.33	67.51± 1.52a	60.61± 1.54 .c
Cellulose	62.72± 3.05	64.67+ 1.46	57.52± 3.29e,f
Pentosans	63.19±14.72	67.27+ 9.58a	53.55± 6.79e,f
Other carbohydrates	63.54± 1.14	61.46+11.12	62.05± 7.10
Feeding value			
De Kcal/100	266.20	270.28	249.63
SV %	31.28± 4.76	35.63±13.44	27.95± 5.68e,f
TDN %	55.22± 4.84	58.80±13.86	50.85± 5.81e,f
DCP %	8.68± 0.91	7.67± 0.18d	8.38± 0.90e,f

a The difference between LH and CH is significant ($P < 0.05$).

b The difference between LH and GH is significant ($P < 0.05$).

c The difference between CH and GH is significant ($P < 0.05$).

d The difference between LH and CH is highly ,, ($P < 0.01$).

e The difference between LH and GH is highly ,, ($P < 0.01$).

f The difference between CH and GH is highly ,, ($P < 0.01$).

The physical form appeared not to affect significantly the NFE digestibility, being in harmony with the finding of Buchanan *et al.*(1968) and Zerebcov and Vrakin (1970).

Concerning lignin digestibility, the differences being only insignificant between long and chopped hay. Digestibilities were within the range of El-Talty (1970) and (1973), while that of ground hay was within the range of Abou-Raya *et al.*, (1963).

Cellulose digestibility of chopped hay was within the ranges of El-Talty (1970) and (1973) and Abou-Raya *et al.* (1963). But with long hay was within the range of El-Talty (1970) and (1973) more than that of AbouRaya *et al.* (1963). While for ground hay was nearer to the lower limit of the range of

El-Talty (1970) and (1973). The slight decrease in cellulose digestibility with ground hay appeared to be due primarily to a more rapid rate of passage of ground hay through the elemintary tract. This is in agreement with Jonson *et al.* (1964).

Pentosan digestibility was 63.19 % with long hay increased significantly to 67.27 % in chopped hay and decreased highly significantly to 53.55 % in ground hay. The difference between chopped and ground was highly significant

was

The other carbohydrates digestibility was the maximum in long hay (63.54 %) decreased to 61.46 % in choppedhay and decreased to 62.05 % in ground hay. Results were similar to those obtained by El-Talty (1970) and (1973) with hay.

*The Feeding values as SV, TDN, DCP% and kcal/*100 g

It was found that chopped hay had the highest feeding values as SV, TDN and DE kcal/100g, being 35.63 % 58.80%, and 270.28 kcal (on DM basis), respectively . The corresponding values were 31.28, 55,22 and 266.20 with long hay and 27.95, 50.85 and 249.63 with ground hay. The low feeding value of ground hay was as a resultant of low digestibilities of the majority of nutrients must likely due to rapid passage through the digestive tract. The higher feeding value of chopped hay may be due to a more suitable physical form which adjust the passage of the diet. Lower rate of passage would allow better utilization with the microflora. The results of the effect of the physical form on SV and TDN here are in agreement with those of Johnson *et al.* (1964). The trend of DCP in the three forms of hay was in harmony with that found by Jonhson *et al.* (1964). With chopped hay, DCP %, was wihtin the general range with 60 samples (Abou-Raya *et al.*, (1969).

Regarding DE (kcal/100 g DM), the highest value was with chopped hay followed by long then the ground hay (270.28, 266.20 and 249.63, respectively). Results were higher than those obtained using the prediction equation of Abou-Raya *et al.* (1972) (DE, kcal. = 34.81 + 3.71 TDN %).

N-balance and CP content (2.12 and 13.25 %) were withim the range of published data on DM basis (1.56-3.22 % N and 9.78-20.12 % CP) with Egyptian clover hay.

Generally it can be concluded that

1. The physical form of hay affects its digestibilities and feeding value.
2. Chopping the hay increases the digestibilities of major nutrients as well as its nutritive value.
3. Grinding decreases hay digestibilities to the extent that it must not be used when hay fed alone.

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تأثير المعاملة الميكانيكية للدريس على قيمته الغذائية

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أجريت هذه الدراسة لمعرفة التاثير الميكانيكى على دريس البرسيم من حيث معاملات الهضم والقيم الغذائية عند تغذيته للأغنام بمفرده ومجهز فى ثلاث صور وهى : طويل أو دريس مقطع (بطول ٥ ـ ٧ سم) ، ودريس مطحون ناعم •

كما شملت الدراسة معاملات الهضم للمركبات الغذائية الدقيقة التى تدخل تركيب الكربوهيدرات الخام حيث أستبدل تقسيمها الى ألياف خام والمستخلص خالى الأزوت بتقسيمها الى لجنين وكربوهيدرات كطريقة أفضل فى التحليل • ودرست الكربوهيدرات أيضا بطريقة تفصيلية الى سليلوز وبنتوزان وكربوهيدرات أخرى • ومن النتائج أمكن استخلاص أن :

التغذية على الدريس الناعم أدت الى خفض القيمة الهضمية لجميع المركبات الغذائية فيما عدا المستخلص خالى الأزوت عند مقارنته بكل من الدريس السليم (الطويل) والمقطع مما نتج عنه أقل قيمة غذائية • أما أعلى قيم هضمية لمعظم المركبات الغذائية كانت عند التغذية على الدريس المقطع مما نتج عنه أعلى قيمة غذائية • كما لوحظت أعلى قيم هضمية للمادة الجافة والبروتين ومستخلص الاثير والكربوهيدرات الأخرى عند التغذية على الدريس السليم •

تبين أن أفضل صورة الدريس للتغذية هى الصورة المقطعة حيث تعطى زيادة القيمة الغذائية المتحصل عليها عن نفقات عملية التقطيع وعلى العكس من ذلك عملية طحن الدريس حيث ظهر أنها غير مفيدة لحفضها القيمة الغذائية للدريس مع رفعها لتكاليف تحضيره للتغذية •