

The dry matter degradability of wheat straw Fractions

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ABSTRACT

The degradation characteristics of the straw of two varieties of wheat (Hourani and Sham3) as referred to production year and sowing dates were measured by incubation in nylon bags in the rumen of four fistulated sheep. The nutritive value of stem, leaf and chaff fractions of the wheat straw, and the effect of incubation periods on the degradability were studied using a Randomized Complete Block Design. The results showed that dry matter degradability increased as the incubation period advances for all treatments and straw fractions. The maximum dry matter degradability obtained was 57.4% at 72 hours of incubation for stem fraction. However, the dry matter degradability for leaf fraction was 73.0% and for chaff fraction was 77.9%.

INTRODUCTION

In the past few years the world increased its cultivation of wheat for human consumption. This indirectly increased the amount of wheat straw. Necessarily the agricultural by-products became available for the utilization by the livestock, mainly ruminants, particularly in the dry season. The addition of protein or a potential source of nitrogen such as urea to roughages should, in theory, improve their nutritive value (O'Donovan, 1968). Tuah, *et al* (1968) reported that the different varieties of cereals produce different nutritive values of straw.

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The differences in leaf stem ratio produces differences in quality of the different botanical fractions (Ramanzin, *et al* 1986). The studies reported in this experiment were designed to examine the dry matter degradability of wheat straw fractions from two different varieties of wheat as affected by year of production and sowing dates.

MATERIAL AND METHODS

Straws:

Straws from two varieties of wheat (Hourani and Sham3) were used. These varieties were grown in early, medium and late season in 1988 and 1989 at the International Centre For Agricultural Research in The Dry Areas (ICARDA). After harvesting the straw was then separated by hand for individual botanical fraction (stem, leaf and chaff). The straw fraction was ground before incubating.

Animals:

Four mature castrated Awassi male sheep were used. Permanent rumen fistula was applied. The mean initial live weights of sheep were 50 kg. The sheep were housed in individual cages. Water was provided all time.

Feeding and Management:

Daily, each sheep was given chopped Vetch Hay (*Vicia sativa*) to which 1000 grams with supplement minerals and trace elements were added. The feed was offered twice in equal amounts at 0800 hours and 1500 hours.

Experimental Procedures:

About 2 gm. of the dry ground straw fraction sample were incubated in nylon bags. The procedure described by Orskov *et al* (1980) was adopted. The incubation periods for leaf and chaff were 12, 24, 48 and 72 hours while the stem was subjected to an additional period of 24 hours. Each botanical fraction was incubated separately in the rumen of each sheep. Twelve bags were incubated together in the rumen of each sheep for the same period. The bags after being taken out were washed in a tap water until the water in the bag was clear. They were then dried for 48 hours in a draught oven at 70°C.

Dry matter degradability determination:

The degradability of dry matter in the components of straw was determined by measuring dry matter loss from samples incubated in nylon bags for various periods in the rumen of sheep. The

mathematical model described by Orskov and Mc Donald (1979) was used in determining the degradabilities.

$$P = a + b(1 - e^{-ct})$$

where:

P is dry matter loss; **a** is the intercept of the degradation curve at time zero; **b** is the component of potentially degradable material which will in time be degraded; **a + b** is the potential degradability; **c** is the rate constant of **b**; **a**, **b** and **c** are constants; **t** is the time of incubation; and **e** is the natural logarithm.

Statistical Analysis:

The results were statistically analyzed using the procedures described by Steel and Torrie (1980).

RESULTS

For all the fractions of wheat straw, dry matter degradability increased with increase in time of incubation period.

Table (1) shows the relationship between the varieties, fractions, sowing dates, years and the incubation period on the wheat dry matter degradability. There are significant difference ($P < 0.05$) between varieties for 6, 12 and 24 hours incubation period, while at 48 and 72 hours

incubation periods they were highly significant ($P < 0.01$). Dry matter degradability was highly significant ($P < 0.01$) for the different fractions as all incubation period. There were highly significant differences ($P < 0.01$) between years for all incubation periods. However, no significant differences between sowing date for all incubation periods, except at 6 hours incubation period were observed. Mean values of potential degradability and rate constant of dry matter loss of wheat straw from the equation. $P = a + b (1 - e^{-ct})$ are shown in Table (2). There are significant differences ($P < 0.05$) between varieties at (a and b), but no differences at rate constant c. Also, there were highly significant differences ($P < 0.01$) between fractions for (a and b) but not significant for c. There was no indication of significant differences between sowing dates for (a, b and c) during this experiment, although the differences were highly significant for (a, b and c) between different years.

Table 1. Percentage dry matter degradability of wheat straw (varieties, fractions, sowing dates and years) at different incubation periods.

Incubation period (hours)

Item	6	12	24	48	72	96
Varieties						
Hourani	18.80	25.50	39.95	49.78	54.01	13.88
Sham3	19.41	26.61	43.00	55.51	61.07	16.04
S.E.	0.18	0.34	0.78	0.29	0.24	
Significance Fractions				***	***	
Stem	14.33	18.15	32.54	43.48	47.35	44.89
Leaf	20..47	30.64	46.46	57.60	62.03	
Chaff	22.51	29.37	45.43	56.86	63.25	
S.E.	0.22	0.42	0.95	0.36	0.29	
Significance Sowing Dates	***	***	***	***	***	
Early	18.77	25.91	41.23	52.55	57.55	47.17
Medium	18.77	26.12	41.24	52.87	57.91	44.71
Late	19.76	26.13	41.95	52.52	57.16	42.84
S.E.	0.22	0.42	0.95	0.36	0.29	
Significance Years	**	NS	NS	NS	NS	
1988	17.48	22.89	36.12	46.18	51.18	13.89
1989	20.72	29.21	46.83	59.12	63.91	16.02
S.E.	0.18	0.34	0.78	0.29	0.24	
Significance	***	***	***	***	***	

S.E. = Standard error

*, ** and *** = Significantly different at 5,1 and 0.1% probability level, respectively.

NS = Non Significant.

Table 2. Mean values of potential degradability and rate constant of dry matter loss of wheat straw from equation : $P = a + b$

(1 - e	")			
Item	a	b	c	a + b
Varieties				
Hourani	5.17	51.37	0.048	56.54
Sham3	3.69	59.80	0.046	63.49
S.E.	0.52	0.61	0.000	0.69
Significance Fractions	*	***	NS	***
Stem	1.38	46.54	0.046	47.92
Leaf	4.43	59.55	0.051	63.98
Chaff	7.48	60.67	0.044	68.15
S.E.	0.64	0.56	0.000	0.85
Significance Sowing Dates	***	***	NS	***
Early	4.26	56.06	0.046	60.32
Medium	4.14	56.40	0.046	60.54
Late	4.89	54.29	0.049	59.18
S.E.	0.64	0.56	0.000	0.85
Significance Years	NS	NS	NS	NS
1988	5.55	48.28	0.044	53.83

1989	3.27	62.93	0.051	66.20
S.E.	0.52	0.61	0.000	0.69
Significance	**	***	**	***

S.E. = Standard error

* ** and * * * = Significantly different at 5,1 and 0.1% probability level, respectively.

NS = Non Significant.

DISCUSSION

The dry matter degradabilities of wheat straws were significantly different between the varieties of Hourani and Sham3, where Sham3 had more dry matter degradability than Hourani. This could be attributed to the distribution of the botanical fractions of wheat straws and also may be explained by the genetical differences between two

varieties. This finding agrees with that reported by Tuah *et al.*, (1986) who stated that the differences between the varieties of the crops studied in the dry matter loss values could be due to either differences in the proportion of leaf, stem and chaff and / or differences in the digestibility of these components resulting from differences in the extent of lignifications. The same result was obtained by Kerman *et al* (1984) who showed that there were differences in the proportions of leaf, stem and chaff between six varieties of wheat. All fractions of wheat straw, leaves had the highest dry matter degradability values, followed by chaff and stems, except at 6 and 72 hours in incubation periods where chaff had the highest dry matter degradability values, followed by leaves and stems. This might be due to the differences in chemical composition and may be explained by variations in physical structure. Similar results were obtained by Thiago and Kellaway (1982). Kernan *et al* (1984) found that the differences in dry matter low values between fractions of the same straw type can be partially related to the observed differences in chemical composition.

The interactions of varieties and years for dry matter degradability of wheat straw showed high significant differences. This was probably due to the crude protein content, which was affected by rainfall. This agrees with the finding of Rihawi and Treacher (1990) who have reported that wide variations in rainfall from year to year have major effects not only on grain and straw yield, but also on the yield and composition of the stubble remaining after harvest.

The maximum potential extents of dry matter degradability values of wheat straw fractions were chaff, leaf and stem in a declining order. The differences between each two fractions were highly significant. This many reflect differences in the proportions of the botanical fractions as the height of the plant varies and due to differences in the digestibility of these fractions. Bhargava *et al* (1988) reported that leaf blade, leaf sheath, chaff and stems differed widely in their nitrogen, rate constant and potential extent of dry matter degradability.

CONCLUSIONS

The dry matter degradability of wheat straw was highest for leaf fraction than chaff and stem. Chaff had highest degradability than stem. This could be due to the differences in the proportion of the fractions. The differences in degradability between different fractions is attributed to difference in the physical structure and chemical composition. The interaction of the varieties and period (years) indicated the effect of rainfall on the differences in degradability.

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