

THE EFFECTS OF MILLING AND THE ADDITION OF CONCENTRATES OR MOLASSES ON THE CONSUMPTION OF POOR QUALITY HAY BY MILKING COWS

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Three trials were carried out with the purpose of studying some factors which might affect the consumption of low quality hay by dairy cows receiving concentrate supplements. The first two trials were each carried out with 6 Holstein cows using a 3 x 3 Latin Square design with 3 levels of supplementation: 5, 7 and 9 kg/d of concentrate with 16.7% protein in the first trial and 32.7% in the second. The dry matter (DM) consumption of the hay was less than 3 kg/d in both trials and decreased between 0.05 and 0.21 kg for each kg of DM of concentrate consumed. The supplementation increased milk production in both experiments. The third trial was to determine the effect of the physical form of the hay (whole vs milled) and the addition of molasses (0 vs 200 g/d) on the hay intake of cows receiving 5 kg/d of concentrate. Eight Brown Swiss cows were used in 2 x 2 factorial design within a 4 x 4 Latin Square. Hay intake and milk production were not affected by any of the treatments.

Key words: dairy cows, poor quality hay consumption, effect of milling, concentrates, molasses

The use of hays in animal feeds is one of the alternatives used during the the dry season in tropical areas where the precipitation is seasonal. The hays produced and sold under these conditions are, in general, of low quality as the ambiental limitations during the rainy season mean that hay must be made at the beginning of the dry season from pastures with long periods of growth.

Little is known of the nutritional value of these hays and the quality and quantity of concentrates necessary to balance the nutrient deficiencies in these fibrous materials when fed to milking cows. In temperate countries, cereal straws of a quality similar to these hays (protein content less than 5% and digestibility between 35 and 50%) have received special attention as cattle feeds. Physical and chemical methods of treatment have also been used to improve consumption (Smith and Broster 1977; Owen 1979).

Three experiments were carried out with the objective of discovering the effect of the level of supplementation with concentrates of different protein content, the milling of the hay and the addition of small quantities of molasses on consumption and productivity of dairy cows fed a basal diet of low quality Bermuda hay.

Materials and Methods

Experiments 1 and 2:

These experiments were carried out with the purpose of studying the effect of the level of concentrate supplementation on the consumption of low quality Bermuda grass hay and milk production. In Experiment 1 a concentrate with 16.7% crude protein (dry weight basis; CP=N x 6.25) was fed and in Experiment 2 the concentrate contained 32.7% CP. In each experiment six Holstein cows of 2 or more lactations were used, At the outset of the experiment these cows had 58 ± 9 and 47 ± 10 days in milk, were producing 15.6 ± 2.3 and 16.3 ± 1.9 kg milk/d and had liveweights of 432 ± 62 and 416 ± 31 kg in Experiments 1 and 2 respectively. The experimental design in

the two trials was a 3 x 3 Latin Square with periods of 6 weeks, The measurements taken in the last four weeks were used in the statistical analysis, The supplementation levels were 5, 7 and 9 kg of concentrate daily, feeding 1.5 kg at each milking and the rest at 0900h. In both trials Bermuda grass hay (*Cynodon dactylon* Pers) was fed ad libitum, at 1100h, The composition of the hays and concentrates used are shown in Table 1.

Table 1:
Chemical composition of hays and concentrates

	Experiment	Dry matter %	Crude protein %	Ash %	Cell wall %
Concentrates	1 *	93.9	16.7	5.2	23.9
	2 **	93.9	32.4	7.2	-
	3 *	96.4	15.8	6.1	23.1
Hays	1	92.7	4.0	7.6	75.8
	2	95.7	7.4	6.6	75.6
	3 Whole	97.6	7.1	7.0	74.9
	Milled	95.5	7.6	8.4	75.5

* Concentrate formula: waste maize meal 68%, cotton seed cake 29%, minerals 2%, common salt 1%.

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DM, CP and ash content were determined according to A.O.A.C (1965) procedures and the cell wall content determined according to the method described by Van Soest (1967). The digestibility of the hay and concentrate in Experiment 1 was determined in an in vivo digestibility trial using 8 sheep. All were fed hay ad libitum and four also received 0.5 kg/d concentrate. The digestibility of the organic matter of the concentrate, estimated by the differential method (Fredriksen 1973) was 70% and that of the hay was 43.4%. Milk production was determined daily and samples of milk were taken once a week to determine protein content (Udy 1965). Solids not fat was determined by density and fat by the Milko-tester. The animals were weighed twice a week and liveweight change was estimated by regression.

Experiment 3:

This experiment was carried out with the objective of determining the effect of milling the hay and the addition of small quantities of molasses on hay consumption by dairy cows of average milk production receiving concentrates. Eight Brown Swiss cows of two or more lactations were used. At the outset of the trial these had 86 ± 37 days in lactation, a milk production of 10.1 ± 1.2 kg/d and a liveweight of 460 ± 23 kg. The experimental design was a 2 x 2 factorial design within a 4 x 4 Latin Square with periods of 3 weeks. The results of the last week were used for this analysis. One variable was the physical form of the hay, it being supplied both whole and milled using a hammer mill with a screen with holes of 1 cm diameter. The other factor was

the addition or non addition of 200 g/d of molasses sprinkled over the hay. All the animals received a fixed level of 5 kg/d of concentrate fed in equal parts during the two milkings. The same hay and concentrates were fed as in Experiment 1.

Results

The consumption and production of the cows in Experiment 1 and 2 are presented in Table 2. The milk production figures obtained in both trials were similar, however, the response to supplementation on the concentrate levels used was lower with the concentrate of 32,4% CP. The production obtained at the lower level of concentrate (10.2 kg/d) being similar to the maximum production obtained (11.8 kg/d). In the two trials the lower level of supplementation caused slight weight losses, in comparison with gains of almost 0,5 kg/d on the high concentrate levels.

Table 2:
Experiments 1 and 2, production and chemical composition of milk, liveweight change and feed intake

	Experiment 1				Experiment 2			
	Level of concentrate				Level of concentrate			
	5	7	9	$S_{\bar{x}}$	5	7	9	$SE_{\bar{x}}$
Milk production (kg)	9.5	11.2	12.8	0.48**	10.2	11.2	11.8	0.28*
Composition of milk (%)								
Fat	4.0	3.2	2.9	- ^a	4.2	3.9	3.4	0.34
Solids not fat	7.6	7.6	7.8	0.13	8.1	8.1	8.3	0.05
Protein	3.2	3.1	3.1	0.10	3.2	3.1	3.4	- ^a
Liveweight change (kg/d)	-0.06	0.37	0.48	0.10	-0.07	0.23	0.44	0.31
Hay intake, kg DM/d	2.9	2.8	2.2	0.16 ⁺	2.1	1.8	1.5	0.25
Total intake, kg DM/d	7.5	9.3	10.2	0.30**	6.8	8.3	9.9	0.24**

⁺ P < 0.10; * P < 0.05; ** P < 0.01 ^a Mean of the two periods

The fat content of the milk dropped with supplementation. This decrease, in spite of being appreciable, was not statistically significant, probably because of the low number of animals used in each test. Hay consumption dropped slightly with supplementation in the two experiments. This effect was only significant in Experiment 1 (P < 0.10). Hay consumption dropped between 0,05 and 0.21 kg DM/kg DM concentrate fed.

The hay consumptions obtained in Experiment 3 (Table 32) were higher than those observed in the other two trials. However, no improvement was noted in consumption due to the effect of milling or the addition of the 200 g of molasses. The milk production measured in the last week of each period was also not affected by these treatments,

Discussion

The results of the three trials show very varied consumptions of the low quality hay fed to the cows receiving concentrates. The higher consumptions obtained in

Table 3:
Hay intake and milk production

	Physical form of hay			Quantity of molasses in hay		
	Whole	Milled	SE _x	0	200	SE _x
Hay intake (kg DM/d)	4.84	4.83	0.22	4.95	4.72	0.22
Milk production (kg/d)	8.9	9.0	0.14	8.9	9.0	0.14

Experiment 3 cannot be explained with the information available. The digestibility of the hay used in this trial was not determined and it could have been superior to that used in the other two experiments. The increase in the level of concentrate from 5 to 9 kg/d caused a slight drop in the consumption of hay (Table 2), comparable to that obtained with similar quality straws in temperate countries (sampling and Murdoch 1966; Andrews et al 1972; Horton and Holmes 1976). The increases in the consumption of low quality forages when feeding concentrates initially reported by Blaxter and Wilson (1963) in sheep, were observed in cows by Campling and Murdoch (1966) only when the supplementation level was 4 kg/d or less. At the level of concentrates used in these trials the drop in hay consumption could be due to a drop in the cellulitic activity of the microorganisms of the rumen and to a drop in the flow of digesta from the rumen, as these authors pointed out.

The evaluation of the effect of the protein content of the ration on hay consumption in Experiment 1 and 2 is not statistically valid as different animals and different hays were used. However, it was observed that the consumption of fibrous material remained equally low in the second trial (Table 2), in spite of the protein content of the concentrate being almost double that used in Experiment 1. The inclusion of a high percentage of cottonseed cake in the concentrate in Experiment 2, a primary material of low degradability (A.R.C. 1980), could also have decreased the negative effect of the concentrate on the cellulosis in the rumen and on the consumption of hay. The absence of response to the higher percentage of protein and to the use of a primary material of low solubility in this test, is probably due to the high ratio of concentrate to forage in the diet. The change in the composition of the concentrate in Experiment 2 and the rise in the protein percentage does not appear to have had an effect on milk production in comparison with the results obtained with the low protein concentrate in Experiment 1. The protein contents obtained in the total diets in this latter trial remained over 12% due to the low consumption of hay observed and are theoretically sufficient for an efficient utilization of energy in the rumen (A.R.C. 1980). Milk production was limited fundamentally by the energy consumption in both trials. At the high levels of supplementation in Experiment 2, the low response obtained could be due to the excess of protein consumed and the energetic value required for its elimination (Oldham and Alderman 1981). The tendency for milk fat to decrease with the level of concentrate supplementation is probably a consequence of the decrease in the fibre content of the total ration, when the proportion of hay in this diet was decreased appreciably (Broster et al 1979).

The milling of the hay in Experiment 3 had no effect on consumption. The effect of this physical treatment on consumption of straws and hays in ruminants is known (Owen 1979), however the little published evidence shows that the processing of forages has a small effect on consumption when the forage is fed in high concentrate diets (sampling and Milne 1972; Greenhalgh and Wainman 1972)

The quantity of molasses offered was about 4% of the hay consumed and also did not have an effect on the consumption, Preston (1972) pointed out that small quantities of molasses added to dried, milled hay improved voluntary consumption. This was not observed in this trial and could be due to the fact that this effect does not occur when the animal also received an appreciable quantity of concentrates. The results obtained in these trials show that the nutritive value of low quality hay for dairy cows is very low when they are fed separately from the concentrates because of their low nutritive value and low consumption. To satisfy the requirements of these animals it is necessary to increase appreciably the concentrate level in the ration, with the consequent negative effect on the fat content of the milk even in cows of average production. The feeding of milled hay mixed with the concentrate in complete diets could improve its consumption as has been demonstrated with hays in temperate countries (Owen et al 1968; Greenhalgh and Wainman 1972), but this implies higher capital investment in tropical countries where these resources are available,

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