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NUTRITIVE VALUE FOR SHEEP OF UNTREATED HOOP PINE SAWDUST SUPPLEMENTED WITH UREA OR BIURET

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SUMMARY

In a trial lasting 100 days, three groups of eight 18-months old wether sheep were fed daily 1 000 g basal ration or 800 g basal ration plus 200 g sawdust, or 800 g basal ration, to measure the digestibility and nutritive value of hoop pine (*Auracaria cunninghamii*) sawdust.

The dry matter digestibility of the sawdust was 1·7% and it made no contribution to animal performance.

The rations were supplemented with either urea or biuret, but there was no difference between supplements in animal performance or ration digestibility. However, biuret-supplemented sheep apparently retained more nitrogen than urea-supplemented sheep.

A mixed softwood sawdust and two mixed hardwood sawdusts were also examined and had dry matter digestibilities of 3·1%, 4·3%, and 4·3% respectively.

I. INTRODUCTION

Wood and wood residues contain about 70 to 80% carbohydrate and therefore are a potential source of energy for ruminant animals. Feist, Baker and Tarkow (1970) have indicated that the annual output of low quality wood and unused wood residues in the U.S.A. is more than 100 million tonnes, but equivalent information for Australia is not available. Although the potential value of wood residues in ruminant feeding has long been recognized (for example Archibald 1926), poor digestibility has remained a barrier to their widespread use.

In Australia, interest in feeding wood residues, particularly sawdust, arises only during periods of extreme feed shortage such as droughts. During these times, the popular press commonly carries reports of highly favourable responses to the incorporation of sawdust into ruminant diets. However, these reports are often difficult to evaluate objectively.

This paper presents the results of an investigation into the nutritive value of untreated hoop pine (*Auracaria cunninghamii*) sawdust for sheep and also the results of digestibility trials on a mixed softwood and two mixed hardwood sawdusts.

II. MATERIALS AND METHODS

Hoop pine sawdust

DESIGN AND TREATMENTS. This experiment was designed to enable digestibility data to be collected and to measure the contribution made by hoop pine sawdust to a diet for sheep.

The experimental animals were 24, 18-month old Merino x Border Leicester wethers with a mean liveweight of 32·5 kg (range 26·8 to 37·7 kg). They were randomly divided into three groups each of eight sheep after initial stratification on the basis of liveweights, and were allocated to the following dietary treatments: treatment 1, 1 000 g basal ration per head per day; treatment 2,800 g basal ration plus 200 g sawdust per head per day; treatment 3, 800 g basal ration per head per day. The sheep were housed in individual metabolism crates and were drenched with vitamins A and D3 at the commencement of the experiment.

The rations were supplemented with non-protein nitrogen in the form of urea (46% N) and biuret (37% N) on an isonitrogenous basis, four sheep in each treatment receiving urea and the other four receiving biuret.

The formulation of the basal ration is shown in table 1. Previous work with other sawdusts had suggested palatability could be a problem, so a high level of molasses was included in the ration. However, the consistency of the ration was very poor and a small quantity of sawdust was added to absorb the molasses.

TABLE 1

COMPONENTS OF THE BASAL RATION (% AS FED)

Sorghum grain	65·2
Molasses	18·6
Lucerne chaff	6·5
Hoop pine sawdust	5·6
Urea	2·8 (or biuret 3·5†)
Minerals mixture*	1·3

* $CaHPO_4.2H_2O$ 350 g, $CaCO_3$ 200 g, NaCl 100 g, $CaSO_4.2H_2O$ 50 g, $CuSO_4.5H_2O$ 1 g, $ZnSO_4.H_2O$ 0·3 g, $MnSO_4.H_2O$ 0·15 g, $CoCl_2$ 0·1 g, KI 0·025 g.

† All other components varied proportionately.

The test ration consisted of a mixture of 80% basal ration and 20% hoop pine sawdust, and the sawdust was oven dried at 100°C before incorporation into the rations.

The experiment lasted 100 days, not including a preliminary adaptation period of 14 days.

MEASUREMENTS. All sheep were weighed full and fasted (24 h without feed, 16 h without water) at the commencement and termination of the experimental period.

Feed intakes were measured daily throughout the experiment and residues, which rarely occurred, were weighed and discarded. The feeds were sampled at intervals throughout the experiment and daily during the collection periods, and were analysed for dry matter and nitrogen.

Total daily outputs of faeces and urine were measured during two consecutive periods of 7 days, beginning 1 month after the commencement of the experiment. Faeces from each sheep were bulked within each period and stored at 5°C. Urine was collected into a solution of concentrated hydrochloric acid and mercuric chloride (25/1 V/W) to maintain a low pH (1·5 to 2·5) and to inhibit microbial action. Aliquots of urine from each sheep each day were bulked within each collection period and stored at 5°C. Bulked samples of faeces and of urine were mixed and sub-sampled for analysis, faeces for dry matter and nitrogen, and urine for nitrogen.

Relative wool growth was measured by clipping patches 100 cm^2 on the left and right midsections of each sheep at the beginning and end of the experiment. Wool samples obtained were scoured and weighed.

A sample of hoop pine sawdust was taken for proximate analysis, and chemical analyses were carried out essentially by the methods of the AOAC (1965), except for the neutral detergent fibre analysis on hoop pine sawdust which was done according to Van Soest (1963) and Van Soest and Wine (1967).

Statistical comparisons between treatments were made by standard analysis of variance techniques.

Mixed sawdusts

Four groups each of five individually fed wether sheep were used for the estimation of the DM digestibilities of the two mixed hardwood and the mixed softwood sawdusts. Sheep in one group were fed 1 000 g day^{-1} of a basal ration similar to that in table 1 supplemented with urea, and in the other three groups were fed 800 g day^{-1} of the same basal ration plus 200 g day^{-1} of one of the mixed sawdusts. Faeces were collected daily for 10 consecutive days following a preliminary feeding period of 10 days.

III. RESULTS

The composition of hoop pine sawdust is shown in table 2. This table indicates that the nutritive value of the sawdust lies almost entirely in its capacity to supply energy to the animal. The crude protein content of the basal (urea) ration was 18·2% and of the basal (biuret) was 18·7%. With sawdust added, the crude protein contents were 14·2% and 15·7% respectively.

TABLE 2

COMPOSITION OF HOOP PINE (*Auracaria cunninghamii*) SAWDUST (% D.M.)

Crude protein (N x 6·25)	0·9	
Crude fibre	72·9	
Ether extract	0·29	
Ash	5·9	
Ca	0·11	
Cellulose	49·6	Neutral detergent fibre
Hemicellulose	10·9	Neutral detergent fibre
Lignin	29·7	Neutral detergent fibre

Table 3 summarizes the dry matter digestibility co-efficients of the test ration and of the basal rations at two levels of intake, and also presents the growth rate, nitrogen balance and wool growth data of sheep fed these diets. There was no significant difference in digestibility between diets supplemented with urea and those supplemented with biuret. However, the test ration was significantly ($P < 0 \cdot 01$) less digestible than the basal ration (64·4 V. 82·3% average S.E. ± 0·55).

TABLE 3

Dry Matter Digestibility, Fasted Growth Rate, Wool Growth, and Nitrogen Balance of Sheep Fed a Basal Diet with or without Hoop Pine Sawdust

Daily Ration	Digestibility (% D.M.)	Growth Rate (g day^{-1})	Wool Growth (scoured g day^{-1} 100 cm^{-2})	Nitrogen Balance (g day^{-1})*
Basal 1 000 g	81·9^{a}	108·9	0·173	7·75
Basal 800 g + sawdust 200 g ..	64·4	67·9^{a}	0·160	6·56^{b}
Basal 800 g	82·7^{a}	69·8^{a}	0·175	6·11^{b}
L.S.D.$_{P=0 \cdot 05}$	1·65	11·41	0·0428	1·201

* The nitrogen balance of biuret supplemented sheep was significantly ($P < 0 \cdot 01$) greater than that of urea supplemented sheep (7·57 *v.* 6·05 g day^{-1} average S.E. ± 0.323 g).

Means in the same column with the same superscript are not significantly different a = $P < 0 \cdot 01$; b = $P < 0 \cdot 05$.

The dry matter digestibility of hoop pine sawdust, calculated by the difference method and using the mean digestibility (81·9%) of the 1 000 g basal plus either urea or biuret rations as a base, was 4·4%. If the mean digestibility (82·7%) of the 800 g basal plus either urea or biuret was used as a base, then the hoop pine dry matter digestibility was estimated to be 1·7%.

There was no significant difference in fasted growth rate between urea and biuret supplemented animals (83·5 V. 80·8 g day^{-1} average S.E. ± 3·07). Those sheep which consumed 1 000 g day^{-1} of the basal ration grew significantly faster ($P < 0 \cdot 01$) than the sheep consuming 800 g day^{-1} of the basal ration with or without 200 g day^{-1} of sawdust. The difference in growth rate between sheep fed 800 g day^{-1} of basal ration and sheep fed 800 g day^{-1} of basal ration + 200 g day^{-1} of sawdust was not significant.

The mean nitrogen retention of sheep supplemented with biuret (7·57 g day^{-1} ± S.E. 0·323) was signfiicantly higher ($P < 0 \cdot 01$) than that of sheep supplemented with urea (6·05 g day^{-1} ± S.E. 0·323).

Wool growth was not significantly ($P = 0 \cdot 05$) affected by the treatments.

The mixed softwood and the two mixed hardwood sawdusts had dry matter digestibilities of 3·1%, 4·3% and 4·3% respectively.

IV. DISCUSSION

The digestibility of hoop pine sawdust was calculated by the difference method using a daily diet of either 1 000 g or 800 g of basal ration to determine the reference digestibility. The 800 g reference is probably most accurate in this case since the digestibility of the diet could be expected to increase when intake was reduced (Leaver, Campling and Holmes 1969), and this resulted in an estimate of sawdust dry matter digestibility of 1·7%. Untreated hoop pine sawdust can therefore act only as a dietary diluent, and will not make a worthwhile contribution to the animals nutrient supply. This is evidenced by the total lack of growth response to the inclusion of 200 g day^{-1} in the diet (table 3). In contrast, the consumption of a further 200 g day^{-1} of basal ration produced an additional 40 g day^{-1} of live weight.

The mean nitrogen retention for the sheep consuming 1 000 g day^{-1} of basal ration plus biuret was inflated by a single very high value (12·2 g day^{-1}), but even when this value was excluded retention by biuret supplemented sheep was significantly ($P < 0 \cdot 01$) higher than by urea supplemented sheep. However, this difference was not reflected in differences in growth rate and wool growth, despite the fact that it is equivalent to about 9·5 g of protein or 35 g of muscle per day.

Various methods have been used to improve the digestibility of sawdust and low quality roughages, the most promising being alkali treatment, but the low nutritive value of such roughages can support only very moderate treatment costs. Feist, Baker and Tarkow (1970) reported an average improvement in *in vitro* digestibility of 18·6 percentage units for 11 hardwood sawdusts following treatment with 20% by weight of sodium hydroxide. However, responses by individual sawdusts ranged from 5 to 51 percentage units. Wilson and Pigden (1964) found marked increases in *in vitro* digestibility of poplar wood and wheat straw following treatment with up to about 9% sodium hydroxide, but above this level increases were negligible.

By acting as a dietary diluent, however, sawdusts may have an important physical role in maintaining the health of ruminants consuming diets containing a high proportion of concentrates. Anthony and Cunningham (1968) have shown that sheep are able to compensate for as much as 35% sawdust in a concentrate mixture by increasing dietary intake to maintain digestible energy intake. A similar ability to compensate has been demonstrated by dairy cows (Satter, Baker and Millet 1970). At low levels of inclusion in concentrate rations for steers, sawdust has also been found to be equivalent to ground hay (El-Sabban *et al* 1969), and Morris, Gartner and Pepper (1967) have shown that roughage quality is unimportant when the roughage comprises 10% of a concentrate diet for steers. Sawdust is also highly absorptive and, because of this property, it may find some use as a carrier for liquid feedstuffs such as molasses.

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