EFFECT OF RICE HULLS IN GRAIN BASED DIETS ON LIVE WEIGHT CHANGE, INTAKE AND ACIDOSIS IN SHEEP

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SUMMARY

The effect on intake, live weight change and acidosis of replacing whole oat or whole wheat grain diets with 0, 10, 20 or 30% ground rice hulls, under a feeding regime similar to those used in the live sheep trade, was investigated. The results suggest that a grain diet with rice hulls added is likely to be no more beneficial in the live sheep trade than the same diets excluding rice hulls.

INTRODUCTION

Rice hulls, the outer cuticle of unprocessed rice, is a major by-product (approximately 20% milling yield) of the rice industry. Presently about 40% of rice hulls in Australia are used in various applications while the rest is field dumped and burnt (Hutton, personal communication). Rice hulls have a low nutritive value, are high in fibre and are low in metabolisable energy (estimated for ruminants *2.5* MJ/kg).

The live sheep export industry requires about 200,000 tonnes of feed per annum. Since most of the sheep used are adult, and at present no premium is paid for live weight gain, diets can be formulated with relatively low energy concentrations. Presently only pelleted diets are used. *However* pelleting does restrict the use of cereal grains because after grinding and pelleting, the surface area available for microbial attack increases and starch becomes more degradable.

Inclusion of rice hulls might alleviate the acidosis which is frequently associated with pelleted diets based on cereal grains (Watson *et al. 1986).* This might reduce the need for further modifications with rumen modifiers and/or alkali and facilitate the feeding of loose grain based diets.

This experiment examines the response of changes in the proportion of ground rice hulls in whole grain based diets on liveweight change, intake and acidosis under a feeding regime similar to that used in the live sheep trade,

MATERIALS AND METHODS

Three sources of 128 adult Merino wethers (384 in total, fasted mean live weight = 52.5 kg, s.d.= 5.1) were allocated by stratified randomisation based on live weight and source to one of 64 groups of six sheep. Each group was maintained in an outside pen (39 m^2 with 0.30 m/hd trough space).

The experimental design was one replicate of a fully randomized 4 * 2 * 2 * 2 * *2* factorial. The treatment factors were:

4 levels of rice hulls (0, 10, 20, 30 percent)
2 grain types (whole wheat and whole oats)
2 levels of feeding (maximum of 1.0 (kg/hd)/day and *ad libitum)*

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2 levels of slaked lime (1.9% limil[a] or 1.0% finely ground limestone)
2 levels of Avotan[b] (0.43% or 0%)

[a] David Mitchell Estates Ltd., approximately 90 % calcium hydroxide
[b] Cyanamid Australia Pty Limited, estimated 10 % avoparcin

The diets were mixed, using a paddle mixer, in batches containing 200 kg of grain and ricehulls. In addition all diets contained molasses (1.9%), common salt (0.5%) and a trace mineral/vitamin premix (0.1%). Similar to the practice in the live sheep trade, diets were gradually introduced to sheep, following a 24 hour fast, by replacing a hay diet with the grain/ricehulls rations over a "feedlotting" period of 6 days. Thereafter the sheep *were* offered only their assigned rations, during a three week "shipping" phase.

Residues were collected each day and physically separated into rice hull and grain contents. These weights were used to calculate intake and the rice hull discrimination percentage. This was defined as (rice hull proportion of diet consumed divided by rice hull proportion of diet offered) x 100.

Jugular blood samples were taken for D-lactate measurements from all sheep (5-7 hours after feeding) on day 2 and 15 of the "shipping phase". On the same days, and at the same time, rumen samples were taken by stomach tube and rumen pH determined immediately. These rumen collections were taken from 2 sheep of 16 treatments; namely treatments containing either 0% or 30% rice hulls, and either with or without both slaked lime and avoparcin.

Statistical analysis was performed using analysis of variance for fasted live weight change, grain intake, total intake, rice hull discrimination percentage (for the diets containing 10, 20, 30% rice hulls) and D-lactate (with $\log(y+0.3)$ transformation on each wether), using four and five factor interactions as error. The rice hull treatment and its interactions were divided into orthogonal polynomial responses. The pH values were analyzed using three and four factor interactions as error. In most pens fed a maximum of 1.0 (kg/hd)/day, on most occasions, intake was not restricted. This allowed analysis (the residuals were checked) of intake using all pens. Multiple regression analysis was done on a pen basis to determine relationships between intake and live weight change.

With the sole exception of rumen pH, the results suggested that slaked lime and avoparcin responses were additive to *rice* hull responses. Thus they can be considered separately. This paper is restricted to the rice hull response.

RESULTS

For the oats-restricted diet, grain intake (GI) decreased linearly (almost $P<0.001$) as the level of rice hulls increased (Fig. la), whereas for the other diets there was no indication ($P>0.1$) of any response.

There was a very strong discrimination against rice hulls (Fig. lb). With restricted feeding this discrimination averaged 55%, and did not change with the proportion of rice hulls in the diet. However, with *ad libitum* feeding the rice hull discrimination percentage increased linearly ($P<0.02$) from negligible for 10% ricehull diets to between 20 and 40% (depending on grain type) with 30 % ricehull diets.

The responses of total intake (TI) to the percentage of ricehulls in the diet, for-various grain type and feeding level combinations, reflected the -grain intake and discrimination responses (Fig. 1c).

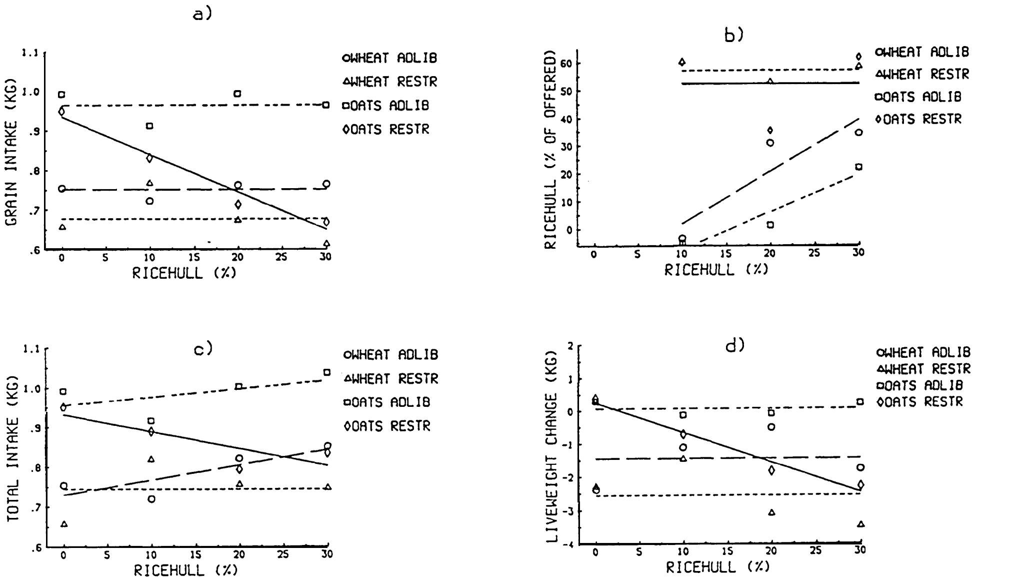

Fig. 1. Rice hull percentage vs (a) grain intake; (b) rice hull discrimination percentage; (c) total intake and (d) liveweight change.

Over the three week "shipping" period the intake of wheat based diets was erratic, whereas the intake of the oat diets increased steadily.

As with grain intake, the restricted oat diets decreased live weight change, from 0.5 kg to -2.5 kg, when rice hulls levels were increased from 0 to 30%. For the other diets the live weight change appeared to be the same at every level of rice hulls used (see Fig. 1d).

For wheat and oats there was no evidence of separate relationships between grain intake and live weight change. Multiple regression analysis showed a quadratic response for GI, which accounted for 67% of variance (Fig. 2). In comparison the quadratic response for TI accounted for 58% of variance. The addition of TI and TI^2 terms to the quadratic GI model did not improve the model ($P>0.1$). However addition of GI and G12 terms to the quadratic TI model did improve the relationship ($P<0.001$).

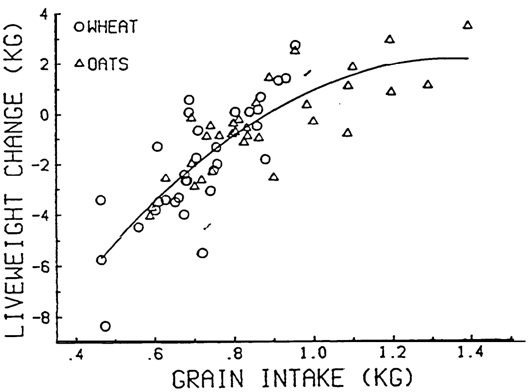

Fig. 2. Relationship between liveweight change and intake of oats or wheat.

High plasma D-lactate values (> 0.3 mmol/l) occurred in 5.8% of sheep, particularly with the wheat *ad libitum* feeding regime (13.3%). Overall mean of plasma D-lactate for day 2 was low (back transformed mean was -0.01 mmol/l), although there was a linear increase with increasing levels of rice hulls ($P<0.05$). However, between 0 and 30% rice hulls the difference was only about 0.1 mmol/l.

For the diets without avoparcin and slaked lime, the rumen pH on day 2 at 0% rice hulls was higher than at 30% (5.9 v 5.0, s.e.d. = 0.19). However, this effect disappeared for diets with slaked lime and avoparcin. No abnormally high plasma D-lactate nor extremely low rumen pH values (all between 5.2 between 6.9) occurred on day 15.

DISCUSSION

Grain intake was not increased by addition of rice hulls to the diet. When comparable diets *were* given as pellets, Hodge *et al.* (1986) found that digestible organic matter intake was higher with 40% than with 20% rice hulls and the incidence of *severe* weight loss was reduced. In the diets used in this study, strong discrimination against rice hulls occurred with ad libitum feeding, with a decrease in discrimination for increasing rice hulls in the diet. Even with this discrimination, for some diets the intake of rice hulls was still about 15% of the total intake. Thus it can not be reasonably argued that the lack of response to rice hulls was due to few *rice* hulls being eaten.

Live weight change was primarily determined by grain intake. Grain intake was dependent on the amount and type of grain available to the sheep. Although the intake of oat diets was higher than wheat diets, there was no evidence that wheat had higher metabolisable energy value, in spite of generally higher published values. This observation is in agreement with those of Kenney (1985).

Usually, plasma D-lactate concentrations increase when readily fermentable carbohydrates are over-consumed (Giesecke and Stanggassinger 1979). In this study, the D-lactate and rumen pH measurements *were* taken on only two occasions of the total feeding period. However, they indicate that increasing levels 'of rice hulls in the diets did not alleviate acidosis.

This experiment has indicated that a loose grain diet with rice hulls is likely to be no more beneficial to the live sheep trade than the same diet excluding rice hulls,

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