

Balance study on sheep fed with beet molasses solubles

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A balance study was carried out to investigate digestibility and retention of major nutrients in wethers fed rations in which condensed beet molasses solubles (CBS) formed 27% of the dietary DM. Results showed that CBS contained 8,3 MJ of ME and 19 g ruminal degradable protein-nitrogen and should be included in rations containing components with high ME contents. CBS with sugar beet pulp and hay in the ratio 27:57:16 on a DM basis stimulated crude fibre digestibility. The adverse effect of high levels of potassium can be offset by the inclusion of 10 g MgO per kg CBS.

'n Balansstudie is gedoen om die verteerbaarheid en retensie van die vernaamste voedingstowwe te ondersoek in hamels gevoer met rantsone waarvan die opgeloste voedingstowwe van gekondenseerde beetmelasse (CBS) 27% van die dieet DM uitgemaak het. Resultate het getoon dat CBS 8,3 MJ ME en 19 g proteïen-stikstof wat in die grootpens afgebreek kan word, bevat en dit behoort ingesluit te word in rantsone wat bestanddele met 'n hoë ME inhoud bevat. CBS met suikerbeetpulp en hooi in 'n verhouding van 27:57:16 op 'n DM basis het ruwesel verteerbaarheid gestimuleer. Die nadelige effek van hoë kalium vlakke kan teengewerk word deur 10 g MgO per kg CBS in te sluit.

Keywords: sheep, beet molasses solubles, digestibility, nitrogen retention, allantoin excretion, magnesium absorption, magnesium supplementation.

Introduction

Molasses solubles are a by-product obtained from sugar beet or sugar cane molasses during alcohol fermentation. Fresh molasses solubles have a low concentration of dry matter (DM) and are too unstable for use as an animal feed. When condensed to > 50% DM the product becomes more durable. Condensed molasses solubles contain many valuable nutritional compounds and have been used as an animal feed, especially for ruminants (Yano, Kobayashi & Kawashima, 1977; Karalazos & Swan, 1977; Wahlberg & Cash, 1979; Kulasek, H. Leontowicz, Krzemiński, M. Leontowicz, Sobczak, Motyl, Hempel-Zawitkowska, Pierzynowski & Bartkowiak, 1982). In a previous experiment it was found that condensed beet molasses solubles (CBS) contain about 30% crude protein and 30% minerals in DM (Kulasek *et al.*, 1982). About one third of the minerals in CBS consists of potassium and ruminants fed with CBS are potassium loaded. Excess potassium in the diet disturbs mineral metabolism and inhibits magnesium absorption especially (Yano *et al.*, 1977; Martens & Rayssiguier, 1980).

The aim of the balance study was to investigate digestibility and retention of major nutrients and minerals in wethers fed rations of which CBS constituted 27% on a dry matter

basis. Magnesium oxide was used as a mineral supplement to improve magnesium retention on these diets.

Material and Methods

The experiment was conducted on 12 wethers of about 55 kg body mass, divided into three groups. Control group (I) received 0,4 kg dry sugar beet pulp, 0,3 kg commercial concentrate and 0,15 kg meadow hay daily. The remaining experimental groups (II and III) received 0,3 kg CBS (67% DM) and 0,1 kg beet pulp instead of concentrate. Furthermore, experimental group (III) received 3,6 g MgO daily. After an adaptation period of five days, faeces and urine were collected.

Results and Discussion

Digestibility of major nutrients (Table 1) was similar in all groups, except crude fibre for which digestibility was higher in CBS fed animals. Better digestibility of fibre in sheep fed CBS rations could be caused by higher cellulolytic activity of the ruminal contents. This result confirmed our previous observation that a CBS diet was associated with an elevated acetic acid concentration in the rumen of bulls (unpublished). Wahlberg & Cash (1979), in experiments on sheep fed diets containing 5% CBS or condensed cane molasses solubles (on DM basis), did not observe a significant influence of these feeds on digestibility of fibre or other nutrients.

Table 1 Apparent digestibility of major nutrients, nitrogen retention and allantoin excretion in sheep fed diets containing beet molasses solubles

| Measurement | Group ^c | | |
|--|--------------------|-------------------|-------------------|
| | control I | with CBS | |
| | | II | + MgO III |
| Dry matter intake (g/d/animal) | 710 | 750 | 750 |
| Apparent digestibility coefficients (%): | | | |
| Dry matter | 78,3 | 78,6 | 79,9 |
| Crude protein (N × 6,25) | 72,9 | 65,8 | 66,0 |
| Crude fibre | 73,8 ^a | 80,8 ^b | 79,3 ^b |
| N-free extract | 86,3 | 85,4 | 87,5 |
| Nitrogen retention (g/d/animal) | 1,6 | 1,8 | 0,6 |
| Allantoin excretion (g/d/animal) | 2,2 | 1,2 | 1,7 |

^{a,b}Means within same row bearing different superscripts differ significantly ($P < 0,05$)

^cEach group of sheep consisted of 4 wethers

Nitrogen retention and allantoin excretion were lower in sheep fed CBS diets ($P > 0,05$). The amount of allantoin in urine can be used as an index of microbial protein synthesis in the rumen. Decreased microbial synthesis in the rumen and lower digestibility of nitrogen compounds in sheep fed CBS diets suggest that CBS diets were deficient in rumen degradable protein, which inhibited microbial protein synthesis.

Assuming calculated apparent digestibility of CBS crude protein and N-free extract, to be 61% and 86% respectively, and assuming energetic regression coefficients for sheep, it was calculated that 1 kg CBS DM contains 8,3 MJ of metabolic energy (ME) and 19 g ruminal degradable protein-nitrogen (RDP-N).

Mineral digestibility and retention is shown in Table 2.

Table 2 Digestibility and retention of minerals in wethers fed diets containing beet molasses solubles

| Measurement | Group ^c | | |
|-----------------------------------|--------------------|-------------------|-------------------|
| | control I | with CBS | |
| | | II | + MgO III |
| Intake (g/d/animal) | | | |
| Crude ash | 222 | 466 | 469 |
| Potassium | 8,38 | 26,02 | 26,02 |
| Magnesium | 2,14 | 1,36 | 3,52 |
| Digestibility coefficients (%) | | | |
| Crude ash | 41 ^b | 69 ^a | 70 ^a |
| Potassium | 92 ^b | 99 ^a | 99 ^a |
| Magnesium | 47 ^a | 30 ^b | 33 ^b |
| Magnesium retention, (g/d/animal) | 0,69 ^a | 0,15 ^b | 0,58 ^a |

^{a,b}Means within same row bearing different superscripts differ significantly ($P < 0,05$)

^cEach group of sheep consisted of 4 wethers

Digestibility of crude ash was higher in sheep fed with CBS which suggests that minerals of CBS are readily available to animals. CBS diets significantly reduced magnesium absorption which was caused by excess potassium in the CBS

diets. Similar results were obtained by Yano *et al.* (1977) in sheep fed diets containing 40% CBS on a DM basis. Supplemental magnesium oxide did not change the apparent digestibility of Mg, but elevated retention of magnesium to the value observed in control animals fed the diet without CBS (Table 2).

In conclusion, one kg CBS DM contains about 8,3 MJ of metabolic energy and 19 g RDP-N. These results show that there is a deficiency in the CBS of approximately 7 MJ of metabolic energy per kg CBS DM, and that this should be included in rations containing feeds with high concentrations of metabolic energy. CBS fed with sugar beet pulp and hay, at 27, 57 and 16% on a dry matter basis respectively stimulated crude fibre digestibility in sheep.

High levels of potassium in CBS lowered the apparent digestibility of magnesium. According to the mineral balance results it was concluded that CBS should be supplemented with *ca* 10 g MgO per kg CBS magnesium.

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