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EFFECTS OF SOIL-CONTAMINATED FEED ON DRY MATTER AND WATER INTAKE IN SHEEP

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SUMMARY

Rations of crushed barley, chaffed lucerne hay and molasses were mixed with soil to provide dietary soil contents ranging from 0 to 800 g/kg DM. These mixtures were offered *ad libitum* to 30 sheep in each of two trials of 6 weeks' duration. Voluntary intake was similar on all treatments, there being no compensation for reduced digestible dry matter (DDM) content in treatments containing soil. Intake appeared to be limited by weight of dry matter (DM) rather than by nutritive value or volume. Liveweight changes were directly proportional to DDM intake. Metabolizable energy requirement for maintenance was reached when soil comprised 55 to 60% of the diet and the basal feed used contained approximately 11.3 MJ of ME/kg DM. Water intake initially appeared to be inversely proportonal to the amount of soil consumed, but a third trial demonstrated that total water intake was directly related to DDM intake and independent of soil consumption.

INTRODUCTION

There is little precise information about the effect of ingested soil on voluntary intake and liveweight gain in ruminants. Previous work has been largely concerned with the effect of ingested soil on teeth wear (Healey and Ludwig, 1965) and soil as a source of mineral nutrients (Rigg and Askew, 1934; Grace and Healey, 1974).

Healey and Drew (1970) reported that the amount of soil ingested by hoggets grazing swedes increased as animals grazed closer to the ground. Soil intakes as a percentage of dry matter (DM) intake at the end of swede breaks could have reached a maximum of 20 to 30%.

Nicol *et al.* (1976) suspected that soil contamintion of pasture fed to cattle may have reduced DM digestibility and intake. Consequently the following trials were designed to explore the effect of several levels of soil contamination on feed intake and liveweight gain in hoggets.

MATERIALS AND METHODS

In each of two trials the basal ration was offered for 10 days to 48 penned hoggets before applying treatments in which soil was a contaminant. The basal ration consisted of equal proportions by dry weight of crushed barley and chaffed lucerne hay plus 60 g/kg hot molasses. The *in vivo* digestibility of this ration was 74.5% in both trials, and the metabolizable energy content 11.3 MJ/kg DM calculated from the following relationships: 18.5 MJE/kg DM × DDM% = DE; ME = 0.82DE.

Finely sieved soil (Wakanui silt loam) was mixed with the basal feed to give the following proportions of soil on a dry matter basis:

Trial 1:	Soil %	0	12.5	25	37.5	50
Trial 2:	Soil %	0	20	40	60	80

Thirty animals were then selected, randomly allocated to the five treatments and offered the appropriate ration *ad libitum* for 6 weeks.

In vivo digestibility was measured by total faecal collection in two animals from each treatment. Samples of feed residues and faeces were analysed for zirconium by X-ray fluorescence spectroscopy to assess the amount of selection between soil and feed particles which may have occurred during feeding.

Liveweight was measured at weekly intervals and total water intake recorded over five consecutive days during the fifth week. At the end of trial 2, two animals from each treatment group were slaughtered, and carcasses, pelts, and full and empty gastro-intestinal tracts weighed. Histological samples of rumen, abomasum, and small and large intestine were obtained.

A third trial examined water intake more intensively. Nine wether hoggets were monitored in metabolism crates for 21 days and fed one of three treatments devised to separate the influence of soil from DDM intake:

Treatment 1: *ad libitum* basal ration
Treatment 2: *ad libitum* 50% soil, 50% basal ration
Treatment 3: basal ration restricted to level of treatment 2

In vivo digestibility, water intake, urine and faecal water were measured for 14 days after 7 days on the experimental rations. Liveweight was measured at the start and finish of the trial.

RESULTS AND DISCUSSION

INTAKE AND LIVEWEIGHT GAIN

DM intakes were not significantly different between treatments in either trial 1 or trial 2 (Fig. 1). Since the soil-plus-feed mix-

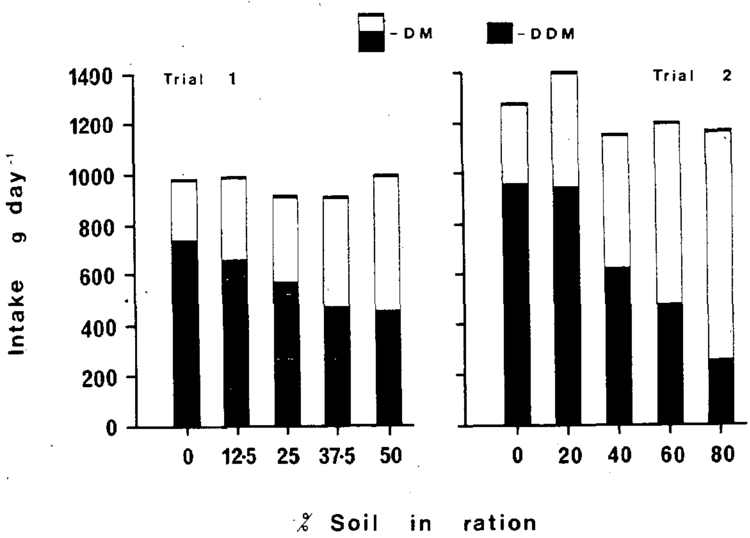

FIG. 1: *DM and DDM intakes in trials 1 and 2.*

tures were denser than the basal ration (up to 2.5 times), these similar intakes indicated that it was weight rather than volume which controlled appetite in these experiments.

Because DM intake was about the same in all treatments, the addition of soil to the basal ration reduced the digestible dry matter (DDM) intake. Figure 2 shows the linear relationships between liveweight gain, DDM intake and percentage soil in the ration. The intake corresponding to the maintenance requirement of a 35 kg pen-fed hogget was attained when dietary soil contamination was between 55 and 60% (Fig. 2).

Visual inspection of rejected feed and zirconium analyses indicated that in trial 1 up to 6% of the soil offered may have been rejected but minimal selection of feed from soil particles occurred in Trial 2.

POST-MORTEM DATA

Carcass, pelt, and empty and full gastrointestinal tract weights were inversely related to degree of soil contamination of the diet. High levels of dietary soil reduced the size of the rumen. Ruminal papillae from animals on high soil intakes were worn and heavily pigmented.

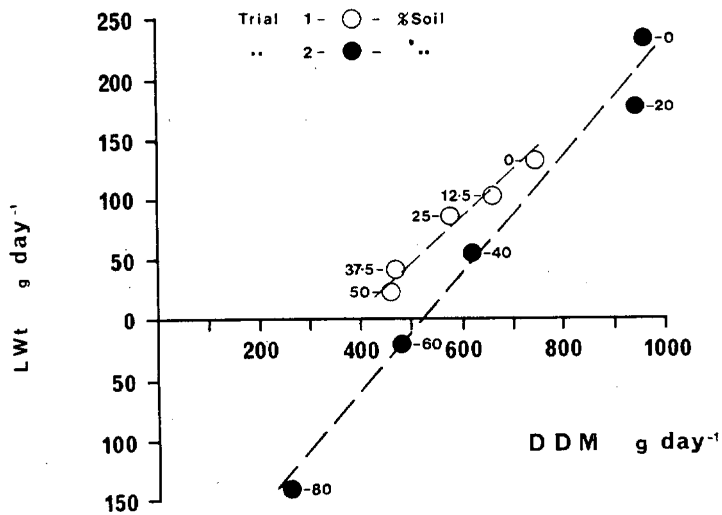

FIG. 2: *Liveweight gain and DDM intake in trials 1 and 2.*

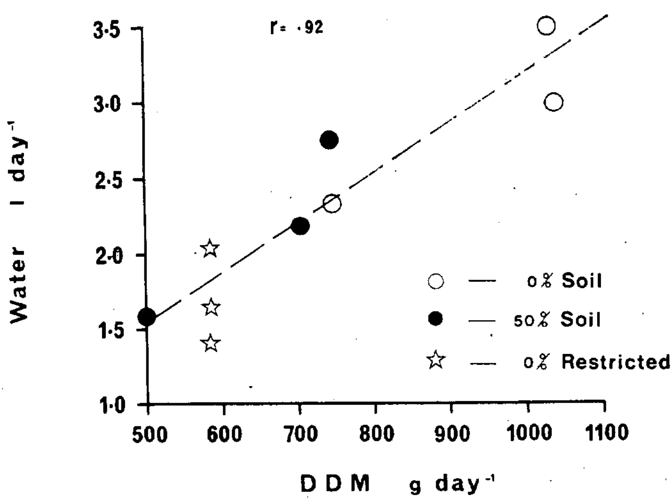

FIG. 3: *Total water intake and DDM intake for individual hoggets in trial 3.*

Water Metabolism

A strong negative relationship was observed in trial 2 between water intake and degree of soil contamination after a similar trend had been noted in trial 1.

However, trial 3 demonstrated that total water intake was directly related to DDM intake ($r = 0.92$) and was independent of the amount of soil in the ration (Fig. 3). Faecal water plus urinary water was also positively related to DDM intake. The water balance of the sheep (including calculations of insensible and retained water) were consistent with the findings of Wallace *et al.* (1972), who also showed a close relationship between DDM intake and water intake and output.

CONCLUSION

Sheep can ingest large quantities of soil for several weeks without dramatic consequences, but as DDM intake is not increased to compensate for dietary soil contamination, animal production will be adversely affected.

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