

ENERGY STANDARDS FOR GROWING RABBITS :  
PERFORMANCE AND DIGESTIBILITY AS AFFECTED BY HAY CONTENT,  
FINENESS OF GRINDING AND LEVEL OF FEEDING

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Introduction

Present literature contains little information on factors which affect feed digestibility in rabbits. In ruminants much research has been carried out to identify these factors (eg. intake level, roughage:concentrate ratio and physical form of roughage) and to assess their magnitude. The present study was undertaken to provide information on these factors as part of a programme to develop energy feeding standards for growing rabbits. Experiment 1 investigated the effects of chemical and physical characteristics on intake and digestibility of diets. Experiment 2 was designed to investigate the effects of level of feeding on the digestibility of diets varying in energy density.

Materials and Methods

Animals

One hundred and twenty weaned Californian x New Zealand rabbits, initially seven weeks of age and weighing approximately 800g were used in each experiment.

Diets

Diets were pelleted and were of the same composition in both Experiments, diets LH (Low Hay, 273g/kg), MH (Medium Hay, 556g/kg) and HH (High Hay, 831g/kg) contained 125, 195 and 265g/kg crude fibre respectively and were of the same crude protein content (160g/kg). The composition of diets is given in Table 1. In Experiment 1 prior to pelleting, (4mm die), the hay in diets LH<sub>f</sub>, MH<sub>f</sub> and HH<sub>f</sub> was ground through a 1mm screen whereas that in diets LH<sub>c</sub>, MH<sub>c</sub> and HH<sub>c</sub> was ground using a 6mm screen. The dimensions of the pellets produced were approximately 15 x 8mm.

Experimental Design and Procedure

A 3 x 2 factorial design was used in both Experiments 1 and 2, with 20 individually fed animals being allocated at random to each of six treatments, according to liveweight and sex on day 0 of the experiments. In Experiment 2 diets LH<sub>f</sub>, MH<sub>f</sub> and HH<sub>f</sub> were fed at two levels, ad libitum and restricted. Intakes of all rabbits were monitored before restriction commenced and animals chosen which had similar intakes and weights. Of these, half received full feed and half received 70% of ad libitum intake. The experimental periods were approximately 65 days with measurements made of daily gain, feed intake and digestibility. Nine digestibility trials starting on day 14 of the experiments, were carried out each using

16 animals. In Experiment 1 faeces were collected daily for 5 days and in Experiment 2 for 7 days with a 2-day preliminary period in the digestibility crates.

#### Statistical Analysis

There were differences in precision for some treatment combinations due to large co-efficients of variation within treatments HH<sub>c</sub> (High Hay coarse) and HH<sub>f</sub> (High Hay fine) and these were incorporated in a weighted analysis of variance. However, the results were almost identical to the unweighted analysis and therefore results presented here and those obtained from the unweighted analysis of variance.

#### Results

A summary of the results obtained in Experiment 1 is given in Table 2. There was a highly significant ( $P < 0.001$ ) effect of percentage hay on weight gain, 83% hay (HH High Hay) gave significantly ( $P < 0.001$ ) less live-weight gain than diets containing 27% hay (LH Low Hay) or 55% hay (MH Medium Hay) regardless of whether it was coarsely or finely ground. Rabbits fed finely ground diets containing 55% hay showed significantly ( $P < 0.01$ ) less live-weight gain than those fed diets containing 27% hay, whereas differences between these diets when coarsely ground were non-significant (Figure 1). There was a highly significant effect of hay inclusion on DMI (g/day), intakes of diets LH (Low Hay) and MH (Medium Hay) were significantly higher ( $P < 0.05$ ) than those of diets HH (High Hay). Particle size did not have a significant effect on dry matter intake of any of the six diets. Organic matter digestibility decreased significantly ( $P < 0.001$ ) with increasing level of hay in the diet. There was a significant ( $P < 0.05$ ) difference between the average organic matter digestibility of diets LH and MH, and diets HH. Particle size did not have a significant effect on digestibility.

The results of Experiment 2 are summarised in Table 3. There was a tendency for lower digestibility with restricted feeding but these differences were not statistically significant.

#### Discussion

The results obtained in Experiment 1 are in contrast with those obtained by other workers (Leplace and Lebas 1977) who have reported increased retention time and apparent dry matter digestibility when a finely ground ration was compared with one containing larger particles. It appears that small particles are retained in the caecum longer than larger less-digestible particles, which are preferentially expelled. In this experiment the only significant effect of particle size was on weight gain of rabbits fed diets containing 27% hay (LH Low Hay). A possible explanation for this is that the large particles in Diet LH<sub>c</sub> (Low Hay coarse) caused the concentrate portion to have lower gut retention time and lower digestibility leading to reduced weight gain.

It would appear that with a crude fibre in excess of 195 g/kg rabbits are unable to consume enough feed to satisfy their requirements for energy. The relationship between intake and energy content obtained in Experiment 1 seems to differ from that obtained by other workers due to the large drop in intakes of Diets HH. However, the weights of rabbits fed these diets were much lower than rabbits fed the high energy diets. When DM

intake g/kgW<sup>0.75</sup>. day was plotted against organic matter digestibility (Figure 2) a curvilinear relationship was obtained with no sharp decrease on feeding the high hay diets, which agrees with results obtained by other workers.

From Experiment 2 there seems to be a trend towards lower DM digestibility of diets when fed at a restricted level although these differences were non-significant. This is contrary to expectations as the apparent digestibility of feed by other species is known to decrease with increasing intake. These results can perhaps be explained by the magnitude of the metabolic faecal output. Although this is closely correlated to dry matter intake, it is probable that rabbits which had a restricted feed intake had a greater metabolic faecal output than those fed ad libitum. This would lead to an underestimation of the true digestibility coefficients for the animals with restricted feed intake. This factor together with the rabbit's ability to recycle digesta could account for the small reductions obtained in this experiment.

Table 1  
Composition of diets

Diet	LH	MH	HH
Barley	57.7	28.56	-
Soya Bean Meal	4.4	5.32	6.250
Herring Meal	8.00	8.00	8.00
Hay (Grass)	27.7	55.5	82.86
Dicalcium Phosphate	0.367	0.599	0.545
Salt	0.333	0.321	0.270
Vitamins and Minerals Premix	1.50	1.50	2.00

Analysis of diets (%)

Nutrient	LH	MH	HH
Protein	16.00	16.00	16.00
Oil	2.30	2.12	1.94
Fibre	12.00	19.50	26.91
Ash	6.109	7.32	8.517
Calcium	0.753	0.925	1.09
Phosphorus	0.700	0.700	0.700
Lysine	0.957	1.032	1.107
Av. Lysine	0.807	0.870	0.932
Meth	0.500	0.500	0.500
M + C	0.740	0.727	0.714
Salt	0.800	0.800	0.800
DM	86.13	86.4	86.816
ME Ruminant MJ/kg	10.582	9.561	8.551
ME Chick MJ/kg	9.487	7.635	5.803

Table 2

Experiment 1 - Mean daily dry matter intake (DMI) g/day, average weight gain (ADG) g/day and organic matter digestibility % (OMD)

Diet	DMI g/day	SEM	ADG g/day	SEM	OMD %	SEM
LHf	112.7	7.9	31.6	0.74	68.5	1.46
LHc	106.4	6.7	28.2	0.81	73.1	1.68
MHf	128.3	11.4	28.4	0.77	59.7	2.02
MHc	121.8	9.8	29.4	0.87	55.6	1.99
HHf	115.2	12.5	17.5	0.83	51.2	2.99
HHc	118.5	12.0	17.08	0.93	53.7	3.51
S.E. difference		4.07		1.17		

Table 3

Experiment 2 - Effect of feeding level on digestibility

Diet	DM digestibility %	SED	OM digestibility %	SEM
LH Ad libitum	71.5	1.69	73.3	2.25
LH Restricted	70.8	1.32	72.14	1.90
MH Ad libitum	50.2	2.48	51.2	2.06
MH Restricted	50.9	2.43	51.7	1.64
HH Ad libitum	39.8	2.64	39.1	1.67
HH Restricted	37.7	2.40	37.0	2.59

#### References

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**Figure 1**

Experiment 1 - Graph showing liveweight gain (g/day) against hay content (g/kg) of diet when coarsely or finely ground

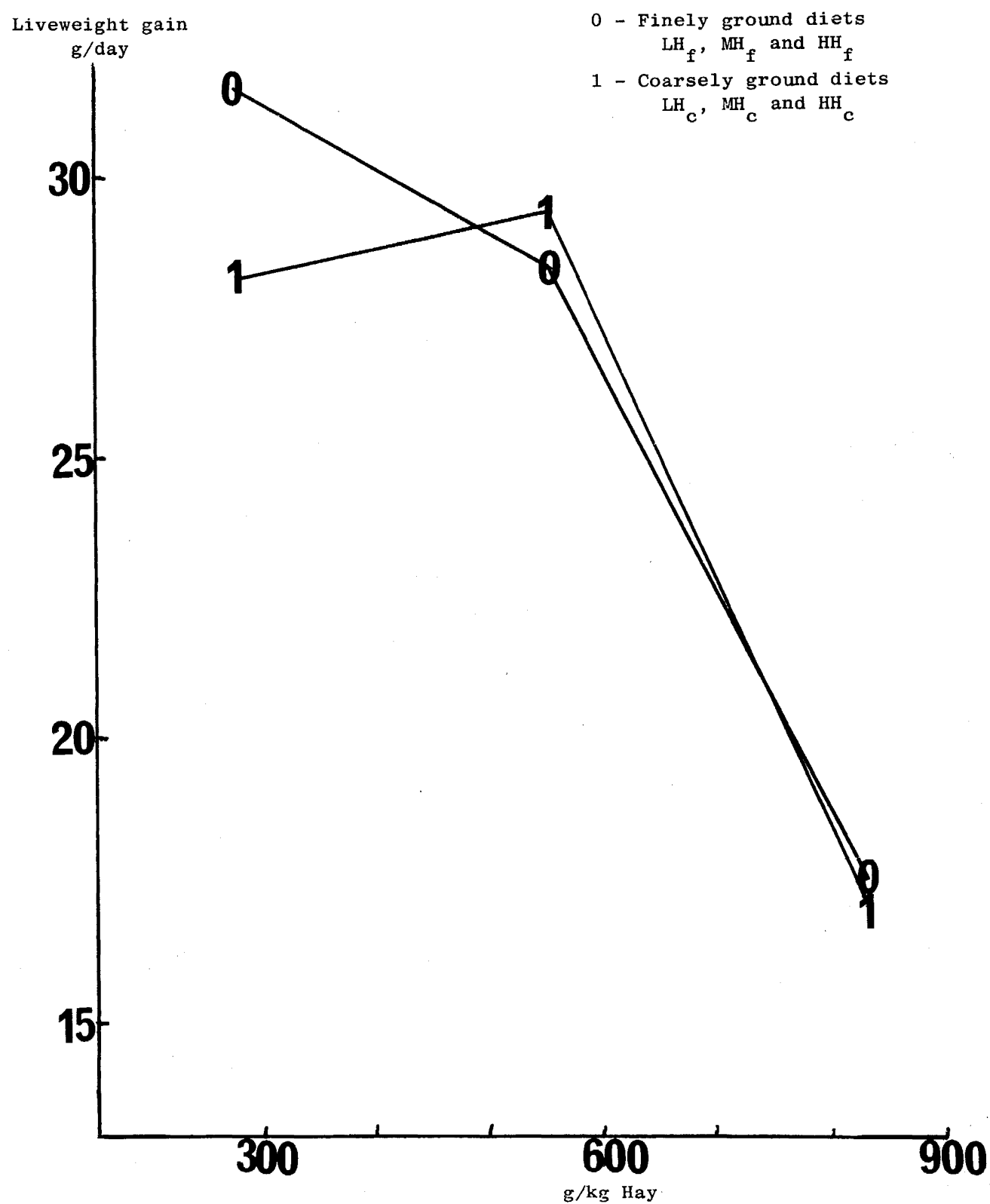
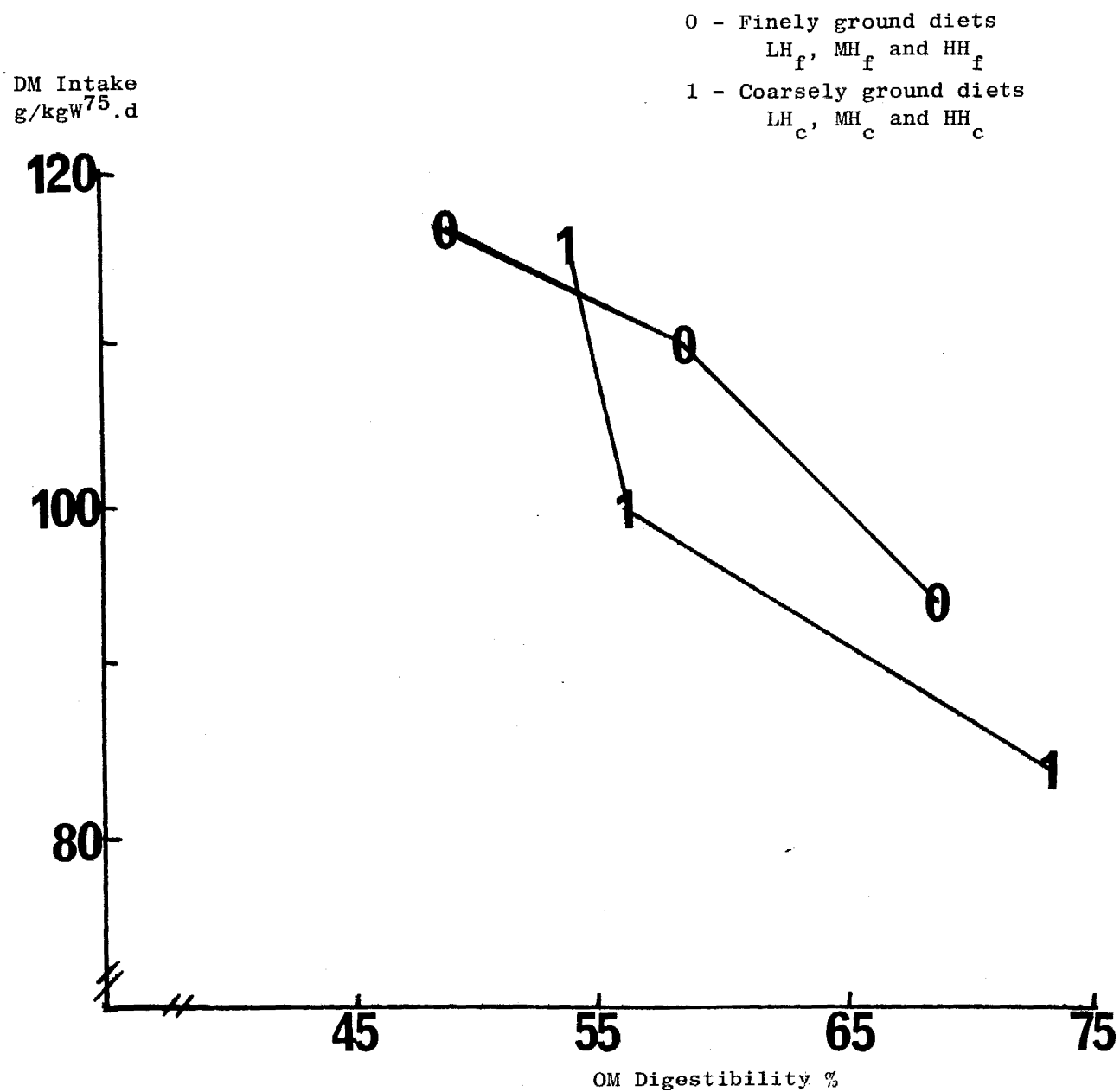


Figure 2

Experiment 1 - Dry matter intake  $\text{g/kgW}^{0.75}$ . day plotted against OM digestibility (%)



### Resumen

No han sido publicados normas de alimentación que indiquen los requerimientos energéticos de conejos en crecimiento, también factores que afectan el consumo y digestibilidad y consequentemente comportamiento, no han sido adecuadamente investigados. Dos Experimentos fueron llevados a cabo. En el Experimento 1 fueron investigados los efectos de las características físicas de las dietas, las cuáles fueron diferentes en contenido de energía digestible; mientras que en el Experimento 2 fueron investigados los efectos de niveles de alimentación. En ambos experimentos un diseño factorial 3 x 2 fué utilizado, con 20 repeticiones por tratamiento de conejos al destete (Peso 800 g) los cuáles fueron individualmente alimentados. Las dietas fueron peletizadas (4 mm de diámetro) y tuvieron la misma composición en ambos experimentos. Las dietas HB (Heno Bajo, 273 g/kg), HM (Heno Medio 556 g/kg) y HA (Heno Alto, 831 g/kg) contuvieron 125, 195 y 265 g/kg de fibra cruda respectivamente y fueron del mismo contenido proteico (160 g/kg). En el Experimento 1 el componente heno de las dietas HB<sub>f</sub>, HM<sub>f</sub> y HA<sub>f</sub> fue molido através de un cedazo de 1 mm, mientras que las dietas HB<sub>c</sub>, HM<sub>c</sub> y HA<sub>c</sub> el cadazo usado fué de 6 mm. En el Experimento 2, las dietas HB<sub>f</sub>, HM<sub>f</sub> y HA<sub>f</sub> fueron ofrecidas ad libitum o a 70% del consumo ad libitum. Los experimentos duraron 65 diea 6 las medidas tomadas fueron ganancia diaria, consumo y digestibilidad. Un total de 144 determinacions de digestibilidad fueron hechas. Los resultados en el Experimento 1 mostraron que el consumo de materiaseca y la digestibilidad de la materia orgánica disminuyeron ( $P < 0.001$ ) al aumentan los niveles de heno, independientemente de que hubiera sido finamente o enteramente molido. Los conejos no pudieron consumir suficiente alimento para mantener aceptables ganancias de peso cuando fueron alimentados las dietas conteniendo 831 g heno/kg. Las dietas conteniendo 55% de heno finamente molido, produjeron significativamente bajas ( $P < 0.01$ ) ganancias de peso vivo en relación a aquellas conteniendo 27% de heno, mientras que las diferencias entre las dietas enteramente molidas conteniendo 27 y 55% de heno no fueron significativas. El tamaño de la partícula no tuvo efecto significativo en el consumo de materia seca y digestibilidad. Los resultados del Experimento 2 mostraron que el nivel de alimentación no tuvo efecto significativo sobre digestibilidad.

### Summary

There are no published feed energy standards for growing rabbits. Indeed nutritional factors that affect intake and digestibility, and consequently performance, are not well documented. Two Experiments have been carried out. Experiment 1 investigated the effects of physical characteristics of diets varying in digestible energy content, while Experiment 2 investigated the effects of level of feeding. A 3 x 2 factorial design was used in both experiments, with 20 individually-fed, weaned rabbits (weight 800g) per treatment. Diets were pelleted (4mm die diameter) and were of the same composition in both experiments. Diets LH (Low Hay, 273g/kg), MH (Medium Hay, 556g/kg) and HH (High Hay, 831g/kg) contained 125, 195 and 265g/kg crude fibre respectively and were of the same crude protein content (160g/kg). In Experiment 1 the hay component in diets LH<sub>f</sub>, MH<sub>f</sub> and HH<sub>f</sub> was ground through a 1mm screen whereas that in diets LH<sub>c</sub>, MH<sub>c</sub> and HH<sub>c</sub> was ground using a 6mm screen. In Experiment 2, diets LH<sub>f</sub>, MH<sub>f</sub> and HH<sub>f</sub> were fed ad libitum or at 70% of ad libitum intake. The Experiments lasted 65 days with measurements made of daily weight gain, feed intake and diet digestibility. A total of 144 digestibility determinations were made. Results from Experiment 1 showed that dry matter intake and organic matter digestibility decreased significantly ( $P < 0.001$ ) with increasing levels of hay regardless of whether it was coarsely or finely ground. Rabbits could not consume enough feed to maintain acceptable growth rates when fed diets containing 831g hay/kg. Diets containing 55% hay finely ground gave significantly lower ( $P < 0.01$ ) live-weight gains than those containing 27% hay, whereas differences between the coarsely ground diets containing 27 and 55% hay were non significant. Particle size did not have a significant effect on dry matter intake or digestibility. Results from Experiment 2 showed that level of feeding did not have a significant effect on digestibility.

