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THE EFFECT OF DIETS CONTAINING 50% ROUGHAGE ON PERFORMANCE AND DIGESTIBILITY IN GROWING RABBITS

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A growth and digestibility trial was conducted with 36, forty-day-old, weaned, male, Californian rabbits (weight, 0.77 kg) individually-fed a reference diet (Dixons SGIV) or one of three diets containing 50% roughage (lucerne, ryegrass or wheat straw). Average daily weight gains were 33.2, 33.3, 32.0 and 23.6 ± 1.80 (SED) g respectively. Rabbits on lucerne and ryegrass showed similar feed conversion rates, those on reference diet were better and those on wheat straw poorer ($P < 0.001$).
Diets differed ($P < 0.001$) in energy digestibility, 70.9, 59.2, 55.2 and 45.1 ± 2.00% for reference diet, lucerne, ryegrass and wheat straw respectively. Digestible energy of the four diets also differed ($P < 0.001$), 13.19, 11.02, 10.09 and 8.42 ± 0.39 MJ/kg DM.
The results indicate that rabbits can perform satisfactorily when a medium quality forage forms 50% of the diet, but performance is reduced when a poor quality roughage is substituted.

Key Words: Rabbits, roughage, digestibility, liveweight gain

Rabbits are able to grow on diets with a wide range of fibre content (Butcher et al 1981) despite the poor digestion of fibre (Aitkin and Wilson 1962; Spreadbury 1975; Van Schonbroek and Cloet 1968; Udén and Van Soest 1982).

Various reports from Oregon State University Rabbit Research Center indicate that although the fibre component of forages is poorly digested by rabbits, they make better use of the forage protein than other livestock (Cheeke 1977; Cheeke 1980; Harris et al 1981). Thus forages have a role to play in the nutrition of rabbits. High quality forages (dried grass) are an important ingredient in commercially prepared diets for rabbits, and give a good performance. Very poor quality forages such as straw give a poorer performance (Butcher et al 1981) while the utilization of medium quality forages by rabbits is unclear.

The objective of this experiment was to investigate the performance of growing rabbits when three types of roughages form 50% of their diet; lucerne or alfalfa (*Medicago sativa*) was used as an example of a medium quality legume, perennial ryegrass (*Lolium perenne*) as un example of a medium quality grass and wheat straw (*Triticum aestium*) as an example of a poor quality roughage. A standard laboratory diet, Dixons SGIV (Short and Gammage 1959), was used as a reference diet.

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Materials and Method

The experiment involved 36, forty-day-old, weaned, male, Californian rabbits allocated at random to one of four diets, and conducted under simulated tropical conditions, ie 25°C ambient temperature with a 12 hour day length, humidity varied between 40 and 80 RH.

The lucerne and ryegrass used were from established leys grown on the farm (Reading University) and harvested in late June using a reciprocating mower (Allen scythe). The forages were allowed to wilt for a day and then dried at 85°C for 4 days. Three diets were formulated (Table 1) to contain 50% roughage with similar contents of protein, lysine, methionine plus cystine, calcium, phosphorus and salt. Ingredients were ground to pass a 2 mm screen, mixed thoroughly and cold pelleted (9 mm diameter, 10-15 mm length) using a 7.5 horse power pelleting press*. A standard laboratory diet, Dixons SGIV (Short and Gammage 1959), was used as a reference diet.

All rabbits were individually caged, feed and water were available ad libitum until slaughter at 2 kg liveweight, feed consumption and liveweight were recorded twice weekly (Table 3). On days 18, 24 and 30, three rabbits per treatment were placed in metabolism crates for seven days to determine diet digestibility. Faeces were collected daily and freeze-dried prior to analysis. Roughages and diets were analysed (Table 2) for proximate consti

Table 1:
Composition of pelleted diets (g/kg)

Ingredient	Diet			
	Lucerne	Ryegrass	Wheat straw	Reference
Barley	372	187	138	
Soya	57	224	285	
Dicalcium phosphate	1	8	7	
Calcium carbonate	0	9	0	
Salt	1	0	1	
Molasses	25	25	25	
Methionine	2	2	2	
Lysine	1	0	0	
Vitamin-mineral premix	25	25	25	
Soya oil	16	20	17	
Wheat straw	0	0	500	
Ryegrass	0	500	0	
Lucerne	500	0	0	
White fishmeal				100
Grassmeal				200
Bran				400
Sussex ground oats				120
Middlings				180

*R.A. Lister Farm Equipment Ltd., Monmouth, U.K.

Table 2:
Chemical analysis of diets and roughage components (g/kg dry matter)

	Roughages			Pelleted diets			
	Lucerne	Ryegrass	Wheat straw	Lucerne	Ryegrass	Wheat straw	Reference
Dry matter	949	932	895	833	868	844	883
Ash	92	59	52	85	86	79	87
Crude protein	196	81	30	177	176	178	208
Crude fibre	300	292	454	185	170	244	85
Ether extract	14	9	12	35	36	36	35
N-free extract	399	559	452	519	532	465	586
Neutral detergent fibre	463	647	853				
Acid detergent fibre	381	365	581	272	225	340	120
Cellulose	266	273	437	189	169	249	80
Lignin	103	82	133	82	59	81	36
Calcium	16	4	3	12	13	10	12
Phosphorus	3	2	1	6	8	7	9
Gross energy MJ/kg				18.62	18.30	18.67	18.60
In vitro digestibility[a]							
Organic matter	59.1	65.4	42.7				

[a] Tilley and Terry (1963)

tuents (Association of Official Agricultural Chemists 1970), cell wall components (Goering and Van Soest 1970), measurement of in vitro digestibility using rumen liquor (Tilley and Terry 1963), energy content (by a Gallenkamp Adiabatic bomb calorimeter), calcium (by atomic absorption spectrophotometry after dry ashing) and phosphorus (by the ammonium vanado-molybdate method).

Results

There were no obvious health problems observed during this trial, which was completed by all rabbits (Table 3). Diet had a significant ($P < 0.001$) effect with rabbits on the wheat straw diet reaching slaughter weight at a greater age, and having a poorer daily live-weight gain ($P < 0.01$) than rabbits on the other three diets. Rabbits on lucerne and ryegrass diets showed similar voluntary feed intake while rabbits on wheat straw diet consumed significantly more ($P < 0.001$) and rabbits on the reference diet less total feed ($P < 0.001$).

Feed conversion ratio was superior on the reference diet, but poorer on the wheat straw diet ($P < 0.001$) compared with lucerne and ryegrass which were similar. There were to significant differences between diets for carcass weight or killing out %, due to slaughter at similar live weights. The

Table 3:
Mean growth, feed consumption and slaughter data

Diets	Reference	Lucerne	Ryegrass	Wheat straw	Significance	S.E.D. between means
Initial live weight (kg)	0.78	0.76	0.72	0.81	N.S.	0.08
Age at 2kg live weight (days)	80^a	80^a	80^a	92^b	***	0.48
Slaughter weight (kg)	2.11	2.11	2.02	2.06	N.S.	0.10
Daily weight gain (g)	33.17^a	33.30^a	32.00^a	23.59^b	***	1.80
Total feed intake (kg dry matter)	3.70^a	4.60^b	4.55^b	6.40^c	***	0.23
Feed conversion ratio (kg feed DM/kg gain)	2.80^a	3.43^b	3.52^b	5.19^c	***	0.19
Hot carcass weight (kg)	1.10	1.08	1.03	1.02	N.S.	0.06
Killing out $\%^a$	56.48	56.62	57.23	55.66	N.S.	0.72
Weight of gut contents (g)	159.89^a	203.44^b	218.78^b	223.00^b	**	17.70

a) $K.O.\%^a = \frac{\text{carcass weight}}{\text{(slaughter weight - gut contents)}} \times 100$

abc Row means accompanied with a different superscript are significantly different ($p < 0.05$)

Table 4:
Results of digestibility trial

Diets	Reference	Lucerne	Ryegrass	Wheat straw	Significance	S.E.D. between means
No. of replicates	9	9	9	9		
Digestibility coefficients (%)						
Dry matter	70.89[a]	60.82[b]	56.02[c]	45.76[d]	***	1.92
Organic matter	72.01[a]	61.12[b]	56.56[c]	45.60[d]	***	1.91
Crude protein	76.61[a]	68.57[b]	68.85[b]	73.00[a]	**	2.09
Gross energy	70.90[a]	59.18[b]	55.15[c]	45.09[d]	***	2.00
Acid detergent fibre	19.06[a]	27.39[b]	17.36[a]	20.44[ab]	*	3.48
Digestible energy (MJ/kg DM)	13.19[a]	11.02[b]	10.09[c]	8.42[d]	***	0.39

[abcd]Row means with different superscripts are significantly different ($P < 0.05$)

increased feed intake of rabbits on wheat straw diet was not reflected in greater gut contents, but gut contents weighed significantly less ($P < 0.01$) for the reference diet.

Calculated digestible energy values and digestibility coeficients (Table 4) for dry matter, organic matter and gross energy generally declined ($P < 0.001$) in the order, reference diet, lucerne, ryegrass and wheat straw. Crude protein digestibility was higher for the reference and wheat straw diets compared with lucerne and ryegrass ($P < 0.1$). Lucerne showed a slightly higher ($P < 0.05$) acid detergent fibre digestibility compared to ryegrass and reference diets.

Discussion

This experiment demonstrates that liveweight gains are satisfactory when medium quality roughages (OM digestibility around 60%) form 50% of the diet of growing rabbits. Any decrease in the digestible energy value of the feed is compensated for by and increase in feed intake and is reflected in a poorer feed conversion ratio.

It is notable that no difference occurred between the performance of rabbits on lucerne and ryegrass diets despite the higher overall digestibility for the lucerne diet in the rabbit, while measurement of in vitro digestibility using rumen liquor (Tilley and Terry 1963) suggested that ryegrass had a higher organic matter digestibility than lucerne (Table 2).

Lucerne (as a substitute for dried grass) has already proved to be a successful ingredient in pelleted diets for rabbits, even when included at levels of 70-90%, where growth rates are maintained with slightly lower feed effciency (Harris et al 1981).

Rabbits on the wheat straw diet generally gave a poor performance, probably a consequence of the low digestibility and high fibre content. High fibre diets generally decrease dry matter (Hoover and Heitman 1971;Partridge 1980) and organic matter (Besedina 1969) digestibility in the rabbit. It is possible that low quality fibrous feed ingredients such as straw act not only as a filler, that is very poorly digested, but also reduce efficiency of utilisation of the concentrate portion of the feed.

In conclusion, under the conditions of the present study, the results indicate that rabbits can perform satisfactorily when medium-quality roughages form 50% of the pelleted diet, but performance is reduced when a poor quality roughage (straw) is substituted with regard to growth rates, feed efficiency and diet digestibility.

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