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Effects of different dietary protein contents in N.Z.W. rabbits on balance and carcass composition.

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Introduction

When the ratio between nutrients in the diet is unbalanced metabolic pathways are modified and nutrients utilization is impaired. Differences in the rate of excretion of urinary metabolites and changes of blood constituents levels reflect the metabolic effects of feeding unbalanced diets. Unless the dietary impairment is only a short-term modification, animal performances are negatively affected. The effects upon carcass composition of different energy/protein ratios in the diet have been observed in rabbits by Fraga et al. (1983). The present work was undertaken as part of a research scheme on protein metabolism carried out by our Institute (Nordio et al.-1982, Greppi et al.-1985). The aim of this study was to evaluate the effects of different dietary protein levels upon nitrogen and energy utlization in male NZW rabbits submitted to feed intake restriction.

Materials and methods

22 NZW male rabbits of about the same initial weight (1 kg) and age were used. Animals were housed in individual metabolic cages in a temperature controlled room. Feed intake and body weight were daily recorded throught the trial. Water was provided *a d libitum*. The experiment was designed according to the following scheme:

Adaptation period (15 days) : all the rabbits were given 40 g of a 220 g CP / kg D.M. diet (H) and 40 g of a 140 g CP/ kg D.M. diet (L). Both diets were pelletted, their composition and proximate analysis are shown in Tab. 1.

Dietary adaptation period (30 days) : the animals were sorted into two groups H and L with the aim of obtaining close average body weight values. Rabbits in each group were fed 90 g of one of the diets. Food was given twice a day (with a 12 hours interval between meals) in order to avoid the drawbacks caused in fasting rabbits by a too much rapid feed intake (Parigi-Bini and Chiericato-1974).

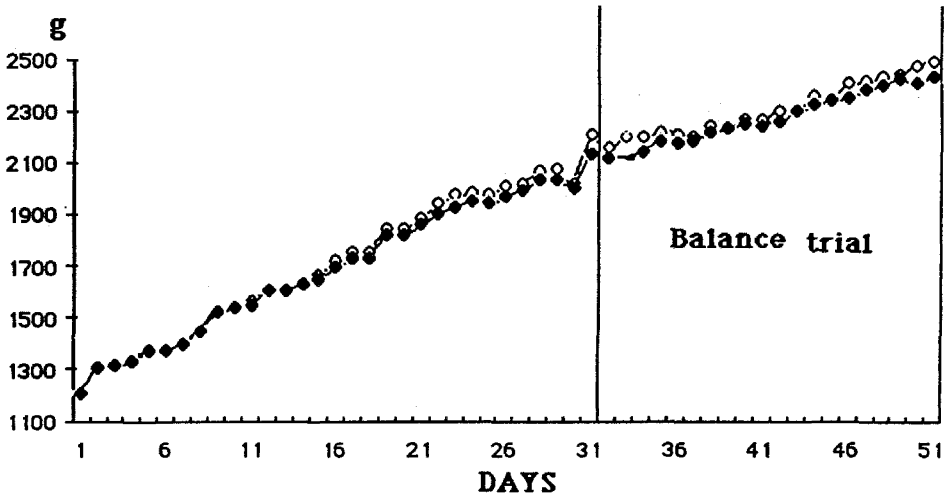
Balance trial (20 days): at the begining of the trial the mean body

weight was 2202 g (H group) and 2124 g (L group). The details of the procedure followed to collect the *excreta* have been described previously (Greppi et al. 1984). Duplicate analysis were performed on faeces and feeds according to the A.S.P.A.(1980) methods to determine: dry matter, ashes, nitrogen, crude fat, crude fiber (Weende). Gross energy was measured using an adiabatic calorimeter. Urine specimens collected in sulphuric acid were diluted with distilled water to the volume of 500 ml and analysed in duplicate for nitrogen content. The gross energy content of urine was calculed by the equation of Parigi-Bini and Cesselli (1976). For both urines and faeces individual samples from each rabbit were obtained as a pool of 4 consecutive daily collections. Specimens were stored at -20°C.
After 12 days from the begining of the balance trial 10 subjects were slaughtered while the remaining 10 rabbits were sacrificed after a further 8 days period.
Animals were killed after a 12 hours fasting. One subject from each group was eliminated from the experiment. Live weight and carcass weight were recorded at slaughtering. The carcasses were weighted before and after removing the liver, the kidneys, the stomach and the gut. The whole gastrointestinal tract and the intestine with their content, the liver, the kidneys and the gastrocnemius muscle were weighted. The carcasses were grinded accuratley and analyzed for dry matter, nitrogen, ashes, crude fat and gross energy content.

Results and discussion

The restricted amount of feed administred to the rabbits was always consumed completely. No difference in the average body weight between groups has been observed throught the trial (Fig. 1). The average body weight gain was 16.1 g/d in group H and 16.6 g/d in group L during the balance trial. Toward the end of the trial body weight gain tended to slow down, as espected.
Thereafter no significant differences were observed within a group as a consequence of the 8 days interval between the sacrifice of the two sets of animals. So data are presented for each diet group as a whole. Carcasses and organs weights are shown in Tab. 2.
The only significant difference between groups was for gut weight, higher in the rabbits fed the low protein diet.
This difference could be related to the presence of a larger amount of indigested feed residues in the intestine of the rabbits fed the low protein diet. Carcasses composition figures are shown in Tab. 3. The most striking difference between diets was for crude fat

Fig 1. Live weight in experimental period



Daily mean values for body weight in male rabbits fed diet containing 220 g CP/kg D.M.(•=diet H) or 140 g CP/kg D.M. (o=diet L).

content which was considerably higher in the L group.This explains the difference which also occours between the gross energy content. Our results agree with those reported by Fraga et al. (1983) which used rabbits of the same live weight.

A significantly higher nitrogen content has been observed in the carcasses of the rabbits fed the high protein diet, however when the total body amount of nitrogen was compared no significant difference was found.

When nitrogen retention was compared (Tab. 4), it appears that the difference between rabbits fed diets with different protein level was small and not significant (848 mg in group H, v. 792 mg in group L). The nitrogen excretion with the u ines was considerably higher in the rabbits fed the high protein diet which furthermore eliminate more nitrogen also with the faeces. Energy balance figures (Tab.4) show that energy retention is the same in the two groups even though the energy intake in the group H was slightly higher. These findings do not agree with the well known effect of a high protein diet upon energy utilization (Dehalle-1980, Ouhayoun and Delmas -1980, Lebas -1975). This conflict however could be only apparent since our experimental conditions differ from those of the other workers. In the present research, in fact,

rabbits were submitted to a severe feed and energy restriction and live weight gain was considerably lower than that obtained in standard feeding conditions.

Conclusions

This study confirms that when energy intake is restricted an increased protein intake cannot improve body weight gain and energy utilization. Different energy/protein ratio however deeply affects body composition especially as far as lipids content is concerned. When the effects of dietary differences upon nutrients utilization are to be investigated and when body weight gain is low, the nutrients balance technique is less effective than body composition analysis.

Summary

The effects of dietary protein level upon nutrients utilization, body composition, liver, gastrointestinal tract and kidneys weight, were investigated in male rabbits. Rabbits in the experimental groups, 10 subjects each, were housed in individual metabolic cages and administred diets with 220 g (H) and 140 g (L) CP/kg dry matter, respectively. After 30 days of adaptation a 20 days digestibility trial followed. The trial was divided into two subperiods, one half of the rabbits in each group were sacrified after each subperiod. Findings obtained show that N and energy balances were the same. Organs weight was not significantly affected by the diet. Body composition figures show that feeding the lower protein diet caused larger lipids accumulation while protein gain was lower.

Résumé

Cette expérience nous a permis de déterminer le bilan azoté et énergétique des lapins mâles adultes de race néozélandaise.
A l'abattage des animaux on a procédé à la détermination des poids du foie, des reins, du muscle gastrocnemius et du tube digestif. L'expérimentation porte sur la comparaison de deux régimes qui se distinguent uniquement par la teneur en protéines.Vingt lapins mâles adultes (2 groupes de 10) ont été élevés en cage individuelle à métabolisme et alimentés avec des régimes apportant 90 grammes d'aliment à 22 % de protéines pour le groupe A et à 14% de protéines pour le groupe B.

A la fin de la période d'adaptation aux régimes de la durée de 30 jours,les animaux ont été soumis à une période expérimentale de bilan de la durée de 20 jours.
La rétention azotée et énergétique est sensiblement la même dans les deux groupes.
A l'abattage des animaux la constatation des effets des régimes sur la composition de la carcasse est la suivante: le régime à niveau protéique plus élevé produit une réduction de l'adiposité des carcasses.

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TABLE. 1 Composition of experimental diets (%) and proximate analysis of diets (% of DM)

Diet	H	L
Soja 50%	44	25
Straw	20	20
Solka Flock	7	7
Corn Starch	24	43
Corn oil	2.5	2.5
Dicalcium Phosphate	3	3
Calcium Carbonate	1	1
Mineral Mixture*	0.5	0.5
Vitamin Mixture*	0.25	0.25
Methionine (p.p.m.)	200	200
Dry matter	90.88	89.86
Crude Protein(Nx6.25)	21.68	13.95
N	3.47	2.23
Crude fat	3.26	3.07
Crude fibre (Weende)	20.19	17.99
N-Free Extractives	47.11	58.83
Energy kJ/g	19102	18406
Ash	7.76	6.16

*Mineral and vitamin mix added to final diet according Gaman. Diets were obtained from Laboratorio Piccioni (Gessate-Milano)

TABLE 2 Slaugthering data in grams (mean ± s.e.)

Diet	H	L	F test
Body weigth	2332 ± 27	2301 ± 33	n.s.
Empty carcass	1902 ± 22	1806 ± 18	n.s
Carcass weigth	1989 ± 28	1977 ± 20	n.s.
Muscle°	3.64 ± 0.22	3.78 ± 0.20	n.s.
Liver	71 ± 3	75 ± 5	n.s.
Kidneys	14 ± 0.6	13 ± 0.6	n.s.
Gastrointestinal tract	°° 430 ± 20	439 ± 22	n.s.
Intestine°°	135 ± 3	161 ± 9	*

° Muscle= gastrocnemius
°° Gastrointestinal and intestine with content.
n.s. = not significant
* = P<0.05

TABLE 3 Slaugthering data: chemical composition (mean ± s.e.)

Diet	H	L	F test
Dry matter %	32.15 ± 0.28	32.98 ± 0.46	n.s.
N %D.M.	3.48 ± 0.05	3.32 ± 0.02	*
Fat %D.M.	4.76 ± 0.49	6.49 ± 0.67	**
GE kJ/g D.M.	7311 ± 141	7960 ± 200	*
Water g	1350 ± 24	1325 ± 24	n.s.
N g	69.24 ± 1.77	65.67 ± 1.04	n.s.
Fat g	94.06 ± 9.39	127.45 ±12.37	**
GE kJ	14530 ± 296	15731 ± 432	*

n.s. = not significant
* = P<0.05
** = P<0.01

TABLE 4 Nitrogen and energy balance (mean ± s.e.)

Diet	H	L	F test
N balance (mg/day)			
Intake	2838	1803	
Urinary	1562 ± 32	654 ± 18	**
Faecal	428 ± 16	357 ± 15	*
Retained	848 ± 31	792 ± 22	n.s.
Energy balance (kJ/day)			
Intake	1562	1488	
Urinary	19 ± 0.40	8 ± 0.27	**
Faecal	472 ± 11	412 ± 14	*
Retained	1071 ± 11	1068 ± 14	n.s.

n.s. = not significant
* = P<0.05
** = P<0.01