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Growth and digestive transit in the rabbit. Variations determined by physical form, composition and crude fiber content of the feed

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Introduction.

Two separate studies were carried out to determine the effects of the physical form (flour vs pellets) and the crude fiber content of the diet on growth and digestive transit in growing rabbits. Lebas (1973) showed that growth and feed efficiency were lower with a diet presented as flour than with the same diet pelleted. On the other hand, Colin *et al.* (1976) demonstrated improved growth performances and reduced occurrence of diarrhea with increasing levels of crude fiber in the diet. In this report, we study the modifications of digestive transit determined by these diet characteristics.

Material and methods.

Experiment 1 : Thirty 6 week-old Californian rabbits were used. They were fed *ad libitum* with one of the following three diets :

Pellet A : Standard commercial diet (Laplace, Lebas and Rioperez, 1974) ;

Meal B : Experimental diet (soyabean oil meal, maize and barley straw) according to Lebas (1973) ;

Pellet B : Diet obtained after pelleting meal B.

At the age of 8 weeks, the rabbits received *per os* a single dose of ^{141}Ce at 9 : 30 a.m. (Laplace, Lebas and Rioperez, 1974). The hard feces were collected during 72 hrs (Lebas and Laplace, 1974) and the hourly excretion of ^{141}Ce determined. Residual radioactivity in the GI tract was also measured after killing as previously described (Laplace and Lebas, 1975).

Experiment 2 : Thirty 6 week-old Californian rabbits were fed *ad libitum* one of the following three diets :

Pellet A : The same as in Experiment 1 ;

Cellulose diet : Soyabean oil meal (32 p. 100), manioc (52 p. 100) and wood cellulose (12 p. 100) ;

Cellulose-free diet : Soyabean oil meal (32 p. 100) and manioc (64 p. 100).

At the age of 8 weeks, the rabbits received ^{141}Ce as in Experiment 1. The hard feces were collected once daily during 5 days.

Results and discussion.

Experiment 1.

The lowest growth rate was obtained for rabbits fed meal B (30.9 g/day), as compared to that obtained with pellet B (33.3 g/day) or pellet A (35.5 g/day). Meal B was ingested during the whole 24-hour period, whereas the two pelleted diets were observed to be eaten mainly during the dark period. Mean daily feed intake was 118 g for pellet A, only 96 g for pellet B, but 114 g for meal B.

Dry matter excretion (hard feces) was lower (meal B : 21.4 g ; pellet B : 18.7 g) with B diets (apparent dry matter digestibility 78 p. 100) than with pellet A (38.5 g and DM digestibility 64 p. 100). Excretion rhythm during the 24-hour cycle was very different from the normal one in the rabbits fed meal B. The average hour of excretion of hard feces (Lebas and Laplace, 1975) was located 2 hrs earlier in the circadian cycle, i.e. at 11 : 47 p.m. (pellet A : 2 : 10 a.m. ; pellet B : 1 : 31 a.m.).

^{141}Ce was retained longer in the digestive tract with B diets than with pellet A (table 1). Residual radioactivity 72 hrs after administration was lower with pellet A,

TABLE 1

Experiment 1 : Percent of total radioactivity excreted during each of the 3 experimental days and remaining in the gastrointestinal tract : mean and standard deviation of the mean

Feeding	Pellets A	Pellets B	Meal B
1st day	71.6 3.3	55.9 3.7	54.6 2.8
2nd day	19.1 1.9	24.3 1.7	25.2 1.7
3rd day	6.2 1.0	8.9 0.8	10.8 1.0
Residual radioactivity (GI tract)	3.2 0.6	10.3 2.3	8.5 1.2

but the same distribution was observed with the 3 diets in the various digestive compartments (stomach 13.7 ; small bowel 2.8 ; cecum 63.2 ; colon 20.2 p. 100 of total residual activity in the GI tract).

The effect of the physical form of the diet was studied by comparing the effects of

pellet B and meal B ; mean retention time was not very different. However, the higher intake of flour (meal B), allowed digestion of a greater quantity of dry matter per day without any favorable effect on the growth of the rabbits. This lower feed efficiency may be explained by a disturbance in the normal rhythm of feed supply. Such a possibility is supported by the increased feed intake during the « daylight period », and the correlative displacement of the average hour of excretion of hard feces.

Experiment 2.

As compared to the daily weight gain of rabbits fed the standard diet (36.7 g), animals fed the cellulose diet had a daily gain of 29.1 g and those fed the cellulose-free diet only 20.7 g. The mean daily feed intake was 124, 90 and 73 g, respectively, for standard, cellulose and cellulose-free diets. The mean hourly intake during the daylight period (9 : 30 a.m.-4 : 30 p.m.) always represented one-third of that recorded during the dark period.

^{141}Ce was excreted earliest in the hard feces (fig. 1) of rabbits fed the standard diet ; it was excreted latest in rabbits fed the cellulose-free diet.

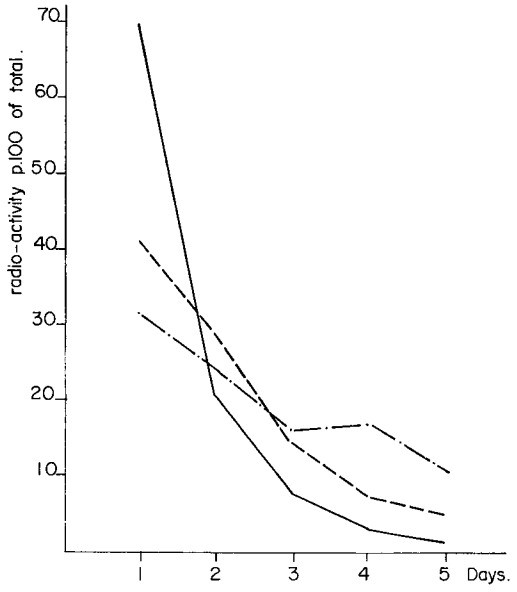

FIG. 1. — *Experiment 2 : daily excretion of radioactivity in hard feces* (p. 100 of total radioactivity recovered).
———— standard pellet A ; — — — cellulose diet ; —·—·— cellulose free diet.

Consequently, the addition of wood cellulose reduced the retention time of a cellulose-free diet and at the same time increased feed intake. Calculated from the apparent digestion coefficient of dry matter (64, 83 and 92, respectively) for standard, cellulose and cellulose-free diets (Colin, 1976) the total daily dry matter digested was 79, 75 and 68 g, respectively, for the three diets in that order.

Conclusion.

From these data it seems that the most digestible diet is ingested in lower quantities and is retained for a longer time in the digestive tract. Thus, the same quantity of dry matter can be digested if the diet includes enough crude fiber and if its physical form does not disturb the circadian cycle of feed intake.

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Résumé. Soixante lapins âgés de 8 semaines ont été utilisés au cours de deux expériences pour l'étude des effets de la forme physique (farine vs granulé) de l'aliment et de sa teneur en cellulose sur la croissance corporelle et le transit digestif évalué à l'aide d'un marqueur radioactif (^{141}Ce).

La forme physique de l'aliment n'a pas d'effet direct sur le temps de rétention. Mais l'ingestion, en période diurne, d'une quantité plus importante lors de distribution de farine conduit, en raison de la perturbation du rythme alimentaire, à une moindre vitesse de croissance malgré la digestion d'une plus grande quantité de matière sèche.

La suppression de la cellulose dans la formule alimentaire conduit à un allongement du temps de rétention et à une réduction de la vitesse de croissance.

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