

EFFECT OF ILEAL CANNULATION ON RABBIT DIGESTION AND CAECOTROPHY : AN INTERLABORATORY STUDY.

GIDENNE T.(*), BLAS E (**), CARABAÑO Rosa(***), MERINO J.M.(***)

(*) INRA, Station de Recherches Cunicoles,
BP 27, 31326 - CASTANET-TOLOSAN - France

(**) Universidad Politecnica de Valencia, Departamento de Ciencia Animal,
Camino de Vera, 14 - 4602 VALENCIA - Spain

(***) Universidad Politecnica de Madrid, ETSIA,
Departamento de Nutricion Animal, 28040 - MADRID - Spain.

SUMMARY : An interlaboratory study, concerning the effect of ileal cannulation on the digestion and caecotrophy in the rabbit, was performed simultaneously in three experimental locations using the same procedure. In the absence of simultaneous ileal digesta sampling, the digestibility of dry matter or fibre (NDF, ADF) did not differ between cannulated or control rabbits. But, a lower crude protein digestibility (-2.6 points) was observed for cannulated animals, as a consequence of a reduced recycling of protein originating from a lower excretion of soft faeces (12.2 vs

16.1 gDM/d, $P=0.011$). As hard faeces excretion did not differ between the two groups, the ratio hard/soft faeces was higher in cannulated rabbits.

Simultaneous ileal collection and digestibility measurement led to a 2 points decrease of the dry matter digestibility ($P<0.01$), without significant interaction between cannulation and laboratory effect.

The incidence of ileal cannulation was not negligible, but insufficient to compromise the validity of nutritional studies performed on cannulated rabbits.

RÉSUMÉ : *Incidence de la canulation iléale sur la digestion et la caecotrophie chez le lapin. Une étude inter-laboratoires.*

Une étude inter-laboratoires de l'incidence de la canulation iléale sur la digestion et la caecotrophie chez le lapin, a été réalisée simultanément dans 3 sites expérimentaux, à partir d'un protocole commun.

En l'absence d'une collecte simultanée de digesta iléaux, la mesure de la digestibilité apparente fécale de la matière sèche et des fibres (NDF, ADF) ne diffère pas entre le groupe de lapins munis d'une canule à l'iléon terminal et les animaux témoins. Par contre, la plus faible digestibilité des protéines (-2,6%) pour les lapins canulés peut être liée à un moindre recyclage de protéines du fait de la plus faible

excrétion de caecotrophes de ces animaux (12.2 vs 16.1 gMS/j, $P=0.011$). L'excrétion de fèces dures ne différant pas entre les deux groupes, le ratio fèces dures/caecotrophes est donc plus élevé chez les lapins canulés.

La collecte de digesta iléaux réalisée simultanément à la mesure de digestibilité fécale, entraîne une baisse de 2 points ($P<0.01$) de la digestibilité de la matière sèche de l'aliment, mais sans interaction significative entre l'effet de la canulation et celui du site expérimental. Sans être négligeable, l'effet de la canulation iléale n'est toutefois pas suffisant pour compromettre la validité des études réalisées chez l'animal canulé.

INTRODUCTION

Rabbits fitted with ileal simple cannula are needed for partitioning physical and chemical events between small and large intestine, i.e. measurement of the ileal digestibility or ileo-rectal retention time or to look at the composition of the digesta entering the caecum for fermentation. Compared to the caecal cannulation, the implantation of a cannula in the terminal ileum need more precision and delicacy, and it appear to be more "bulky" relative to the size of the digestive organ concerned. Thus ileal cannulation

could have some consequences on rabbit digestive processes. However, since long-term chronic ileal cannulation succeeded for adult rabbit (GIDENNE and BOUYSSOU, 1986), the validity of this technique was controlled by one laboratory and only for two parameters : the quality and the representativeness of the digesta sampled (GIDENNE, 1988a), and the incidence of the cannulation on the digestibility measurement (GIDENNE, 1988b).

The purpose of the present study was to control in three different laboratories the influence of the cannulation at the terminal ileum on the fecal

Table 1 : Characteristics of the cannulated and control rabbits according to the laboratory.

Laboratory	Group	Number	Strain	Live weight (g)	Intake (gDM/d)
A	cannulated	4	NZW(1)× V	4282 ± 385	122 ± 8
	control	5	NZW × V	3502 ± 175	108 ± 3
B	cannulated	10	NZW × CAL(2)	2790 ± 340	138 ± 4
	control	7	NZW × CAL	2890 ± 40	144 ± 6
C	cannulated	4	NZW × CAL	2677 ± 41	99 ± 1
	control	4	NZW × CAL	2751 ± 49	99 ± 1

(1) New Zealand White strain ; (2) Californian strain

digestibility and caecotrophy, and also to control the incidence of ileal sampling performed simultaneously to the digestibility measurements on the values of the digestibility coefficients.

MATERIAL AND METHODS

Animals, housing and feeding

A same experimental procedure was replicated in three research laboratories, using female adult rabbits for control and cannulated groups (Table 1). Ileal cannulation was performed using glass cannula according to the technique of GIDENNE *et al.* (1988). Animals were housed individually in metabolism cages, under a 12/12h light-dark schedule.

In each laboratory the two groups of animals (cannulated and control) received a standard pelleted feed, differing by their ingredients but similar in chemical composition : 16–18 % crude protein and 13–16 % crude fibre (air dry basis). The feed intake was maintained at 85 % of the *ad libitum* level, to avoid an excessive fattening of the animals (Table 1).

Digestibility measurements, soft faeces and ileal digesta collections.

Apparent faecal digestibility coefficients were calculated, after a seven days adaptation period to the feed, from total daily collection of faeces during 6 days (4 days in one location). Faeces were pooled individually in plastic bags and stored at -18°C for further analyses.

Soft faeces excretion was measured individually on rabbits wearing a collar during 24 h (from 2 pm to

2 pm). This measure was repeated 2–3 days later when rabbits recovered their initial intake. Values were retained if animals had eaten over 80% of their daily ration. The mean values from the two repetitions were used for calculations (Table 3).

In order to test the incidence of ileal sampling on digestion, a total of six collections of ileal digesta were performed during three days (two collections/day with a time interval such to cover a 24h cycle) (GIDENNE, 1992), during a further period (six days) of faecal digestibility measurements.

Chemical analysis

Dry matter (DM) was determined by heating at 103°C for 24h. Analyses were performed on duplicate samples of feeds and faeces. Organic matter (OM) was determined by ashing at 550°C for 5h. Nitrogen was measured by a Kjeldhal procedure and converted to crude protein (CP) using the factor 6.25. Neutral and acid detergent fibre residues (NDF, ADF) were determined according to the procedure of Van Soest using an amyolytic pretreatment (Van-Soest *et al.*, 1991).

Calculation and statistics

When ileal sampling was performed simultaneously to the digestibility measurements, the coefficients were corrected for the dry matter collected at ileum which was thus unexcreted in faeces. As the ileal digesta are digested at a mean rate of 50% in the caeco-colic part of the digestive tract (GIDENNE and RUCKEBUSCH, 1989 ; GIDENNE, 1992 ; MERINO and CARABAÑO, 1992), the correction was based on the assumption that 50% of the quantity of ileal digesta sampled was added to the fecal dry matter.

Table 2 : Incidence of ileal cannulation on fecal digestibility

	Fecal digestibility (%)			
	DM	CP	NDF	ADF
Control (n = 16)	62.3	75.9	27.4	11.1
Cannulated (n = 18)	62.3	73.3	29.0	13.2
Pooled SD	3.0	3.3	8.5	7.2
<i>P Level</i>				
<i>Cannulation</i>	0.91	0.033	0.36	0.48
<i>Laboratory</i>	<0.01	0.12	<0.01	<0.01
<i>Interaction</i>	0.77	0.43	0.74	0.64

Pooled SD : Pooled standard deviation (root of the mean square error).

A two way analysis of variance was conducted with GLM procedure of the Statistical Analysis System (SAS, 1988) for determining the ileal cannulation and laboratory effects.

However, the level of the interaction between the cannulation and the laboratory effect was not significant whatever the variable (Tables 2, 3, 4), thus the results were pooled and presented as arithmetic means with pooled standard deviation.

RESULTS AND DISCUSSION.

The laboratory effect, highly significant for almost all measurements, covered dietary factors (type of diets, level of intake) but also animals (strain, live-weight, breeding conditions) and human factors.

Incidence of the ileal cannulation on fecal digestibility.

The dry matter and the cell wall fractions (NDF and ADF) digestibility of the feed were unaffected by the cannulation (Table 2). But the crude protein

Table 3 : Incidence of ileal cannulation on hard and soft faeces excretion.

	g FM/d		g DM/d		HF/SF ratio	
	HF	SF	HF	SF	HF	SF
Control	70.7	44.7	34.1	16.1	1.2	1.8
Cannulated	68.2	34.5	38.8	12.2	1.9	3.1
Pooled SD	17.9	13.5	6.8	4.4	0.7	1.3
<i>P level</i>						
<i>Cannulation</i>	0.81	0.041	0.12	0.011	0.091	0.075
<i>Laboratory</i>	<0.01	<0.01	<0.01	<0.01	0.098	0.134
<i>Interaction</i>	0.28	0.17	0.65	0.15	0.96	0.85

HF : hard faeces (n = 7 and n = 8 for control and cannulated group respectively, as data from one laboratory are missing)

SF : soft faeces (n = 14 and n = 18 for control and cannulated group respectively)

FM : Fresh matter basis ; DM : Dry matter basis

Table 4 : Incidence of ileal sampling on digestibility measurement.

	DM collected at ileum g/d	DM fecal digestibility (%) uncorrected(1)	DM fecal digestibility (%) corrected(2)
Control (n = 7)	–	67.2	67.2
Cannulated (n = 8)	2.3	66.1	65.1
Pooled SD	0.56	1.3	1.3
<i>P level</i>			
<i>Cannulation</i>	–	0.028	<0.01
<i>Laboratory</i>	0.091	<0.01	<0.01
<i>Interaction</i>	–	0.78	0.93

(1) : values not corrected for DM collected at ileum ; (2) : values corrected for DM collected at ileum.

digestibility was significantly lower (–2.6 points) for cannulated animals. This contrasts with previous studies (KAMETAKA, 1970 ; GIDENNE, 1988b) where no effect of cannulation on digestibility was registered even for the protein fraction. Similarly no effect of ileal cannulation in pigs was observed on whole-tract (FURUYA *et al.*, 1974) or on ileal digestibility (MOUGHAN and SMITH, 1987).

This negative effect of cannulation observed here for crude protein digestibility will be related to the following results on caecotrophy

Incidence of the ileal cannulation on the caecotrophy.

The quantity of hard faeces excreted by the rabbits wearing a collar (prevention of the caecotrophy practice) was similar to that previously recorded during the digestibility measurements, and it was not affected by the ileal cannulation either on dry matter or on fresh matter basis (Table 3). Likewise, the dry matter level of hard and soft faeces did not significantly differ between control and cannulated group : namely 58.0 and 37.7 % DM, respectively for hard and soft faeces.

The soft faeces excretion in control group was similar to that previously obtained in adults (YOSHIDA and KANDATSU, 1968 ; JILGE, 1974 ; GIDENNE and LEBAS, 1987) or in finishing fattening rabbits (CARABAÑO *et al.*, 1988 ; MOTTA, 1990). But compared to control, the soft faeces excretion registered for cannulated rabbit was significantly lower (–20%), and led to a higher hard/soft faeces ratio. However, this reduction of soft faeces production was

relatively slight, as our values remained similar to those reported for growing rabbits (FRAGA *et al.*, 1991 ; GIDENNE and LEBAS, 1987).

This lower production of soft faeces resulted in a lower recycling of nutrients by caecotrophy and especially for the microbial protein (PROTO, 1976 ; HÖRNICKE, 1981 ; GALLOUIN, 1983), and could conduct to the lower crude protein digestibility of cannulated rabbits observed here (Table 2).

Incidence of the ileal sampling on the fecal digestibility.

As digestibility coefficients changed according to the period of measurements (GIDENNE, 1993) we compared only the values from control and cannulated rabbits obtained simultaneously, and data from only two laboratories were available (Table 4). The sampling of ileal digesta simultaneously to the digestibility measurements induced a slight but significant reduction (–1 point) of the dry matter digestibility (uncorrected) of the feed. When a correction for the ileal sampling was applied, the DM digestibility of cannulated rabbit was lowered by 2 points. However, as no interaction was observed between cannulation and laboratory effect (mainly diet effect), comparative digestibility measurements between feed could be performed. Moreover, the difference with control animals remained weak, and the dietary intake or the rabbits behaviour was not affected by ileal sampling. In comparison, when rabbits were cannulated on the caecum, the sampling of digesta (only three collections for 6 days) did not affect the digestibility coefficients measured simultaneously (BELLIER, 1994).

CONCLUSION

The implantation of simple T-cannula in the terminal ileum of adult rabbits could have some little consequences on rabbit digestion, as observed here on the digestibility or caecotrophy. However the incidence of the ileal cannulation remains slight, suggesting that the validity of the measurement on ileo-cannulated rabbits was not compromised.

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