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DETAILED DESCRIPTION AND INCIDENCE ACCORDING  
TO FIBRE DEFICIENCY AND SANITARY STATUS.**

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# NON-SPECIFIC ENTERITIS IN THE GROWING RABBIT: DETAILED DESCRIPTION AND INCIDENCE ACCORDING TO FIBRE DEFICIENCY AND SANITARY STATUS.

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## ABSTRACT

The effect of a sharp reduction of the dietary fibre level (19% ADF "standard" vs 9% ADF "deficient") were studied on two groups of rabbits differing by their sanitary status : conventional "C" or specified pathogen free "SPF". Daily weight gain of C rabbits fed the fibre deficient diet was reduced by 10% ( $P < 0.01$ ) between 28 and 42d. of age, and by 25% between 42 and 56d. of age, compared to those fed standard diet. The negative effect of the fibre deficiency on growth of SPF rabbits was only significant during the post-weaning period. The fibre deficiency led to a twice higher risk of digestive troubles (SRi = sum of morbidity and mortality). The overall morbidity (daily controlled) of C rabbits doubled ( $P < 0.01$ ) with deficient diet, while diet effect remained not significant for SPF. The mean number of days with diarrhoea (MND), that quantified the impact of the digestive troubles increased twofold for C rabbits fed deficient diet ( $P = 0.011$ ) reaching 2.2 days/rabbit. The effect of the diet on MND was similar for SPF rabbits, but MND remained low ( $< 0.4$ d./rab.). SPF rabbits were less affected by the fibre deficiency (SRi was twice lower) and had a shorter diarrhoea phase (1 d. vs 3d. for C rabbits).

## INTRODUCTION

Enteritis is presently considered as a major problem in rabbit breeding. Symptoms, essentially a diarrhoea, could have several origin. However, it is possible to distinct enteritis originating from an identified pathogenic agent (e.g. *Escherichia coli* O103, *Clostridium spiroforme*...) from those where any clear pathogenic origin is detected (Sinkovics, 1984). The reduction of the dietary fibre level is a major factor that increases the incidence of non-specific enteritis in the growing rabbit (Lebas *et al.*, 1998). Although some physiological factors implicated in digestive troubles were reviewed (Gidenne, 1996), several points remain unclear. For instance, the presence of pathogenic flora could presumably increase the impact of enteritis. In fact, few studies directly addressed the problem of non-specific enteritis, and an accurate description of the disease is lacking. Moreover, the consequences of a diarrhoea on zootechnical performances is frequently limited to a count of dead animals, whereas the impact of the digestive troubles is much more important and is qualified under the term of morbidity: transitory diarrhoea, reduction or fall in weight gain.

Therefore, our study aimed to describe more precisely the digestive troubles, using daily control of the health status of conventional rabbits, fed either a standard or fibre deficient diet (without change in origin or nature of the cell wall). We also replicated the study with specified pathogen free "SPF" rabbits to evaluate if the digestive flora could interact with dietary factor.

## MATERIALS AND METHODS

### *Experimental design and diets*

Two experimental pelleted diets differing in fibre level were compared: a standard (S) (ADF= 19%) and a fibre deficient one (D) (ADF= 9%). Origin and proportions of fibre

fractions were similar among diets, as well as the ratio digestible protein / digestible energy (table 1). The effect of the diet was studied in two populations of animals differing by their sanitary status and thus bred in two locations: conventional rabbits (group C) and specified pathogen free rabbits (group SPF).

**Table 1 : Ingredients and chemical composition of experimental diets.**

Ingredients, %	Standard	Deficient	Chemical composition	Standard	Deficient
Dehydrated Beet pulp	20.0	7.5	(% air dry basis)		
Dehydrated alfalfa	30.0	9.0	Crude Protein (Nx6.25)	16.0	17.6
Wheat bran	20.0	5.0	Starch	9.6	32.0
Wheat straw	6.0	2.0			
Wheat	12.4	54.3	N.D.F	37.9	19.2
Soya bean meal	10.0	19.0	A.D.F.	18.9	8.7
Vitamins and minerals	1.6	3.2	Lignins (ADL)	3.4	1.5

### *Animals and housing*

Eighty conventional rabbits (30 and 50, resp. for diet S and D) and 72 SPF rabbits (26 and 46, resp. for diet S and D) were bred from weaning (28d) to slaughtering (70d) in individual cages. Conventional animals were New Zealand White x Californian hybrid (INRA Toulouse, strain 1067), whereas SPF animals were New Zealand White produced at INRA Tours. They were obtained free of coccidia, *Passalurus*, *Pasteurella*, *Clostridium spiroforme* and enteropathogen *E. coli* (O103, O132, O128, O26, O15) and were reared as SPF animal (Coudert *et al.*, 1988). Water and feeds were given *ad libitum*.

### *Zootechnical performances and control of the sanitary status*

Live-weight and feed intake were controlled weekly. Data from morbid animals were not excluded of performance calculation (table 2), to evaluate the impact of the fibre deficiency.

Mortality and morbidity was individually controlled every day from 28d to 70d of age. Morbidity control consisted in external examination, following a strict protocol, to detect all clinical signs of digestive trouble or sickness: light or acute or finishing diarrhoea, caecal impaction, presence of mucus in excreta, abnormal caecotrophy behaviour (> three days with significant soft faeces excretion). In addition, animals without visible digestive trouble, but showing a severe disturbance in feed intake or growth (loss of weight during a week) were classed as morbid. A rabbit was accounted morbid only one time, even if diarrhoea lasted several days. Dead animals were only accounted in mortality rate, even when they exhibited clinical signs of diarrhoea before dead. Therefore, we calculated a sanitary risk index (SRI) corresponding to the sum of morbidity and mortality rate, knowing that each animal was deducted only once and categorised either death or morbid.

In addition, as health status was controlled daily, we calculated the mean number of days with diarrhoea (table 6) to evaluate the global impact of the digestive troubles on animals: (sum of days with diarrhoea) / (initial number of rabbits). We also attempted to qualify the digestive troubles themselves, by calculating the mean duration of a diarrhoea (table 7) for two classes of rabbits (ill or dead): (sum of days with diarrhoea) / (number of rabbits, either ill or dead)

### *Statistics*

The effect of the sanitary status was not statistically analysed as rabbits of C and SPF group were bred in two experimental locations, and we cannot exclude an effect

of the location on the incidence of enteritis. Thus, results obtained on group C and SPF were separately presented. Data of feed intake, growth and diarrhoea duration were subjected to an analyse of variance according to general linear model procedure of SAS software package. Chi<sup>2</sup> test and the procedure Catmod (SAS) were used for data of morbidity and mortality.

## RESULTS

### *Growth and feed intake*

A relatively high variability affected the performances (table 2), as data originating from morbid animals were not discarded to evaluate the zootechnical response according to the dietary treatment. For conventional (C) rabbits fed fibre deficient diet, the postweaning growth (DWG for 28-42d. of age) was reduced by about 12% ( $P<0.01$ ), compared to those receiving standard diet. A sharp decrease of DWG (-25%) was then recorded (period 42-56d) for C rabbits fed deficient diet. Therefore, the final live weight (at 70d) of C rabbits fed deficient diet was 7% lower compared to those fed standard diet. On 28-70d. period, the lower DWG (-10%,  $P<0.01$ ) of rabbits fed deficient diet was associated with a sharp decrease in voluntary feed intake (-32%,  $P<0.01$ ).

Inversely for SPF rabbits, the detrimental effect of the fibre deficient diet on growth was only observed ( $P<0.01$ ) during the post-weaning period. Even, the 28-70d DWG was significantly higher for SPF rabbits fed the deficient diet, as the feed intake was only reduced by 20%.

**Table 2. Growth and feed intake of C and SPF rabbits, fed a standard or fibre deficient diet.**

Diet :	Standard	Deficient	Root MSE	P level
<b><u>"C" - Conventional rabbits</u></b>				
Weaning weight (28 d.), g	625	636	51	0.33
Final weight (70 d), g	2385	2210	255	0.013
Period : weaning- 42 d.	89.9	64.5	13.2	<0.01
Daily feed intake , g.d <sup>-1</sup>	48.2	42.2	8.6	<0.01
Daily weight gain, g.d <sup>-1</sup>				
Period : 42-56 d.	134.3	80.7	24.8	<0.01
Daily feed intake, g.d <sup>-1</sup>	44.4	33.7	12.5	<0.01
Daily weight gain, g.d <sup>-1</sup>				
Period : 56-70 d..	145.4	103.1	30.3	<0.01
Daily feed intake, g.d <sup>-1</sup>	34.9	36.3	17.1	0.76
Daily weight gain, g.d <sup>-1</sup>				
Period : Weaning- 70d.	122.2	82.5	12.6	<0.01
Daily feed intake, g.d <sup>-1</sup>	41.7	37.5	5.7	<0.01
Daily weight gain, g.d <sup>-1</sup>				
<b><u>SPF rabbits</u></b>	<b><u>Standard</u></b>	<b><u>Deficient</u></b>	<b><u>Root MSE</u></b>	<b><u>P level</u></b>

Initial live weight (28 d.), g	588 2258	591 2352	40 111	0.81 <0.01
Final live weight (70 d), g				
<i>Period : weaning- 42 d.</i>	87.7	66.7	9.0	<0.01
Daily feed intake , g.d <sup>-1</sup>	48.7	44.4	4.8	<0.01
Daily weight gain, g.d <sup>-1</sup>				
<i>Period : 42-56 d.</i>	123.9	96.0	12.2	<0.01
Daily feed intake, g.d <sup>-1</sup>	37.8	42.0	5.2	<0.01
Daily weight gain, g.d <sup>-1</sup>				
<i>Period : 56-70 d..</i>	146.0	123.5	19.1	<0.01
Daily feed intake, g.d <sup>-1</sup>	32.2	37.2	4.2	<0.01
Daily weight gain, g.d <sup>-1</sup>				
<i>Period : Weaning- 70d.</i>	119.2	95.9	10.5	<0.01
Daily feed intake, g.d <sup>-1</sup>	39.7	41.9	2.5	<0.01
Daily weight gain, g.d <sup>-1</sup>				

From weaning to slaughtering, the morbidity of C rabbits (table 4), controlled daily, was twice higher ( $P < 0.01$ ) with deficient diet compare to the standard one. This effect was more particularly pronounced between 43 and 56d of age, where morbidity tripled with deficient diet. Reversely, the morbidity of SPF rabbit was not significantly affected by the diet although it doubled between 28 and 70d of age ( $P = 0.16$ ).

For the whole growth period, the sanitary risk index (SRi) increase twofold for both group fed deficient diet ( $P < 0.01$ ), reaching 98 and 58% (table 5) respectively for C and SPF rabbits. The highest dietary effect was registered during the period 43-56d of age either for C or SPF rabbits.

The mean number of days with diarrhoea (MND) quantified more precisely the impact of the digestive troubles (table 6). MND doubled in C rabbits fed deficient diet ( $P = 0.011$ ) reaching 2.2 days/rabbit. The diet effect on MND was similar for SPF, but MND remained low ( $< 0.4d./rab.$ ).

#### *Description of digestive troubles*

All rabbits died with diarrhoea symptoms, whatever the diet or the sanitary status. In 90% of cases, the death was preceded by morbidity. Only 10% of case were rapid death without previous clinical symptoms of enteritis. Morbidity in C rabbits was mainly characterised by diarrhoea (>70% of cases) that were preceded by a sharp decrease in feed intake and live weight. For rabbits fed standard diet, about 15% of cases of morbidity corresponded only to a strong fall of feed intake (without diarrhoea), while those fed deficient diet exhibited frequently troubles of caecotrophy (significant excretion of soft faces). For SPF rabbits, no diarrhoea was observed for morbid fed the standard diet, and about half cases of morbidity corresponded to a decrease of intake and weight without symptom of diarrhoea.

The mean duration of the digestive troubles was evaluated for morbid and dead rabbits (table 7). No significant interaction between the diet effect and the health status was noticed. The duration of the diarrhoea was similar among the two diets, for either C or SPF. For conventional animals, the diarrhoea appeared longer (2 to 4 days) in morbid, compared with those which died (1 to 2 days). Obviously, the death interrupted the "normal" evolution of the disease observed in morbid : light or beginning diarrhoea followed (or not) by an acute phase and then by a finishing phase. In SPF animals, the diarrhoea meanly lasted only one day compared to 3 days in C group.

## DISCUSSION

### *Methodology*

The methods employed in this study aimed to describe precisely the digestive troubles caused by a fibre deficiency. Although not complex, this approach is time consuming as daily control of health is essential, and thus it is difficult to apply on large size groups. For instance, we found here twice increase in morbidity for SPF animals, but which remained not significant. This outlines the importance of using a large groups of animals to study non-specific digestive pathology.

**Table 3 - Mortality rate (%) for C and SPF rabbits, fed a standard or fibre deficient diet.**

Sanitary status Diet :	<u>"C" - Conventional</u>			<u>"SPF" - Specified Pathogen Free</u>		
	Standard	Deficient	<i>P level</i>	Standard	Deficient	<i>P level</i>
Period						
28-42 d.	0.0	8.0	0.11	11.5	17.3	0.51
43-56 d.	3.3	12.0	0.18	0.0	6.5	0.18
57-70 d.	4.1	2.0	0.58	0.0	4.3	0.28
28-70 d.	7.5	22.0	0.11	11.5	28.2	0.10

The concept of evaluating the morbidity and the impact of diarrhoea (mean duration) is not original itself. However, although applied in other species (pigs etc.), very few authors used this methodology to describe non-specific digestive troubles in growing rabbit (Sinkovics *et al.*, 1980; Gidenne, 1995). Our results indicated that mortality measurement revealed only the more acute troubles, accounting for only one third of the cases. A precise morbidity measurement allowed us to deduct the two other third of cases of rabbits having digestive troubles. Furthermore, the calculation of a sanitary risk index (SRI=mortality + morbidity) gave a more accurate evaluation of the health state of animals and of the impact of enteritis, that is greatly underevaluated if only mortality is recorded.

**Table 4 - Morbidity rate (%) for C and SPF rabbits, fed a standard or fibre deficient diet.**

Sanitary status Diet :	<u>"C" - Conventional</u>			<u>"SPF" - Specified Pathogen Free</u>		
	Standard	Deficient	<i>P level</i>	Standard	Deficient	<i>P level</i>
Period						
28-42 d.	6.6	14.1	0.32	3.8	13.0	0.23
43-56 d.	10.0	38.0	0.011	0.0	6.5	0.18
57-70 d.	18.8	24.0	0.59	11.5	10.8	0.93
28-70 d.	35.5	76.0	<0.01	15.3	30.4	0.16

### *Effect of a fibre deficiency on health state and performances.*

A half reduction (-50%) of the dietary fibre supply doubled the risk of digestive troubles in either SPF or conventional rabbits (SRI), and globally resulted in a twice-higher number of days with diarrhoea. The effect of the dietary fibre deficiency on mortality was more clear till 8 weeks of age, and is associated to lower postweaning growth performances, as recently observed (Gidenne and Jehl, 1999; Pinheiro and Gidenne, 1999). Reversely, the fibre deficiency increased morbidity level after the postweaning period, in agreement with results of Pinheiro and Gidenne (1999). Finishing growing rabbits were not significantly affected by the fibre level, in terms of

either mortality or morbidity. This supports the hypothesis that fibre effect interacts with the development of digestive system, including digestion by the caecal flora. On the other hand, the fibre level did not affect the manifestation of the digestive troubles, as mean duration of the diarrhoea was similar among diets.

**Table 5: Sanitary risk index\* for C and SPF rabbits, fed a standard or a fibre deficient diet.**

Microbial status Diet :	"C" - Conventional			"SPF" - Specified Pathogen Free		
	Standard	Deficient	<i>P level</i>	Standard	Deficient	<i>P level</i>
Period						
28-42 d.	6.6	22.0	0.087	15.3	30.3	0.16
43-56 d.	13.3	50.0	<0.01	0.0	13.0	0.055
57-70 d.	22.9	26.0	0.76	11.5	15.1	0.15
28-70 d.	42.9	98.0	<0.01	26.8	58.4	<0.01

SRi, % : (death +morbid animals) / (initial number of animals).

*Effect of the sanitary status of the rabbits.*

To test if the impact of a non specific enteritis caused by fibre deficiency could be dependant or not of the digestive flora, we have compared C (conventional) to SPF rabbits. At our knowledge, such comparison of rabbits differing by their microbial status remains original.

First, growth performances (DWG) of SPF or C were differently affected by dietary treatment. In SPF group, the fibre deficiency only reduces DWG during the two weeks after weaning, whereas in conventional animal DWG was reduced until 56d of age. SPF fed deficient diet maintained a sufficiently high level of energy intake to cover their growth needs, thus resulting in a higher final live weight, compared to conventional one.

The mortality level seemed similar among SPF of C rabbits, while morbidity appeared half-lower for SPF. Consequently the health state of SPF rabbit was globally better (SRi  $\approx$  40%, and MND  $\approx$  0.2d. per rabbit) than for conventional animals (SRi  $\approx$  70%, and MND  $\approx$  1.6), and seemed not dependent of the fibre level. Moreover, the manifestation of the diarrhoea appeared shorter for SPF animals (meanly one day), while it lasted about 3 days for conventional animals.

**Table 6 - Mean number of days with diarrhoea\* (MND, per rabbit) , for conventional and SPF rabbits, fed a standard or a fibre deficient diet.**

Period 28-70d.	Diet		<i>RMSE</i>	<i>P level</i>
<i>Microbial status</i>	Standard	Deficient		
<i>Conventional</i>	1.07	2.22	1.9	0.011
<i>SPF</i>	0.11	0.35	0.49	0.059

\* MND = (Sum of days with diarrhoea) / (initial number of rabbits)

In conclusion, a fibre deficiency clearly increased the incidence of digestive troubles for the growing rabbit, and more particularly after weaning, but without change in clinical signs of the disease. Rabbits without specified pathogenic flora were less affected by the fibre deficiency (but not exempt) and exhibited a shorter diarrhoea phase, suggesting that flora could modulate the expression of a non-specific enteritis

caused by a fibre deficiency.

**Table 7 - Mean duration of a diarrhoea\* for conventional and SPF rabbits, according to their health status (ill or dead) and to the diet.**

Period 28-70d.	<u>Diet effect</u>		<u>Health status</u>		<i>RMSE</i>	<u><i>P level</i></u>		
	Standard	Deficient	morbid	dead		<i>Diet</i>	<i>Health</i>	<i>D * H</i>
Conventional	4.0	2.8	3.2	2.3	1.6	0.97	0.042	0.11
SPF	1.0	1.1	1.0	1.1	0.3	0.47	0.54	NE

\* (Sum of days with diarrhoea) / (number of rabbits either morbid or dead) ; NE : not estimable.

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