

## THE EFFECTS IN THE RABBIT, OF HEPATIC COCCIDIOSIS ON THE DIGESTIBILITY OF FAT AND ENERGY

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### SUMMARY

Parasitism with *E. stiedai* induces an hepatomegaly in rabbits, accompanied with slight symptoms and a transient decrease in food intake. However a study of the digestibility of lipids and energy shows that the parasitic development is accompanied by a disturbance in the digestive utilization of the diet mainly concerning lipids, not only during the disease period but also during the « chronic period ». This defect in dietary lipid utilization can be tied with the retention icterus observed in rabbits when infected with *E. stiedai*. It can explain to a large part the reduction of utilization of energy in parasited animals, mainly during the chronic phase of the disease.

Intestinal coccidiosis occupies an important place in the intestinal pathology of the rabbit. However the same situation does not apply to hepatic coccidiosis. This parasitism often remains inapparent and mortality is extremely rare in well managed conditions. However, as the techniques of rearing improve, so it becomes more and more important not to neglect the conditions disturbing the vital functions of the rabbit. *Eimeria stiedai* as it grows in the biliary canals affects hepatic function and produces an hepatic and retention jaundice. As well as this direct action *E. stiedai* also affects the kidneys and produces digestive disturbance. Therefore we tried to investigate the outcome of these digestive troubles on the nutritional status of the animal. In this preliminary trial, the effects of *E. stiedai* on food intake and the digestibility of the dry matter, energy and fat content has been studied.

### MATERIAL, AND METHODS

« Fauve de bourgogne » rabbits, reared in individual cages in a strictly controlled environment were used. Faeces analysis and periodic *post mortem* carried out on animals from this unit showed it to be free from *E. stiedai* infection. The animals received a commercial food containing no feed additives.

Two groups of 10 animals were used. These groups were constituted by forming 10 pairs of rabbits, the animals in each pair being of equal weight and then putting one from each pair in both groups at random. One of the groups was then contaminated and the other left non-contaminated to act as control.

Inoculation of *E. stiedai* was carried out 10 days after constituting the groups. The animals at this time were 8 weeks old. 10 000 oocysts of *E. stiedai* per animal were administered into the stomach. The animals were weighed at the time of inoculation and on the 20th and 46th day post inoculation.

Six animals in each group were killed on the 20th and the 46th day after inoculation. At slaughter the weight of the carcass and liver were registered.

The amount of food consumed was registered daily. On the 18th and 19th day and again on the 32nd and 33rd day after inoculation, faeces were collected, weighed and lyophilised for dry matter determination. The experimental device used allowed good separation of faeces and urine. The total calorific value of the excreta was measured with a Gallenkamp adiabatic bomb calorimeter.

The percentage of fat in the faeces and the food was then determined as follows : a sample is acidified by adding to it a mixture of water and 6N hydrochloric acid (50/50 V/V) 20 ml of acid being required for 5 grams of the sample.

Twenty hours later, 50 ml of a 2/1 (V/V) solution of chloroform and methanol are added and the fat extraction is then continued using the method of FOLCH *et al.* (1974).

The apparent digestibility of the dry matter, of the energy content and of the fat was then calculated using the standard formula.

$$AD = \frac{\text{Intake (I)} - \text{Excreta (E)} \times 100}{(I)}$$

A statistical analysis was carried out on the results obtained. For each period studied, a variance analysis between the « healthy » and the « control » groups was carried out (F test).

## RÉSULTS

### 1. — *Weight gain, food intake and hepatic lesions*

During the 10 days period before the inoculation, the animals in each group had similar growth rates. After inoculation, however, the growth rate was decreased by approximately 65 p. 100 during the 20 days which immediately followed the inoculation and by approximately 50 p. 100 during the period day 20 to day 46 after inoculation.

On day 20 after inoculation, the consequence of the parasite is shown by only a 10 p. 100 reduction in the carcass weight. However this weight includes the weight of the liver which has undergone an important hepatomegaly, the liver now weighing 3 times as much in the inoculated rabbits as in the healthy controls. On day 46 post inoculation, the reduction in the carcass weight has reached 30 p. 100 the hepatomegaly remaining unchanged.

Food intake (fig. 1) was the same in both groups up until day 7 after inoculation. After this day there followed a period during which the inoculated rabbits' intake was less than that of the control group. During this period two (2) distinct minima were noted, one around the 10th day and the other around the 18th and 19th day post inoculation. Food intake then came back to almost normal around the 24th or 25th day after inoculation.

### 2. — *Digestibility*

#### a) *Dry matter.*

The quantity of dry matter in the faeces of the inoculated rabbits on days 18 and 19 was significantly less than that of the controls. However on days 32 and 33 the

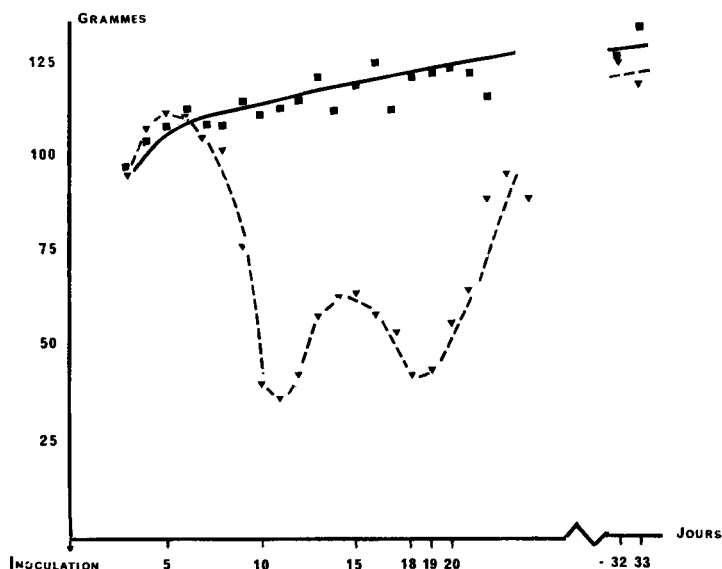
FIG. I. — Effect of *E. stiedai* infection on food intake

TABLE I

*Influence of parasitic infection on the average weight gain*

	Initial live weight	Weight gain (g)		
		D <sub>-10</sub> <sup>(1)</sup> to D <sub>0</sub>	D <sub>0</sub> to D <sub>20</sub>	D <sub>20</sub> to D <sub>46</sub>
Non inoculated control	1 152	204,5	658,5	1 300,0
Inoculated	1 184	222,5	222,0*	641,3*

<sup>(1)</sup> Dates expressed with regard to the inoculation day (D<sub>0</sub>).

\* Significantly different from the non inoculated control for the same period (P &lt; 0,01).

Number of animals in each group :

— D<sub>-10</sub> to D<sub>20</sub> = 10 ;— D<sub>20</sub> to D<sub>46</sub> = 4.

quantities in both groups are very much the same. During the first period studied, the digestibility of the dry matter was greatly reduced in the infected group whereas during the second period there was little difference.

b) *Digestible energy.*

In the control group, a slight increase in the digestible energy of the ration was noted between the first and the second periods. In the inoculated group, a more pronounced increase was noted in the same direction. In the experimental group, however, the digestible energy was much less in both of the periods than in the control group.

TABLE 2

*Influence of parasitic infection on the average carcass and liver weight*

	D <sub>20</sub> <sup>(1)</sup>		D <sub>46</sub>	
	Non inoculated control	Inoculated	Non inoculated control	Inoculated
Weight of carcass (g)	1 057,0	953,0*	1 561,3	1 078,8*
Weight of liver	81,0	259,8*	97,8	294,0*

<sup>(1)</sup> Dates expressed with regard to the inoculation day D<sub>0</sub>.

\* Significantly from the non inoculated control for the same period (P &lt; 0,01).

Number of animal in each group :

— D<sub>20</sub> : 6 ;— D<sub>46</sub> : 4.

TABLE 3

*Incidence of parasitic infection on digestibility*

	D 18-19 <sup>(1)</sup>		D 32-33	
	Non inoculated control	Inoculated	Non inoculated control	Inoculated
Dry matter excreted . . . .	96,4	47,9	86,4	93,3
AD dry matter (%) . . . . .	60	36	60	57
Digestible energy (kcal/kg)	2 451 ± 84	2 131 ± 239	2 618 ± 158	2 309 ± 101
Rate of lipids in the faeces (% of lyophilized matter) . . . . .	5,07 ± 0,49	7,24 ± 0,88*	5,13 ± 0,41	7,16 ± 0,95*
AD lipids (%) . . . . .	57,8 ± 3,0	18,6 <sup>(2)</sup> ± 5,2*	61,4 ± 3,2	34,9 ± 4,5*

<sup>(1)</sup> Expressed with regard to the inoculation day D<sub>0</sub>.<sup>(2)</sup> The average is applicable to 8 animals only, the two other ones have a faecal excretion superior to the ingestion of lipids.

\* Significantly different from non inoculated control for the same period (P &lt; 0,01).

— dry matter in food : 88,02 p. 100 ;

— total energy in food : 3 981 kcal/kg ;

— lipids in food : 4,16.

c) *Fat.*

Table 3 shows the results of the fat analysis of the faeces. In both of the periods under consideration one can see a significant increase in the quantity of fat in the faeces of the infected animals. The digestibility of fat in the infected group was also much less than in the control group, passing from an extremely low level on days 18 and 19 to a level representing 57 p. 100 of that of the control group during the second period.

## DISCUSSION AND CONCLUSION

The accuracy obtained in measuring the digestibility of the dry matter of the energy content and of the fats seems low when compared to that obtained in other domestic animals. Two reasons may explain this difference. Firstly the period of 24 hours used for the balance studies was short. For the results of the digestibility of the energy content, especially, we can only make hypotheses. It is nowadays considered desirable that such measurements be carried out over 8 to 10 days. The second reason may be that the caecotrophy brings a great variability in estimation of the food intake.

It is also possible that the nycthemeral rhythm of faecal excretion varied between the two groups.

However, despite the variability of the results the trial shows quite clearly the importance of the effect of the factor under consideration namely the parasite *E. stiedai* and also the importance of the moment chosen to measure the digestive utilisation of the diet.

It should be noted that from days 18-19 to days 32-33 the digestible energy of the diet increases in the control animals although no variation in the digestive utilisation of the dry matter is seen. It is possible that the age of the animals makes a difference but it is impossible to draw any firm conclusions given the lack of results on the utilization of energy in the rabbit (NEHRING, SCHIEMANN and JENTSCH, 1959; CRASEMANN and SCHNEEBERGER, 1961; LEBAS, 1975; COLIN and ALLAIN, 1975). It is perhaps opportune to recall that despite the fact that NEHRING, SCHIEMANN and JENTSCH, 1959 and d'AGUILERA, 1970, have shown that the rabbit is quite capable of digesting oil, the work of LEBAS, 1975 clearly shows that in certain circumstances the rabbit poorly digests the fatty portion of his diet. The measurements carried out do not, in any case, allow a complete interpretation of the variation in the utilization of the energy content as the digestibility of the cellulose, of the carbohydrates and of the protein was not measured.

The results reported here bring to light new facts on the evolution and the consequences of the disease. It is well known that during the days which follow the infection, the parasite develops causing lesions in the liver and an hepatomegaly. We found that these events occur on the 20th day after inoculation. Our results also clearly show that the development of the parasite is accompanied by a considerable disturbance of the digestive utilization of the ration. The digestibility of all the constituents of the dry matter is reduced, this decrease being most important for the fats.

During the second phase of the disease, the chronic phase, the hepatomegaly remains but increases no further. The growth rate and the digestibility of the dry

matter return to normal but it is interesting to note that the insufficiency in fat digestibility persists and that this insufficiency could, for the major part, explain the difference in the digestible energy still existing between the healthy control group and the infected group. One must however bear in mind the reserves previously mentioned.

The insufficiency of fat utilization appears to be a consequence of the retention jaundice which follows the infection by *E. stiedai*. The hepatic lesions have therefore a lasting effect on the digestive function and the nutritional status of the animal.

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## RÉSUMÉ

### INFLUENCE DE L'INFESTATION PAR LA COCCIDIÈ *EIMERIA STIEDAI* SUR LA DIGESTIBILITÉ DES LIPIDES ET DE L'ÉNERGIE CHEZ LE LAPIN

Chez le Lapin, l'infestation par la coccidie *Eimeria stiedai* entraîne une hépatomégalie, accompagnée de légers symptômes et d'une diminution transitoire de l'ingestion d'aliments. Cependant une étude de la digestibilité des lipides et de l'énergie montre que le développement parasitaire est accompagné d'un trouble de l'utilisation digestive du régime, concernant principalement les lipides, non seulement pendant la période de maladie clinique aiguë, mais aussi pendant la période chronique. Ce défaut dans l'utilisation des lipides alimentaires peut être lié à l'ictère de rétention observé chez les lapins infestés par *E. stiedai*. Ceci peut expliquer pour une large part la diminution de l'utilisation de l'énergie chez les animaux parasités, principalement pendant la phase chronique de la maladie.

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