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Reproduction and Digestibility of Rabbit Does with the Supplementation of L-Carnitine

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Abstract: The use of metabolic modifiers such as carnitine has improved the use of energy and animal productivity. In the present experiment 38 hybrid (New Zealand×California), unmated rabbit does of 3200 g of average body weight were individually caged to assess three levels L-carnitine effect (0, 75 and 150 mg kg^{-1} dry matter) in diet, on reproduction and total tract digestibility of nutrients. With the use of carnitine the number of rabbit offsprings at birth ($p<0.05$) and weaned ($p<0.05$) were increased, however the weight at weaning was reduced ($p<0.05$), furthermore the feed intake was augmented. Increasing carnitine level in fed, affected nutrients digestibility ($p<0.05$), including energy. Therefore the supplementation with 150 mg of carnitine has a positive effect on the rabbit doe reproduction and digestibility of nutrients.

Key words: Reproduction, digestibility, rabbit, supplimentation, offsprings, nutrients

INTRODUCTION

In rabbit production systems, the energy availability in young rabbit does during the first lactation is the primary cause of poor reproductive performance (Xiccato *et al*., 1999). Normally the no gestating doe consumes 160 to 170 g of feed per day to fulfil nutrient needs, however when they are older than 16 weeks, these animals may be overfed and gain weight in the form of body lipids, which can be stored in the dorsal and renal areas, as well as on the ovaries (Bioti, 2004; Mantzoros, 2000; Xiccato *et al*., 1999). On the other hand, in normal condition a rabbit doe can produce 8-9 kits using the energy consumed (Bioti, 2004).

The availability of energy from ingredients has a direct impact in the reproduction of most females due to alterations of the circulating LH and GnRH and dieting reduces their pulsatile secretion (Xiccato *et al*., 1999; Young *et al*., 2004). Boiti (2004) and Cunninghan *et al*. (1999) reported that reducing energy intake of the rabbit doe affects negatively the hipotalamus-hypofisis axis and the female reproduction.

Some researcher (Boiti, 2004; Xiccato *et al*., 1999; Young *et al*., 2004), have reported that the mammal female reproduction is an energy consuming process. They also mentioned that with lower energy intake the survival of the offspring's is altered and the subsequent reproductive cycle. Boiti (2004) and Hileman *et al*. (2000) and Mantzoros *et al*. (2000) suggested that leptin from fat has an inhibitory effect on the LH, insulin synthesis and steroidogenesis through the Insulin like Growth Factor (IGF), furthermore Kikuchi *et al*. (2001) observed in rodents such action on the pre-antral follicle development. On the other hand, the β-oxidation cycle improves the store energy availability and affects reproduction (Boiti, 2004; Mantzoros *et al*., 2000; Milisits and Levai, 2004; Rommers *et al*., 2002; Xiccato *et al*., 1999) and allows the maturation of follicles, reducing this way the open interval.

Furthermore, L-carnitine can improve the usage of fatty acids through the -β-oxidation and therefore augments the availability of energy for reproduction, through the synthesis of carnitine-palmitoil-transferase I and 2 (Woeltie *et al*., 1990). However, most of studies on the use of carnitine are related with pig (Musser *et al*., 1999; Owen *et al*., 2001 a,b; Rincker *et al*., 2003). Ramanau *et al*. (2004) and Wayland *et al*. (2005) in pigs reported an augmentation of the lactose and milk protein content with the use of carnitine which improves the weight gain of piglets (Musser *et al*., 1999; Owen *et al*., 2001 b; Ramanau *et al*., 2004). However, during the literature review no studies of the use of carnitine on the rabbit doe reproduction and digestibility of nutrients were found.

MATERIALS AND METHODS

Thirty six unmated hybrid does (New Zealand×California) of 14 week of age and average weight

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of 3200 g, were caged individually (cage size; 1×0.60×0.45 m) provided with feeder and water fountain to warrant *ad libitum* consumption. Each cage had a nest (50×33×27 cm). The cages were placed at 1.15 m above the cement floor. Cages were placed in an indoor (5×10.5×3.5 m) facility under controlled condition for light (16L:8D) and temperature (18-23°C) during the experiment. The does were randomly assigned to one of the three carnitine levels (0, 75 and 150 mg kg^{-1} dry matter). All animals were fed a commercial pellet diet and freely watered.

Rabbit does were served during the first 10 day of the experiment and after the 10th day, a pregnancy test was performed by external abdominal palpation. The gestating does were placed in the nest when they had 28 days of gestation, at parturition and at 35 days the number of offsprings was recorded. On the other hand, 12 does were used to asses the nutrient digestibility as response to the carnitine level in the feed. The digestibility test consisted in 21 days during which, the last five served to measure the feed intake and faeces collection. The feed was evaluated for Dry Matter (DM), Organic Matter (OM), Neutral Detergent Fiber (NDF) and gross energy (Adiabatic oxygen calorimeter, Parr Industries). Reproduction and digestibility data were analysed as a randomised trial using the SAS package and stablishing an alpha of 0.05 to declare differences among treatments and when they were obtained the means were separated by the Duncan test (SAS, 1985).

RESULTS AND DISCUSSION

No effect of the carnitine was found ($p>0.05$) on the number of rabbit doe mating, with an average of 2.7 (variation coefficient of 16%). On the other hand the number of rabbit kit per caged doe was 8.4, it was similar between the control and the 75 mg of carnitine treatment (8.05 *vs.* 7.96; $p>0.05$), higher values were observed for the 150 mg, such difference means one animal more ($p<0.05$; Table 1). The latter effect was also observed in pigs (Ramanau *et al.*, 2004) which according to the authors the response was due to the augmentation of the energy available for reproduction.

The number of rabbit kits born alive was similar among the first two treatments ($p>0.05$) and increased with the 150 mg of carnitine in the feed ($p<0.05$). The response may be the result to the available energy for lactation which permitted the kits to survive during gestation of the doe. Ramanau *et al.* (2004) on the other hand, reported no effect of carnitine on the number of piglets born. The number of kits that were born dead was in average 0.16% and similar among treatments ($p>0.05$).

Table 1: Rabbit doe performance with carnitine supplementation

	L-carnitine (mg kg^{-1} of feed)			
	0	75	150	Probability
Rabbit kits				
Total born, per doe	8.05a	7.95a	9.17b	0.0001
Born alive, per doe	7.82a	7.83a	9.00b	0.0001
Born dead, per doe	0.19	0.13	0.17	0.9113
Weaned, per doe	7.55a	7.57a	8.79b	0.0001
Body weight at weaning, kg	0.86a	0.85a	0.80b	0.0001
Intake and nutrient digestibility				
Dry matter intake, g d^{-1}	132.30a	134.98a	142.55b	0.001
Digestibility, %				
Dry matter	60.35a	62.28b	63.98c	0.001
Organic matter	57.87a	59.74b	61.71c	0.001
Crude protein	61.00a	62.70b	64.53c	0.001
NDF	38.56a	41.29b	44.17c	0.001
Gross energy	62.58a	64.29b	65.99c	0.001

The number of weaned kits averaged 8 and was similar for the two first levels of carnitine in the diet, but with 150 mg was increased ($p<0.05$). Also the weight at weaning was similar for the control and the 75 mg of carnitine ($p>0.05$), but with 150 mg the offsprings were lighter ($p<0.05$). The does consumed 136.74 g d^{-1} of feed, which was similar amount of control and 75 mg carnitine, but intake was increased with 150 mg ($p<0.05$). The latter could be explained with higher need of energy in does may have to keep up with the demand of the kits. The *in vivo* digestibility of nutrients (dry matter, NDF, crude protein and energy) was increased with the carnitine supplementation ($p<0.05$; Table 1). Hence the use of carnitine in the diet tended to improve the energy utilisation.

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