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Feed composition at the onset of feeding behaviour influences slaughter weight in rabbits

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ABSTRACT

This study aimed to assess the influence of feed composition at the onset of solid feed intake, at 18 to 28 d of age, on growth performance and health in young rabbits until slaughter age (70 d). 796 rabbit kits, issued from 64 does followed during two successive reproduction cycles, were divided into 2 experimental groups differing in the diet that the suckling rabbits received from 18 to 28 d of age. From 18–28 d, young rabbits in the RF group were fed a diet that met the needs of reproductive does (R; 10.57 MJ DE/Kg, 128 g DP/kg, 199 g DF/kg), while young rabbits in the FF group were fed a diet that met the needs of growing rabbits (F; 9.35 MJ DE/kg, 98 g DP/kg, 258 g DF/kg). From 28 to 70 d rabbits of both groups were fed the F diet. Does received the R diet throughout the experiment thanks to experimental cages that allow separate feeding between mothers and their litters. In both groups, feed was offered *ad libitum* before weaning (35 d) and from 63 to 70 d of age but was restricted from weaning to 63 d. Feed intake, animal weights and health status were recorded weekly. Mortality was recorded daily. Feed intake was higher in the RF group than in the FF group from 18 to 21 d (+ 27%, $P<0.001$) and 21–28 d (+14.7%, $P<0.01$). Feed intake was similar in both groups from 28 to 35 d (34 g/d/kit, NS). This resulted in a higher average daily gain from 18 to 28 d (+13.9%, $P<0.001$) and a higher weight at weaning (+7.7%, $P<0.001$) in the RF group compared to the FF group. This difference in live weight between the two groups was reduced at 70 d (+2.4%, $P<0.05$) due to a lower feed conversion rate in the FF group at 42–49 d and 63–70 d ($P<0.05$). Mortality was low before (1.2%) and after weaning (0.4%), and no differences were seen between the groups concerning mortality and morbidity (NS). This did not support the hypothesis that suckling rabbits regulate feed intake based on energy content of the diet at the onset of solid feed intake, but suggests that the moment of distribution of fattening feed before weaning has an impact on weight at weaning and kit health during the fattening period.

1. Introduction

Growth performance and the health of rabbit kits play a very important role in the economic viability of rabbit farms. Digestive diseases in young rabbits are a major problem in rabbit breeding systems leading to reduced performances, mortality and economic losses. Studies have shown that digestive problems can be linked to a mismatch between the composition of the feed ingested by rabbits and digestive maturity, from which a number of feeding strategies have arose (de Blas, 2013; Pascual et al., 2014).

A review on nutrition of rabbits around weaning reported that lactating does and their suckling rabbits have antagonist nutritional needs since the first need a high level of energy to support lactation, while the second need a high level of fibre to preserve digestive health (Gidenne and Fortun-Lamothe, 2002). To overcome this situation, the feasibility and interest of early weaning (around 25 d old), which allows a separation of feeding between mother and young, was studied (Gutiérrez et al., 2002; Pascual, 2001; Gallois et al., 2008). Another solution is the introduction of a separate feeding system for does and their litters (Fortun-Lamothe et al., 2000). It allows for the distribution of feeds that are better adapted to the different physiological states of the animals and avoids the need to change feed at weaning which could have

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adverse effects (Gidenne and Fortun-Lamothe, 2002; Fortun-Lamothe et al., 2005). Feeds better adapted to the physiological states of the animals, notably an increase in digestible fibre for kits and the energy source for does, have been found to reduce mortality of kits and improve doe body condition (Pascual et al., 2002; Gómez-Conde et al., 2007). Previous studies based on this principle have demonstrated the positive effects of a feed high in fibre, principally acid and neutral detergent fibre (ADF and NDF), and low in starch before weaning on growth performances and kit health (Debray et al., 2002; Soler et al., 2004), although some showed no differences (Feugier et al., 2006; Gidenne et al., 2007) or even adverse effects (Gutiérrez et al., 2002). However, when given the choice, rabbit kits showed a marked preference to eat in the feeder of their mother rather than from their own (Fortun-Lamothe and Gidenne, 2003). Therefore, physiological regulation of feed intake before weaning of suckling rabbits need to be better understood in order to define a relevant feeding strategy before weaning that optimizes the trade-off between growth and health performance before and after weaning.

Currently in French rabbit farms the most common feeding strategy is to distribute energy-rich feed during the first 4 weeks of lactation to meet the needs of females, then more fibre rich feed during the week before weaning to meet the needs of young rabbits and avoid adding the stress of a feed composition change to that of weaning (Gidenne and Fortun-Lamothe, 2002). Additionally, the feed intake is generally restricted after weaning to reduce health problems in growing rabbits (Gidenne et al., 2009; Romero et al., 2010; Gidenne et al., 2012). To our knowledge, no studies have tried to combine the use of a separate feeding system before weaning with a restricted feed intake after weaning.

The objective of this study was to determine the influence of feed composition when suckling rabbits start to eat solid feed on feed intake, growth performance and health status before weaning until the end of the fattening period when feed intake is limited after weaning. Two hypotheses were tested during this experiment (i) that before weaning rabbit kits regulate their solid feed intake levels in function of the energy content of feed as seen in rabbits after weaning, and (ii) that the moment of distribution of fattening feed before weaning has an impact on weight at weaning and kit health during the fattening period. Two different feeds were tested, a feed formulated to meet the needs of reproducing females, with a higher energy, protein and starch content, and a feed formulated to meet the needs of growing rabbits, which had a lower energy and protein content with a high fibre content to ensure digestive health. In the study, all the females were fed the same diet throughout the experiment to dissociate maternal effects and the effect of the experimental diets.

2. Material and methods

The experiment was designed and carried out according to the European Union recommendations on the protection of animals used for scientific purposes (European Union, 2010) at the PECTOUL Experimental Unit (INRA, Toulouse, France), and was approved by the French government (no. 0873.01).

2.1. Animals, diet and experimental design

Before weaning, a total of 90 litters were used for this trial (796 rabbits of both sexes). These animals were divided into 156 cages (5 rabbits/cage) during the fattening period. Animals were issued from 64 rabbit does, which were selected for prolificacy (INRA 1067) and inseminated with semen from males selected for growth rate (Hypharm) for two successive reproductive cycles. The litters were equalized at 10 kits 3 d after birth (day 0) by cross-fostering or culling. Does and litters were housed in wire cages (width: 61 × length: 68 × height: 35 cm) containing a nest box for kits (width: 39 × length: 27 × height 35 cm), and maintained in a ventilated breeding unit with a 16 h light schedule (0600–2200 h). Cages were equipped to feed the kits independently from their mother (Fortun-Lamothe et al., 2000). The kits were inhibited from eating from the mothers' feeder through the use of a weighted grill system, and the doe was excluded from the area containing the kits feeder. Kits had access to the mothers' area in order to suckle. The separated feeding system was put in place at 18 d of age. Weaning took place at 35 d of age, where litters were split into cages of 5 kits/cage in function of weight ranks within the litter (kits 2, 4, 6, 7, and 9).

Table 1
Ingredients, chemical composition and physical properties of experimental diets.

	R[a]	F[b]
Ingredients (g/kg)		
Wheat	103	0
Barley	58	30
Bran	210	204
Wheat middling	70	60
Rapeseed meal	100	0
Sunflower meal	224	230
Molasses	20	20
Apple pomace	20	21
Fruit pulp	65	100
Beet pulp	48	250
Alfalfa	30	60
Rapeseed oil	5	0
Minerals	2	2
Amino acids	2	2
Vitamin premix	2	2
Chemical composition (g/kg)[c]		
Crude Protein	173	147
Crude Fat	31	26
Starch	166	72
Crude fibre	143	179
Ash	74	90
Acid detergent fibre (ADF)	173	220
Neutral detergent fibre (NDF)	320	390
Acid detergent lignin (ADL)	56	69
Digestible fibre[d]	199	258
Digestible energy (MJ/kg)[e]	10.57	9.35
Digestible protein[e]	128	98
Physical properties of pellets		
Diameter (mm)	4.0	4.0
Length (mm)	13.2	13.9
Hardness (Kahl index; kg)	4.1	4.9

[a] R (Reproduction diet): diet formulated to meet the needs of reproductive females.
[b] F (Fattening diet): diet formulated to meet the needs of growing rabbits.
[c] Calculated according to the tables of ingredients (Sauvant et al., 2004), unless otherwise specified.
[d] Calculated as the sum of (NDF–ADF) and water insoluble pectins according to tables of ingredients (Maertens et al., 2002).
[e] Calculated according to tables of ingredients (Maertens et al., 2002).

Two experimental pelleted diets were used during the experiment (Table 1). The R diet was formulated to meet the nutrients needs of reproductive females, and was rich in digestible energy (10.57 MJ DE/kg), in digestible protein (128 g DP/kg) and in starch (166 g/kg), but had a moderate digestible fibre (DF) content (199 g DF/kg). The F diet was formulated to meet the nutrients requirements of fattening rabbits while limiting nitrogen emission and preventing digestive disorders. Therefore, the F diet had lower digestible energy (9.35 MJ/kg) and protein content (98 g DP/kg) than the R diet, but had a higher DF content (258 g DF/kg). The hardness of the pellets was measured with a Kahl apparatus