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Feeding programmes based on highly-digestible fibre weaning diets: Effects on health, growth performance and carcass and meat quality in rabbits

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ABSTRACT

The effect of three different dietary programmes on health, growth performance and carcass and meat quality in young rabbits weaned at 28 d was studied using a diet (F) rich in highly-digestible fibre, from 17 to 63 d of age (group FF); using diet F from 17 to 42 d followed by a diet poor in highly-digestible fibre and rich in starch and fat (S) until 63 d (group FS); and using a standard diet C with intermediate highly-digestible fibre and starch content, containing 100 ppm of zinc-bacitracin, from 17 to 63 d (group CC). A highly-digestible fibre diet could be useful to reduce the incidence of digestive disorders. However, it decreased slaughter weight (2294 g in FF vs. 2406 g in CC; $P<0.05$) and carcass and meat traits, e.g. dressing out percentage (55.4% in FF vs. 56.7% in CC; $P<0.05$), meat to bone ratio (5.73 in FF vs. 5.94 in CC; $P<0.05$) and hind leg fat content (3.81% in FF vs. 4.71% in CC; $P<0.05$) at 63 d of age. Switching to a high starch and fat diet at late fattening improved chilled carcass weight at 63 d of age (1339 g in FS vs. 1263 g in FF; $P<0.05$) mainly through the promotion of liver development (7.53% in group FS vs. 6.47% in group FF; $P<0.05$) and fat deposition (3.89% in FS vs. 2.63% in FF; $P<0.05$), and increased hind leg fat content (+1.2 points of fat percentage; $P<0.05$). However, this switch increased health risk (35.1% in FS vs. 17.6% in FF; $P<0.05$).

1. Introduction

Digestive disorders are the main factor responsible for reduced performance and health in growing rabbits, especially in recent decades when the incidence of Epizootic Rabbit Enteropathy (ERE) has increased. The inclusion of antimicrobials has often controlled the negative effects of ERE, but has increased the health costs. Moreover, high usage of antimicrobials increases the risk of presence of residuals in the meat and impairs consumer perception towards intensive rabbit farming. It is well known that adequate nutrition and feeding strategies can minimise the risk of these disorders (Gidenne et al., 2010). Among these strategies, the beneficial effect of increasing highly-digestible fibre (mainly soluble fibre and hemicelluloses) and reducing starch on the digestive health of growing rabbits is well established (Blas and Gidenne, 2010; Martínez-Vallespín et al., 2011a; Trocino et al., 2013a) and consequently widely used. Highly-digestible fibre promotes fermentative activity and induces favourable changes in caecal environment (Martínez-Vallespín et al., 2013; Trocino et al., 2013b).

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Soluble fibre has high water holding capacity promoting the formation of gels. Its dietary inclusion instead of starch could thus reduce digestive rate of passage and feed intake, but negative effects on live weight (LW) gain of growing rabbits has not been reported (Trocino et al., 2011; Martínez-Vallespín et al., 2011a). However, as recently reviewed (Trocino et al., 2013a), an increase in full gastrointestinal tract weight and a consequent reduction in dressing percentage have been reported when rabbits were fed with diets containing high levels of soluble fibre, usually from sugar beet pulp. This possible detriment on carcass yield could be alleviated by switching to a more concentrated diet in late fattening period, when the incidence of digestive disorders is usually lower.

Thus, the aim of this work was to compare two feeding programmes based on the use of a highly-digestible fibre diet from the beginning of feed intake to the end of the fattening period or switching at 42 d to a diet poor in highly-digestible fibre and rich in starch and fat. Their effect on health, growth performance and carcass and meat quality was evaluated in an ERE context, in comparison with a standard feeding programme with intermediate highly digestible fibre and starch content containing 100 ppm of zinc–bacitracin.

2. Material and methods

2.1. Diets

Three pelleted diets were used in the current study. Diet F was characterised by a high level of highly-digestible fibre [HDF, calculated as the sum of neutral detergent soluble fibre (NDSF) and hemicelluloses; 384 g per kg dry matter (DM)]. Diet S was formulated mainly replacing part of this HDF (−140 g per kg DM) with starch (+101 g per kg DM) and ether extract (+23 g per kg DM) (Table 1). A medicated commercial rabbit diet (including 100 ppm of zinc–bacitracin; Bacipremix 50, Pintaluba, Spain) was used as a control (diet C). The diets had similar crude protein (CP) and acid detergent fibre (ADF) contents (178 and 217 g per kg DM, respectively), and included 66 ppm of robenidine (Cycostat 66 G, Alpharma, Belgium) as coccidiostat.

Chemical analyses of diets were performed according to the methods of the Association of Official Analytical Chemists (2000): 934.01 for DM, 942.05 for ash, 976.06 for CP and 920.39 for ether extract, with acid-hydrolysis of samples prior to the extraction. Starch content was determined according to Batey (1982), by a two-step enzymatic procedure with solubilisation and hydrolysis to maltodextrins with thermo-stable α-amylase followed by complete hydrolysis with amyloglucosidase. The resulting glucose was measured by the hexokinase/glucose-6 phosphate dehydrogenase/NADP system. Neutral detergent fibre (NDF), ADF and acid detergent lignin fractions were analysed sequentially (Van Soest et al., 1991) with a thermo-stable α-amylase pre-treatment and expressed exclusive of residual ash, using a nylon filter bag system. The NDSF content was determined according to Hall et al. (1997), after adapting the method to the modifications proposed by Martínez-Vallespín et al., (2011b).

Table 1
Ingredients and chemical composition (g/kg DM) of the experimental diets.

	F	S	C[1]
Ingredients			
Wheat		240	
Beet pulp	280		
Wheat bran	150		
Soybean hulls		100	
Wheat straw		50	
Animal fat	30	60	
Cane molasses		10	
Basal mix[2]	540	540	
Chemical composition			
Dry matter (DM)	911	914	908
Ash	78	68	68
Crude protein	178	177	178
Ether extract	48	71	36
Starch	69	170	146
Neutral detergent fibre (NDF)	374	329	368
Acid detergent fibre (ADF)	217	219	215
Acid detergent lignin	58	53	48
Hemicelluloses (as NDF-ADF)	157	110	153
Neutral detergent soluble fibre	227	134	161

[1] Commercial diet for growing rabbits (Nanta, Spain) including 100 ppm of zinc–bacitracin (Bacipremix 50, Pintaluba, Spain). Ingredient composition not available.

[2] Alfalfa, 250 (g/kg DM); Sunflower meal, 200; Soybean meal, 60; L-Lysine HCl, 3; DL-Methionine, 1; L-Threonine, 1; Calcium hydrogen phosphate, 12; Calcium carbonate, 2; Sodium chloride, 5; Vitamin/Trace element mixture (L-510, Trouw Nutrition, Spain), 5; Cycostat 66 G (Robenidine, Alpharma, Belgium), 1.

2.2. Experimental design

The experimental procedures were approved by the Committee of Ethics in Research of the Universitat Politècnica de València and followed the rules established by the Royal Decree 1201/2005 (BOE, 2005) on protection of animals used for scientific purposes. Rabbits were housed in an experimental farm affected by ERE with temperatures of 18 to 24 °C and a photoperiod of 16 h light:8 h darkness throughout the experimental period.

Rabbits came from a three way cross using synthetic lines reared at Universitat Politècnica de València (Baselga, 2002). Crossbred females from lines A and V selected for reproductive traits were inseminated with semen from males of the parental line R selected for growth rate. At 17 days of age, 300 suckling rabbits were distributed in litters standardised to 10 animals, housed separately from the does in adjacent (50 × 70 × 32 cm WHL) cages and randomly assigned and fed with diet F (18 litters, group F) or diet C (12 litters, group C). Feed intake of the litters until weaning (28 days of age) and individual LW at 17 and at weaning at 28 days were controlled. Animals had access to suckling once per day and milk intake was measured at days 21, 22, 23, 24, 25 and 28 of lactation, by weighing the does before and after suckling. Females were always fed ad libitum with a commercial diet for reproductive rabbit does.

After weaning, 128 rabbits from group F and 64 rabbits from group C were housed in individual cages (26 × 50 × 31 cm). Animals from group C continued with diet C until 63 days of age (group CC). However, half of the rabbits