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Effect of body fatness and selection for prolificacy on survival of rabbit does assessed using a cryopreserved control population

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Abstract

The aim of this experiment was to investigate the effect of body condition and selection for prolificacy on the reproductive life span of female rabbits. The body condition was obtained by ultrasound measurement of the perirenal thickness of 166 crossbred does at day 10 after parturition in 6 consecutive parities. Two genetic groups were included: the current generation of does crossbred between two lines, both selected within line for number of pups at weaning, and a control group consisting of animals from the same cross but from 12 generations earlier. This control population was obtained by use of cryopreservation techniques, and made a simultaneous comparison between animals of different generations possible. A proportional Cox model was used to obtain estimates of survival characteristics. Twelve generations of selection for litter size at weaning did not significantly affect reproductive life span. Animals in poor body condition were found to have a significantly ($P<0.05$) higher risk of dying than animals in better condition. Also, animals with high body fat mobilisation had a higher risk of culling ($P<0.05$) than animals with intermediate mobilisation. Animals with zero pups born alive were also found to have a high risk of culling ($P<0.001$).

Keywords: Survival analysis; Body fatness; Genetic selection; Rabbits; Prolificacy

1. Introduction

Selection for increased litter size in rabbits has been successful (García and Baselga, 2002), and thus has increased the energy demand on the dams to support the offspring during the lactational period. However, feed intake has not increased with selection in rabbits (Costa et al., 2004). It has therefore been suggested that the increased energy demand is met by an increased feed efficiency and/or by an increasing mobilisation of the body reserves during lactation (Quevedo et al., 2005; Costa et al., 2004). Correlated responses in body reserves to selection for aspects of reproduction performance have been reported in a number of species (e.g. Quevedo et al., 2005; Pryce et al., 2001; Rauw et al., 2003). As body reserves have

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an integral role in supporting reproduction, it may be expected that these correlated effects of selection may affect reproductive life span and lifetime reproductive performance.

Both size and mobilisation of the body reserves have been reported to have a marked influence on the reproduction and lactation of the animals. For example, sows with insufficient body reserves show a longer weaning-to-oestrus interval and lower ovulation rate (Zak et al., 1997), and reduced pup development and increased pre-weaning mortality were associated with insufficient reserves in mice (Rauw et al., 2003). However, body fatness and body fat mobilisation may also affect the robustness and survival opportunity of the animal. In this context, excessive mobilisation of body reserves has been reported to have negative consequences on reproductive performance (Zak et al., 1997) and survival under commercial conditions (Grandinson et al., 2005).

To our knowledge, the effect of body fatness and mobilisation of fat reserves on the survival of rabbit does has not been reported, nor has it been reported whether genetic selection for litter size has changed this effect. Based on the available literature, we expected that genetic selection for litter size would increase the importance of the fat reserves and that there would be a positive effect of body mass on longevity and a negative effect of high mobilisation on survival.

The aim of the study was to investigate whether 12 generations of selection for litter size at weaning have changed the effect of body fatness and body fat mobilisation on the reproductive life of rabbit does.

2. Materials and methods

2.1. Experimental design and animals

A total of 166 reproductive crossbred rabbits from crosses between two maternal lines (A and V) from the Department of Animal Science of Polytechnic University of Valencia, Spain, were used. These lines have both been selected within line for litter size at weaning (Estany et al., 1989). Half the animals were crosses from the current generation (26th and 29th in V and A) of the selection lines for litter size, hereafter referred to as the selected group. The control group consisted of crossbred offspring from cryopreserved animals of earlier generations of the same lines. These offspring came from embryos harvested from generation 16 of the V line and generation 15 of the A line. The animals entered the experiment at 3 months of age, were first artificially inseminated at 4.5 months, and were only culled if they failed to become pregnant after three consequent inseminations. Pedigree information for each animal was included for two generations. The design of the experiment has been described in detail previously (Quevedo et al., 2005). A summary of the performance within each genetic group and parity number is presented in Table 1.

The length of reproductive life was calculated as days from first positive palpation to end of life. All surviving animals were killed at day 10 of lactation after their 6th parturition. Thus, all animals surviving the experimental period have an unknown survival and these data were therefore considered to be censored. The data included 111 (67%) censored and 55 (33%) uncensored records.

2.2. Feed

Within genetic groups, animals were randomly assigned to a high energy (12.6 MJ digestible energy/kg dry matter) or a medium energy diet (10.8 MJ digestible energy/kg dry matter) ad libitum from 3 months of age and until the 28th day of the first gestation. Thirty-four females of the selected group received a high fibre diet (7.3 MJ digestible energy/kg dry matter) until day 28 of gestation. After day 28 in gestation, the number of feed groups was reduced to a high or a medium energy diet, as the animals on the high fibre diet continued on the high-energy diet. In the current study, we focused on the feeding regime from day 28 onwards. Both the medium and the high-energy diet were formulated to meet the energy requirement of the does (De Blas and Mateos, 1998).

2.3. Management of litters

After parturition, litter size was standardised to 10 pups. Pups that died during the lactation period were replaced with pups of the same size, as a means to maintain the same lactational effort on the dam throughout lactation. Does were inseminated between