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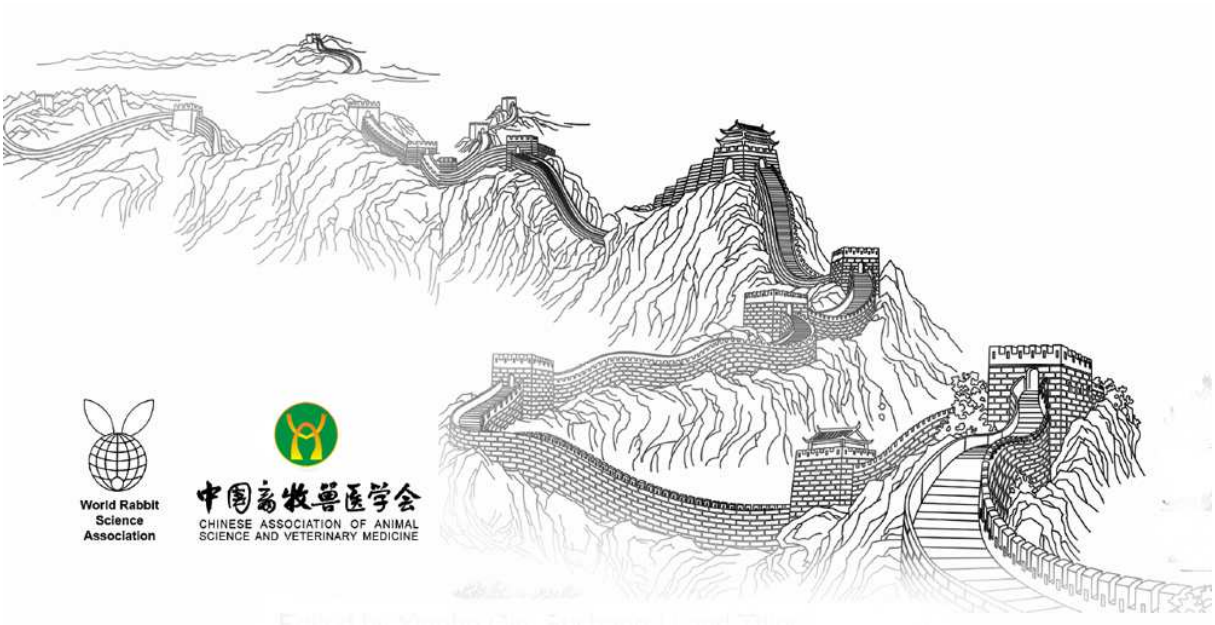

ARE GROWING DIETS PROVIDING ENOUGH PROTEIN TO HIGH GROWTH RATE RABBITS ?

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ABSTRACT

Growing rabbits from paternal lines are characterized by a high growth rate, but they are frequently fed with safety diets formulated for crossbred animals, which perhaps did not provide enough protein to ensure their genetic potential expression. A total of 45 growing rabbits widely differing in their daily growth rate were used (selected from 140 weaned rabbits from three different genetic lines). The animals were fed with a diet containing 111 g digestible protein (DP)/kg dry matter (DM) from 28 to 63 days of age. Feed intake, feed conversion rate (FCR) and ileal digestibility for DM (dDMi), crude protein (dCPi), lysine and sulphur amino acids was controlled. DM intake increased linearly with the empty body weight gain (ΔEBW) of the animals. As expected, animals from the paternal line showed better FCR (2.36±0.04) than those coming from maternal lines (2.67±0.05; P<0.05). Although the greater was the ΔEBW the greater was the dDMi and dCPi for low growth rates (20-40 g/d ΔEBW), a quadratic effect was observed from this moment. Consequently, DP intake of animals with a high growth rate (>40 g ΔEBW/d) was lower to that expected for their daily weight gain. This fact, coupled to their greater maintenance requirements, could cause a drop in DP and amino acids available to be retained in the body, which could be punishing their genetic potential expression. Determining limiting amino acids requirements in function of growth rate will be need to develop specific growing diets for paternal lines.

Key words: Rabbits, protein, amino acids, ileal digestibility and growth rate.

INTRODUCTION

Genetic selection on parental lines has improved growth rate and the conversion rate (CR) of rabbits (Baselga, 2004), but it probably would have changed their requirements. To ensure their genetic potential expression, growing diets must provide enough nutrients (energy, protein, aminoacids…) in function of growth rate. Otherwise, growth rate of animals with a high potential could be punished, hindering the selection process.

Commercial feeds for growing rabbits are formulated to ensure an adequate growth of crossbred animals, and protein levels around 14% did not impair growth performance up to 55 g of daily body weight gain (Carabaño *et al*., 2009). Furthermore, since the epizootic rabbit enteropathy (ERE) onset, the dietary protein content was reduced (Carabaño *et al*., 2009), while the fibre was increased (Trocino *et al*., 2013), in order to reduce the impact of this illness during the growing period. Therefore, a possible reduction of nutrients' availability could occur under these circumstances. This problem could be more marked on animals with high growth rate, showing difficulties to express their genetic potential when fed with the current commercial growing diets.

The present study has evaluated how a common growing diet, formulated at minimum requirements for digestible protein to avoid digestive problems, could be affecting ingestion, feed conversion rate and ileal digestibility during the growing period in function of animals growth rate.

MATERIAL AND METHODS

The experimental diet was formulated following the recommendations for growing rabbits (de Blas *et al*., 2010), as well as those for safe diets under ERE outbreaks. Therefore, the dietary content of crude protein (CP), digestible protein (DP), neutral detergent fiber (NDF) and starch were 158, 111, 304 and 157 g/kg dry matter (DM), respectively. The content of lysine, methionine and cysteine were 7.54, 2.55 and 2.28 g/kg DM, respectively.

A total of 140 weaned rabbits from three UPV genetic types were used to ensure a wide range for daily weight gain. The genetic types used were: H line (founded by hyper-prolific criteria at birth and selected for litter size at weaning during 17 generations; n=34), LP line (founded by hyper-functional longevity; n=66), and R line (founded and selected during 25 generations for average daily gain during the growing period; n=40). From these animals, we selected only 45 at 42 days of life in function of their daily weight gain until this moment, in order to cover a wide range for this trait. The animals were feed with the experimental diet from 28 to 63 days of life, but a marked version of the feed (including 0.5% of lucerne marked with ytterbium) was offered from 53 days until their slaughtering at 63 days (intra-cardiac injection of sodium thiopental, 75 mg/kg of live weight). A representative sample of ileal digesta to determine ileal digestibility was obtained from the distal part of the small intestine. Ileal samples were stored at -40ºC until their analysis. Body weight and feed intake were controlled at 28 and 63 days.

Feed and ileal content were analyzed for DM, crude protein (934.01 and 976.05, respectively; Association of Official Analytical Chemists, 2000), gross energy (combustion in an adiabatic bomb calorimeter Gallenkamp) and amino acid (following the high pressure liquid chromatography method defined by Kivi (2000)). Ytterbium was analyzed according to García *el al*. (1999), by absorption spectrometry (Smith-Hieftje 22, Thermo Jarrell Ash, MA, USA).

Data of DM intake (DMI), feed conversion rate (FCR) and ileal digestibility for DM (dDMi), crude protein (dCPi), lysine (d(Lysine)i) and sulphur (d(Sulphur)i) amino acids were represented in function of empty body weight (EBW) gain to explore the effect of daily growth rate on these parameters. Differences between genetic types were studied using a generalized lineal model, that included genetic type as fixed effect and EBW gain (ΔEBW) when required (SAS, 2009).

RESULTS AND DISCUSSION

R animals showed a clear greater ingestion of feed (135.77±3.71 g DM/d) compared with the animals from the maternal lines (97.25±3.87 and 103.91±3.12 for H and LP animals, respectively; $P<0.05$). However, differences between genetic types disappeared when ΔEBW is included as a co-variable in the model. As shown in Figure 1A, ΔEBW is the main responsible of the greater DMI.

Figure 1B shows how average daily ΔEBW affected FCR of growing rabbit. As expected, animals from the paternal line (R) showed a better FCR (2.36±0.04) than those coming from maternal lines (2.70±0.05 and 2.65±0.04 for H and LP animals, respectively; $P<0.05$). Feki *et al*. (1996) already showed similar differences between this same paternal line (2.63±0.05) and other maternal lines (on av. 3.05±0.05). Although environmental factors could have improved the phenotypic FCR values, distance between maternal and paternal lines has not been widely increased after 20 years of selection. In fact, Sánchez et al. (2004) did not find correlated response for FCR after selection for daily weight gain for 15 generations in rabbits.

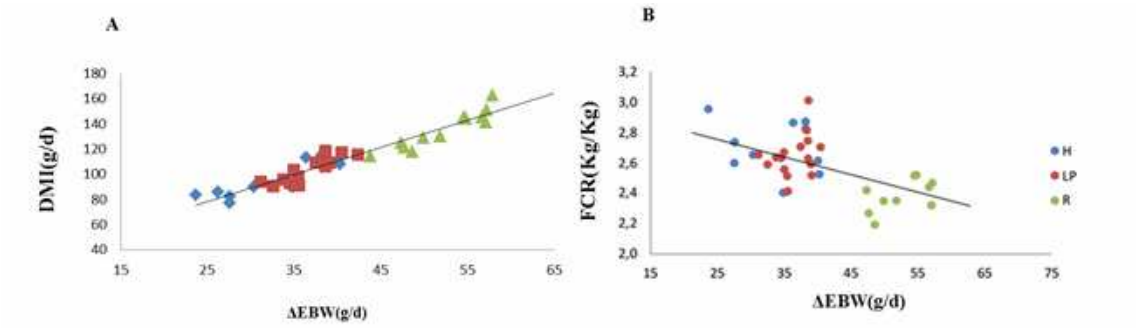

Figure 1: Feed conversion rate (FCR) and dry matter intake (DMI) between 28 and 63 days of life in function of daily empty body weight gain (ΔEBW). Genetic types: H (in blue), LP (in red) and R (in green).

On the other hand, to achieve a better FCR, the selection by growth rate should improve digestive efficiency. However, Figures 2A and 2B show that, although the greater was the ΔEBW the greater was the dDMi and dCPi for low growth rates (20-40 g/d ΔEBW), a quadratic effect was observed from this moment. LP animals showed a significantly higher dDMi respect to R and H animals (+16 and +33%, respectively; P<0.001), perhaps related to their greater ability to obtain resources under challenging conditions (Savietto *et al.*, 2012). These differences seem to be related to the genetic type, as inclusion of ΔEBW as covariate did not affected the results. In fact, the increase of ΔEBW did not improved the d(Lysine)i and d(Sulphur)i, even decreased for the latter (Figures 2C and 2D).

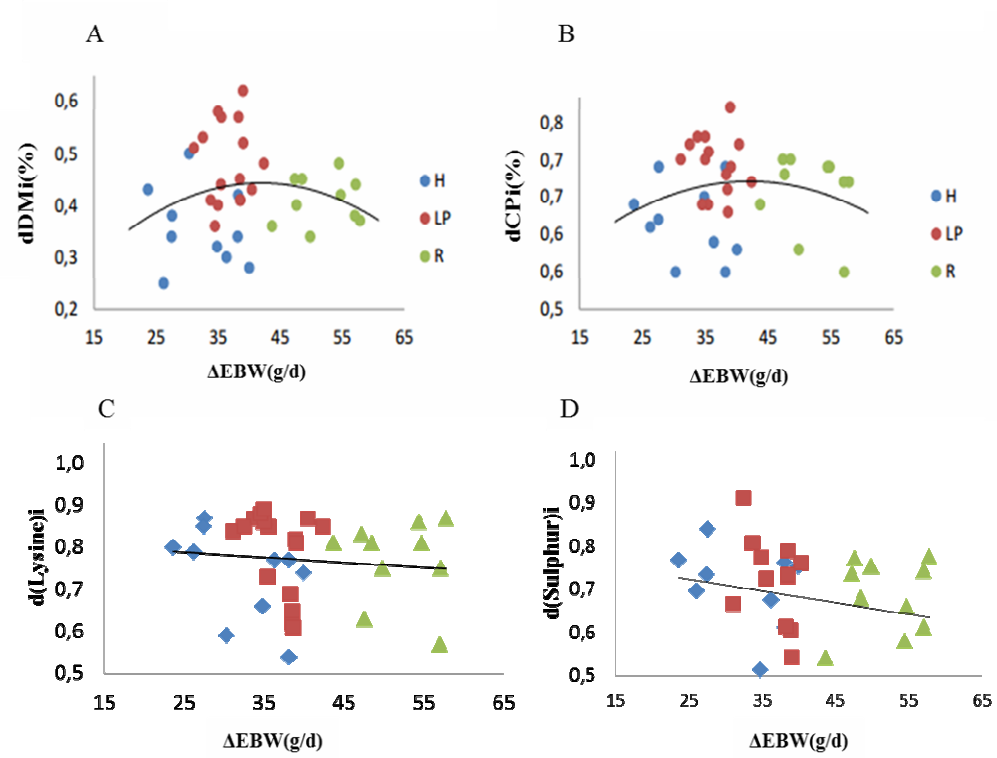

Figure 2: Relationship between ileal digestibility of dry matter (dDMi), crude protein (dCPi), lysine (d(Lysine)i) and sulphur amino acids (d(Sulphur)i) in function of daily empty body weight gain (ΔEBW). Genetic types: H (in blue), LP (in red) and R (in green).

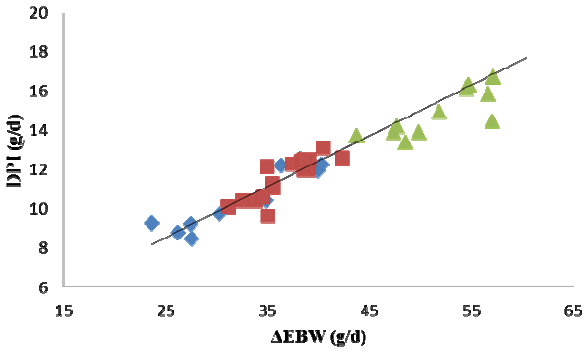

Figure 3: Relationship between digestible protein intake (DPI) and daily empty body weight gain (ΔEBW). Genetic types: H (in blue), LP (in red) and R (in green).

Finally, as it can be show in Figure 3, DP intake of animals with a high growth rate (>40 g ΔEBW/d) was lower to that expected for their daily weight gain. This fact, coupled to their greater maintenance requirements, could cause a drop in DP and amino acids available to be retained in the body, as recently described by Marín-García *et al*. (2016), which could be punishing the genetic potential expression.

CONCLUSIONS

These results reveal a possible protein deficit on growing rabbits with a high growth rate, when common moderate protein diets for growing rabbits are used (146 g CP/kg). With these diets, animals characterised by a high growth rate (>48 g body weight/d) have a protein provision lower to that required. Determining limiting amino acids requirements in function of growth rate will be need to develop specific growing diets for paternal lines.

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