Replacing starch with digestible fibre in growing rabbit feeding

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ABSTRACT - To evaluate the effect of replacing dietary starch with digestible fibre (DF=pectin and hemicelluloses) on health status, digestive physiology, growth performance, and carcass traits, 250 hybrid rabbits weaned at 27 d were fed until slaughter (76 d) five diets with increasing DF to starch ratio (1.0 to 1.9; DF 18.9 to 22.2%; starch 19.6 to 11.5%). The digestibility of dry matter (64.7, 65.2, 66.8, 67.5 and 67.6%) and NDF (27.9, 32.2, 35.0, 40.2 and 41.5%) increased (probability of linear component of variance, L<0.001) with increasing DF to starch ratio. Final live weight and daily growth tended to decrease (L=0.06), feed intake significantly lowered (130 to 122 g/d, L=0.01) and feed conversion ratio improved (2.72 to 2.68; L<0.01). Health status, caecal fermentation and ileal mucosa traits of rabbits did not change. The feeding strategy failed in controlling the diffusion of epizootic rabbit enteropathy.

Key words: Rabbits, Digestible fibre, Starch, Health status.

Introduction – During the last decade, feeding strategies for growing rabbits have been conditioned by the great diffusion of digestive pathologies, the consequent impairment of animal health, and the European limits to antibiotic utilization in livestock production. Since a long time, among different dietary nutrients, a negative role on digestive health has been attributed to starch. Recently, the most digestible fibre fractions (DF=pectin and hemicelluloses) have shown positive effects on animal health, besides caecal fermentative activity and feed efficiency (Soler et al., 2004; Gómez-Conde et al., 2007; Xiccato et al., 2006 and 2008). The present study aimed to evaluate whether replacing starch with DF in diets for growing rabbits could affect digestive efficiency, growth performance, health status, and meat quality.

Material and methods – Two hundred fifty hybrid rabbits weaned at 27d of age were kept in individual cages and fed five diets (A, B, C, D and E) with increasing DF to starch ratio (1.0 to 1.9 corresponding to DF increasing from 18.9 to 22.2% as-fed basis, and starch decreasing from 19.6 to 11.5%). The diets had similar protein (15.9% on average) and ADF (18.1%) concentrations and did not contain any antibiotic or coccidiostat.
drugs. Individual live weight and feed intake were recorded three times a week. Health status was monitored daily. At 35 d of age, 6 rabbits per diet were sacrificed to sample caecal content. Epizootic rabbit enteropathy (ERE) appeared few days after weaning and quickly became so aggressive to impose an antibiotic treatment in water (tiamuline hydrogen fumarate at 250 mg/l, colistin sulphate at 180 mg/l) from 43 to 49 d. At 53 d an *in vivo* digestibility trial was performed on 60 rabbits (12 per diet). During the trial, 39 rabbits died. At 76 d the rabbits were slaughtered at a commercial slaughterhouse. Diet digestibility, chemical composition of diets, faeces and caecal content, and carcass traits were determined as described by Xiccato *et al*. (2003). Digestible fibre was calculated as the difference between total dietary fibre (TDF), determined by AOAC gravimetric/enzymatic procedure, and ADF. Growth performance and carcass traits were analysed by ANOVA using the GLM procedure of SAS. Mortality and morbidity were analysed by the CATMOD procedure.

**Results and conclusions** – Health status was severely affected by ERE without significant differences among groups (mortality: 18.2, 13.6, 25.0, 13.6 and 18.2%; morbidity: 15.9, 18.2, 20.5, 25.0 and 25.0% in diets A, B, C, D, and E). Differently previous researches found that mortality decreased with increasing DF to starch ratio (Soler *et al*., 2004; Xiccato *et al*., 2008). In the present study, rabbits fed low DF to starch ratio diets fell ill and died earlier than rabbits fed high ratio diets: the medians of death age were 38, 41, 42, 43, and 45 d for diets A, B, C, D, and E. A high infestation by coccidial oocysts was also found in the intestinal mucosa, which could have favoured the ERE diffusion and made useless the feeding strategy. Replacing starch with DF linearly (L<0.001) increased digestibility of dry matter (64.7, 65.2, 66.8, 67.5 and 67.6%), NDF (27.9, 32.2, 35.0, 40.2 and 41.5%) and DF (59.9, 62.4, 65.8, 67.4, and 71.4%) as also found by others (Gidenne and Perez, 2000; Xiccato *et al*., 2008). As gross energy digestibility increased from 64.3 to 67.9%, the nutritive value of diets increased (10.6, 10.8, 11.0, 11.1 and 11.1 MJ/kg), confirming that DF may efficiently replace starch as energy source. The dietary treatment did not affect caecal fermentation nor ileal mucosa traits (data not reported). Previously, Gómez-Conde *et al*. (2007) found improved gut barrier functions (higher villi height, greater sucrase activity and ileal starch digestibility) with increasing soluble NDF in 25-d-old weaned rabbits.

Final live weight and daily growth tended to decrease with DF to starch ratio (L=0.06), feed intake significantly diminished (130 to 122 g/d, L=0.01) and feed conversion improved (2.72 to 2.68; L<0.01) (Table 1). These results depended on significant differences in the second period of growth (48-76 d), while during post-weaning (27-48 d), in presence of ERE, groups showed similar results (data not reported). At commercial slaughter, cold carcass weight and dressing percentage (L≤0.10) and carcass dissectible fat (L=0.02) decreased with increasing DF to starch ratio (Table 1), while meat pH and colour (data not reported) were similar.

In conclusion, increasing DF to starch ratio from 1.0 to 1.9 improved feed efficiency, impaired final weight and dressing percentage, without changing caecal fermentation activity and meat quality. Despite dietary treatment modified the time of ERE appearance and death, the feeding strategy failed in controlling its diffusion and consequences.
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| Table 1. Growth performance and main slaughter traits. |
|---------------------------------|-----|-----|-----|-----|-----|-----|-----|
| Diet                            | A   | B   | C   | D   | E   | L   | Q   |
| DF to starch ratio              | 1.0 | 1.1 | 1.3 | 1.5 | 1.9 |     |     |
| Rabbits, no.                    | 36  | 38  | 33  | 38  | 36  | 0.79 | 0.44 |
| Live weight at 27d, g           | 562 | 560 | 552 | 560 | 560 | 0.06 | 0.45 |
| Live weight at 76d, g           | 2,902 | 2,815 | 2,816 | 2,819 | 2,785 | 0.04 | 0.53 |
| Daily weight gain, g/d          | 47.8 | 46.0 | 46.2 | 46.1 | 45.4 | 0.09 | 0.91 |
| Feed intake, g/d                | 130 | 129 | 125 | 122 | 122 | 0.08 | 0.97 |
| Conversion index                | 2.72 | 2.81 | 2.72 | 2.66 | 2.68 | <0.01 | 0.32 |
| Dressing percentage, %          | 60.1 | 60.6 | 60.2 | 59.8 | 59.3 | 0.09 | 0.23 |
| Reference carcass (RC), g       | 1,424 | 1,394 | 1,362 | 1,375 | 1,371 | 0.23 | 0.44 |
| Dissectible fat, % RC           | 3.5 | 2.8 | 2.8 | 3.0 | 2.8 | 0.02 | 0.14 |
| Muscle/bone ratio               | 5.55 | 5.68 | 5.76 | 5.67 | 5.55 | 0.97 | 0.28 |

L: Probability of the linear component of variance; Q: Probability of the quadratic component.