

## Nutritional effects of feed form, and wheat compared to maize, in the D+ and D- chicken lines selected for divergent digestion capacity

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### Abstract

Experiment 1 consisted in the genetic selection of two divergent lines D+ and D- on the basis of AMEn value measured at 3 weeks of age with birds being fed a wheat diet, using the wheat Rialto cultivar characterised by a high *in-vitro* viscosity value. Significant difference (3413 J/g DM;  $P < 0.0001$ ) in AMEn between lines reached 29 % on 4<sup>th</sup> generation. From the experiment 2 consisting in the test of feed form (mash *versus* pellet) on feed intake and AMEn value, it could be concluded that difference in feed intake is not a major explanation for the AMEn difference between lines. Experiment 3 conducted on the 4<sup>th</sup> generation birds showed a strong [line x cereal] interaction on residual feed intake up to 6 weeks of age. Line effect on residual feed intake disappeared on the 8<sup>th</sup> week.

### Introduction

A previous experiment (Mignon-Grasteau et al., 2004) showed the beginning of a divergent genetic selection of D+ and D- lines, based on the AMEn value of a wheat diet made with a wheat cultivar (Rialto) characterised by a high *in vitro* viscosity value. The present paper shows the development of this selection up to the 4<sup>th</sup> generation (experiment 1), the effects of feed form and lines on feed intake and AMEn (experiment 2), and the effects of cereals (wheat from Rialto cultivar *versus* maize) and lines on residual feed intake from 2 to 9 weeks of age (experiment 3).

### Materials and Methods

Experiment 1 followed the genetic selection experiment on digestion capacity previously described for the zero and first generations (Mignon-Grasteau et al., 2004). It consisted in the selection for the next generation birds up to 4<sup>th</sup> one, with the same methods as those previously used (Mignon-Grasteau et al., 2004).

Experiment 2 was conducted with D+ and D- birds (male and female) from the 3<sup>rd</sup> generation. This experiment consisted in a 2x2 factorial design testing the lines (D+ *versus* D-) and the feed form (mash *versus* pellet) on feed intake and AMEn with 18 individual replicates per treatment. Birds were put in individual metal cages at d0 and reared as previously described (Péron et al., 2005). Feed intakes and AMEn values were measured individually for 3 days at 3 wk in *ad libitum* condition, using acid-insoluble ash as an indigestible marker, as previously described (Péron et al., 2005). Birds were fed a standard starter diet up to 6d. Then, they were fed a 24% protein growing experimental diet based on Rialto wheat (54%), soyabean meal (31%), maize gluten (5%) and rapeseed oil (4.5%). The diet was pelleted (2 mm diameter) with steam. After pelleting, half was ground on 8 mm screen for distribution as mash. The other half was given direct as pellet.

Experiment 3 was conducted with D+ and D- birds from the 4<sup>th</sup> generation. Effect of lines (D+ *versus* D-) and cereals (maize *versus* Rialto wheat) on growth and residual feed intake were tested according to a 2x2 factorial design, with 8 floor pen replicates per treatment and 10 birds (mixed male or female) per pen, from d0 to d63. Residual feed intakes were the residual values of the multiple linear regression giving feed intake as a function of growth and metabolic weight ( $P^{0.75}$ ) variables, calculated with all the data of the experiment 3 (n = 256). Birds were fed a standard starter diet up to 7d. Then, they were fed *ad libitum* either maize or Rialto wheat diets from d7 to d63. From d7 to d56, growth diets (12720 J/g; 21.5% crude

protein; 57% maize or 55% wheat) were given and, afterwards, finishing diets (12180 J/g; 19% crude protein; 68% maize or 70% wheat). Feed intake for each pen, and individual weight were measured every week.

## Results and Discussion

According to Figure 1, a huge difference in phenotypic AMEn value between lines was reached at the 4<sup>th</sup> generation of divergent selection on AMEn, which is not really surprising as heritability of AMEn was previously observed to be rather high (0.36; Mignon-Grasteau et al., 2004). AMEn genetic values of D+ and D- lines (expressed as genetic standard deviation unit) were completely separated on 4<sup>th</sup> generation ( $0.78 \pm 0.252$  (SD) and  $-0.74 \pm 0.218$  (SD), respectively). AMEn selection was conducted while maintaining no difference in 3 wk live weight between lines. Thus, growth curves of both lines observed on experiment 3 were rather similar. However, at d7, D+ (114g) were smaller than D- (137g), and relative growths (growth : weight) were higher ( $P < 0.05$ ) in D+ than in D- (+7.3% in mean) from d7 to d56.

As D- birds fed on wheat diets show low digestions and similar weight compared to D+ birds, their feed intakes are usually much higher than those of D+ birds. Thus, for D- birds, a question arises about the effect of feed intake on digestion. Experiment 2 was conducted to answer this question, as change in feed form affects feed intake. Mash form markedly reduced the difference in feed intake between lines (Figure 2). Despite that, difference in AMEn between lines remained the same (Figure 2). Thus, it can be concluded that feed intake cannot be proposed as a major factor explaining difference in AMEn between lines.

In experiment 3, feed conversion was appreciated using residual values of a multiple linear regression line giving feed intake as a function of growth and metabolic weight ( $P^{0.75}$ ) variables (Figure 3). This method was preferred to the feed : gain ratio because this ratio is known to be affected by relative growth, and relative growth was higher in D+ than in D- (see above). Thus, these residual feed intake values were thought to depend on digestion more precisely than the feed:gain ratio. According to Figure 3, it can be concluded that the effect of genetic selection only concerned the growth period up to d49. After this age, effect of selection did not appear any more. Despite a genetic selection using a Rialto wheat diet, a line effect ( $P < 0.05$ ) could be observed with the maize diet on 3<sup>rd</sup>, 5<sup>th</sup> and 6<sup>th</sup> week (Figure 3). As expected, the line effect was much higher with the Rialto wheat diet than with the maize diet (Figure 3). This emphasises the importance of the cereal quality when a selection is performed on feed conversion. This also shows that nutritional studies on cereal quality should be performed taking the genetic origin of birds into account.

Figure 1  
Experiment 1. Phenotypic AMEn (J/g DM) values of D+ and D- lines  
(means and standard deviations)  
measured with a wheat (Rialto cultivar) diet at 3 weeks of age.  
Divergent genetic selection was done on the basis of AMEn.

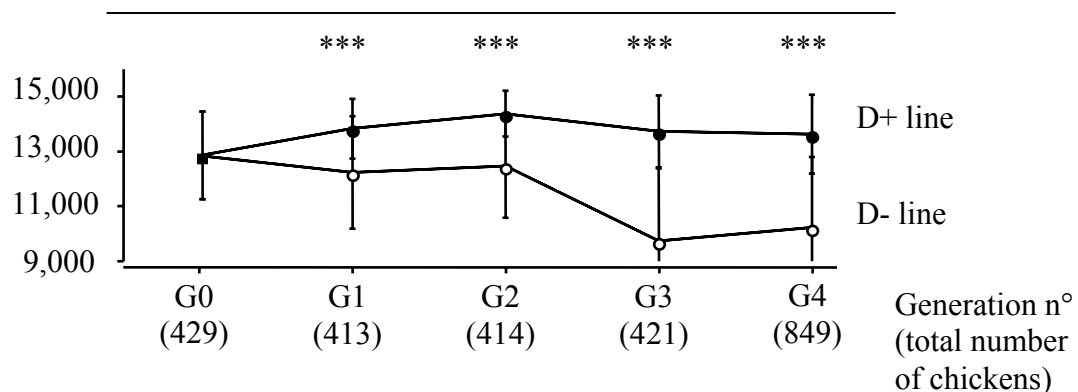


Figure 2  
 Experiment 2. AMEn values and relative daily feed intakes  
 (means and standard errors, n=17)  
 in 3 wk old D+ and D- chickens (G3) fed a wheat (Rialto cultivar) diet  
 given as mash or pellet

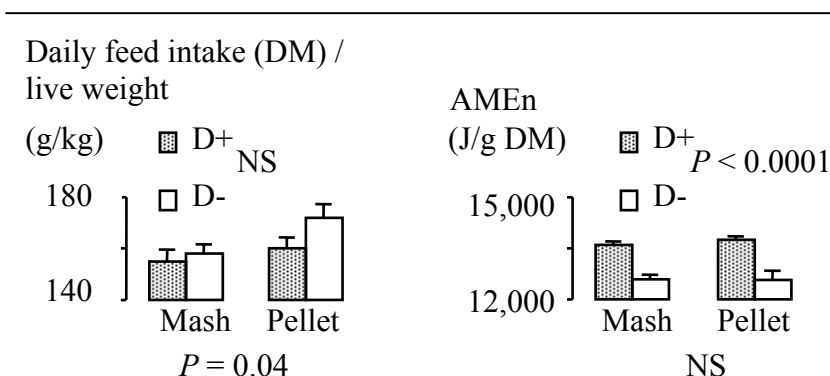
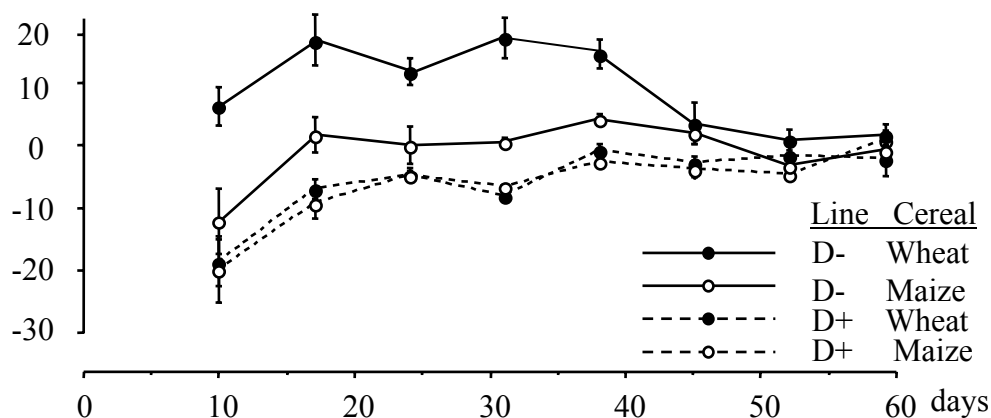


Figure 3  
 Experiment 3. Residual feed intake\* (means and standard errors, n=8 floor pens)  
 of D+ and D- chickens (G4) fed wheat (Rialto cultivar) or maize diets  
 given as pellet from 1 to 9 weeks of age.

Line (L) effect	***	***	***	***	***	**	NS	NS
Cereal (C) effect	*	**	**	***	***	NS	*	NS
L x C interaction	*	*	**	***	**	NS	NS	NS



\* Residual values from the multiple regression line giving feed intake as a function of metabolic weight and growth. Data are expressed as per cent of the mean feed intake

## References

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