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ASSESSING PELLET QUALITY FOR RABBITS THROUGH PHYSICAL OR CHEMICAL ANALYSIS AND RELATIONSHIP WITH GROWTH PERFORMANCE AND LIVEABILITY

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ABSTRACT

An experiment was conducted to evaluate the interest of changing pellet diameter and to relate rabbit growth performance to measured quality criterias. Treatment consisted in changing the dye of the press, resulting in three diets : small, medium and large pellet (2.5, 3.5, 5.0 mm diameter respectively). Pellets were assessed for apparent density, weight of 100 pellets, hardness, durability, dry matter, starch solubility in water or in presence of α-amylase, water holding capacity. Treatment was applied on 144 rabbits for 5 weeks post weaning. Physical measurements on pellets were hardly affected by dye change, except weight of 100 pellets, which decreased with pellet size. Starch solubilities in water were 8.84, 7.75, 8.09 % for small, medium and large pellets respectively. Starch solubilities in presence of α-amylase were 57.25, 49.38 and 46.23 %, for small, medium and large pellets respectively. First 3 weeks ADG decreased (50.0, 48.1, 47.5 for small, medium and large pellets, $P < 0.05$) and FCR increased (2.23, 2.36, 2.52 for small, medium and large pellets, $P < 0.01$) when pellet diameter increased. Late performance was not affected by pellet size. Number of eated pellets increased when pellet size was reduced.

INTRODUCTION

Rabbits should be fed pellets, as their behaviour, health and growth performance are very sensitive to dust and fines (INRA, 1984). Deciding optimal pellet size should be is a key question for feed manufacturers, as it has consequences on feed formulation, factory yield and energy consumption.

Several reports have dealt with pellet size comparison, resulting in divergent observations. In France, Lebas (1971) reported increased feed intake and feed conversion ratio (FCR) for finishing rabbits when pellet diameter increased from 5.0 to 7.0 mm. Growth rate was not affected in this study. He also mentioned no difference among pellets of 2.5 and 5.0 mm diameter. In the USA, Harris et al. (1984) concluded from several trials that feed spillage was due to pellet length rather than width . They could not conclude to an effect of pellet diameter on growth performance comparing diameters of 5/32 and 3/16 inch. (nearly 4 and 4.75 mm, respectively). Danish researchers reported 2 g increase average daily gain for rabbits from weaning to slaughter when pellet diameter decreases from 5 to 3 mm (Beretning fra Statens Husdryrbrugs forsøg, 1990). In Belgium, Maertens (1994) reported an advantage to 4.8 over 3.2 and 2.5 mm pellet diameters for growth of wean to slaughter rabbits, the effect decreasing with age post-weaning. FCR was not affected.

The different authors suggested that physical quality criterias (durability, hardness) and chemical quality criterias (starch gelatinization) may interfere with size.

A trial was designed to evaluate the interest for rabbit performances of changing the pellet diameter post-weaning and to relate growth performance to measured quality criterias.

MATERIAL AND METHODS

1- Animals and housing

The trial (number 82-95-04) took place at UCAAB's research farm, located in Montfaucon (Aisne, France).
Two consecutive batches of 72 VITALINE rabbits from does raised on the farm were weaned at 31 d (± 1) and selected for the trial. In each batch, the animals, males and females, were splitted into 12 cages with 6 rabbits each based on weight and parents.
All the cages were provided with a feeder and a waterer. Room temperature and air quality were monitored with dynamic ventilation, light regimen was 16 H light/8 H dark.

2- Diets : formulation, manufacture, controls

The feed was a conventional formula based on alfalfa, wheat bran, barley, wheat, soybean meal, wheat straw, beet pulp and molasses (Table 1). 3 experimental diets were derived from the same mixes of this formula, which differ according to the pelleting conditions. Changing the dye led to different press yield, steam input and power consumption. Three dyes were selected, differing in hole diameter and dye thickness : small (2.5×25), medium (3.5×45) and large (5.0×55). Length should not have changed as cutter position was adapted when the dye changed.
Particle size distribution, apparent density and reposition angle were determined on the feed prior to pelleting. Then, the pellets were assessed for apparent density, weight of hundred pellets, hardness (Kahl index), durability (Pfost), dry matter, enzymatic starch, starch solubility in water, starch solubility in presence of α-amylase and water holding capacity (method with centrifugation).

3- Experimental procedures

The experimental diets were available ad libitum for 35 days from weaning. Feed refusal were weighed every week and discarded. The rabbits were weighed individually three times : at weaning (BW1), at day 21 (BW21) and at day 35 (BW35) post weaning. Dead rabbits were discarded from the cage just after death and recorded.

4- Calculations and statistics

The cage is the experimental unit. Average rabbit daily gain (ADG), average rabbit daily feed intake (ADFI), FCR and mortality were calculated from farm records for each cage.
The trial design was : 4 replicates (cages) × 2 batches × 3 treatments.
Data were analyzed through variance-covariance analyses using GLM procedure of SAS 6.12 software, except mortality. In this case, effect of treatment was tested using chi-square statistics on the distribution dead or alive rabbits.

RESULTS AND DISCUSSION

1- Influence of different dye on feed measurements

Results of the analyses are summarized in Table 2. Pelleting increased apparent density of the feed in a same extent for the three treatments, but small pellet density was less (0.68 compared to 0.71). Weight of 100 pellets and hardness increased whith pellet size. Durability

was high and it did not differ. Large pellet had less dry matter than both medium and small pellets. Starch solubility in water and water holding capacity varied according to the dye thickness ÷ hole diameter ratio (DCR : dye compression ratio) and not according to pellet diameter. Starch solubility in presence of α-amylase increased when pellet size decreased.

2- Influence of different dye on rabbit performance

Table 3 shows the effect of pellet diameter on performance. In the first period post weaning (to 21 d) ADFI, ADG and FCR were affected by treatment ($P< 0.05$, $P < 0.05$, $P < 0.01$, respectively). 5.0 mm pellets resulted in higher ADFI and poorer FCR compared to both 2.5 and 3.5 mm pellets. ADG was 2.5 g higher with 2.5 mm pellet compared to 5.0 mm pellet ; 3.5 mm pellet produced intermediate ADG. This resulted in similar hierarchy in BW21. Mortality was not affected by the treatment. Correcting ADFI and FCR for dry matter content of pellet did not change significance of the differences.
From day 21 to 35, no mortality was recorded. No criteria was affected by the treatment. BW35 differed significantly comparing 2.5 and 5.0 mm pellets, reflecting differences in BW21. Overall results reflected the initial period.

As doe's feed was a 3.5 mm pellet, we suggest that the highest feed intake post weaning was not related to previous experience of the rabbits.

Among the analyzed criterias both weight of hundred pelle ts and starch solubility in presence of α-amylase varied somehow according to ADG.
Maertens (1994) suggested that as rabbit eats the feed pellet by pellet, large pellets may also provide faster eating rate which could improve performance if eating time is a limiting factor. From our results, we calculated an average number of pellets eaten per rabbit and per day (Table 4). Considering the differences, we can not support the hypothesis of the positive effect of reducing the number of pellet eaten. Furthermore, we obtained the opposite effect with the highest ADG when the number of pellets eaten increases.
ADG in the first 3 weeks post weaning seemed to respond to higher starch solubility in presence of α-amylase. We hypothesize that starch was made more or less readily soluble in physiological conditions depending on the pelleting procedure, with an advantage of smaller pellet diameters.

CONCLUSION

Post weaning rabbits responded to different pellet sizes. ADG and FCR improved when pellet diameter decreased from 5.0 to 2.5 mm, maintaining usual physical quality (durability). Mortality was not affected by pelleting conditions.
We suggested that :

- starch solubility in presence of α-amylase is related to these improvements ;
- pellet size does not limit eating rate or eating rate is not a limiting factor for rabbit growth post weaning.

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TABLE 1. COMPOSITION OF THE DIET

Ingredients	*(%)*
Wheat	12.0
Barley	13.0
Wheat bran	14.0
Beet pulp	4.5
Alfalfa (17% CP)	28.0
Soyabean meal (Brazil)	11.5
Wheat straw	10.0
Sugarbeet molasses	5.0
Methionine premix	1.0
COV 84 U*	1.0
Nutrition	
DE kcal.kg-1	2390
CP g. kg-1	157.0
EE g. kg-1	18.0
Starch g. kg-1	181.5
NDF g. kg-1	317.0
ADF g. kg-1	176.0
ADL g. kg-1	38.0

** Commercial trace elements and vitamin premix, UCAAB, Château Thierry, France.*

TABLE 2. EFFECT OF CHANGING THE DYE ON PHYSICAL AND CHEMICAL CHARACTERISTICS OF THE DIET

Dye	2.5 × 25	3.5 × 45	5.0 × 55
Dye Compression Rate	10.0	12.8	11.0
Press yield kg.h-1	400	490	600
Meal apparent density	……..0.45……		
Pellet apparent density	0.68	0.71	0.71
Weight of 100 pellets g	7.67	13.48	28.68
Kahl hardness index	10.50	41.05	14.60
Durability %	99.23	99.11	98.90
Dry matter g.kg-1	893.0	891.3	876.9
Starch solubility %			
in water	8.84	7.75	8.09
in presence of α-amylase	57.25	49.38	46.23
Water holding capacity g water.g-1 pellet DM	4.84	4.59	4.76

TABLE 3. INFLUENCE OF PELLET DIAMETER ON POST-WEANING

PERFORMANCE OF RABBITS

	2.5 × 25	3.5 × 45	5.0 × 55	Statistical Significance
BW1	779	770	769	N.S.
BW21	1823 [a]	1781 [ab]	1771 [b]	P < 0.05
BW35	2395 [a]	2366 [ab]	2306 [b]	P < 0.05
Period 1-21				
ADFI g	111.9 [b]	113.5 [b]	119.7 [a]	P < 0.05
ADG g	50.0 [a]	48.1 [ab]	47.5 [b]	P < 0.05
FCR	2.23 [b]	2.36 [b]	2.52 [a]	P < 0.01
Mortality %	6.25	6.25	8.30	N.S
Period 22-35				
ADFI g	161.0	161.1	157.5	N.S
ADG g	40.8	41.8	38.2	N.S
FCR	3.94	3.85	4.13	N.S
Mortality %	0	0	0	N.S

[a, b] *: different superscripts indicate significant differences*

TABLE 4. INFLUENCE ON PELLET DIAMETER ON THE NUMBER OF PELLETS EATEN PER RABBIT AND PER DAY

	2.5 × 25	3.5 × 45	5.0 × 55
Eaten pellets per day			
Period 1-21	1459	842	449
Period 22-35	2099	1195	549