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VALUE OF WHEAT STRAW AND ALFALFA HAY AS FIBER SOURCE FOR FATTENING RABBITS IN ALGERIA

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ABSTRACT

The objective of the present experiment was to determine if the poor growth (24-26 g/d) of the rabbit synthetic strain selected in Algeria, when fed with commercial diets, could be improved with the utilization of better balanced diets. Two experimental balanced diets (16% crude protein, 28.5% NDF) were formulated with alfalfa hay (32%) or wheat straw (22%) as main fibre source. The other raw materials were respectively barley (25 or 24%), soybean meal (6.5% or 14%), wheat bran (35 or 36%), oil (0 or 1%), minerals and vitamins (1.5 or 4%). The growth performances of 227 rabbits of the synthetic strain (31 days old) fed with one of theses 2 diets or with a commercial diet used as Control diet were studied until slaughter age (79 days). Average daily gain (ADG) with the Control diet was 26.8 g/d, within the range of previous measures. With alfalfa and straw diets, growth rate was improved by about 20% (ADG 31.5 and 33.0 g/d respectively for the 2 fibre sources; $P<0.001$). With the 2 experimental diets, in the same order, carcass yield was also significantly improved ($P<0.001$): 65.4 and 66.4% *vs* 63.5% with the Control diet, without significant modification of carcass adiposity. The first conclusion of the authors is that growth rate of rabbits of the new synthetic line could be easily improved with the use of a better balanced diet than the classical commercial ones. The second conclusion is that if alfalfa (dehydrated or hay) is not available or at an excessive price, wheat straw could be used without problem as main fibre source in rabbit diet's formulation.

Key words: Growing rabbit, wheat straw, alfalfa,

INTRODUCTION

In order to improve rabbit production in Algeria a synthetic stain was created some years ago (Gacem *et al.*, 2008). When this strain was compared with 2 locally available rabbit populations (Gacem *et al.*, 2009), the numerical production was significantly increased (+2 kits per litter) as was the adult weight of the does (+6% to 11% according to the reference). Moreover, growth rate during the weaning to slaughter period was quite the same for all genotypes: 23-24 g/day. This poor performance was attributed by the authors to the imbalance of rabbit diets commercially available. Effectively most of the Algerian commercial diets are fibre deficient with a relatively low protein content of 12-15%. For example the crude fibre analysis of 5 commercial diets was determined during the summer 2011, three had less than 6% crude fibre and the two others about 9%. The result is an important excess of energy relatively to the protein content (Lebas and Gacem, 2011)

The objective of the present experiment was to determine if the growth rate of the synthetic strain could be improved with better balanced diets. To remain practical, the diets were formulated exclusively with the classical raw ingredients available in Algeria for rabbit feeds formulation, *i.e.* barley, soybean meal, wheat bran and alfalfa. Because the price of imported dehydrated alfalfa is very high and because alfalfa hay is not always available, wheat straw was also studied as possible main source of fibre for rabbit diets formulation.

MATERIAL AND METHODS

Experimental design and animals

Three pelleted diets were used in the study: the commercial diet normally employed in the ITELV rabbitry, used as control, a second diet based on alfalfa hay as main source of fibre and a third diet in which wheat straw completely replaces alfalfa hay as main fibre source. A total of 227 young rabbits of both sexes, individually identified, were placed at weaning (31 days) in collective cages with 3 to 4 rabbits per cage (one level, 35 x 80 cm, h 30 cm). To reduce the risk of error in the diets distribution, all rabbits fed the same diet were placed in adjoining cages. Because it was not possible to place all experimental cages in the same room, 58 + 53 rabbits were placed in one room and received the Control diet or the "Alfalfa diet" and 62 + 54 rabbits were placed in a second room and received the Control diet or the "Straw diet". Thus, number of rabbits receiving the Control diet was about twice than that attributed to each experimental diet. As feed, water was also distributed *ad libitum* with automatic nipple drinkers. Ventilation of the rooms was artificial and a pad cooling system was used to reduce the excess of summer temperature. The experiment was conducted from August 16 to October 3, 2011.

Rabbits were individually weighed at weaning and then every week until 79 days of age. Only rabbits alive at the end of the experiment were included in the analysis. Fattening period was divided in 2 periods: 31-58 days and 58-79 days of age. For technical reasons feed intake was not measured during the first period. Then for each cage, average daily weight gain, daily feed intake, and feed conversion ratio were determined for the second period only, after correction for the number of rabbits effectively alive in each cage at the end of each experimental week.

At the end of the experiment, without previous starving period, 16 rabbits per treatment with an average live weight similar to that observed for the whole corresponding treatments, were slaughtered. Skin and full digestive tract were weighed immediately after removing. Carcass adiposity was estimated according to the French score method (AFNOR NF V47-001). Carcasses were weighed about 1 hour after slaughter, and according to local tradition, they were presented with ears attached to the head, liver, kidneys and legs extremities.

Composition of experimental diets

The 3 diets were manufactured in the same factory. Their composition is given on Table 1. For the 2 experimental diets, "Alfalfa diet" and "Straw diet", the common raw materials were taken out the same stocks, but it was no necessarily the same situation for the commercial control. The protein content of the 2 experimental diets was similar around 16%, a little bit higher than that of the Control diet (14.9%). The NDF content was similar for the 3 diets (27-29% NDF), but the ADF content was lower in the commercial Control diet than in the 2 experimental diets (13.5% and 13.7%). It must be underlined that the crude fibre content, still frequently used in Algeria for the estimation of the fibre content of a diet, was clearly lower in the commercial diet (8.4%) than in the experimental diets (12.0%).

Statistical analysis

Records were analysed using a model of variance analysis with fixed effects and interaction (GLM procedure according to SAS, 1988). The 2 effects considered in this model were the experimental group (3 levels: 2 experimental diets and 1 control) and the position of cages in the rooms (6 levels corresponding to groups of 3 cages in each line of cages, 1 line per treatment). For individual weights study, a covariance analysis was also performed with utilization of initial weight as covariable because initial weight of rabbits alive at the end of the experiment was significantly different between treatments. Mortality rates were compared with the chi-square method (one side exact test of Fisher).

Table 1: Composition of the experimental diets.

Ingredients (presence or %)	Control diet	Alfalfa diet	Straw diet
Barley grain	yes	25.0%	24.0%
Soybean meal	yes	6.5%	14.0%
Hard wheat straw	no	-	22.0%
Alfalfa hay	yes	32.0%	-
Hard wheat bran	yes	35.0%	35.0%
Vegetable mixed oil	no	-	1.0%
$CaCO_3$	yes	0.5%	2.0%
Dicalcium phosphate	no	-	1.0%
Oligo & vitamins premix Nutristar	1.0%	1.0%	1.0%
Analytical composition (% as fed)			
Dry matter	88.1	89.0	88.1
Total ash	10.1	9.4	9.3
Crude protein (N x 6.25)	14.9	16.5	15.9
Crude fiber (Weende)	8.4	12.0	12.0
NDF (van Soest)	27.0	28.6	28.7
ADF (van Soest)	10.5	13.5	13.7
Lignins (ADL Van Soest)	3.1	3.7	3.7

RESULTS AND DISCUSSION

Absence of difference between the 2 experimental rooms

As expected, all performances of control rabbits placed in each of the 2 rooms were quite identical for individual daily growth (26-27 g/d), feed intake (89.5 – 89.2 g/d) and mortality (14.5 – 13.8%). Accordingly, the experimental room was not included in the statistical models and the authors have definitively considered only 3 treatments: control (120 initial rabbits), Alfalfa diet (53 initial rabbits) and Straw diet (54 initial rabbits).

Mortality

During the whole experiment, mortality rate of the control rabbits was 14.2%, a value lower than the 23-26% classically observed in this ITELV experimental rabbitry (Gacem *et al.,* 2009). With the Straw diet, mortality was not significantly lower: 9.3% (P=0.261) and with Alfalfa diet mortality was significantly higher than that observed with the control: 26.4% (P=0.045), but within the range of "classical" mortality observed in this rabbitry (Gacem *et al.,* 2009). Mortality difference between the 2 experimental diets was also significant (P= 0.0182). Most of the mortality cases were preceded by a short period of diarrhoea. The higher mortality with Alfalfa diet was observed mainly at the end of the experiment (second period) and should most probably be attributed to a lack of conservation of one or two bags of the Alfalfa pelleted diet.

Individual growth performance

Growth rate is presented in the Table 2. For the whole period, the average daily gain was similar for the 2 experimental diets (31.5 and 33.0 g/day with Alfalfa and Straw diets respectively), and significantly higher than that of the control rabbits (26.8 g/day).This late value is in the top of the range of growth rates previously observed with this commercial diet. The 20% improvement of the growth rate above that of the control demonstrates clearly that the low fattening performance previously mentioned (Gacem *et al.,* 2009) could be at least partially attributed to a nutritional imbalance of the commercial diet.

Compared with the first period of the experiment, the growth rate during the second one was increased for the 2 treatments without great health problems (Straw diet and Control diet). This could be

partially attributed to the ambient temperature lowering. Effectively the average temperature measured in the experimental rooms was 28.8°C during the first experimental week and only 23.4°C during the last one. The inverse tendency observed with the Alfalfa diet could certainly be attributed to the health problems previously mentioned.

Table 2: Individual growth performance of rabbits: number of rabbits, average initial weight, least square means of live weight and average daily growth, with initial weight as covariable (common initial weight = 429.4 g) – Only rabbits alive at the end of the experiment are included.

Parameters	Diets			Residual coef. of variation	Probability value
	Control	Alfalfa	Straw		
Initial rabbit number	120	53	54	-	-
Final rabbit number	103	39	49	-	-
Initial weight at 31 d. (g)	414 a	469 b	430 a	22.4%	0.006
Live weight at 58 d. (g)	1054 0	1295 b	1252 b	12.4%	< 0.001
Live weight at 79 d. (g)	1716 a	1942 b	2013 b	10.4%	< 0.001
31-58 d daily gain (g/d)	23.1 a	32.0 b	30.5 b	19.6%	< 0.001
58-79 d. daily gain (g/d)	31.5 a	30.8 a	36.3 b	16.6%	< 0.001
Overall daily gain (g/d)	26.1 a	31.5 b	33.0 b	13.6%	< 0.001

a, b : On one line, with the same letter means or least square means are not different at P=0.05

Average performance by cage during the second period

The feed intake was significantly lower with the control diet than with the 2 experimental diets (Table 3). But in relation with its high energy level (associated with the low ADF content) the feed conversion ration was better for the Control diet. The poor feed conversion ratio observed with Alfalfa diet is most probably explained by the health problems previously mentioned for the second experimental period.

Table 3: Average feed intake and daily growth per cage during the 3 last weeks of the experiment.

Parameters	Diets			Résiduel coef. of variation	Probability value
	Control	Alfalfa	Straw		
Number of cages	38	16	17	-	-
Daily feed intake (g/d/rabbit)	89.3 a	123.5 b	121.0 b	14.8%	<0.001
Average daily growth (g/d/rabbit)	31.8 a	31.4 a	36.3 b	13.6%	0.002
Feed conversion ratio	2.83 a	4.00 c	3.38 b	15.7%	<0.001

a, b : On one line, with the same letter means are not different at P=0.05

Slaughter performance

Slaughter results are summarized in Table 4. As it is classically observed (Ouhayoun, 1990), the carcass yield is higher with the 2 experimental diets (65.4-66.4%) corresponding to the higher growth rate, than with the Control diet (63.5%). This corresponds mainly to a smaller relative proportion of the full digestive tract despite of a slightly but significantly higher proportion of skin. The main practical consequence for the carcasses is a weight increased by 23% without significant variation of the adiposity.

CONCLUSIONS

From this study 2 main conclusions could be drawn:

- The poor growth rate previously observed during the weaning to slaughter period with rabbits of the synthetic strain selected in Algeria, is mainly a consequence of the unbalanced commercial diets locally available, rather than of a lack of genetic potential.
- The diet's fibre content could be increased indifferently with a higher proportion of alfalfa or of wheat straw. The choice between these 2 fibre sources would be decided in relation with their

relative local price and that of sources of proteins available such as soybean meal. Effectively, when wheat straw proportion is increased in place of alfalfa in a diet, the proportion of protein-rich raw material must be increased also in order to maintain the diet's protein level.

Table 4: Slaughter performance of rabbits according to dietary treatments.

Parameters	Diets			Residual coef. of variation	Probability value
	Control	Alfalfa	Straw		
Rabbits number	16	16	16	-	-
Live weight (LW) (g)	1697 a	2033 b	2015 b	14.8%	0.002
Skin weight (g)	162 a	223 b	206 b	18.7%	<0.001
Full digestive tract (g)	369	380	364	14.4%	0.669
Carcass weight (g)	1081a	1330 b	1338 b	15.8%	0.001
Carcass yield (% LW)	63.5 a	65.4 b	66.4 b	2.57%	<0.001
Skin (% LW)	9.5 a	11.0 b	10.2 ab	10.4%	0.001
Full digestive tract (% LW)	22.0 a	18.8 b	18.1 b	9.7%	<0.001
Carcass adiposity score (1)	3.44	3.06	2.94	29.9%	0.304

(1) score from 1 = no apparent abdominal fat, to 5 = kidneys completely covered by adipose tissue
a, b : On one line, with same letter means are not different at P=0.05

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REFERENCES

AFNOR 2004. Echelle d'adiposité des carcasses de lapin .Norme AFNOR NF-47-001 – Available on Internet at the URL: http://www.cuniculture.info/Docs/Phototheque/Abattage/Carcasse-Decoupe/Notes-de-gras-Lapin.pdf

Gacem M., Zerrouki N., Lebas F., Bolet G., 2008. Strategy for developing rabbit meat production in Algeria: creation and selection of a synthetic strain.*9th World Rabbit Congress - June 10-13, 2008 - Verona - Italy,* 85- 89.

Gacem M., Zerrouki N., Lebas F., Bolet G., 2009. Comparaison des performances de production d'une souche synthétique de lapin avec deux populations locales disponibles en Algérie. *13èmesJournées de la Recherche Cunicole, 17-18 novembre 2009, Le Mans*, *149-152*

Lebas F., Gacem M., 2011. Souche synthétique cunicole : diffusion, interaction nutrition sélection, chez le lapin en Algérie. *Conférence INRAA , 7 décembre 2011, Algiers*

Ouhayoun, J. , 1990. Abattage et qualité de la viande de lapin. 5*èmes Journées de la Recherche Cunicole en France, 12-13 Décembre, 40.1-40.21*