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VALORISATION OF WHEAT BY-PRODUCTS BY GROWING RABBITS OF LOCAL ALGERIAN POPULATION

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ABSTRACT

A control diet (17.5% protein and 13.9% crude fibre) was based on soya meal (11%), dehydrated alfalfa (35%), hard wheat bran (25%) and barley (25%). In complete substitution of barley and partial substitution of soya meal, hard wheat bran was increased up to 56% in diet A, and in diet B two hard wheat by-products were employed (bran 30% and middlings 23%). Eighty one rabbits of the local population, were caged individually and received *ad libitum* from weaning (28 d.) to 84 days, one of the 3 pelleted diets. Digestibility of diets A and B was measured with 10 rabbits per diet for dry matter (66.0 - 75.4%) nitrogen (81.3% - 85.7%), crude fibre digestibility (20.9% - 35.9%) and digestible energy content (2658 and 2933 kcal/kg DM). For diets A, B and control, growth rate and feed conversion ratio were, in that order, 27.8 - 28.8 and 30.5 g/d ($P<0.05$) and 4.39 - 3.91 and 4.52 ($P<0.01$). Despite a higher final live weight for the control (2157 *vs* 2017 and 2011 g for A an B ; $P<0.01$) hot carcass weight was not significantly affected by treatments (1475 g on average). Nevertheless, liver weight was higher in the control (113 *vs* 91.7 and 90.4 g; $P<0.01$).

INTRODUCTION

The rational rabbit breeding develops in Algeria, mainly in rural areas. Breeding units are generally small and utilise rabbits of the unselected local population raised in wire mesh cages. Most of the breeders are young with a short specific training. One of the main limiting factor to the development of this type of production, remains the absence of balanced pelleted feeds available at an acceptable price. This is why efforts should be made to produce balanced pelleted feeds made with local raw materials, available at a lower price than imported ones.

Algeria imports and consumes annually a great amount of wheat and then great quantities of wheat by-products are available, such as wheat bran or middlings. These locally produced by-products are generally employed as feed concentrate for ruminants. It should be interesting to extend to rabbit feeding the utilisation of these local products as we proposed previously for some other Algerian raw materials (BERCHICHE and LEBAS, 1996; BERCHICHE *et al*., 1999)

The aim of the present experiment was to study the possibility of introduction of hard wheat by-products (middlings and bran) at high level - more than 50% - in rabbit's diets and to estimate consequences on growth and slaughter performances of rabbits of local Algerian population.

MATERIAL & METHODS

Diets

Three balanced pelleted diets (protein 17.5% DM and fibre 13.5% DM), one control and 2 experimental diets were formulated and produced in a small local feeds manufacturing plant (table 1). The control diet was based on soya meal, dehydrated alfalfa, wheat bran (25%) and barley (25%). Hard wheat bran was increased up to 56% in diet A in complete substitution of barley and partial substitution of soya meal,. In diet B, both hard wheat by-products were employed for the substitution : bran 30% and middlings 23%.

Table 1 : *Composition of the 3 diets*

Diets	**Control**	**A**	**B**
Ingredients	***%***	***%***	***%***
• Soya meal	11	5	8
• Dehydrated alfalfa	35	35	35
• Hard wheat bran	25	56	30
• Hard wheat middlings	-	-	23
• Barley	25	-	-
• Mineral & Vitamins	4	4	4
Chemical composition			
• Dry matter (% as fed)	95.2	93.0	95.8
• Crude proteins (% DM)	17.5	17.8	17.2
• Crude fibre (% DM)	13.9	14.4	13.3
• Ether extract (% DM)	3.4	3.2	3.5
• Gross Energy (kcal/kg DM)	3670	4030	3892

Animals and experimental design

A total of 81 rabbits of the local Algerian population were utilised. They were born in the experimental facilities of the laboratory. On the day of weaning (28 days after kindling), rabbits were placed in wire mesh individual cages in flat deck disposition (one level). They were distributed between 3 homogenous groups of 27 each, according to weaning weight and litter origin.

During the 8 weeks of the experiment, rabbits were fed *ad libitum* one of the 3 diets, with a weekly control of live weight and feed consumption. Fresh water was always available.

Ten of the 27 rabbits of each of the A and B groups were placed in special cages, for estimation of diet's digestibility according to the standardised European procedure proposed by PEREZ *et al*. (1995). Because of the too small number of digestibility cages available at this moment in the laboratory, digestibility of the control diet was not measured, but it was in a previous experiment (BERCHICHE, 1998).

At the end of the experiment, all rabbits were slaughtered in controlled conditions according to BLASCO *et al.* (1993). The following weight were measured : raw skin, full digestive tract + other white abdominal organs, hot carcass, liver and kidney fat. According to local tradition, carcasses were presented with head, thoracic content (heart, lungs, …), liver, kidneys and with extremities of the legs and the corresponding skin. Slaughter rate was calculated on hot carcass basis.

Chemical and Statistical analysis

Dry matter estimation of diets and faeces was performed according to PEREZ *et al*. (1995) for digestibility studies and chemical determination were made according to AOAC recommendations (1984).

Experimental data were analysed with a one way variance analysis on help of the STAT-ITCF version 5 (1991) statistical package. Calculations were done only for rabbits alive at the end of the experiment.

RESULTS AND DISCUSSION

Nutritional composition of diets

Protein and fibre levels in the 3 diets (table 1) can be considered as acceptable for rabbit mixed feeds (LEBAS 1992, De BLAS & MATEOS, 1999). Digestible energy content of diet B (table 2) was 12% higher than the recommended value of 2500 kcal/kg (as fed basis). On the contrary, the previously calculated digestible energy value on the control diet - 2225 kcal/kg as fed (BERCHICHE, 1998) - was 11% lower than the recommendation.

The highest digestibility of dry matter and energy observed for diet B was related to the higher digestibility of wheat middlings compared to wheat bran (BOURDON et al., 1989) and can be partly explained by the higher fibre digestibility observed with diet B compared to diet A (table 2).

Because in diet B the proteins were also highly digestible, the digestible-protein-to-digestible-energy ratio was lower in diet B (50.1 g/1000 kcal) than in diet A (54.6) or in the control diet (estimated at 56.7 g/1000 kcal). In these conditions, protein providing should not be considered as a limiting factor for rabbit's growth.

Table 2: *Digestibility of the experimental diets A and B*

Criteria	**Diet A**	**Diet B**	*CV (%)*	Signification
Digestibility coefficients (%)				
• Dry matter	65.4	75.3	*5.1*	**
• Proteins	81.3	85.7	*3.0*	**
• Crude fibre	20.9	35.9	*32.5*	**
• Energy	66.0	75.4	*5.3*	**
Calculated criteria				
Digestible energy (kcal/kg DM)	2658	2933	*5.3*	**
Digestible proteins (% DM)	14.5	14.7	*2.9*	ns
Digest. Prot./Digest. Energy (1)	54.6	50.1	*3.2*	**

** P<0.01; ns : non significant. (1) g/1000 kcal.

Growth performance

Nine rabbits died during the experiment, 4 in the control group, 1 with diet A and 4 with diet B. In the control group, the 4 rabbits died during the first experimental week, most probably in relation with weaning and cage changing stress i.e. without any significant relationship with the feed consumed. In the group B, rabbits died with diarrhoea during the 3rd and the 4th experimental weeks. It may be a consequence of the low level of non-digestible fibre (8.5% non-digestible crude fibre) as suggested by LEBAS (1992).

Average daily growth was similar for the 2 experimental diets A and B, but significantly lower than in the control group (table 3). As the feed intake was higher in the group A (lower diet's DE content) than in the Group B, the feed conversion ratio was lower in group B than in group A. Most probably because of the low digestible content of the control diet, feed conversion was the worst in the control group (4.52). Nevertheless it was not significantly different from that observed for group A rabbits.

The average growth rate observed in this experiment between 4 and 12 weeks (29 g/d) was the highest the authors never observed with rabbits of the Algerian local population. For example they observed an average of 27 g/d in a previous experiment (BERCHICHE et al., 1999) and only 22 g/d in their first experiment with this rabbit genotype (BERCHICHE et al., 1996).

Table 3 :*Average growth performances between weaning (28 d) and slaughter age (84 d)*

	Control	**Diet A**	**Diet B**	*CV (%)*	Signific.
Final number of rabbits	*23*	*26*	*23*	-	-
• Initial weight (g)	453	459	459	*25.3*	ns
• Final weight (g)	2157[a]	2017[b]	2011[b]	*9.1*	**
• Average daily growth (g/d)	30.5[a]	27.9[b]	28.8[b]	*10.0*	*
• Feed intake (g/d)	123.6[a]	111.0[b]	104.2[b]	*12.2*	**
• Feed conversion ratio	4.52[a]	4.39[a]	3.91[b]	*15.8*	**

ns : non significant; * P<0.05; ** P<0.01; a, b : on the same line, data with different letters are significantly different (P<0.05).

Slaughter performances

The average slaughter live weight (2060 g) obtained at 84 days represented around 69% of the 3 kg adult weight of the genotype, i.e. a significantly higher degree of maturity than that commonly practised in Europe (50-55%; OUHAYOUN 1989; COLIN, 1999). In relation with this higher maturity, the average slaughter rate (71.6%) is higher than that generally observed for hot carcasses (62-65%) with the same presentation (GIACCONE, 1989; OUHAYOUN 1989). Nevertheless, OUHAYOUN & CHERIET (1983) have observed similar values for rabbits submitted to different protein regimen. Despite this high degree of maturity, kidney fat percentage measured on carcasses of the A and B groups remained at a relatively low level (2.36 and 2.41% for A and B respectively; NS).

Because the skin weight was higher in the control group (258 g *vs* 213-220 g; table 4) hot carcass weight was not significantly different from one group to the others despite the highest live weight previously mentioned for the control group. Nevertheless, liver was heavier in this control group (P<0.01). It must be emphasised that the average proportion of skin (10.7% of live weight) was widely lower than the classical values observed for New Zealand White or commercial hybrid rabbits (14 to 16%; OUHAYOUN 1989). This may be a characteristic of this Algerian local population.

Table 4 : *Slaughter performance*

	Control	**Diet A**	**Diet B**	*CV (%)*	Signific.
Number of slaughtered rabbits	*23*	*26*	*23*	-	-
• Live weight	2157[a]	2017[b]	2011[b]	*9.1*	**
• Skin (g)	258[a]	213[b]	220[b]	*14.2*	**
• Full digestive tract (g)	223	301	299	*15.2*	ns
• Hot carcass weight (g)	1531	1453	1442	*9.0*	ns
• Slaughter rate (%)	71.0	72.1	71.8	*2.6*	ns
• Liver weight (g)	113[a]	92[b]	90[b]	*23.1*	**
• Kidney fat (% carcass)	(1)	2.36	2.41	*24.0*	ns

ns : non significant; * P<0.05; ** P<0.01; a, b : on the same line, data with different letters are significantly different (P<0.05). (1) not determined.

CONCLUSION

This experiment confirms that if well balanced pelleted feeds are available, rabbits of the Algerian local population are able to produce slaughter rabbits of 2 kg minimum at the age of 12 weeks, and then to produce carcasses with a weight corresponding to the local market wishes. It's a very important information for rabbit development in Algeria because this type of rabbit is quite the only one available in the country.

The utilisation of hard wheat by-products as main ingredient of the diet allows to produce acceptable balanced diets. The best feed efficiency was observed with diet B (30% wheat bran + 23% middlings), but some mortality was observed (4/27 rabbits). The number of rabbits raised in individual cages was too small in this experiment to permit any final conclusion about the effect of diet B on mortality. So before to suggest a wide utilisation of such diet, some new experiments should be conducted, in more common raising conditions (group caging, outdoor raising, …) and an effort to increase the diet's fibre level should also be done.

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