EFFECTS OF GRADUAL INCORPORATION (40 TO 60%) OF HARD WHEAT BRAN, IN SIMPLIFIED BRAN-ALFALFA-MAIZE DIETS, ON VIABILITY, GROWTH AND SLAUGHTER TRAITS OF RABBITS OF WHITE POPULATION UNDER ALGERIAN CONTEXT

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ABSTRACT

Five groups of 24 rabbits of Algerian white population, weaned at 28 days of age, with an average live weight of 532 g, were placed in collective cages (4 rabbits/cage) and were used to study under Algerian conditions the effects on viability, growth and slaughter traits, of gradual incorporation of hard wheat bran in pelleted and balanced feeds devoid of soybean meal. The rabbits received *ad libitum*, from 28 to 84 days of age, one of the 5 experimental diets containing 40% (B40), 45% (B45), 50% (B50), 55% (B55) or 60% (B60) of hard wheat bran, complemented by maize, dehydrated alfalfa and a mineral and vitamins premix exclusively. The average protein and ADF levels were 14.4% and 16.0% respectively. Throughout the experiment, the health status of rabbits was good (average mortality rate of 8.3%) without significant effect of treatments. The average liveweight, daily growth and intake reached by the rabbits fed B45 diet were significantly higher than those of the others groups of rabbits (respectively: 2269, 31.6 and 98.7 *vs* 2047 g, 27.32 g/d and 80.6 g/d. However, the feed conversion ratio of B45 group was significantly (P = 0.007) deteriorated comparatively to the average FCR of the other groups (3.48 *vs* 3.26). For the B40, B50, B55 and B60 groups of rabbits, growth performances were similar and the average liveweight (2047 g) reached at 84 days correspond to a degree of maturity of 56.8 %. The average slaughter rate (66.1%) and the meat/bone ratio (6.6) were not affected by the amount of hard wheat bran in the diet and were similar for the 5 groups of rabbits. In addition, the moderate crude protein level doesn't seem to be a limiting factor for the growth of the rabbit population used. The absence of soybean meal doesn't create any alteration of growth performance.

Key words: Rabbit, hard wheat bran, growth performances, slaughter traits.

INTRODUCTION

In the Algerian context, the development of rabbit breeding required the reduction of the price of feed, which is the most discouraging problem encountered by breeders. Since several years, our laboratory has been working to formulate a balanced feed by using the maximum amount possible of locally available inexpensive raw materials and among these, wheat by-products seem to be of particular interest for the Algerian situation. Algerians are among the largest wheat consumers (205 kg/inhabitant/year) in the world. Consequently, this results in appreciable quantities of wheat by-products left over by industrial Algerian mills (Boudouma, 2009), which can be a locally and inexpensive feed source for rabbit farming.

In previous studies, the incorporation of high rate (50 and 60%) of wheat bran, associated (Berchiche *et al*., 2000; Lakabi *et al.*, 2008) or not (Lounaouci *et al.,* 2011) with wheat middling, induced or not, depending of the trial, a deterioration in growth performances and slaughter rate of growing rabbits when compared with control diet with only 25-30% wheat bran. It must be underlined that in all these studies, wheat bran was not gradually incorporated and soybean meal was also included in the feeds.

The aim of the current research was to study the effects of gradual incorporation rate (40 up to 60%) of hard wheat bran, in diets devoid of soybean meal, on viability, growth and slaughter performances of rabbits of Algerian white population. The additional constraint (in order to reduce the cost feed) was that the diets were formulated to have an average moderate crude protein content of 14%, as suggested by Carabaño *et al.*(2008).

MATERIALS AND METHODS

Experimental design and feeds

The trial was conducted during the months of May and July, in a rabbit unit of a state farm near of Tizi-Ouzou (Algeria). Rabbit unit mean temperature (not artificially controlled) and hygrometry ranged respectively from 19.8°C to 27.5°C (with a maximum of 30°C) and from 68% to 78%, (with a maximum of 92%). No artificial light program was applied.

The five experimental feeds were formulated to contained 40% (B40 diet), 45% (B45 diet), 50 (B50 diet), 55 (B55 diet) and 60% (B60 diet) of hard wheat bran, in complement of maize and dehydrated alfalfa. The list of ingredients and the chemical composition of the five experimental diets are given in Table 1. No antibiotics were added to the feeds or in the water.

Animals, measurements and chemical analyses

A total of 120 mixed-sex rabbits of Algerian white population (Lounaouci *et al*., 2008), weaned at 28 days of age and weighing 532 ±120 g on average, were randomly assigned to the five experimental groups (24 rabbits/diet), according to weaning weight and litter origin. Rabbits were bred into collective (4 rabbits/cage) cages and were fed *ad libitum* experimental diets. Live weight and feed consumption were registered weekly, while the mortality was checked daily. At the end of the trial (at 84 days of age), 10 rabbits/diet were slaughtered according to the rite of sacrifice practiced in Muslim countries and carcasses were dissected according to Blasco et *al*. (1993).

The chemical analyses were performed according to ISO methods and considering the recommendations proposed by the EGRAN group (EGRAN, 2001): DM (ISO 6496:1999), fibre (NDF, ADF and ADL, Van Soest sequential method, ISO16472:2006 and ISO 13906:2008) and CP (N×6.25, Kjeldhal method, NF V18-100, AFNOR, 1997).

Statistical analyses

Data were analyzed as a completely randomized design, with type of diet as the main source of variation, by using the GLM procedure of STATISTICA software (Statistica 2003, Version 6.1, Stat Soft France). When the treatment effect was significant ($P < 0.05$), differences between means were determined using the Newman and Keuls test.

RESULTS AND DISCUSSION

Nutritional composition of feeds

Analytical composition of the 5 diets was similar for crude proteins and fibre (Table 1).The average crude protein content of the 5 diets was close to the new value and objective proposed by Carabaño *et al.*(2008) for protein nutrition in rabbit (respectively: 141 to 148 *vs* 140 g/kg, as fed basis). The fibre level was similar for the 5 diets and was close to the values recommended for growing rabbits (Lebas, 2004): 306, 160 and 45 *vs* 310, 170 and 50 g/kg on as raw basis, for NDF, ADF and ADL, respectively.

Table 1: Ingredients and chemical composition of the five experimental diets

Diets	B40	B45	B50	B55	B60
Ingredients, % as fed					
Maize	21.00	18.00	15.00	14.00	11.00
Dehydrated alfalfa	38.00	36.00	34.00	30.00	28.00
Hard wheat bran	40.00	45.00	50.00	55.00	60.00
Mineral and vitamin premix[1]	1.00	1.00	1.00	1.00	1.00
Chemical composition, g/kg as fed					
Dry matter	893	894	893	891	894
Crude ash	73	72	71	66	65
Crude protein (N×6.25)	141	143	145	146	148
Neutral detergent fibre (NDF)	298	303	307	308	313
Acid detergent fibre (ADF)	157	156	167	161	159
Acid detergent lignin (ADL)	46	46	46	44	44
Cellulose (ADF-ADL)	111	110	121	117	115
Ratio lignin/cellulose	0.41	0.41	0.38	0.37	0.38

[1]: Premix (Rabbit CMV at 1%) provided per kg diet: Se, 0.08; Mg, 2.6; Mn, 2.0; Zn, 6.0; I, 0.08; Fe, 4.0; Cu, 1.10; S, 6.8; Co, 0.04; thiamin, 0.20; riboflavin, 0.20; calcium d-pantothenate, 0.8; pyridoxine, 0.10; biotin, 0.004; nicotinic acid, 2; choline chloride, 12; folic acid, 0.20; vitamin K3, 0.1; dl-α-tocopheryl acetate, 2.0; biotin, 0.004; folic acid, 0.2; cyanocobalamin, 0.002; vitamin A, 950000 IU; vitamin D3, 120000 IU.

Health status, intake and growth of animals

During the whole experiment, the mortality (3/24, 1/24, 1/24, 3/24, 2/24, respectively for B40, B45, B50, B55 and B60 groups) occurred during the first and second experimental weeks. It can be related to the stress of weaning more than to the effect of diets. Throughout the experiment, the health status of rabbits was good (global average mortality rate of 8.3%), probably due to the positive effect of an appreciable level of fibre associated with a moderate content of crude protein (Gidenne, 2003).

The average final liveweight, daily growth and intake reached by the rabbits fed B45 diet were significantly higher than those of the others groups of rabbits (respectively: 2269, 31.6 and 98.7 *vs* 2047 g, 27.32 d/d and 80.6 g/d) and thus regardless of the experimental period considered (Table 2). However, the feed conversion ratio was deteriorated (P= 0.007) when the whole fattening period is considered (3.48 *vs* 3.26). The growth rate of B45 group (31.6 g/day) was clearly higher than that obtained by Berchiche *et al.* (2000), Lakabi *et al.* (2008) or Lounaouci *et al.* (2011) with rabbits fed diets containing high level (more 50%) of hard wheat bran and 4 to 8% of soybean meal (25 to 29 g/d).

Table 2: Effect of gradual incorporation of hard wheat bran on rabbits feed intake and growth

Diets	B40	B45	B50	B55	B60	*SEM*[1]	*P*-value
Rabbits, N	21	23	23	21	22		
Period 28 - 49 d							
Liveweight at 28 d (weaning), g	525	540	531	540	525	12	0.92
Liveweight at 49 d	1023 [a]	1198 [a]	1080 [ab]	1103 [ab]	1104 [ab]	19	0.04
Daily weight gain, g/d	25.63 [b]	31.43 [a]	26.27 [ab]	26.81 [ab]	27.94 [ab]	0.95	0.01
Daily feed intake, g/d	52.84 [b]	72.19 [a]	64.39 [ab]	61.42 [ab]	61.10 [ab]	1.02	0.001
Feed conversion ratio, g/g	2.57 [ab]	2.46 [a]	2.68 [b]	2.9 [b]	2.52 [ab]	0.08	<0.001
Period 49 - 84 d							
Liveweight at 84 d , g	2061 [b]	2269 [a]	2030 [b]	2062 [b]	2035	32	0.01
Daily weight gain, g/d	28.92 [ab]	31.67 [a]	27.09 [b]	28.27 [ab]	26.62 [b]	0.71	0.01
Daily feed intake, g/d	86.96 [b]	103.28 [a]	90.50 [ab]	86.12 [b]	85.91 [b]	1.64	0.002
Feed conversion ratio, g/g	3.76 [ab]	4.10 [b]	3.68 [ab]	3.42 [a]	3.63 [ab]	0.09	<0.001
Global Period 28 - 84 d							
Daily weight gain, g/d	27.69 [b]	31.58 [a]	26.78 [b]	27.72 [b]	27.1 [b]	0.78	0.01
Daily feed intake, g/d	79.83 [b]	98.75 [a]	83.53 [b]	80.62 [b]	78.65 [b]	1.46	0.001
Feed conversion ratio, g/g	3.31 [a]	3.48 [b]	3.30 [a]	3.23 [a]	3.22 [a]	0.06	0.007

[1]SEM: standard error of the mean. Mean values in the same row with a different superscript differ at $P<0.05$.

The intake and growth did not differ among the B40, B50, B55 and B60 groups and their average final liveweight (2047 g) at 84 d of age correspond to a degree of maturity of 57 % (adult weight of 3600 g, Zerrouki *et al.*, 2008), which was slightly higher than that considered optimum (50 –55%) for selected European commercial lines of rabbits, but it was obtained later (84 d of age *vs* 70-77d) (Dalle Zotte, 2002). The growth performances of these 4 groups were similar to those reported by Berchiche *et al.* (2000). It can be assumed that these performances reached a relatively high level, if taking into account the experimental conditions (period May-July, collective cages), the crude protein content of diets (14.4 *vs* 16%) and if we considered the genetic potential of our rabbit line (Lounaouci *et al.* 2008).The experimental treatments had also a significant effect on feed efficiency and the fed conversion ratio was higher (P=0.007) for B45 diet compared to the 4 other groups (3.48 *vs* 3.26).

Slaughter performances

Table 3: Effect of gradual incorporated rate of hard wheat bran on slaughter traits of rabbits at 84 d of age (10/diet).

Diets	B40	B45	B50	B55	B60	*SEM*[1]	*P*-value
Measured							
Slaughter weight (SW), g	2006 [b]	2268 [a]	2134 [ab]	2121 [a]	2166 [a]	28	0.04
Skin, g	195 [a]	245 [a]	210 [a]	192 [a]	202 [a]	4.90	0.02
Full digestive tract, g	344	380	352	357	358	9.55	0.91
Cold Carcass Weight (CC), g	1335 [b]	1500 [a]	1395 [b]	1397 [b]	1438 [b]	20	0.02
Hindleg, g	148.5	152.6	155.1	152.7	158.1	2.32	0.74
Calculated							
Skin, % SW	9.71 [a]	10.78 [b]	9.83 [a]	9.08 [a]	9.34 [a]	0.15	0.02
Digestive tract, % SW	16.99	16.73	16.54	16.86	16.53	0.36	0.99
Perirenal fat, % CC	0.63 [a]	0.95 [b]	1.19 [b]	1.02 [b]	1.11 [b]	0.07	0.02
Dressing out percentage CC/SW, %	66.73	66.15	65.33	65.85	66.40	0.45	0.82
Meat/Bone ratio	6.4	6.7	6.5	6.7	6.9	0.13	0.42

[1]SEM: standard error of the mean. Mean values in the same row with a different superscript differ at $P<0.05$.

The treatment significantly affect the slaughter weight and some characteristics of the carcass (skin and perirenal fat) of the rabbits. Nevertheless, the proportion of digestive tract was not affected by the level of incorporation of hard wheat bran, nor the slaughter rate or the muscle/bone ratio (Table 3). The high dressing out percentage (CC/SW = 66.1%) of the 5 groups was one of the consequences of the low proportion of the raw skin (9.7% SW) and is probably an adaptation to the relatively hot climate encountered in Algeria as suggested by Lebas and Ouhayoun (1987). Moreover, the meat to bone ratio was similar to that observed with selected rabbits slaughtered at 55% of adult weight (2.4 kg): 6.6 *vs* 6.3 (Ouhayoun, 1989).

CONCLUSIONS

The results suggest that the incorporation of 45% of hard wheat bran in a growing rabbit's diet without soybean meal permits the best growth performances. The dressing out percentage (66.1%) was high but similar for all groups regardless of the bran incorporation rate considered. Nevertheless, new experiments including a higher number of rabbits, following the current recommendations for crude protein and fibre and completed with a determination of nutrients digestibility are necessary to confirm our first results.

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