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EFFECT OF SUBSTITUTING GROUNDNUT CAKE WITH DIFFERENT LEVELS OF RICE BRAN ON GROWTH AND WOOL PRODUCTION OF GERMAN ANGORA RABBITS

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Abstract: An experiment was conducted on 72 German Angora rabbits (42 youngs and 30 adults) divided into three groups to assess the effect of three experimental diets (T_1, T_2 and T_3) with different levels of groundnut cake replaced by rice bran on their growth performance, wool yield, quality, and digestibility of nutrients. The inclusion rate of groundnut cake was decreased from 20 to 15 to 10% and that of rice bran increased from 13 to 18 to 23% in T_1, T_2 and T_3, respectively. The same diets presented 16.1, 15.1 and 14.0% DM of crude protein and 11.3, 11.1 and 10.9 MJ/kg DM of digestible energy, respectively. All animals were kept under similar housing and management conditions and the experiment was continued for a period of 225 days (3 shearings). No significant effects of the experimental diets on body weight gain, wool yield and wool attributes were observed in young and adult rabbits. However, the wool yield at the 2nd shearing was higher in the T_1 group (P<0.05) indicating the positive effect of a diet higher in protein and energy on the wool production at an early stage of growth. Voluntary intake both of concentrates and roughages were not affected by the dietary treatment. The digestibility coefficients of dry matter and crude fibre were increased both in young and adult rabbits with the reduction of groundnut cake, while those of crude protein and ether extract were decreased in young rabbits only. From this experiment it can be concluded that groundnut cake can be safely replaced with rice bran in adult feeds at rates of up to 10% of the total content, while in young rabbits it may not be advantageous to go above a 5% level of replacement to avoid a substantial reduction in protein concentration, and the impairment of growth and wool production.

Key words: angora rabbit, groundnut cake, rice bran, digestibility, growth, wool.

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INTRODUCTION

Feed is the largest single item of cost in rabbit production (Maertens, 1992) and this cost can often be reduced by using geographically available feed resources to make rabbit farms profitable and viable. In Angora rabbits, the digestibility of nutrients does not differ from that of meat rabbits (Fekete, 1988), but nutrient requirements differ mainly because of the wool fibre, which contains about 93% protein (Schlolaut, 1987). In these rabbits, protein and energy concentrations are the most important nutritive factors. The energy requirement of Angora rabbits is similar to broiler rabbits and a lower dietary energy concentration could be compensated by an increased feed intake. Unlike western countries, in India, protein sources are costlier than energy sources and the replacement of protein sources (e.g. groundnut cake) by energy sources (e.g. rice bran) may reduce feeding costs and be advantageous if there are no adverse effects on production. Grain milling by-products are reported to be nutritious rabbit feedstuffs; among these, rice bran is available in large quantities in many tropical countries and is a major feed ingredient for rabbits (Cheeke, 1987). With this in mind, this experiment was conceived to substitute groundnut cake for different levels of rice bran in Angora rabbit feeds.

MATERIALS AND METHODS

An experiment was conducted using 72 German Angora rabbits (42 youngs of 50 d of age and 30 adults of above two years of age), divided into three groups of 12 young and 10 adults each. All rabbits were weighed and sheared manually before the start of the experiment and kept individually in wire cages under similar housing and management conditions. During the experimental period the rabbits were shorn by only one operator to avoid variation in wool quantity and quality.

Three experimental diets (T_1, T_2 and T_3) were prepared by substituting groundnut cake for rice bran as sources of protein and energy (Table 1). All other ingredients in the diets were kept at the normal level. The chemical composition of the experimental

Table 1: Ingredients of experimental diets (%).

Diets	T_1	T_2	T_3
Corn grain	30	30	30
Barley grain	15	15	15
Groundnut cake	20	15	10
Soybean flakes	2	2	2
Rice bran (deoiled)	13	18	23
Rice phak	10	10	10
Molasses	6	6	6
Fish meal	2	2	2
Salt	0.5	0.5	0.5
Mineral mixture	1.5	1.5	1.5

diets, groundnut cake, rice bran and roughage is listed in Table 2. The experimental diets were presented in mash form together with green roughage, a mixture of rye grass (*Lolium perene*), tall fescue (*Festuca arundinacea*), *Paspalum* spp. and white clover (*Trifolium repens*). Feed and water were offered *ad libitum* and total dry matter intake (DMI) was recorded fortnightly.

Initial body weight, body weight and wool yield of each animal at 1st, 2nd and 3rd shearing (done every 75 d) and wool characteristics, i.e. fibre diameter, staple length and guard hair, were recorded up to the third shearing. After the 2nd shearing a digestibility trial of 5 d duration was conducted on four young and four adult rabbits from each group and the concentrate and roughage intake and faeces voided during the period were recorded.

Feed and faeces were analysed for proximate principle, calcium, phosphorus (AOAC, 1990) and fibre fractions (GOERING and VAN SOEST, 1984). The NDF determination was carried out without α-amylase. The digestible energy (DE) was

calculated on the basis of crude fibre and ash concentration using the equation given by Fekete and Gippert (1986). The data were analysed for young and adult groups separately for dietary treatment using one-way analysis of variance (ANOVA) according to Snedecor and Cochran (1994).

RESULTS AND DISCUSSION

The chemical composition of experimental diets (Table 2) revealed higher crude protein (CP) and ether extract (EE) levels (16.1% and 3.1% DM) and lower crude fibre (CF) (8.5% DM) in T_1 as compared to T_2 and T_3. This variation was due to their corresponding higher and lower levels in groundnut cake as compared to rice bran. The total ash and calcium levels increased in T_2 and T_3 due to the higher levels of rice bran. Fibre fractions (NDF, ADF, lignin, cellulose and hemicellulose) increased in T_2 and T_3 with rice bran substitution due to the higher fibre levels in the rice bran. The DE of diets decreased from 11.3 to 10.9 MJ/kg DM concentrate due to the replacement of groundnut cake with rice bran, owing to the lower energy value of rice bran. However, these values were in accordance with the recommended levels (Parigi-Bini, 1988). The digestible protein (DP) to DE ratio for concentrate decreased from 11.5 to 9.4 g DP/MJ DE with the increase of the rice bran content. A DP to DE ratio of about 10-10.5 g DP/MJ DE has been identified as optimum for rabbits (de Blas *et al*., 1985). The chemical composition of roughage in this experiment was similar to an earlier study (Bhatt, 2001). All other nutrients in diets were within the recommended limits (NRC, 1977).

The growth performance of the rabbits, and their wool yield and quality characteristics of the rabbits are presented in Table 3. Initial body weight of young rabbits did not differ significantly among groups. Body weight at 1st shearing (125 d of age) decreased linearly (P▸0.05) with rice bran inclusion (about 0.1 kg for each 5% of groundnut cake substitution). There was an increase in body weight from the initial to 3rd shearing in young rabbits in all groups since they were still at the growing stage, whereas no weight change was observed in adults. The growth during the first

Table 2: Chemical composition of experimental diets (T1, T_2 and T_3) and main raw materials (% DM).

	T_1	T_2	T_3	Groundnut cake	Rice bran	Roughage
Dry matter (DM)	91.0	89.3	89.3	91.4	90.2	33.9
Organic matter	91.6	90.9	90.6	93.8	89.5	89.9
Crude protein	16.1	15.1	14.0	42.5	12.1	12.9
Crude fibre	8.5	8.9	9.7	8.5	18.5	21.1
Ether extract	3.1	2.7	2.4	6.1	4.2	2.8
Total ash	8.4	9.1	9.4	6.2	10.5	10.1
Nitrogen free extract	63.9	64.2	64.5	36.7	54.7	54.2
Calcium	1.7	1.8	2.2	0.20	1.2	2.9
Phosphorus	1.1	1.1	1.0	0.62	2.1	2.2
Neutral detergent fibre	40.6	41.3	43.0	19.5	41.5	48.4
Acid detergent fibre	18.6	19.0	20.3	11.5	21.9	28.5
Hemicellulose	22.0	22.3	22.7	8.0	19.6	19.9
Lignin	2.9	3.1	3.6	2.0	8.3	4.1
Cellulose	15.7	15.9	17.7	6.5	13.6	24.4
Acid insoluble ash	2.4	2.5	2.4	2.1	2.2	1.3
Digestible energy (MJ DE/kg DM)[1]	11.3	11.1	10.9			
Digestible protein to DE (g/MJ)	11.5	10.2	9.4			

[1]Calculated by the equation of FEKETE and GIPPERT (1986)

3 months of age has been reported to be crucial and to be influenced by nutrient supply (HARDMAN *et al.*, 1970), as recorded among young rabbits in this experiment.

In young rabbits, the wool yield increased from the 1st to 3rd shearing in all groups. At the 2nd shearing, the wool yield in group T_1 was significantly higher (P▸0.05) than the T_2 and T_3 groups. The increase in wool yield with increased body weight of young rabbits up to the 3rd shearing (275 d) found in this experiment

agrees with earlier findings (DE ROCHAMBEAU and THEBAULT, 1990). The lower weight at the 1st shearing in T_2 and T_3 rabbits must be due to lower protein and energy concentrations of these diets, which impaired growth but not wool production. However, at the 2nd shearing the rabbits in treatment groups compensated body growth to some extent (as compensatory growth) with lower wool production. In adults, the wool yield at the 3rd shearing was reduced in all groups due to high temperature stress, as this shearing was performed in the hot season. A similar drop in the wool yield of adult Angora rabbits in the summer had been recorded in previous studies (CHARLET-LERY *et al.*, 1985; BHATT *et al.*, 1999).

Table 3: Growth performance, wool yield and wool characteristics.

Diets	Young rabbits			Pooled SE	Adult rabbits			Pooled SE
	T_1	T_2	T_3		T_1	T_2	T_3	
No. of rabbit	14	14	14		10	10	10	
Body weight (kg):								
Initial	0.84	0.83	0.83	0.02	3.13	3.12	3.14	0.12
1st shearing	1.54[a]	1.41[b]	1.30[c]	0.06	2.96	2.90	2.99	0.08
2nd shearing	2.42	2.14	2.22	0.16	3.04	3.07	3.09	0.09
3rd shearing	2.50	2.45	2.39	0.08	3.06	3.11	3.04	0.11
Wool yield (g):								
1st shearing	54.3	57.0	51.0	3.3	128.3	135.6	125.5	8.9
2nd shearing	96.6[a]	84.5[b]	85.9[b]	4.9	134.0	123.0	128.6	12.6
3rd shearing	105.0	104.0	106.0	6.8	111.0	120.0	115.0	11.9
Average yield	83.1	81.8	77.9	4.9	124.3	122.8	123.3	5.4
Average wool characteristics:								
Staple length (cm)	5.4	5.7	5.7	0.1	5.5	5.5	5.4	0.2
Fibre diameter (mm)	13.8	13.6	12.3	0.3	14.8	14.3	13.9	0.5
Guard hair (%)	4.7	4.2	3.8	0.6	5.8	4.4	4.0	0.8

Means within a row, within age group, with different superscripts differ. ($P<0.05$).

Dry matter intake did not change significantly according to dietary treatment (Table 4). However, the DMI values of concentrated diet were higher with lower groundnut cake content in young rabbits, but not significantly which was probably due to is reduced energy level.

The digestibility coefficients of nutrients (Table 4) revealed significant differences ($P<0.05$) for the digestibility coefficients of DM, crude protein (CP), crude fibre (CF) and ether extract (EE) in young rabbits, but only for DM and CF in adult rabbits. In general, the nutrient digestibility was comparatively higher in young rabbits, as has been observed by others (XICCATO and CINETTO, 1988). The digestibility of DM in young and adult rabbits increased with lower groundnut cake levels, different to what had been expected, due to the increase of the CF and fibre fractions and the estimated DE concentration. The digestibility of CP and EE was significantly reduced ($P<0.05$) in young rabbits, whereas no effect was observed in adult rabbits due to the replacement of groundnut cake with rice bran. The proteins of legumes are known

Table 4: Dry matter intake and digestibility coefficients of experimental diets.

Diets	Young rabbits			Pooled SE	Adult rabbits			Pooled SE
	T1	T2	T3		T1	T2	T3	
Dry matter intake (g/d):								
Concentrate	62.4	69.9	73.2	4.4	106.7	105.3	106.7	5.1
Roughage	48.8	48.3	47.6	1.2	50.8	49.9	50.5	1.2
Total	111.2	118.2	120.8	5.6	157.5	155.2	157.2	5.8
Digestibility coefficients (%):								
Dry matter	68.7^{ab}	69.6^{b}	73.6^{a}	2.0	62.1^{c}	67.0^{b}	70.7^{a}	0. 9
Crude protein	80.7^{a}	74.7^{b}	73.0^{b}	2.9	71.2	72.7	76.2	2.5
Crude fibre	31.2^{b}	32.1^{b}	39.0^{a}	3.1	28.7^{b}	33.6^{b}	42.3^{a}	2.3
Ether extract	82.7^{a}	75.8^{a}	67.0^{b}	1.3	61.3	60.7	59.8	8.1
Nitrogen free extract	76.1	78.7	82.1	1.3	69.6	74.2	76.4	1.6

Means within a row, within age group, with different superscripts differ. ($P<0.05$).

to be more digestible than those of cereals. The digestibility of crude protein is also influenced by age (Fraga, 1998). Fernández *et al.* (1994) observed higher EE digestibility in adults than young rabbits and stated that this could be attributed to the increase in feed intake. The digestibility of CF increased significantly ($P<0.05$) with of the reduced content of groundnut cake both in young and adult rabbits. This could be due to the increased proportion of rice bran fibre reported to have high digestibility in broilers (Cheeke, 1987) as well as in Angora rabbits (Bhatt *et al*., 2002).

From this experiment it can be concluded that rice bran does not negatively affect digestive efficiency in Angora rabbits and can replace groundnut cake in adult feeding at contents of up to 10%. In young rabbits, it may not be advantageous to exceed 5% of groundnut cake replacement with rice bran due to the reduction of dietary protein concentration, which impairs both growth and wool production.

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