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GROWTH RESPONSE AND ORGAN WEIGHTS OF YOUNG RABBITS FED GRADED LEVELS OF DIETARY RAW SOYBEAN IN THE HOT HUMID TROPICS

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ABSTRACT : Graded levels (0%, 5%, 10%, 15%, 20% and 25%) of raw soybean (RSB) were incorporated into six formulated isocaloric and isonitrogenous diets and fed *ad libitum* to 48 young rabbits of the New Zealand and Californian strains. Diet A (0% RSB) containing toasted soybean meal served as the control. The rabbits were aged between 6-8 weeks. The experiment lasted 56 days. Feed intake and feed conversion showed no significant difference (P>0.05) between the treatment groups and the control. However, average daily feed intake appeared to increase non significantly as the level of raw soybean in the diets increased, from 5% to 25%. There was also no significant difference (P>0.05) in live weight gain between the treatment groups and the control. Nevertheless, animals in the 15% RSB diet showed superior numerical value for average daily live weight gain (14.0g/day *vs* 11.7 for 5% RSB diet). The dietary incorporation of raw soybean had no significant effect (P>0.05) on weight of spleen, kidney, heart, testes and liver. However, RSB inclusion at 25% level led to gross morphological alterations in some organs, particularly inflammation as well as necrosis of hepatocytes with infiltration by lymphocytes, in the liver. The results indicated that rabbits, unlike other monogastrics such as pigs and poultry do not show growth depression to dietary raw soybean which can be incorporated in their ration up to 20% level for short periods under tropical conditions.

RÉSUMÉ : Influence de régimes à teneurs croissantes en soja brut sur la croissance et le poids des organes de jeunes lapereaux élevés sous climat tropical humide.
Des quantités croissantes de graines de soja brutes (0, 10, 15, 20 et 25%) ont été incorporées à des régimes isocaloriques et isoazotés qui ont été distribués ad libitum *à 48 jeunes lapins de race Néo Zélandais et Californiens âgés de 6-8 semaines. L'expérimentation a duré 56 jours. La différence de consommation et d'indice de consommation des groupes expérimentaux par rapport au groupe témoin n'est pas significative. Cependant, la consommation augmente légèrement mais non significativement en même temps que s'élève le taux de RSB dans l'aliment, entre 5 et 25%. Il n'y a pas non plus de différence significative (P>0.05) entre le gain de poids des groupes expérimentaux et le groupe de contrôle. Néanmoins, les animaux du groupe 15% RSB ont montré un gain de poids journalier moyen plus élevé (14.0g/jour vs 11.7 pour le lot 5% de soja brut). L'incorporation dans l'aliment du soja brut n'a pas d'effet significatif (P>0.05) sur le poids de la rate, des reins, du foie, des testicules et du foie. Toutefois, l'incorporation au taux de 25% conduit à d'importantes altérations morphologiques de certains organes, plus particulièrement dans le foie avec inflammation voire nécrose des cellules avec infiltration de lymphocytes. Les résultats montrent que contrairement à d'autres monogastriques tels que les porcs ou la volaille, le lapin ne ralentit pas sa croissance avec l'incorporation dans l'aliment de graines de soja brutes qui peut être effectuée jusqu'au taux de 20% pour de courtes périodes dans des conditions de climat tropical humide.*

INTRODUCTION

Soybean (*Glycine maxima*) is one of the oldest cultivated legumes in the world with a crude protein value of between 38-44% (TEWE, 1984 ; HERKELMAN *et al.*, 1992). The crop is cultivated principally for its oil bearing seeds which are widely used for human consumption or as a concentrate feed ingredient for farm animals. Soybean is normally subjected to processing (heat treatment) before usage. This is done either by toasting or boiling in order to inactivate its content of antinutritional factors, trypsin inhibitors (RACKIS, 1972 ; LALLES, 1993). Thus, properly treated soybean is a feed ingredient of exceptionally high nutritional value (BALLOUN, 1980).

The effect of the antinutritive factors in feeding dietary raw soybean to ruminants can be greatly reduced due to the synthesis of B-complex group and fermentative microbial degradation by rumen bacteria to produce essential amino acids (ROOKE *et al.*, 1982) ; MIR *et al.*, 1984). Rabbits have hind gut fermentation and also habitually practice caecotrophy which ensures more efficient use of nutrients by redigestion of materials which have been subjected to the action of microorganisms in the caecum (CHEEKE *et al.*, 1986). The rabbit thus appear to have nutritional advantage over other livestock especially pig and poultry. This study was designed to investigate the growth response and organ weights of young rabbits to the inclusion of varying levels of raw soybean in their diets.

MATERIALS AND METHODS

Forty-eight young rabbits, aged between 6 and 8 weeks, of the New Zealand White and Californian strains were randomly assigned to a control group (A) and five treatment groups (B to F). Each group had 8 animals on the basis of similar body weight irrespective of strains and was replicated four times with 2 animals per replicate. The animals were housed in conventional all wire rabbit hutches, and kept two per compartment. Location of the experiment was within the hot and humid tropical rain forest belt in Nigeria, with mean daily maximum and minimum

temperatures of 32-34°C and 21-23°C respectively. There was one week conditioning period prior to the commencement of the experiment during which the animals were allowed to adjust to their respective diets and stabilise their intake.

Graded dietary levels (0%, 5%, 10%, 145%, 20% and 25%, representing diets designated A, B, C, D, E and F respectively) of raw soybean (RSB) were incorporated into the six unpelleted diets. The control diet (diet A) contained heat treated (toasted) soybean meal. All diets were formulated individually to have similar energy an protein values. The rabbits in each group were fed *ad libitum* the corresponding diet over a period of eight weeks. The composition of the formulated diet is presented in Table 1. Samples of each diet were collected and analysed in duplicate for nutrient composition according to the method of the Association of Official Agricultural Chemists (A.O.A.C., 1984.)

Records of feed intake and body weights were taken weekly for 8 weeks (56 days). For feed intake, known quantities of the experimental diets were supplied daily and the remaining feed in the feed trough in each compartment was collected and weighed on a daily basis. Feed intake for each animal was therefore determined by the difference between the feed supplied and the left-over feed in the feeders. The initial weight of individual animals was taken at the beginning of the experiment. Subsequently, at weekly intervals, changes in the rabbit live weight were recorded. The difference between initial and final weight of the individual animals constituted the body weight gain. At the end of the experimental period, two representative rabbits from each of the six dietary groups were sacrificed for *post mortem* examination and some of the vital organs (liver, kidney, spleen, heart and testes) were removed and weighed.

Data obtained from the study were subjected to one-way analysis of variance by the method of STEEL and TORRIE (1980) and the difference between the means were determined using DUNCAN's (1955) Multiple Range Test method.

RESULTS AND DISCUSSION

The chemical composition of the experimental diets supplied to the rabbits is also presented in Table 1. There was marginal increase in crude protein content and decrease in crude fibre content with increase in the level of RSB in the diet. Although, the results showed slight variation between figures for calculated crude protein and crude fibre, and those for analysed crude protein and crude fibre, it may be attributed to differences in source and quality of ingredients. Since almost all the ingredients were incorporated in an attempt to keep the diets isonitrogenous and isocaloric

Table 1 : Dietary ingredients and chemical composition on DM basis.

Ingredients (%)	Diets					
	A	B	C	D	E	F
Maize	13.25	14.20	12.00	12.00	8.75	5.00
Raw soybean	-	5.00	10.00	15.00	20.00	25.00
Soybean meal	12.00	-	-	-	-	-
Fish meal	3.00	7.00	5.00	2.75	1.00	0.25
Palm kernel meal	14.00	16.00	14.00	12.25	9.50	2.50
Brewers dried grain	17.00	18.00	17.00	16.00	14.50	12.50
Maize offals	21.80	22.00	24.40	26.40	28.40	28.40
Rice rough	12.40	12.00	12.30	11.30	14.30	24.05
Palm oil	4.75	4.00	3.50	2.50	1.75	0.05
Salt	0.40	0.40	0.40	0.40	0.40	0.40
Bone meal	1.00	1.00	1.00	1.00	1.00	1.00
* Vitamin/Mineral mixture	0.20	0.20	0.20	0.20	0.20	0.20
Dl Methionine	0.20	0.20	0.20	0.20	0.20	0.20
Chemical composition (% DM)						
Crude protein	18.54	18.89	19.21	19.87	20.60	21.29
Ether extract	4.28	5.16	7.41	8.57	9.88	11.64
Crude fibre	18.88	18.21	18.10	18.00	17.97	17.78
Nitrogen free extracts	48.78	46.74	45.15	44.00	43.32	42.29
Ash	11.52	11.00	10.13	9.56	8.23	7.00
ME.kcal/kg (calculated) ME/0.95=DE	2709 2850	2711 2850	2719 2860	2729 2870	2733 2877	2735 2879

* 1kg of vitamin/mineral premix supplies the following : Vit. A 10,000,000 IU ; vit. D_3 2,000,000 IU ; Vit. B_1 0.75g ; Vit. B_2 5g ; Nicotinic acid 25g ; Vit. B_{12} 0.15g ; Vit. K_3 2.5g ; Biotin 0.05g ; Folic acid 1.0g ; Calcium 12.5g ; Choline chloride 25g ; Cobalt 0.40g ; Copper 8g ; Iron 32g ; Iodine 8g ; Manganese 64g ; Selenium 0.16g ; Zinc 40g.

Table 2 : Performance of rabbits on experimental diets.

	Treatment groups					
	A	B	C	D	E	F
Average initial live weight (g)	907.50 ± 78	857.50 ± 81	815.00 ± 69	907.50 ± 78	837.50 ± 81	912.50 ± 77
Average daily live weight gain (g/d)	13.0 ± 3.2	11.65 ± 2.2	12.68 ± 1.7	14.0 ± 1.8	13.12 ± 3.3	11.87 ± 2.2
Average daily feed intake (g/d)	75.4 ± 3.6	74.83 ± 7.1	74.94 ± 4.6	78.26 ± 4.8	78.41 ± 6.6	79.31 ± 7.6
Feed conversion (feed/gain)	5.86 ± 0.91	6.64 ± 1.71	5.94 ± 1.41	6.02 ± 0.97	6.24 ± 1.13	6.82 ± 1.14

such variations in chemical composition were expected.

Performance parameters as presented in Table 2 shows that, average daily feed intake, average daily weight gain and feed conversion ratio between animals in the control diets (0% RSB) and those on the 5%, 10%, 15%, 20% and 25% RSB diets were not significantly different (P>0.05). Consistent but non significant numerical increase in the daily feed intake on rations containing various levels of RSB indicated it's palatability. Response in terms of average daily live weight gain of the experimental animals (rabbits) to dietary raw soybean is at variance with earlier reports on rats. JAFFE and VEGE LETTE (1968) and LIENER and KAKADE (1969) had reported that, for rats, raw soybean was nutritionally inferior to heated soybean, because it was found to cause growth depression in the animal. JENSEN *et al.* (1970) showed similar results in the pig, as SANCHEZ *et al.* (1984) also did for weanling New Zealand White rabbits. The lack of any adverse effect in the animals as shown in the present study could be attributed not only to caecal fermentation and caecotrophy in rabbits which may have enhanced nutrient utilisation, but also, possibly due to significant regional differences amply manifested in low daily weight gain related to tropical climate.

The growth rate of the animals was comparatively very low, about 11-13g per day. Consequent upon this low growth rate, an inhibitory effect of trypsin inhibitor in raw soybeans might not occur, whereas, with a greater nutritional stress with a higher growth rate (35-40g/day), there may be an effect. Studies on this presumption have been carried out by SANCHEZ *et al.* (1984) who in fact, reported significant growth inhibition with ray soybean.

Organ weights (as percentage of body weight) are shown in Table 3. Dietary incorporation of graded levels of RSB had no significant effect (P>0.05) on the weight of spleen, kidney, heart, liver and testes as these were within the normal range reported by ADUKU and OLUKOSI (1990) and WEISBROTT *et al.* (1974). There was however a linear reduction in the weight of the liver and a linear increase in the weight of the heart as dietary RSB levels increased. No definite correlation was observed between weights of the other organs and the levels of dietary RSB. Tissue pathology report obtained from the animals in treatment F (25% RSB) showed few areas of necrosis of hepatocytes with infiltration by lymphocytes. There was congestion of the central vein and some of the sinusoids. Intestines had necrotic spots and stomach linings showed areas of gastric rupture (ulcer). These findings hint at some kind of adverse effect on the organs from the feeding of RSB at the 25% level.

However, results obtained from this study tend to suggest that, it may be accepted to use raw soybean for rabbits under humid tropical conditions, in which relatively very low rates of gain are typically observed, but it is not appropriate to generalize from these conditions to rabbit production in general. Under such conditions raw soybean can be incorporated in young rabbit diets up to 20% level for short periods and cost of energy in it's processing can be saved.

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Table 3 : Organ weight (% body weight) of rabbits on experimental diets.

	Dietary treatment groups					
	A	B	C	D	E	F
Liver	3.50 ± 0.31	3.23 ± 0.42	3.15 ± 0.28	2.66 ± 0.03	2.73 ± 0.38	3.15 ± 0.04
Kidney	0.62 ± 0.07	0.66 ± 0.07	0.72 ± 0.05	0.68 ± 0.01	0.56 ± 0.03	0.62 ± 0.03
Spleen	0.07 ± 0.04	0.10 ± 0.11	0.09 ± 0.08	0.08 ± 0.07	0.08 ± 0.09	0.06 ± 0.08
Heart	0.22 ± 0.06	0.23 ± 0.07	0.23 ± 0.01	0.24 ± 0.04	0.24 ± 0.03	0.27 ± 0.01
Testes	0.21 ± 0.04	0.26 ± 0.01	0.26 ± 0.02	0.36 ± 0.06	0.22 ± 0.01	0.12 ± 0.05

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REFERENCES

ADUKU A.O., OLUKOSI J.O., 1990. Rabbit management in the tropics. *Living book series GU Publications, Abuja FCT.*

A.O.A.C., 1984. Official methods of analysis. *Association of Official Analytical Chemists, Washington, 126-146.*

BALLOUN S.C., 1980. Soya bean meal in poultry nutrition. *Kenneth C.L. ed., Am. Soybean Asso., Louis M.O., 29.*

CHEEKE P.R., GROBNER M.A., PATTON N.M., 1986. Fibre digestion and utilization in rabbits. *J. Appl. Rabbit Res., 9, 25-30.*

DUNCAN D.B., 1955. Multiple Range and Multiple F tests. *Biometrics, 11, 1-42.*

HERKELMAN K.L., CROMWELL G.L., STAHLY T.S., PFEIFFER T.W., KNABE D.A., 1992. Apparent digestibility of amino acids in raw and heated conventional and low-trypsin-inhibitor soybean for pigs. *J. Anim. Sci., 70, 818-826.*

JAFFE W.G., VEGA LETTE C.L., 1986. Heat-labile growth-inhibitting factors in beans (*Phaseolus vulgaris*). *J. Nutr., 94, 203-210.*

JENSEN A.H., BROWN H.W., HARMAN B.G., BAKER D.H., 1970. Effects of roasting corn and soya bean, fed to swine. *J. Anim. Sci., 31, 1023 (abstr.)*

LALLES J.P., 1993. Nutritional and antinutritional aspects of soya bean and field pea proteins used in veal calf production : a review. *Livest. Prod. Sci., 34, 181.*

LIENER I.E., KAKADE M.L., 1969. Protease inhibitors. *Toxic contstituants of plant food stuffs. Academic Press, N.Y, Liener I.E. ed., 8-53.*

MIR Z., MACLEOD G.K., BUCHANAN-SMITH J.G., GRIEVE D.G., GROVUM W.L., 1984. Methods for protecting soybean and canola proteins from degradation in the rumen. *Can. J. Anim. Sci., 64, 853-856.*

RACKIS J.J., 1972. Biologically active components. In : *Soybeans : Chemistry and Technology, vol. 1 Proteins, 158-202. The Avi Publ. Co. Inc., Westport, CT, AK Smith and SJ Circle ed.*

ROOKE J.A., NORTON B.W., STRONG D.G., 1982. The digestion of untreated and formaldehyde treated soya bean meals and estimation of rumen digestibility by different methods. *J. Agri. Sci., 99, 441-453.*

SANCHEZ W.K., CHEEKE P.R., PATTON N.M., 1984. Evaluation of raw and extruded soybeans and extruded soy flour as protein sources for weanling New Zealand White rabbits. *J. Appl. Rabbit Res., 7, 101-105.*

STEEL T.G.D., TORRIE J.H., 1980. Principles and procedures of statistics. *A biometrical approach, 2nd edition, McGraw Hill Book Co., NY.*

TEWE O.O., 1984. Energy and protein sources in poultry feeds. In : *Poultry seminar on soya bean. Poultry Association of Nigeria (Oyo State) University of Ibadan, Nigeria, July 1984, 52-59.*

WEISTBROTT S.H., FLATT R.E., KAUS A.L, 1974. The biology of the laboratory rabbit. *Academic Press, NY.*