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NUTRITIVE VALUE OF SOYBEAN MILK RESIDUE ON DIGESTIBILITY AND VISCERAL ORGAN OF GROWING RABBITS

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Abstract: A twelve (12) weeks feeding trial was conducted to investigate the nutritive value of soybean milk residue in the diets of growing rabbits. Thirty (30) cross bred rabbits between 5-6 weeks of age were used for the experiment. Soybean milk residue was included in the diets at 0, 5, 10, 15 and 20% for T_0, T_5, T_{10}, T_{15} and T_{20} respectively. Six rabbits were randomly allotted to five (5) dietary treatments and each rabbit served as replicate using Completely Randomized Design (CRD). A 5 day faecal collection was conducted to determine nutrient digestibility on the last week of the experiment. Faecal output from each rabbit was collected daily, dried and stored in an air tight container. At the end of the collection period, faecal output from each rabbit was bulked, thoroughly mixed, weighed and sampled for proximate analysis. Three (3) rabbits from each treatment were slaughtered for visceral organ evaluation. The visceral organ weight were expressed as percentages of live weight. Result of digestibility revealed that, feed digestibility and utilization were not significantly ($P>0.05$) affected by the levels of inclusion of soybean milk residues in the diets. The visceral organ analysis showed that, liver, spleen and lungs were not different ($P>0.05$) across the treatment groups, however, heart and kidney were significantly ($P<0.05$) different across the treatments. It was concluded that soybean milk residue could be incorporated into the diets of growing rabbits up to 20% without compromising nutrients utilization and visceral organs development.

Keywords: Rabbits, Soybean milk residue, Digestibility, Visceral organ

I. Introduction

Animal protein content of the diet of the average Nigerian has been diminishing over the years due to high cost of animal products, which, in turn, is caused by high cost of animal feeds, poverty and a general lack of interest in agriculture and Animal Production in particular, by the various tiers of government, with much more attention paid to petroleum exploitation. FAO (2009) noted that the daily protein intake of an average adult is 65g/caput/day, out of which 35g is expected to be of animal origin. It has been observed that in Nigeria protein intake is 45g/caput/day, with animal protein accounting for 8g/caput/day. The short fall in animal protein intake especially in developing countries could be attributed to high cost of conventional feed ingredients, hence the use of non-conventional feed stuff as an alternative to reduce cost of feed (Fakolade*et al.*, 2018). Akinmutimi (2006) noted that feed accounts for about 70 – 80% cost of monogastric livestock production. It is therefore, necessary to source for feed ingredients, which are cheap, readily available and capable of supplying the nutrients required by the animal for optimal growth and development.

One of the ways of meeting the animal protein requirements of the Nigerian populace is increasing the production of rabbits (Iyeghe-Erakpotobor*et al.*, 2002).Rabbit possess several attributes that are advantageous when compared to other animals, they have high rate of reproduction, they are more efficient in transforming low quality plant material into high quality animal protein, they have a higher digestibility of roughage than poultry and pigs, and can convert roughages into meat more efficiently, they produce high quality meat that are palatable, low in fat/cholesterol and provide steady source of income (Taiwo*et al.*, 2004;Owen*et al.*,2009; Nistor*et al*., 2013).

Soybean production has greatly increased in Nigeria over the years, which has resulted in a concomitant increase in the consumption of the products. Soybean milk residue is a by-product of milk and cheese production and is used for feeding ruminant animals such as cattle, sheep and goats. It is readily available and cheap in towns and villages where cheese is widely produced and eaten (Iyeghe-Erakpotobor, 2010). The nutritive value, composition and utilization of soybean milk residue cannot be over emphasize. Wang and Cavins (1989) noted that soybean residue is rich in protein, especially essential amino acids and it contain about 27% protein on (dry matter basis) with excellent nutritional quality and a superior protein efficiency ratio which shows a potential source of low cost vegetable protein for human consumption. Soybean milk residue is rich in cellulose, and it accounts for approximately 50% of the dry weight in soybean withvery few calories (Shuhong, *et al*., 2013). It has also been reported that dietary fiber in soybean milk residue can reduce blood fat and blood pressure, lower the level of cholesterol in the blood, protect againstcoronary heart disease, and prevent the occurrence of constipation and colon cancer. Despite the numerous advantages, fresh soymilk residue can easily be spoiled by microorganisms due to its high moisture content and must therefore, be dried immediately.Therefore, this experiment is aimed at investigating the nutritive value of soybean milk residue on digestibility and visceral organ of growing rabbits.

II. MATERIALS AND METHODS

Experimental site

The study was conducted at the rabbit unit of the Livestock Teaching and Research Farm, University of Agriculture Makurdi, Benue state. Nigeria. Makurdi is located on Latitude 7°44'N and longitude 8°54'E. Makurdi is in the southern guinea savannah region of Nigeria and has two distinct seasons. The wet season lasts from April-October while the dry season is from November – March. Annual Rainfall ranges between 1105mm – 1600mm. Mean temperature ranges between 21°C in January and 35°C in March. Relative humidity ranges between 69% in August and September and 39% in January and February. (Anon, 2004).

Source of soymilk residue

The soybean milk residues were collected from the soymilk producers within Makurdi Metropolisand the residue was spread to dry on concrete platform for 5-7 days, depending on the prevailing weather condition, the residue was milled and incorporated into feed.

Experimental animals and management

A total of thirty (30) mixed-breed weaner rabbit of 5-6 weeks of age were purchased from the Livestock Teaching and Research Farm, University of Agriculture Makurdi. The animals were dewormed and they were allowed to acclimatize to their environment for a week before the commencement of theexperiment. The animals were individually weighed and randomly allocated to five experimental diets so as to minimize mean treatment live weight differential. Each treatment had three males and three females and each animal served as replicate. The rabbits were housed in hutches with an iron frame and wire mesh placed in an open sided house with dwarf walls. The hutches were partitioned into cages of 90 x 60 x 90 cm, occupied by one animal each. Feeders and water troughs were attached firmly to the wall of the cages. Feed and water were provided for all animals *ad libitum*. The feeding trial lasted for 12 weeks.

Experimental Design

Completely randomized design (CRD) was used for the experiment.

Experimental procedure

The proximate composition of soybean milk residue and experimental diets were determined using AOAC(1990).

TABLE 1: Gross composition of experimental diet

Ingredients	T_0	T_5	T_{10}	T_{15}	T_{20}
Maize	32.57	31.05	26.85	21.51	14.35
Full fat soybeans	37.05	26.70	25.94	26.67	23.30
Rice offal	25.86	20.28	18.59	17.20	10.87
Brewer dried grain	0.00	10.00	10.00	10.00	20.00
Soymilk Residue	0.00	5.00	10.00	15.00	20.00
Palm Oil	0.00	2.34	3.91	4.90	6.91
Bone meal	3.66	3.75	3.80	3.80	3.65
Common salt	0.25	0.25	0.25	0.25	0.25
Synthetic Methionine	0.36	0.38	0.39	0.40	0.39
Synthetic Lysine	0.00	0.00	0.02	0.02	0.03
Premix	0.25	0.25	0.25	0.25	0.25

Total	100	100	100	100	100
CALCULATED COMPOSITION					
Crude Protein	18.00	18.00	18.00	18.00	18.00
Crude Fibre	12.00	12.00	12.00	12.00	12.00
Metabolisable Energy (kcal/kg)	2,700	2,700	2,700	2,700	2,700

Experimental diets

Five experimental diets tagged T_1, T_2, T_3, $T_4$and $T_5$was formulated to contain 0%, 5%, 10%, 15% and 20% soymilk residue respectively.

Carcass evaluation

At the end of the feeding trial, three rabbits per treatment which live weight approximated their treatment mean live weight, were selected for slaughter and their carcasses evaluated. The rabbits were starved for 15 hours before slaughtered. Starving helps to improve accuracy of estimation of real live weight and to reduce the volume of the gut contents and thereby reduce contamination of the carcass during dressing. Each rabbit was slaughtered by cutting the jugular vein with a sharp knife and allowed to bleed thoroughly. The carcasses were eviscerated, singed and weighted. The visceral organs which includes; heart, lung, liver, intestines and spleen were removed carefully and weighed. The weights of the visceral organs were expressed as percentages of live weight.

Digestibility

Digestibility study was conducted during the last week of feeding. Faecal samples were collected daily 5 daysto determine nutrient digestibility. Pieces of nylon net was tied under individual cages to collect faeces. Faecal output from each rabbit was collected daily, dried and stored in an air tight container and at end of the collection period, the faeces from each rabbit was bulked, weighed and thoroughly mixed and sampled for proximate analysis according to AOAC (1990).Determination of apparent nutrients was calculated using this equation.

$$\text{Apparent digestibility} = \frac{\text{Nutrient intake} - \text{Nutrient voided}}{\text{Nutrient intake}} \times 100$$

Statistical analysis

All data obtained were subjected to one way analysis of Variance (ANOVA) for completely randomized design (CRD) using Minitab statistical software, where significance difference occurred, parameter means were separated using least significant difference (LSD).

III. Results and Discussion

Proximate composition of soybean milk residue is presented in Table 2. A crude protein of 24.06% reported for soymilk residue in this study is higher than 19.99% reported by Darunee and Wichai (2014), but lower than 27.00% and 27.88% reported by Liu (1997) and Sompong and Pirote (2008). The crude fibre value of 14.81% is higher than 5.61% and 12% reported by Darunee and Wichai (2014) and O'Toole, (1999) but lower than 20.00% reported by Odeyinka*et al.* (2007). The ether extract value of 2.52% obtained in this study is lower than 4.27% and 4.98% reported by Odeyinka*et al.* (2007) and Sompong and Pirote (2008) respectively. The ash content value of 6.42% obtained in this study is lower than 9.80% reported by Odeyinka*et al.* (2007). The NFE value 48.87% obtained in this study is higher than 45.50% reported by Odeyinka*et al.* (2007). These differences could be attributed to variation in location, soybean varietiesand the processing methods used.

The digestibility of all the nutrient evaluated were comparable as there were no significant difference among the treatments. The moderately high nutrient digestibility values observed in this study could be attributed to adequate nutrient supply by the test diets.

The dry matter digestibility values obtained in this study were slightly higher than the values reported by Ojebiyi*et al.* (2013) who fed cassava sievate and soymilk residue to rabbit.Crude protein digestibility decreased as the level of soybean milk residue increased in the diet, but showed no significance difference ($P>0.05$). Crude fibre digestibility values obtained in this study were within the values that was reported by Attah*et al.* (2012) when melon seed offal was fed to rabbits but higher thanthe value reported by Iyeghe-Erakpotobor*et al.* (2006) who fed soybean cheese waste/maize offal diet and brachiaria grass hay to rabbits. This could attributed to the mixture of soybean cheese waste/maize offal and brachiaria grass hay used in the diet by the researcher. The ether extract and nitrogen free extract values were not significantly ($P>0.05$) affected by the inclusion of levels soybean milk residue in the diet.

Viscera organ of rabbits fed graded levels of soybean milk residue is presented in Table 4. The values obtained for heart and kidney were significantly (P<0.05) affected by the dietary treatments. In feeding trial, it is common and most important to use the weight of some visceral organ like heart, liver and kidney toxicity.Bone (1979) reported that abnormality will be observed in the weight of liver and kidney if there were any toxic elements in the feed. Despite the significance difference (P < 0.05) obtained for heart and kidney, there was no indication of toxicity during the growth period. This result agreed with the report ofEl-Tohamy and El-Kady (2007), but contrasts the report of Tamburawa*et al.* (2012), who reported non-significant difference when soybean milk residue was fed to rabbits. The kidney weight obtained in this study correspond with the value reported by Ojebiyi*et al.* (2013) when cassava sievate/soybean milk residue replace maize in growing rabbits diet. The weight of the liver obtained in this study is higher than value reported by Henry *et al*. (2012) but lower than the value reported by Ogunsipe and Agbede (2012). The lung and kidney weight compared favorably with the report of Maidala and Doma (2016) and Attah*et al.* (2012). The result shows that none of the visceral organ were damaged by the experimental diet since most organs were comparable with the report of other workers. This implies that inclusion of soy milk residue up to 20% did not compromise with the growth and development of visceral organ.

IV. Conclusion

Soybean milk residue could be incorporated in grower-finisher rabbitdiets up to 20% without adverse effect on visceral organ and nutrient digestibility. It alsoreduced the cost of production, increased the profit margin and could make rabbits to be available to the public at a cheaper price.

Table 2: Proximate Composition of Soybean milk Residue

Parameter	
Crude protein (%DM)	24.06
Ash (%DM)	6.42
Ether extract (%DM)	2.52
Crude fibre (%DM)	14.81
NFE (%DM)	48.87
ME(kcal/kg)	2837.04

NFE = Nitrogen Free Extract, ME = Metabolizable energy was Calculated using the formula (37 x %CP + 81 x %EE + 35.5 x %NFE + 35.5 x %CF). Pauzenga (1985), as modified by Carew on the basis that CF digestibility by rabbits is about 22% (Gidenne *et al*, 1998).

TABLE 3:Effect of graded levels of soymilk residue on nutrient digestibility of grower rabbit

Nutrients	T_1	T_2	T_3	T_4	T_5	SEM
Dry matter (%)	80.38	48.27	71.70	66.62	75.81	8.60^{ns}
Crude protein (%)	90.41	81.06	82.90	82.18	84.71	3.46^{ns}
Crude fibre (%)	54.41	16.65	46.08	48.41	55.34	9.50^{ns}
Ether Extract (%)	78.06	88.55	92.56	92.29	94.91	7.28^{ns}
NFE (%)	81.96	65.07	76.02	66.46	63.62	7.33^{ns}

NFE = Nitrogen free extract. SEM = Standard error of mean. NS = No Significant difference at 5% level of probability.

Table 4: Effect of feeding graded levels of soybean milk residue on visceral organ of growing rabbits

Parameters	T_1	T_2	T_3	T_4	T_5	SEM
Heart (%LW)	0.31^{c}	$0.21b^{c}$	$0.22b^{c}$	0.58^{a}	0.26^{b}	0.02*
Liver (%LW)	2.30	1.98	1.71	1.96	2.01	0.14^{ns}
Kidney (%LW)	0.59^{a}	0.44^{b}	0.48^{b}	0.44^{b}	0.64^{a}	0.33*
Lung (%LW)	0.58	0.58	0.59	0.53	0.50	0.07^{ns}
Spleen (%LW)	0.05	0.04	0.03	0.03	0.04	0.01^{ns}

a,b,c = means within rows with different superscripts are significantly different (P<0.05); SEM = Standard error of men; Ns = No significant difference at 5% level of probability

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