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Effects of Replacing Soybean (*Glycine Max*) with Fermented Sickle Pod (*Senna Obtusifolia*) on the Productive Performance and Carcass Characteristics of Domestic Rabbits

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ABSTRACT: An experiment was conducted for 56 days to determine the productive performance and carcass characteristics of domestic rabbits fed fermented *Senna obtusifolia* seed meal (FSOSM)-based diets. A control soybean meal-based diet and diets containing 0, 25, 50, 75 and 100% FSOSM as a replacement for soybean were formulated for the study. Twenty (20) domestic growing rabbits with an initial weight range of 605.25 – 662.75 g were randomly allotted to the five dietary treatments in a Completely Randomized Block Design with four replicates of one rabbit each. The productive performance was not significantly ($P < 0.05$) influenced by the diets. The daily weight gain ranged from 11.11 – 12.09 g/d, total weight gain 622.16 – 677.01 g/d, daily feed intake 55.15 – 61.41 g and feed conversion ratio ranged from 4.83 – 5.02. The carcass characteristics were similarly not affected ($P < 0.05$) by the dietary treatments. Dressing percentage ranged from 50.05 – 59.70% and retail cuts for shoulder, rack, loin and thigh were 17.73 – 18.99, 5.20 – 6.28, 13.26 – 14.17 and 20.28 – 22.33 percent body weight. It was concluded from this study that replacement of soybean with FSOSM up to 100% had no adverse effects on the productive parameters and carcass characteristics of domestic rabbits.

KEYWORDS: Fermented, Rabbits and carcass, Senna obtusifolia.

INTRODUCTION

Rabbit production has greater potentials to address the problem of protein malnutrition and also improve the living standard of people in developing regions of the world. There are cheaper alternative feed resources such as sickle pod (*Senna obtusifolia*). Sickle pod is an abundant and available legume weed seeds in the Northern part of Nigeria. The seeds are reported to have good nutritional properties but they also contain some anti-nutritional factors such as tannin, phytate and oxalate (Ingweye *et al*., 2010; Ardo *et al*., 2019a). These factors have the capacity to reduce nutrient utilization which could consequently affect growth and carcass output. Therefore, there is the need to intensify research on detoxification methods to improve the utilization of the seed by livestock. Fermentation was reported to be effective in reducing toxic factors in feed ingredients and improve their nutritional profile (Runni *et al*., 2016; Smith 2018). At the moment, there appears to be paucity of information on the effects of replacing soybean meal with FSOSM on the productive performance and carcass characteristics of domestic rabbits, hence the need to conduct elaborate study and bridge the above mentioned research gap.

MATERIALS AND METHODS

Study area, collection and processing of test ingredient

The study was conducted at the Rabbit Unit of the Department of Animal Production Livestock Teaching and Research Farm, Adamawa State University, Mubi, Nigeria (Adebayo *et al*., 2020).

Senna obtusifolia seeds were harvested in the wild and boiled for one hour. The boiled seeds were thereafter washed, drained and placed in an air-tight container and allowed to naturally ferment for seven days. After the seventh day, the fermented seeds were

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removed from the fermentation container, sun-dried and milled. Samples of the meal were analysed and used for the formulation of the experimental diets

Chemical analysis

The fermented *Senna obtusifolia* seed meal and experimental diets were analysed in triplicates for proximate composition and levels of anti-nutritional factors using standard laboratory procedures as described by AOAC (2010).

Experimental diets and treatments

Five experimental diets were formulated in which fermented *Senna obtusifolia* seed meal replaced soybean at 0, 25, 50, 75 and 100%. The [composition of the experimental diets is presented in Table 1.

	Level of replacement of soybean with FSOSM				
Ingredients	**0%**	**25%**	**50%**	**75%**	**100%**
Maize	47.00	47.00	47.00	47.00	47.00
Soya bean meal	21.00	15.75	10.50	5.25	00.00
FSOSM	0.00	5.25	10.50	15.75	21.00
Cowpea husk	17.05	17.05	17.05	17.05	17.05
Maize offal	11.00	11.00	11.00	11.00	11.00
Salt (Nacl)	0.30	0.30	0.30	0.30	0.30
Bone meal	3.00	3.00	3.00	3.00	3.00
Methionine	0.25	0.25	0.25	0.25	0.25
Lysine	0.15	0.15	0.15	0.15	0.15
*Premix	0.25	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Table 1: Composition and Calculated Analysis of the Experimental Diets

Calculated Analysis					
Crude protein (%)	20.69	20.03	19.68	19.49	19.55
Crude fibre (%)	3.93	3.08	3.24	3.40	3.56
**Energy (Kcal/kg)	2981.59	2957.96	2928.32	2898.69	2879.05

*Premix supplying the following per kg of feed: Vitamin A = 10,000 IU, Vitamin D_3- 200 i.µ Vitamin E = 200 mg, Vitamin B_1 = 400 mg Vitamin B_2 = 200 mg, Vitamin B_6 = 400 mg Vitamin B_{12} = 400 mg Ascorbic acid = 4g, Vitamin K_3 = 250 mg, Folic acid =40 g, Calcium carbonate = 4g, Nicotinamide = 200 g, Lysine = 4 g, Methionine = 200 g, Cyproheptadine = 80 mg, Amino acid = 4 g, Choline = 1200 mg, Biotin = 12000 mg, Manganese = 10000mg, Sodium sulphate = 40000 mg, Sodium chloride = 40000 mg, iodine chloride = 5 mg and iron sulphate = 6000 mg. **ME = Metabolizable energy calculated according to the formula of Pauzenga, (1985) ME=37 x % CP + 81 x % EE + 35.5 x % NFE, FSOSM = Fermented *Senna obtusifolia* seed meal.

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Experimental animals and their management

A total of 20 growing rabbits were purchased at the National Veterinary Research Institute, Vom, Plateau State, Nigeria. The rabbits were managed inside constructed metal hutches with dimension of 21.5 m^2. They were acclimatized for a period of one week with the experimental diets before the actual commencement of the experiment. The rabbits were dewormed with ivomectin injected subcutaneously at a dose of 0.01ml/rabbit. Known quantity of the experimental diets and water were supplied *ad-libitum* and the experiment lasted for 56 days.

Ethical consideration

Ethical approval for the use of experimental rabbits was obtained from the Animal Welfare and Ethical Committee of the Adamawa State University, Mubi, Nigeria with reference number ADSUIACEC/2022/008.

Experimental design

A total of 20 growing rabbits with weight range of 622.16-677.01 g were randomly allotted to the 5 dietary treatments in a completely randomized block design replicated four times with one rabbits each. The rationale for choosing this design is to block and minimize experimental errors that might arise as a result of differences in weight.

Data collection

Data were collected on productive performance (feed intake, weight gain and feed conversion ratio) and carcass parameters as follows:

Feed intake

Daily feed intake was determined by the difference between daily feed offered and daily feed leftover. Total feed intake was obtained by cumulative addition of the daily feed intake.

Weight gain

The rabbits were weighed at the beginning of the experiment and subsequently on weekly basis to determine weekly weight gain, Daily weight gain was then obtained by dividing weekly weight gain by seven while the total weight gain was arrived at by cumulative addition of the daily weight gain.

Feed conversion ratio

Feed conversion ratio (FCR) was calculated as the ratio of feed intake to weight gain as follows:

$$FCR = \frac{\text{Feed intake}}{\text{Weight gain}}$$

Evaluation of carcass parameters

At the end of the experiment, 3 rabbits were randomly selected from each treatment and were starved of feed for 12 hours but allowed access to water. This was done to avoid contamination of the carcass with intestinal content. The rabbits were weighed and slaughter using acceptable practice described by Mann (1960) and thereafter, the rabbits were immersed in hot water at 40^oC to facilitate loosening of the fur. A sharp scalpel was used to scrap the fur and the rabbits were washed in clean water. The heads and feet were cut and removed and the rabbits were eviscerated, organs and intestinal organs carefully removed. The dressed rabbits were weighed and dressing percentage (DP%) were calculated using the formula below:

$$DP\% = \frac{\text{Dressed weight}}{\text{Slaughtered weight}} \times \frac{100}{1}$$

The dressed carcass were divided into retail cuts (shoulder, rack, loins and thigh) as described by Blasco *et al*. (1993) as shown in Figure 1.

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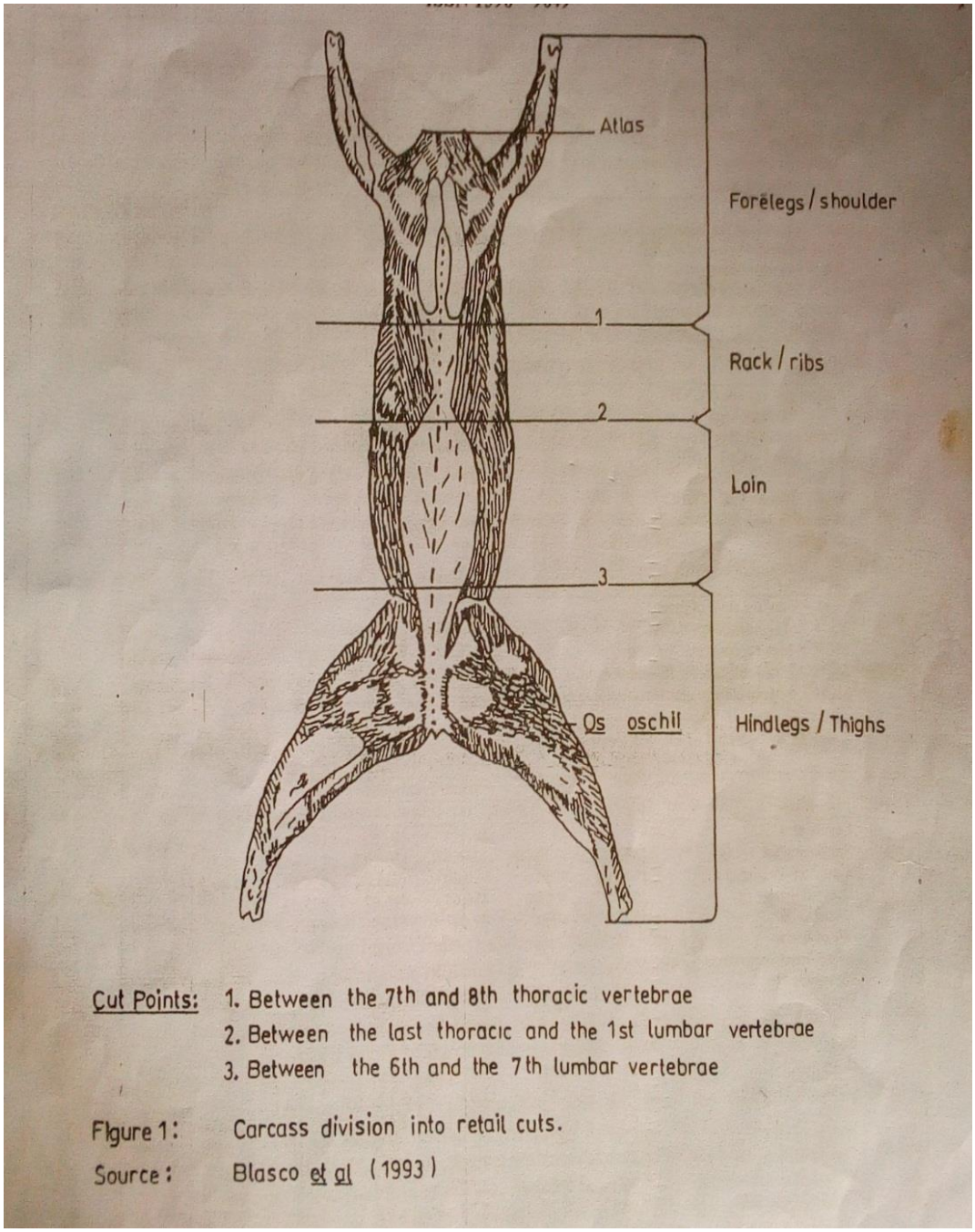

RESULTS AND DISCUSSION

The chemical analysis of the raw Senna *obtusifolia* seed meal (RSOSM), FSOSM and the experimental diets is presented in Table 2. It was observed that the raw seed meal possess moderate protein content but also contain some anti-nutritional factors such as tannin, phytate and saponin. Fermentation reduced the level of the anti-nutritional factors below toxic level and increased the protein content of the seed which is in consonance with the reports of Hong *et al.* (2004), who explained

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Table 2: Chemical Composition of the Experimental Diets, Rsosm and FSOSM

	Level of replacement of soya bean with FSOSM						
	0%	25%	50%	75%	100%	RSOSM	FSOSM
Dry matter	94.66	95.33	94.12	93.45	94.38	95.31	93.17
Crude protein	20.62	19.67	19.87	20.41	19.55	19.45	26.25
Crude fibre	10.30	9.87	9.60	11.86	10.99	13.21	7.98
Ether extract	6.33	6.67	7.75	7.06	7.12	7.32	6.45
Ash	6.67	7.50	7.33	7.15	7.37	7.61	8.09
Nitrogen free extract	40.13	41.53	42.35	40.33	41.66	40.07	39.50
*M.E (kcal/kg)	2700.28	2742.38	2866.36	2759.29	2810.82	2735.07	2895.95
Tannin	0.009	0.07	0.09	0.098	0.12	6.72	1.02
Oxalate	0.001	0.0071	0.0082	0.073	0.091	2.73	0.58
Saponin	0.0031	0.048	0.051	0.078	0.15	1.83	0.03
Phenol	0.0019	0.023	0.024	0.030	0.045	3.80	0.91
Phytate	0.0042	0.0044	0.0052	0.0055	0.0063	2.79	0.05

**ME = Metabolizable energy calculated according to the formula of Pauzenga, (1985) ME=37 x % CP + 81 x % EE + 35.5 x % NFE, RSOSM = Raw *Senna obtusifolia* seed meal, FSOSM = Fermented *Senna obtusifolia* seed meal.
that fermentation is effective in eliminating anti-nutritional factors and also a means of enhancing nutritional value of seed.

The productive performance of domestic rabbits fed FSOSM-based diets is presented in Table 3. There were no significant ($P< 0.05$) differences in any of the growth parameters studied. This is linked to positive impact of incorporating FSOSM in the diets as buttressed by Augustine *et al.* (2017) that FSOSM has moderate concentration of amino acid. This favourable nutritional attributes of the meal might be responsible for the superior feed intake observed in this present study. The values for the average daily feed intake obtained are close to the range of values 57.75 – 77.60 g/d reported by Abdulazeez *et al.* (2016) for 8 weeks old rabbits. The range of values are also not far from 57.75 to 77.6 g/d reported by Tarimbuka *et al.* (2017) for rabbits fed toasted *Senna obtusifolia* seed meal-based diets. The implication and application of this finding is that FSOSM can replace soybean up to 100% without adverse effects on feed intake.

Table 3. Productive Parameters of Domestic Rabbits Fed Fermented *Senna Obtusifoilia* Seed Meal-Based Diets

	Levels Of Replacement Of Soya Bean With FSOSM					
Parameters	0	25	50	75%	100%	SEM
Average initial weight (g)	627.25	647.75	605.75	633.75	662.75	23.24
Average daily weight gain (g/d)	11.70	11.46	11.11	11.49	12.09	3.62
Average total weight gain (g)	655.20	641.76	622.16	643.44	677.01	3.68
Average daily feed intake (g/d)	58.68^{b}	55.35^{b}	55.15^{b}	56.55^{b}	61.41^{a}	1.80^{*}
Average total feed intake(g)	3286.08	3099.60	3088.40	3166.80	3438.40	7.25
FCR	5.02	4.83	4.96	4.92	5.08	0.60
Mortality (no)	0.00	0.00	1.00	0.00	0.00	-

FSOSM = Fermented *Senna obtusifolia* seed meal; NS = Not significant, FCR = Feed conversion ratio

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The average daily weight gain recorded in this study are very similar to the range of 12.32 – 12.98 g/d reported by Odoh (2007) but lower than the range of 16.60 to 10.65 g/d reported by Tarimbuka *et al*. (2017) for rabbits fed toasted *Senna obtusifolia* seed meal-based diets. The result by implication showed that replacement values of FSOSM up to 100% were uniformly utilized and had no adverse effects on the body weight gain of the rabbits. This might be attributed to the impact of fermentation which reduced the levels of the anti-nutritional factors and also increased the protein, amino acid and other beneficial nutrients as reported by Uwagbute *et al.* (2000) and Lasekan and Shabnam (2013) which therefore contributed to better weight gain in the rabbits.

The feed conversion ratio (FCR) among the rabbits were similar (P>0.05). This suggests that fermentation reduced the anti-nutritional factors below toxic levels for the rabbits. This concurred with the findings of Augustine *et al*. (2018) who described fermentation as an effective means to reduce anti-nutritional factors in *Senna obtuifolaia* seed meal. However, the FCR obtained in this current study is higher compared to the range of 3.4 to 3.8 stated by Gidenne and Maertens (2017) but similar to the value of 4.5 conveyed by Fielding (1991) as the estimated FCR for rabbits in the tropics. Tarimbuka *et al.* (2017) in a similar study fed rabbits with toasted *Senna obtusifolia* and reported FCR of 2.37 to 2.79.

The low mortality recorded in group of rabbits fed diet 3 was an evidence that replacement of soy bean with FSOSM up to 100% had little or no adverse effects on the health and survival of the rabbits. Ardo *et al*. (2019b) observed similar trend of mortality in albino rats fed FSOSM-based diets.

The carcass characteristics of rabbits fed FSOSM-based diet is shown in Table 4. It was observed that the experimental diets did not showed any significant (P<0.05) difference on the carcass parameters of the rabbits. The dressing percentage which is an indicator of assessing carcass output were similar to the values of 49.8 and 58.8% reported by Khyla *et al*. (2020) but higher than the range between 51.29 to 51.93% reported by Tarimbuka *et al.* (2017) for rabbits fed TSOSM-based diets. Since the dressing percentages were within the normal range, it therefore means that replacement of soy- bean with FSOSM up to 100% had positive influence on carcass yield of the rabbits fed the experimental diets.

The values for the retail cuts for shoulder, rack, loin and thigh (17.73 – 18.99, 5.20 – 6.28, 13.26 – 14.17 and 20.28 – 22.33 percent body weight) expressed as percentage body weight reported by Joseph *et al.* (2004) are lower than the values obtained in this study. The FSOSM incorporated in the experimental diets had contributed positively in enhancing superior retail cut-up parts of the rabbits.

Table 4. Productive Parameters of Domestic Rabbits Fed Fermented Senna Obtusifoilia Seed Meal- Based Diets

	Levels Of Replacement Of Soya Bean With FSOSM					
Parameters	0%	25%	50%	75%	100%	SEM
Fasted Live Weight (g)	1174.30	1258.30	1179.00	1127.30	1252.00	91.12
Slaughter weight(g)	1137.30	1225.70	1142.00	1093.79	1222.20	68.75
Dressed weight(g)	702.67	637.67	626.00	566.33	604.33	4.08
Dressing percentage (%)	59.70	50.68	52.76	50.13	50.05	1.38
Retail cuts expressed as percentage of live body weight						
Shoulder	18.99	18.36	17.73	18.27	17.97	1.73
Rack	6.44	5.51	5.34	5.20	6.28	2.81
Loin	13.82	13.60	14.17	13.48	13.26	1.01
Thigh	21.43	21.01	22.33	20.28	20.85	1.34

FSOSM = Fermented *Senna obtusifolia* seed meal; NS = Not significant

CONCLUSION AND RECOMMENDATION

It was concluded from this investigation that, FSOSM can replace soybean up to 100% without adverse effects on growth parameters and carcass characteristics of domestic rabbits. Considering the current price of soybean in the country, the use of Senna seed will have economic benefits. We recommend further studies on fermentation temperature and duration on the chemical composition of Senna seed meal-based diets

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