ABSTRACT: A feeding trial was conducted for 28 d to evaluate the effects of feeding albino rats with processed *Senna obtusifolia* leaf meal (SOLM) based diets. Five experimental diets were compounded to contain 0% and 20% each of the sun-dried, boiled, fresh fermented, boiled fermented SOLM-based diets designated as $T_1$, $T_2$, $T_3$, $T_4$, and $T_5$ respectively. A total of 90 young albino rats with initial weight of 13.52–14.48 g were randomly allocated to the dietary treatments in a completely randomized design with three replicates of six rats each. The result of the productive performance was not significantly ($P > 0.05$) different, except feed intake, which indicated significant ($P < 0.05$) variation. The highest total feed intake (365.40 g) was recorded in albino rats fed the control diet (0% SOLM) and 20% boiled and fermented SOLM (334.32 g). The overall weight gain among the albino rats fed the processed SOLM-based diets were not significantly ($P > 0.05$) different. Results on cost benefits revealed a reduction in feed cost per kilogram, cost of feed intake, and feed cost per kilogram body weight gain recorded in SOLM-based diets ($T_2$–$T_5$). Feed cost per kilogram was observed to reduce by 21.86, 20.79, 21.80, and 18.79 in $T_5$–$T_1$, respectively. It was concluded that the processed SOLM-based diets had enhanced the productive performance of albino rats. However, albino rats fed the boiled and fermented SOLM-based diet indicated better feed intake compared with the other groups of rats fed the other processed SOLM-based diets. On economic grounds, the use of processed SOLM as a feed ingredient for albino rats is cost effective because of the reduction in feed cost per kilogram of the SOLM-based diets and feed cost per kilogram body weight gain observed in albino rats fed SOLM-based diets and is, therefore, recommended for feeding albino rats.

Key words: alternative feed, feed conversion, growth performance, *Senna obtusifolia*,

INTRODUCTION

Livestock production is a major agricultural enterprise that has engaged many Nigerians in many important economic activities and still remains very relevant in the Nigerian economy.
However, the scarcity and escalating cost of livestock feed are the main problems militating against the growth and development of the livestock industry in Nigeria. Bawa et al. (2009), however, observed that scarcity and high cost of conventional feedstuffs are among the problems facing the Nigerian livestock industry. These problems can be partly tackled through the utilization of alternative cheaper feed resources. Sanjo et al. (2017) reported that sustainable livestock production in developing countries can be achieved through the utilization of feed resources that are underutilized and less needed by humans as food. *Senna obtusifolia* leaves, which would have been a suitable alternative feed material, was observed to be avoided by most species of livestock, which is an indication that they contain toxic factors. The chemical composition of the leaves as reported by Ayssiwede et al. (2012) revealed that it has good nutritional value (27.40 CP and 2050.47 kcal/kg metabolizable energy), but Yakubu et al. (2017) reported that *S. obtusifolia* leaves contain antinutritional factors, such as tannins, hence the need to process the leaves before incorporation into livestock diets. In view of the above, it has become necessary to evaluate the best processing method(s) that will detoxify the leaves and enhance optimal utilization of the leaves as feedstuff. At the moment, information on the effects of processed *S. obtusifolia* leaf meal (SOLM) based diets on the productive performance and cost benefits of feeding albino rats with SOLM appears to be very scanty, hence the need to conduct more studies in order to bridge this information gap. This study was conducted to investigate the productive performance and cost benefits of feeding albino rats with processed SOLM.

**MATERIALS AND METHODS**

*Institutional Animal Care and Ethic Committee Approval*

The use of the albino rats for the experiment was approved by the Animal Care and Ethic Committee of the Adamawa State University, Mubi. The ethical considerations of the use of the rats were in line with the specifications of Nuffield Council on bioethics.

*Location of the Study Area*

The study was conducted at the Animal House of the Department of Biological Sciences, Adamawa State University, Mubi. The area is located between latitudes 9° 30' and 11° north of the equator and longitudes 13° and 9° 45' east of Greenwich meridian (Adebayo, 2004).

*Collection and Processing of S. obtusifolia leaves*

The leaves of *S. obtusifolia* were harvested in bushes around the Mubi area of Adamawa State, Nigeria. The leaves were divided into four batches as follows:

1. The first batch was properly sun-dried for 5 d until the leaves became crispy;
2. The second batch was boiled for 30 min. The boiling time was taken immediately when the water started to boil;
3. The third batch was wilted, placed in polyethylene bags, and were well compressed to expel air. Thereafter, they were placed in an air-tight container and allowed to naturally ferment for 9 d;
4. The fifth batch was boiled for 30 min, cooled, drained, and placed in an air-tight container and allowed to ferment for 7 d.

*Experimental Diets and Treatments*

Five experimental diets were compounded to contain 0% and 20% each of the sun-dried, boiled, fresh fermented, and boiled and fermented SOLM designated as T1, T2, T3, T4, and T5, respectively as presented in Table 1.

*Chemical Analysis*

The processed SOLM and the experimental diets were analyzed using standard laboratory procedure of AOAC (2010).

*Experimental Animals and Their Management*

A total of 90 young albino rats with average initial weight of 13.52–14.48 g were managed inside constructed metal cages. The rats were acclimatized to the cages and the experimental diets for 1 wk. Thereafter, they were fed with a measured quantity of feed, which was supplied ad libitum. Clean drinking water was regularly supplied. The rats were managed in accordance with the procedure of handling experimental animals as described by Ochei and Kolhatkar (2007) and the Committee on Animal Welfare and Ethics of the Adamawa State University, Mubi. The experiment lasted for 28 d.
Parameters Measured

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

Weight gain The rats were weighed at the commencement of the experiment and the initial weight was recorded. The final weights of the rats were recorded at the end of the experiment and the overall weight gain was obtained by subtracting the initial weight from the final weight. Daily weight gain was determined by dividing the overall weight gain by the total number of days of the experiment.

Feed conversion ratio This was determined by dividing the feed intake by weight gain.

Mortality The mortality was recorded as they occur.

Cost benefits The cost benefits of using S. obtusifolia leaves as feed ingredient for albino rats were determined by calculating feed cost per kilogram of the feed, cost of total feed intake, and feed cost per kilogram weight gain as follows:

Feed cost per kilogram

\[
= \frac{\text{Sum of } \% \text{ inclusion} \times \text{unit cost of each ingredient}}{100 \text{ kg}}
\]

Cost of total feed intake = total feed intake \times cost of feed per kilogram

Feed cost per kilogram weight gain = feed intake \times feed conversion ratio.

Statistical Analysis

Data obtained were subjected to analysis of variance using Statistix 9.0, and Duncan’s Multiple Range Test was used to separate the means where significant difference occurred.

RESULTS AND DISCUSSION

Analyzed Chemical Composition of SLOM and the Experimental Diets

The analyzed chemical composition of the experimental diets is presented in Table 2. The results indicated that the different processing methods were observed to be effective in reducing the levels of the antinutritional factors. The proximate composition of the diets was adequate to meet the nutritional requirements of the albino rats.

Productive Performance

The productive performance of albino rats fed the processed SLOM-based diet is presented in Table 3. The result indicated no significant difference except the overall weight gain and feed intake. The albino rats fed the control diet (0% SLOM) indicated higher feed intake followed by those fed the boiled and fermented SLOM-based diet. These observed effects might be due to the odor of the processed SLOM in the diet, which is in line with the report of Takashi et al. (2013) who reported that this may have a sedative effect and decrease the motivation to feed and weight gain.
The fairly high feed intake observed in T5 might be due to the low levels of antinutritional factors caused by the combined effects of boiling and fermentation and also due to dietary enrichment through the development of diversity of flavor as reported by Steinkraus (2004). Mcfeeters (2004) further observed that microorganisms during fermentation can enhance the flavor of food through a flavor modification mechanism. It was also reported that the central nervous system regulates food-search behavior by modulating the detection of food odorant through centrifugal innervations (Doucette et al., 2008; Doucette and Restrepo, 2008; Fletcher and Chen, 2010). Barbara (2014) in a study observed that natural environment, the relevance of aroma coming from a food source encountered by an animal during food search is a crucial key to determining approach and ingestion of food.

**Cost Benefits**

The cost benefits of feeding albino rats with processed SOLM-based diets is presented in Table 4.

### Table 2. Analyzed chemical composition of the experimental diets

| Proximate components, % | T1 (SDSOLM) | T2 (BSOLM) | T3 (FFSOLM) | T4 (BFSOLM) |
|-------------------------|-------------|------------|-------------|-------------|
| Dry matter, %           | 93.55       | 92.75      | 93.75       | 93.55       |
| CP                      | 19.77       | 18.75      | 20.45       | 19.87       |
| Crude fiber, %          | 5.21        | 5.07       | 4.77        | 4.25        |
| Ash                     | 4.55        | 4.18       | 5.25        | 5.20        |
| Ether extract, %        | 2.65        | 2.33       | 2.25        | 2.35        |
| NFE                     | 41.07       | 40.75      | 39.09       | 40.65       |
| *Energy, kcal/kg        | 2,404.13    | 2,275.10   | 2,326.60    | 2,368.62    |
| Tannins, mg/100g        | 3.90        | 2.03       | 1.85        | 1.75        |
| Phenols, mg/100g        | 22.76       | 13.13      | 9.18        | 8.25        |

BFSOLM, boiled and fermented SOLM; BSOLM, boiled SOLM; CP, crude protein; EE, ether extract; FFSOLM, fresh fermented SOLM; ME, metabolizable energy; NFE, nitrogen-free extract; SDSOLM, sun-dried SOLM.

*Energy calculated according to the formula of Pauzenga (1985): ME (kcal/kg) = 37 × %CP + 81 × %EE + 35.5 × %NFE.

### Table 3. Productive performance of albino rats fed processed SOLM-based diets

| Parameters                  | T1 (0% SOLM) | T2 (20% SDSOLM) | T3 (20% BSOLM) | T4 (20% FFSOLM) | T5 (20% BFSOLM) | SEM   |
|-----------------------------|--------------|-----------------|----------------|----------------|----------------|-------|
| Initial weight, g           | 14.06        | 13.52           | 13.79          | 14.02          | 14.48          | 0.25* |
| Final weight, g             | 137.50       | 116.61          | 129.00         | 127.81         | 132.82         | 9.20* |
| Overall weight gain, g      | 123.74*      | 103.09*         | 115.21*        | 113.79*        | 118.34*        | 5.53* |
| Daily weight gain, g        | 4.42         | 3.68            | 4.11           | 4.06           | 4.23           | 0.32* |
| Total feed intake per rat, g| 365.40*      | 295.12*         | 287.56*        | 285.04*        | 334.32*        | 1.35* |
| Daily feed intake per rat, g| 13.05        | 10.54           | 10.27          | 10.18          | 11.94          | 0.01* |
| Feed conversion ratio       | 2.96         | 2.86            | 2.50           | 2.50           | 2.83           | 0.97* |
| Mortality, number           | 0.00         | 0.00            | 0.00           | 0.00           | 0.00           | —     |

BFSOLM, boiled and fermented SOLM; BSOLM, boiled SOLM; FFSOLM, fresh fermented SOLM; SDSOLM, sun-dried SOLM.

abc, means in the same row with different superscript are significantly different at P < 0.05; NS, not significant.

* P > 0.05.

### Table 4. Cost benefits of feeding albino rats with processed SOLM-based diets

| Parameters                  | T1 (0% SOLM) | T2 (20% SDSOLM) | T3 (20% BSOLM) | T4 (20% FFSOLM) | T5 (20% BFSOLM) |
|-----------------------------|--------------|-----------------|----------------|----------------|----------------|
| Feed intake, kg             | 0.36         | 0.29            | 0.29           | 0.28           | 0.33           |
| Weight gain, g              | 123.74       | 103.09          | 115.21         | 113.79         | 118.34         |
| FCR                         | 2.96         | 2.86            | 2.50           | 2.50           | 2.83           |
| Feed cost/kg                | 117.1        | 95.24           | 96.31          | 95.30          | 98.31          |
| Reduction in feed cost/kg   | 0.00         | 21.86           | 20.79          | 21.80          | 18.79          |
| Cost of total feed intake   | 42.16        | 27.62           | 27.93          | 26.68          | 32.44          |
| Feed cost/kg body weight gain| 124.79      | 78.99           | 69.83          | 66.70          | 91.81          |

BFSOLM, boiled and fermented SOLM; BSOLM, boiled SOLM; FCR, feed conversion ratio; FFSOLM, fresh fermented SOLM; SDSOLM, sun-dried SOLM.

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Feed cost per kilogram, cost of total feed intake, and feed cost per kilogram body weight gain were observed to be lower in SOLM-based diets. The low costs were attributed to the inclusion of the processed SOLM leaves. This finding is in line with that of Sanjo et al. (2017) and Ardo et al. (2018) who made a similar observation for rabbits and albino rats fed SOLM-based diets. These alternative feed ingredients are available, cheap, and less competed for by humans, which makes them cheaper as a feed resource for livestock (Shaahu et al., 2015).

CONCLUSION

It was concluded that the inclusion of 20% of the sun-dried, boiled, fresh fermented, and boiled and fermented SLOM had no adverse effects on the productive performance of the albino rats. On economic grounds, the use of S. obtusifolia leaf meal as a feed ingredient for albino rats is cost effective.

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