Response of Pregnant and Lactating West African Dwarf Goats to Dietary Replacement of Maize with Sun-Dried Cassava Peels

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Abstract: This study evaluated the response of pregnant and lactating West African Dwarf does to replacement levels of maize with sun-dried cassava peels (SCP). A total of twenty seven (27) goats with mean body weight of 15.70±0.81 kg were randomly assigned to 1 of 3 dietary treatments. Each treatment group was replicated nine times with one doe per replicate in a completely randomized design. Experimental diets were formulated to contain 0%, 15% and 30% SCP to replace maize weight by weight (w/w). The replacement levels of maize with SCP had no (P > 0.05) effect on growth performance of the dams and kids. Dietary treatments had no (P > 0.05) effect on live weight changes. However, weeks of gestation had a (P < 0.05) effect on changes in weight. Dietary treatments had no (P > 0.05) effect on milk production and the milk components of ash, butterfat, total solids, solid-not-fat and milk energy content, however, milk protein and lactose content were (P < 0.05) affected. Crude protein was higher (P < 0.05) in the milk of does fed the replacement of maize with SCP at the 0 and 15% levels compared to the does fed 30% replacement levels of maize with SCP. Lactose was higher (P < 0.05) in the milk of does fed the 0 and 30% replacement levels compared to the 15% level of replacement. Crude protein increased linearly (P < 0.00) while lactose showed a quadratic increase (P < 0.00) as levels of replacement increased. In conclusion, replacement of maize with SCP up to 30% level showed no effect on growth performance, and milk production but decreased milk protein and improved lactose content.

Key words: Pregnant, Lactating Maize, Replacement, Sun-dried cassava peels

1. Introduction

Goat production plays a very vital role in the livelihood of rural populations in the developing world as it contributes significantly to improvement of family nutrition and health. Goat husbandry is considered as a form of food security and source of independent income for rural households and subsistent farmers [1]. In most developing countries and especially in Nigeria, the rearing of goats is mainly traditional and as a result, it is characterized by inadequate feed, particularly during the growing season [2]. They are either raised in a communal farming system or allowed to roam in search of feed [3]. The situation becomes worse during the dry season when ruminant animals are unable to meet their protein and energy requirement from available poor quality herbage with consequent marked weight loss and low productivity [4].

Scientists have advocated the feeding of supplements such as concentrates as part of the ways to improve the productivity of small ruminants [5]. The cereal grains such as maize supplies the bulk of the livestock feed and have remained the major energy source in livestock rations. However, with the ever rising cost of maize brought about by its declining production conditions and stiff competition for its use by man and other livestock species [6], [7] the utilization of any energy containing ingredient that can replace maize would desirable. The total or partial replacement of energy feeds of greater cost with lower cost sources such as agro-industrial residues represents a potential alternative to reduce costs of concentrate in order to make the production system more sustainable [8]. One of such by-products to be used in livestock feeding is cassava products.

Cassava (Manihot esculenta) is a root crop cultivated mainly in tropical and sub-tropical regions of the world, it is tolerant to poor soils, diseases and drought, and can yield between 25 to 60 tons/ha [9]. The world production of cassava is estimated at more than 256 million metric tonnes annually [13] with Nigeria, Brazil, Thailand, Vietnam, Indonesia and DR Congo being the largest producers [10, 14], and [15]. The major by-product among the wastes obtained from cassava processing is the cassava peel which accounts for 10-13% of the tuber weight [16] usually with small discarded tubers in various proportions. The potential quantity of cassava peel as a by-product feed ingredient in Nigeria alone is
estimated at 10% of production totals of 5.2 million tonnes per annum [13]. Cassava products have been in use for a long time as an energy source for livestock [17]. However, farmers in the villages have been restricting the utilization of cassava by products, since it was known that those materials contained cyanogenic glycosides compounds, which is potentially toxic [18]. Processing of the peels is therefore recommended in order to reduce cyanogenic content, phytate content and to preserve their nutritive quality [19, 20, 21, and 22]. However, it has a potential to be used in ruminant feed due to advantages such as a high amount of soluble carbohydrates with high digestibility [23].

Several authors have reported on the utilization of cassava peels in the diet of ruminants. [24] Reported that the use of sun-dried cassava peels as an energy source up to 74.0% in supplement rations which completely replaced maize offals did not affect live weight changes in the diet of Red Sokoto goats in first trimester of pregnancy. [25] evaluated the replacement of corn with cassava peel in the diets of dairy cows and they reported a linear decrease in milk production but the milk components of fat, protein, lactose, and total solids were not altered.

There is not much work done on the total replacement of maize with sun-dried cassava peels in the diets of pregnant and lactating West African Dwarf does. Therefore the aim of this study was to assess the effect of varying replacement levels of maize with sun-dried cassava peels in the diets of pregnant and lactating West African dwarf does on growth performance of the does and kids, live weight changes of does during pregnancy and early lactation periods, and milk yield and composition.

2. Materials and methods

2.1. Experimental location

This study was carried out at the Small Ruminants Unit of the Directorate of University Farms (DUFARMS) of the Federal University of Agriculture Abeokuta, in the derived savannah zone of South-Western Nigeria (7°5' N, 3°11.2' E, and 76 m above sea level). The region's climate is humid, with a mean annual rainfall of 1100 mm and annual temperature range of 22.5-30.7°C.

2.2. Experimental animals and their management

A total of twenty seven (27) West African Dwarf (WAD) goats, in their 2nd parity, aged 2-3 years, with mean body weight of 15.70 ± 0.81 kg were used in this study. The animals were housed intensively in individual cross ventilated pens with wooden slatted floors with a dimension of (180x100cm; LxB). They were quarantined for 20 days and routinely dewormed with anti-helminthic drugs (Ivomec and Thiabendazole) and sprayed with acaricides against ecto-parasites. The animals were equalized as closely as possible according to body weight into three groups such that the mean initial weights of the groups were not significantly different and randomly assigned to the three dietary treatments with nine replicates per treatment and one animal per replicate. The does were naturally mated during the late dry season (December- January) and stimulated to come on heat by introducing the bucks. The mating ratio of dams to bucks was 9:1. During the pre-experimental period, which lasted for 14 days after mating, the animals were fed the experimental diets and given fresh drinking water ad-libitum. The actual feeding trial commenced at the end of the pre-experimental period and lasted for 180 days (late dry season to early wet season) (January – June).

2.3. Experimental diets and feeding

The experimental treatments consisted of three replacement levels of maize with sun-dried cassava peels w/w at (0, 15 and 30 %). The experimental diets (Table 1) were allotted randomly to the three groups of goats in a completely randomized design. The animals were fed at 5% of their body weight, consisting of the experimental concentrate diet and drinking water was also given at the same time as the feed.

### Table 1: Composition of experimental diets

<table>
<thead>
<tr>
<th>Replacement levels (%)</th>
<th>0</th>
<th>15</th>
<th>30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ingredients</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Calculated composition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metabolizable energy (MJ/kg/DM)</td>
<td>2.28</td>
<td>2.22</td>
<td>2.16</td>
</tr>
<tr>
<td>Crude protein (%)</td>
<td>15.74</td>
<td>15.23</td>
<td>14.72</td>
</tr>
<tr>
<td>Fat (%)</td>
<td>4.56</td>
<td>4.71</td>
<td>4.88</td>
</tr>
<tr>
<td>Crude fibre (%)</td>
<td>6.98</td>
<td>8.03</td>
<td>9.08</td>
</tr>
<tr>
<td>Calcium (%)</td>
<td>0.89</td>
<td>0.89</td>
<td>0.89</td>
</tr>
</tbody>
</table>
2.4. Parameters measured

2.4.1. Growth performance characteristics of does and kids

The initial body weights of dams were taken with subsequent body weight measured on weekly bases. Feed intake was determined as the difference between daily feed offered and feed leftovers.

(1) Feed intake (g) = feed offered-feed leftovers

Dry matter intake (DMI) was determined using the formula:

(2) DMI (g. day’1) = % Dry matter / 100 x feed intake

The feed conversion ratio (FCR) was calculated as feed intake per unit body weight. Individual birth weights of kids were measured within 8 hours of birth using a sensitive weighing scale and subsequently on a weekly basis throughout the early lactation period. Total weight gain was calculated by subtracting the birth weight from the final weight gain. The average daily gains (ADG) of the kids were determined by dividing the final weight of the kids after the termination of the experiment by the number of days of lactation.

(3) Average daily gains of kids (g) = Final body weight/number of days in lactation

2.4.3. Milk collection procedure and analyses

Milk collection commenced on the 7th day post-partum to allow the kids get all their dams’ colostrum and to foster a good dam-kid relationship. Prior to each week’s milking, the kids were separated from their dams at 1800 hours on the evening preceding the day of milking. The does were hand milked once every week for 5 weeks. Milk yield was measured using a measuring cylinder and recorded. The milk harvested was defined as the partial daily milk yield (PDM), which is a combination of milk off-take and 12-hour milk yield [26]. The Ash (%) crude protein (%), butterfat (%), and total solids (%), were analysed using [27] procedures.

Lactose, solids-not-fat (SNF), and milk energy contents were determined using the formula; lactose = SNF-(% protein-% ash), Solids-not-fat=total solids-% fat, Milk Energy=1.64+0.42 (% Fat) [28].

2.5. Statistical analysis

The data obtained was subjected to analysis of variance (ANOVA) using general linear model procedure of SPSS (2007) and means that differed significantly were separated using Tukey’s honest significant difference (HSD) test, adopting the level of 5% probability.

3. Results

3.1. Growth performance of dams and kids

The effect of the replacement levels of maize with sun-dried cassava peel on growth performance of dams and kids is shown in Table 2. Dietary treatments had no effect (P > 0.05) on final live weights, average daily gains, metabolic weight gains, total feed intake, daily dry matter intake (DMI) and feed conversion ratio of the dams. Numerically, higher final live weight gain and a better FCR value were obtained in does fed 0% level of replacement of maize with sun-dried cassava peel compared to the 15 and 30% replacement levels. However, dry matter intake was numerically higher in does fed 30% replacement level of maize with cassava peel. Dietary treatments did not affect (P > 0.05) birth weight, final weight, and average daily gains of kids.

Table 2: Growth performance characteristics of pregnant West African Dwarf does and kids

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Replacement levels (%)</th>
<th>SEM</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doe</td>
<td>0</td>
<td>15</td>
<td>30</td>
</tr>
<tr>
<td>Initial weight (kg)</td>
<td>14.83</td>
<td>16.23</td>
<td>16.00</td>
</tr>
<tr>
<td>Final weight (kg)</td>
<td>28.00</td>
<td>25.75</td>
<td>26.90</td>
</tr>
<tr>
<td>Weight gain (kg)</td>
<td>13.12</td>
<td>9.52</td>
<td>10.90</td>
</tr>
<tr>
<td>Daily weight gain (g)</td>
<td>90.68</td>
<td>65.51</td>
<td>75.00</td>
</tr>
<tr>
<td>Met. wt. gain (g/doe/d W75)</td>
<td>18.34</td>
<td>14.69</td>
<td>16.07</td>
</tr>
<tr>
<td>Total feed intake (kg)</td>
<td>95.96</td>
<td>96.48</td>
<td>96.04</td>
</tr>
<tr>
<td>Dry matter intake (g/day)</td>
<td>661.7</td>
<td>665.3</td>
<td>650.9</td>
</tr>
<tr>
<td>Feed conversion ratio</td>
<td>8.77</td>
<td>14.26</td>
<td>12.80</td>
</tr>
</tbody>
</table>

Kid
3.2. Effect of week on live weight gains of does during pregnancy and early lactation

The effect of weeks on live weight gains during pregnancy and early lactation are presented in Fig. 1 and 2. Weeks of pregnancy had ($P < 0.05$) effect on mean body weight gain. The body weights of the does from the 1-4th week were significantly different ($P < 0.05$) compared to the weights in the 5-7th week, 8-11th week, 12-18th week, 19th, 20-21st week and the 22nd week. There was no effect ($P > 0.05$) of week of lactation on the live body weight changes of the does during early lactation. However, numerically, there was a slight reduction in their mean body weights from the 1-3rd weeks, and a slight increase from the 4-5th weeks.

Figure 1: Live weight gain of does during pregnancy.

Data represents means of weights as gestation progressed. $abcd$ means with uncommon superscripts are statistically different ($P < 0.05$). The trend line depicted shows an exponential increase in mean body weights.

Figure 2: Live weight changes of does during early lactation.

Data represents means of weights as lactation progressed. The trend line depicted shows a polynomial distribution of the weight data.

3.4. Effect of dietary treatments on milk yield and composition of does

The effect of replacement levels of maize with sun-dried cassava peels on milk yield and composition is shown in TABLE 3. Dietary treatments significantly affected ($P < 0.05$) crude protein and lactose. Does fed diet with 0% replacement levels of maize had the highest ($P < 0.05$) crude protein while lactose was significantly higher ($P < 0.05$) in the 30% replacement level of maize with sun-dried cassava peels. Increasing replacements levels of maize with sun-dried cassava peels showed a linear increase ($P < 0.00$) on milk protein while a quadratic increase ($P < 0.00$) in lactose was observed with increasing replacement levels of maize with sun-dried cassava peels. Milk yield and the milk components of ash, butterfat, total solids, solids-not-fat and milk energy were not affected ($P > 0.05$) by the dietary treatments.

Table 5: Effect of replacement levels of maize with sun-dried cassava peels on milk yield and composition of WAD goats during the five weeks of lactation

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Replacement levels (%)</th>
<th>SEM</th>
<th>$P$-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>15</td>
<td>30</td>
</tr>
<tr>
<td>Milk yield (ml)</td>
<td>318 276 321</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ash (%)</td>
<td>0.73 0.80 0.77</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Butter fat (%)</td>
<td>4.44 4.55 4.35</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The significant and exponential increase in body weights observed after the onset of gestation is to be expected and is a case seen in all mammals. This increase is primarily due to the weight of the developing fetus, and to body weight growth and storage in animals that have not attained maximum growth before getting pregnant [36]. In this study, during the early lactation period, it was observed that dams were heaviest at the first week of lactation, and their weights decreased and this is in agreement with reports by [37] that indicated that as lactation progresses, does mobilize body fat reserve to produce the milk required for their off-spring.

Milk quality is dependent on the nutrients of the feed and it has been reported that dietary characteristics influence milk composition of dairy goats [30]. Milk protein was significantly higher in the does fed replacement levels of maize with sun-dried cassava peels at 0 and 15% compared to the 30% replacement level. This result is contrary to the results of [38] who reported that goat’s milk protein content was not markedly changed in responses to dietary energy and fat. However, previous studies have also shown a positive correlation between both the amount and the concentration of metabolizable energy and milk protein [39]. In this study it was observed that as the level of replacement of maize with sun-dried cassava peels increased, dietary fat was decreasing but the concentration of dietary energy showed no consistent trend. However, the range of values for milk protein obtained in this study compared favourably to the value of 4.26% which has been reported for West African Dwarf goats in early lactation stages [40]. Contrary to the concentration of milk fat that of lactose cannot be easily modified by nutrition and it has been reported to be relatively constant in milk during early and mid-lactation in West African Dwarf goats [41]. In this study the dietary treatments imposed had a significant effect on lactose content and this result is in consonance with the work of [42] that reported a significant effect of diet on lactose content of milk. Lactose is the major osmotic regulator of milk whereas a strong positive correlation exists between lactose synthesis and milk yields [43]. The results obtained in this study confirmed this positive correlation as it was observed that the non-significant milk yield which was highest in the 30% replacement level of maize with sun-dried cassava peels recorded significantly higher lactose content. Results from this study showed no significant effect of dietary treatments on milk fat. It was however, observed that milk fat decreased with increasing milk yield and vice versa. This result agrees with the report of [42] and it further confirms the negative correlation between milk fat and milk yield which had been earlier reported by [44].

5. Conclusion

The findings of this study therefore suggests that up to 30% replacement level of maize with sun-dried cassava peels can be utilized in the diets of pregnant and lactating West African dwarf does with no adverse effects on dry matter intake, live weight changes, and growth parameters measured. However, the replacement level of maize with sun-dried cassava peels at 30% decreased milk protein but however improved lactose content of milk.

6. Acknowledgements

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7. References


