Research Paper Agricultural Science

Nutrient Digestibility and Intake of West African Dwarf (Wad) Goats Fed Diets Containing Graded Levels of Sweet Orange (Citrus Sinensis) Peel Meal

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ABSTRACT

Sixteen West African dwarf (WAD) goats of mixed sexes, aged between 5 - 7 months of age and having an average weight of 6.80kg were used to assess the digestibility and nutrient intake of diets containing graded levels of sweet orange peel meal (SOPM) in a completely randomized design. Four diets A, B, C and D containing 0%, 12.5%, 25% and 50% SOPM respectively were formulated and fed to the WAD goats for 84 days. Results showed that there was no significant difference ($p>0.05$) among the treatments in dry matter and nutrient digestibility of feed fed to the WAD goats. Nutrient intake of the various constituents also, did not show significant difference ($p>0.05$) among the treatments, except in ether extract (EE) values. The EE values treatments A (14.27g/day), B (15.23g/day), and C (14.63g/day) were significantly higher ($p>0.05$) than treatment D (10.97g/day), while treatment A, B and C were similar ($p>0.05$). The study shows that SOPM can be used to replace maize offal up to 50% level without detrimental effect on feed digestibility and nutrient intake by the goats.

KEYWORDS Sweet orange peel meal, WAD goats, nutrient digestibility and nutrient intake

Introduction

Several factors affect livestock productivity, but the most important environmental factor that determines livestock productivity is feed (Bamikole and Ikhatua, 2007). Adu *et al*. (1987) had earlier reported that nutrition remains one of the most important factors that determine the profitability of livestock venture. However, meeting the nutritional needs of the animals has been the major constraint militating against the increased production of valuable sources of animal protein (Fajemisin and Adeleye, 2005). Ruminants do better when energy and protein rich diets are strategically combined for feeding (Adegbola and Asaola, 1986), but the expensive nature of conventional feedstuffs as a result of competition between man and livestock (Ogunbosoye and Babayemi, 2010) makes this combination difficulty. Grasses which are the most abundant basal feed for ruminants most of the times dry up and become dormant (Lakpini, 2002), this leads to changes in the composition, nutritive value and digestibility of the grass species (Pond *et al*., 1995). As a result, the animals are unable to meet their energy and protein needs from the available poor quality herbages with subsequent marked weight losses and decreased productivity (Ademosun, 1995). Ngele *et al*. (2010) reported that several studies have shown that the crude protein of native grasses during the dry season is between 1.5 and 3%. This is by far below the minimum level of 7% CP required in forages to enhance voluntary intake, digestibility and utilization by ruminants (Smith, 1993). Thus, the need to search for alternative feed materials that are locally available and cheaper. Sweet orange peels are one such alternative feedstuff; it is available throughout the year and can be obtained at no cost. In Makurdi, they are seen in refuge dumps wasting away, however, sweet orange peels is reported to have crude protein (CP) values of 9.30-10.96% and nitrogen extract values of 65.30-67.95% (Oluremi *et al*., 2007), while Orayaga (2010) reported a CP value of 7.22% and an NFE value of 74.84%. These reports indicate that sweet orange peels have appreciable amounts of fermentable carbohydrates and if properly harnessed, it could be a source of potential feedstuff in goat production. This study was therefore designed to evaluate the digestibility of feed and nutrient intake by West African Dwarf (WAD) goats fed diets containing graded levels of sweet orange peel meal.

Materials and method

The study was carried out at the Teaching and Research Farm, University of Agriculture Makurdi, Nigeria. Makurdi lies between latitude 7^0 43' N and longitude $8^0$3' E (Microsoft Encarta, 2008). Sweet orange peels were collected from sweet orange retailers who peel and sell oranges for direct consumption. The peels were sun-dried on concrete floors for 48 hours, when it became crispy it was packed and crushed using mortar and pestle and stored in synthetic bags for use. Four complete experimental diets, A, B, C and D were formulated to contain 0%, 12.5%, 25% and 50% SOPM respectively. Sixteen WAD goats aged 5 - 7 months and weighing between 6.775 - 6.813 kg of both sexes were purchased from Markets within Makurdi metropolis and its environs and used for the study. The animals consisted of twelve males and four female, and each treatment contained a female. Animals were treated against PPR (*Peste de petit ruminants*) using PPR vaccine and ivermectin was used to check endo and ecto parasites. Thereafter, animals were randomly distributed into four dietary treatment groups of four replicates each, and each animal was a replicate. The goats were confined individually in a dwarf walled house which was demarcated into pens and each pen was divided into individual compartments. Each compartment was equipped with plastic feeders and drinkers, and the floors of each compartment were covered with wood shavings to act as litter materials and beddings for the goats. The goats were daily fed *ad libitum* between 8:00 hrs and 9:00 hrs, they were also provided daily with fresh cool clean water. Fourteen days were allowed for animals to get used to the environment and feed before data collection commenced, and the study lasted for 84 days. Seven days to the end of the experiment, the animals were transferred to metabolism cages which were fitted with nylon nets below the cages for faecal collection. Faecal samples were collected from each goat daily for seven days. Each sample was weighed, oven dried to constant weight, weighed again and then put into desiccators. The samples were bulked by replicates, mixed properly and sub-

samples were taken from each replicate for analyses of their proximate constituents. Feed and faecal samples that were to be analysed for their proximate constituents were ground using a hammer mill to pass through a sieve of 1 mm diameter. The analyses were carried out according to the methods of AOAC (1995). Data collected was subjected to one way analysis of variance (ANOVA) using the Minitab 14 (1991) statistical software. Means which had significant differences were separated using the Fisher's Least Square Difference (LSD) as outlined by Akindele (1996).

Results and discussion

Table 2 shows the nutrient digestibility of the WAD goats fed the experimental diets. Apparent digestibility of all the nutrients did not show any significant difference ($p>0.05$) among the treatments. This implies that replacement of maize offal with SOPM in the diets of the goats did not impair the digestibility of dry matter or the nutrients. Dry matter values ranged from 93.29 - 94.01%, meaning that diets would have a long shelf life. Observed values were comparable with 82.87 - 93.61% reported by Olatunji *et al*., (2007) for WAD goats fed diets containing yam peels. Sweet orange peel meal contains about 0.08% saponins and 1.26% tannins (Oloche, 2013), crude protein digestibility (89.89 - 93.01%) seemed to have been favoured by the presence of tannins and saponins in the test diets by reducing protein degradation in the rumen so that appreciable quantity was available post-ruminally for digestion. This is consistent with the reports of Barry (1987) and Kumar, (2003). Barry (1987) reported that in ruminants, dietary condensed tannins of about 2 - 3% have shown to impact beneficial effects because they reduce the wasteful protein degradation in the rumen by formation of protein - tannin complex which dissociates post-ruminally at a low pH where the protein becomes available for digestion. While Kumar, (2003) reported that saponins undergo bacteria degradation in the rumen and indeed increase the efficiency of rumen fermentation by reducing the amount of methane produced and increasing the supply of microbial protein to the animal. Crude fibre digestibility values ranged between 79.5 - 82.11%, this was probably so because the rumen micro-organisms were able to effectively digest the nature of fibre in the diets. Observed values were comparable with 78.40 - 80.62% reported by Maigandi and Abubakar (2004) for red Sokoto goats fed diets containing graded levels of *Faidherbia albida* pods. Nitrogen free extract values were between 93.90 - 96.06%, indicating that appreciable amounts of fermentable carbohydrates were digested. This agrees with the report of Kotarski *et al*. (1991) that high organic matter digestibility implies that the major carbohydrate was starch and it was effectively fermented by amylolytic bacteria and protozoan. Table 3 presents the nutrient intake of the experimental animals. None of the parameters was significantly different ($p>0.05$) among the treatments. Dry matter intake ranged from 77.17 - 83.64g/day, implying that the goats had appreciable amount of DM for use. Observed values were comparable with 69.28 - 81.22g/day DM reported by Arigbede *et al*. (2007) for WAD sheep fed graded levels of wild cocoa yam (*Anchomanes difformis*) and *Pennisetum purpureum*. Crude protein intake values were between 21.43 - 23.24g. Treatments containing SOPM had values that were similar to the control implying that the nutrient intakes of these treatments were also adequate. Nitrogen free extract values which ranged between 44.81 - 51.81g/day were similar with the control. This implies that, all the treatments provided moderately average amounts of fermentable carbohydrates for energy supply. Ether extract intake value was significantly ($p>0.05$) lower in treatment D (10.97g) than in treatment A (14.27g), B (15.23g) and C (14.63g). This may have been as a result of the lower EE content in diet D (6.02%) as seen in Table 1. This is no disadvantage to treatment D as excess fat in ruminant feeds slows down the activities of rumen micro organisms when it is above 50g/100kg feed (McDonald *et al*., 1995).

Conclusion

Results obtained from this study showed that replacement of maize offal with SOPM up to 50% level did impair effective digestibility of the feed and nutrient intake was not impaired. Therefore, farmers could replace maize offal with SOPM in the diets of goats up to 50% level without deleterious effects on feed break down and nutrients uptake, this will help alleviate the feed stress small ruminants experience during the long dry seasons particularly in Nigeria dry season period.

Table 1: Dietary composition of experimental diets fed to WAD goats (DM basis)

Feed Ingredients (%)	Experimental Diets			
	A	B	C	D
Rice offal	20.00	20.00	20.00	20.00
Maize offal	48.81	42.71	36.61	24.41
Sweet orange peel meal	0	6.10	12.20	24.40
Full fat Soybeans meal	28.19	28.19	28.19	28.19
Bone ash	2.00	2.00	2.00	2.00
Common salt	1.00	1.00	1.00	1.00
Total	100.00	100.00	100.00	100.00
Determined				
Dry matter	89.80	89.07	89.97	88.67
Crude protein	16.41	16.00	16.23	14.72
Crude fibre	14.22	13.16	11.05	12.27
Ether extract	9.55	7.58	8.67	6.02
Nitrogen free extract	50.81	53.84	54.93	57.93
Ash	9.01	9.42	9.12	9.82

DM= Dry matter, A = 0%SOPM, B = 12.5%SOPM, C = 25%SOPM, D = 50%SOPM

Table 2: Nutrient digestibility of WAD goats fed diets containing sweet orange peel meal (DM basis).

Nutrients (%)	Experimental Diets				SEM
	A	B	C	D	
Dry matter	94.01	93.46	93.77	93.29	0.48^{ns}
Organic mater	90.68	91.43	92.87	90.32	0.28^{ns}
Crude protein	91.32	92.16	93.01	89.89	0.33^{ns}
Crude fibre	82.11	79.51	81.53	81.10	0.93^{ns}
Nitrogen free extract	93.90	95.71	96.06	94.01	0.26^{ns}
Ether extract	92.79	94.47	94.42	90.29	0.33^{ns}

SEM = Standard error of mean, ^{ns} = Not significant ($p>0.05$)

DM= Dry matter, A = 0%SOPM, B = 12.5%SOPM, C = 25%SOPM, D = 50%SOPM

Table 3: Nutrient intake of WAD goats fed diets containing sweet orange peel meal (DM basis)

Nutrients (g/day)	Experimental Diets				SEM
	A	B	C	D	
Dry matter intake (DMI)	81.17	77.17	83.64	83.23	0.73^{ns}
Organic matter intake (OMI)	75.26	73.06	77.71	76.81	0.61^{ns}
Crude protein intake (CPI)	23.24	21.99	23.17	21.43	0.25^{ns}
Crude fibre intake (CFI)	19.31	16.22	15.31	17.24	0.32^{ns}
NFE intake (NFEI)	44.81	50.94	51.25	51.81	1.88^{ns}
Ether extract intake (EEI)	14.27^{a}	15.23^{a}	14.63^{a}	10.97^{b}	0.18*

SEM = Standard error of mean, ^{ns} = Not significant ($p<0.05$), DM= Dry matter A = 0%SOPM, B = 12.5%SOPM, C = 25%SOPM, D = 50%SOPM

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