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Effect of Replacement of Sweet Orange (*Citrus Sinensis*) Peel Meal with Maize Offal on Apparent Digestibility and Nutrient Intake of West African Dwarf (Wad) Goats

[1]J. Oloche, [1]Ayoade, J. A. and [2]Oluremi, O.I.A
[1]*Department of Animal Production, University of Agriculture, Makurdi*
[2]*Department of Animal Nutrition, University of Agriculture, Makurdi*

Abstract: *Sixteen West African Dwarf (WAD) goats of mixed sexes, aged between 5 -7 months of age and having an average weight of 6.80 kg were used to assess the nutrient digestibility and 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 show that there was no effect (p>0.05) of treatment on dry matter, organic matter, crude protein, crude fibre, nitrogen free extract and ether extract digestibility of WAD goats. Nutrient intake was also not affected (p>0.05) among the treatment groups except ether extract intake where treatments A, B, and C were significantly higher (p>0.05) than treatment D, while between treatment A, B and C there was no difference (p>0.0). The study shows that SOPM can be used to replace maize offal up to 50% without negative effect on nutrient digestibility and intake of WAD.*
Key words: *Sweet orange peel meal, maize offal, WAD goats, nutrient digestibility, nutrient intake*

I. 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 lead to a change in the composition, nutritive value and digestibility of the grass species (Pond *et al*., 1995). As a result animals are unable to meet their energy and protein need from the available poor quality herbage with subsequent marked weight loss and productivity (Ademosun, 1994). For instance, studies have shown that the crude protein of native grasses during the dry season is between 1.5 and 3% (Adamu *et al*., 1993) cited by Ngele *et al*. (2010). 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 feedstuffs that are locally available and cheaper. Sweet orange peels is one such alternative feedstuff. It is available throughout the year and can be obtained at no cost (Oluremi *et al*., 2007). This study was therefore designed to evaluate the digestibility and nutrient intake of West African Dwarf (WAD) goats fed diets containing sweet orange peel meal.

II. Materials and Method

The study was carried out at the Teaching and Research Farm, University of Agriculture Makurdi, Nigeria. The site lies between latitude 7^0 43' N and longitude $8^0$3' E (Microsoft Encarta, 2008). Sweet orange peels were collected from sweet orange sellers who peel and retail oranges for direct consumption. This was dried on concrete floors for 48hrs, when it became crispy it was packed and crushed using mortar and pestle and stored in synthetic bags for use. Four experimental diets, 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 used. This consisted of twelve males and four female, and a female was in each replicate. Animals were treated against PPR using PPR vaccine and ivomectin was used to check endo and ecto parasites. Thereafter, animals were randomly distributed into four treatment groups of four replicates each, and each animal was a replicate. These were daily fed *ad libitum* between 8.00 hr and 9.00 hr. They were also provided daily with fresh cool clean water. Twenty one days were allowed for animals to get used to the environment and feed before data collection commenced, the animals were fed for 84 days. Seven days to the end of the experiment, the animals were transferred to metabolism cages and nylon nets were fitted below the cages for faecal collection. Faecal samples were collected from each goat for 7 days, these were bulked and subsamples were taken from each replicate. Both feed and faecal samples were ground using a hammer mill to pass through a sieve of 1 mm diameter and analysed for their proximate constituents. The analysis was carried out according to the methods of AOAC (1990). Data collected was subjected to one way analysis of variance (ANOVA) in a completely randomized design using the Minitab (1991) statistical software.

III. Results and discussion

Table 2 shows the nutrient digestibility of the WAD goats fed the experimental diets. Apparent nutrient digestibility of all the nutrients did not show any significant difference (p>0.05) among the treatments. This indicates that the incorporation of SOPM in the diets of the goats did not have negative effect on digestibility. Dry matter (93.29 – 94.01%) 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 saponin and tannins as reported by Oyewole (2011), crude protein digestibility (89.89 – 93.01%) seemed to have been favoured by the presence of tannin and saponin 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 report of Babayemi and Bamikole (2009), that the presence of tannin and saponin lowers the solubility of proteins entering the abomasums and small intestine for digestion. Crude fibre digestibility ranged between 79.5-82.11%, the high CF digestibility was probably because the rumen micro-organisms were able to effectively digest the nature of fibre in diets. Observed values were comparable to 78.40 – 80.62% reported by Maigandi and Abubakar (2006) for red Sokoto goats fed diets containing graded levels of *Faidherbia albida* pods. Nitrogen free extract were between 93.90 – 96.06%, indicating that appreciable amounts of fermentable carbohydrates was 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 affected (p>0.05) by dietary treatments. Dry matter intake ranged from 77.17 – 83.64g/day, and was similar to 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 intake values which were between 21.43 – 23.24g was 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 sufficient fermentable carbohydrates for adequate energy supply. Ether extract intake was significantly lower in treatment D than in treatment A, B and C. This may have been as a result of the lower EE content in diet D as seen in Table 1. Treatment D had the least EE content (6.02%) this has no disadvantage as excess fat in feed slows down the activities of rumen micro organisms (McDonald *et al*., 1995). However, EE intake observed was higher than 1.70 – 2.27g/day reported by Ngi (2005) for goats fed rice straw and supplemented with graded levels of dried cassava leaf meal and maize offal.

IV. Conclusion

Results obtained from this study showed that incorporation of sweet orange peel meal (up to 50% level) did not hinder effective digestibility of the feed and nutrient intake of the experimental animals. Thus sweet orange peel meal can be incorporated in diets of WAD goats up to 50% level particularly during the dry season to help augment their nutrient intake and alleviate the feed stress small ruminants experience during the dry season period.

Table 1: Dietary composition of experimental diets fed to west african dwarf 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 Soyabean 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 prorein	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: Dry matter and nutrient digestibility (g/kgw$^{0.75}$) of west African dwarf goats fed diets containing sweet orange peel meal (DM basis).

	Experimental Diets				
Nutrients (%)	A	B	C	D	SEM
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}
Ash	80.25	86.76	86.72	81.60	0.78^{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: Dry matter and nutrient intake of west african dwarf goats fed diets containing sweet orange peel meal (DM basis)

	Experimental Diets				
Nutrients (g/day)	A	B	C	D	SEM
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*
Ash intake	13.43	13.67	14.31	14.19	0.13^{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

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