Effects of Dried Water Melon and Sweet Orange Peel (DWMOP) Meal Mixture on the Performance and Carcass Characteristics of Growing Rabbits

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***Abstract*—** A feeding trial was conducted to determine the effects of dried water melon and sweet orange peel (DWMOP) meal mixture on the performance and carcass characteristics of growing rabbits. Sixty (60) 7-8 weeks New Zealand White rabbits of different sex with an average weight of 630 – 645 g were randomly divided into five (5) dietary treatments with six (6) replicates and each rabbit representing a replicate in a completely randomized design (CRD) for a period of 12 weeks. Treatment (T1) 1 was fed basal diet without DWMOP, T2, T3, T4 and T5 were fed basal diets supplemented with DWMOP at levels of 5%, 10%, 15% and 20 % respectively. Result revealed no significant differences ($P>0.05$) in average final weight, daily weight gain, feed intake and feed conversion ratio. Higher mortality was recorded in T1; none was recorded in the other treatments ($P<0.05$). Nutrient digestibility (DM, CP, CF, EE and NFE) were not influenced by feeding DWMOP to the rabbits ($P>0.05$). It was concluded that DWMOP contains several bioactive chemicals and nutrients capable of supporting the growth of animals and it can be fed to rabbits at 20% without any deleterious effect on their general performance.

***Keywords*—** *Rabbits, performance, sweet orange, water melon.*

I. INTRODUCTION

In developed countries, the human population growth is stabilizing while that of developing countries including Nigeria is still increasing rapidly. This has necessitated the need to search for alternative sources of protein to meet up the population growth (Aduku and Olukosi, 2000). Among such alternatives are the use of watermelon peels sweet orange peel and some other plant residues which are found abundant in minerals/ vitamins and can be used to feed animals like rabbits due to fast-growing characteristics and their ability to convert tropical forages and agricultural by-products to human food (meat). Rabbit production has a great potential since it is a means of converting forages and agricultural by-products to rabbit meat (Onifade et al., 1999). Although, the potential has not been fully explored but with a few exceptions, most of the projects centered on rabbit in some developing countries may have failed to be sufficiently productive as to have much impact.

Rabbit meat is sixth after beef, fish, mutton, goat meat (chevon) and bush meat or game animals in the parametric assessment of meat animal production and consumption in Nigeria (Onifade et al., 1999). Aduku and Olukosi (2000) and Onifade et al. (1999) reported that rabbit production has a lot of benefits among which includes its high adaptability, easiness to handle and manage, high growth rate, high efficiency in converting forage to meat, short gestation period and very high prolificacy. It also provides high returns on investment, high quality meat products and it contains high protein level of about 20.8%, low sodium, low fat and cholesterol levels which compares favourably with the local bush meat. Its use for laboratory processes and as pets and its faeces is a good source of manure, and its consumption is without cultural and religious biases (Omole et al., 2005). The presence of caecal microbes enables the rabbit to digest large amounts of fibrous feed as most non ruminant species cannot (Oluremi et al., 2005). Costs of beef, chevon, mutton, chicken and frozen fish are high compared to rabbit meat (Aduku and Olukosi, 2000; Abo et al, 2014).

Although extensive studies had shown that watermelon rind had an appreciable quantity of phytochemicals, antioxidant, proximate components and anti-nutritional factors (Fila et al., 2013). But there are only little or no information on supplementing dried watermelon rinds and sweet orange peel on the general performance and nutrient digestibility of rabbits. This experiment on watermelon rind and sweet orange peel meal inclusion in rabbits' diet will further give an idea on the nutritional composition of the material as well as its use as an alternative unconventional agricultural feedstuff.

II. MATERIALS AND METHODS

EXPERIMENTAL SITE

The experiment was carried out at the University of Abuja Teaching and Research Farm, Animal Science Section, Main Campus, along Airport Road, Gwagwalada, Abuja-Nigeria, located between latitude 8057I and 8055IN and longitude 7005I and 7006IE.

SOURCE OF TEST MATERIAL AND PREPARATION

Freshly cut water melon peel and sweet orange peel (Citrus sinensis) were collected from the popular Orange Market, Mararaba/Nyanyan, a suburb market between Nasarawa state and the FCT Abuja. The samples were thoroughly washed under running water to remove sand particles after which they were sliced to smaller pieces using a home choice knife, and sun-dried. The pulp of the watermelon was carefully scraped off to obtain the rind. The samples were oven dried at 60-70oC for two days, pulverized separately to obtain the water melon rind meal and orange peel meal and stored into an air tight container for further analysis.

ANIMAL MANAGEMENT AND EXPERIMENTAL DESIGN

A total of sixty rabbits 7-8 weeks rabbits with an average weight of 630 – 645 g were sourced from the National Animal Production Research Institute (NAPRI) Zaria, Kaduna State and used for the experiment. Prior to the commencement of the experiment the rabbit hutches were properly cleaned and disinfected. Animals were weighed before the commencement of the experiment to obtain the initial body weight, housed in an all wired hutch and randomly divided into five (5) dietary treatments with six (6) replicates and each rabbit representing a replicate in a completely randomized design (CRD). Animals were allowed two weeks of acclimatization, feeders and drinkers were made available in each hutch. The drinkers were washed regularly before fresh water was frequently served ad-libitum and other prophylactic treatment was administered throughout the experimental period which lasted for 12 weeks.

FORMULATION OF EXPERIMENTAL DIETS

The watermelon peel and the orange peel were mixed together at 50/50 to obtain (DWMOP). The test material was mixed with other ingredients to form five experimental diets. DWSOP was partially used to replace wheat offal at 0%, 5 %, 10 %, 15 % and 20 % respectively.

MEASURED PARAMETERS

Feed intake (g/rabbit) = Feed offered (g) - Leftover (g)

Feed conversion ratio (FCR) = Total feed Intake (g)/ Total weight gain

Average daily gain (ADG) = (Final body weight – Initial body weight)/Total days of the experiment

Mortality was recorded as it occurs.

NUTRIENT RETENTION AND APPARENT DIGESTIBILITY

At the last week of the experiments, fifteen (15) rabbits (3 per treatment) were randomly selected and were housed individually in cages with trays underneath which allow for easy collection of faeces. Each cage was provided with manual feeder and drinker. Feed consumed was measured by weighing the left over feed daily and subtracting from amount of feed provided The digestibility study lasted seven days. Faeces were collected for seven days, dried and mixed thoroughly. Contamination was carefully removed (Perez et al., 2004). The collection was performed each morning before the next daily ration was provided. 5% of faeces voided were dried at 800C. The dried faecal samples were stored in air-tight container for chemical analysis using the methods described by (AOAC, 2000). This can be represented using the equation

Digestibility (%) = (Cfeed - Cfaeces) × 100/Cfeed

Where Cfeed and Cfaeces refer to the amount of feed eaten and faecal excretion respectively.

LABORATORY ANALYSIS

Proximate analysis of the experimental diet and test material were carried out according to AOAC (2005) procedures.

III. STATICAL ANALYSIS

All data were subjected to one -way analysis of variance (ANOVA) using SPSS (18.0) and significant means were separated using Duncan multiple range tests (Duncan, 1955). Significance was declared if $P \leq 0.05$.

Table 1 Chemical composition of experimental diet

Materials	T1	T2	T3	T4	T5
Maize	30.00	30.00	30.00	30.00	30.00

Wheat offal	55.20	52.44	50.20	42.67	34.14
DWMOP	0.00	2.76	5.24	7.53	8.53
Soya meal	9.74	10.74	10.74	10.74	10.74
Groundnut cake	1.26	5.26	5.26	5.26	5.26
Limestone	1.00	1.00	1.00	1.00	1.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Lysine	0.15	0.15	0.15	0.15	0.15
Methionine	0.15	0.15	0.15	0.15	0.15
Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Total	100.0	100.0	100.0	100.0	100.0

CALCULATED ANALYSIS

Crude protein (%)	16.43	16.35	16.22	16.10	16.02
Crude fibre (%)	10.62	10.47	10.30	10.10	10.00
Ether extract (%)	3.52	3.49	3.43	3.38	3.27
Energy (Kcal/kg)	2732.1	2715.0	2700.1	2698.9	2690.0

Table 2 Proximate composition of test material (DWMOP)

Parameters	Composition(%)
Dry matter	87.60
Crude protein	13.67
Crude fibre	1.98
Ether extract	2.10
Energy (Kcal/kg)	1978.9

Table 3 Performance characteristics of growing rabbits fed different levels of DWMOP

Parameters	T1	T2	T3	T4	T5	SEM
IBWt (g)	630.33	631.63	645.36	630.70	631.72	34.16
FWt (g)	1461.0	1461.0	1434.0	1430.0	1389.17	51.22
WG (g)	830.67	829.37	788.64	799.3	757.45	21.09
ADWG (g)	11.86	11.85	11.26	11.41	10.82	5.77
FI (g)	4810.9	4808.6	4809.6	4806.1	4804.8	87.34

ADFI (g)	66.81	68.69	68.71	68.65	68.60	11.21
FCR	5.79	5.79	5.80	5.81	5.88	4.03
Mortality	3	0	0	0	0	0.01

IBWt: Initial weight; FWt: Final weight; WG: weight gain; ADWG: Average Daily Weight Gain FI: Feed Intake; FCR: Feed Conversion Ratio

Table 4 Nutrient retention traits of growing rabbits fed different levels of DWSOP

Parameters	T1	T2	T3	T4	T5	SEM
DM (%)	89.19	88.78	88.50	88.29	88.15	17.11
CP (%)	65.11	65.00	64.89	64.55	64.71	10.29
CF (%)	53.98	51.67	50.88	51.00	51.26	7.38
EE (%)	45.84	44.50	44.04	44.01	44.61	9.06
NFE (%)	71.03	70.20	70.82	70.10	70.00	10.38

DM: dry matter; CP: crude protein; CF: crude fibre; EE: ether extract; NFE: nitrogen free extract

IV.RESULTS AND DISSCUSSION

Table 1 shows the chemical composition of the experimental diet. The crude protein (CP), crude fibre (CF), ether extract (EE) and energy (ME) range between 16.02 – 16.43 %, 10.0 – 10.62 %, 3.38 – 3.52 and 2690 – 2732 Kcal/kg respectively. The values obtained were within the nutritional requirement for rabbits according to NRC (1977). Lebas et al. (1980); Cheeke et al. (2000) and Alagbe (2018) reported a nutritional range of 16-18 % CP, 10-15 % CF, 3.0 – 5.0 % EE and 2500 – 2700 Kcal/kg (ME) for growing rabbits. According to Alagbe (2020), nutrition is one of the important cardinals of management that should not be compromised to achieve good result in livestock production. Table 2 reveals the nutritional composition of test material (DWMOP). The proximate components contained dry matter (DM), crude protein (CP), crude fibre (CF), ether extract (EE) and energy at 87.60 %, 13.67 %, 1.98 %, 2.60 % and 1978.9 Kcal/kg. The value obtained for CP is lower than the values reported for sweet orange peel meal (10.10 %), water melon peel rind (7.45 %), Ipomea batatas leaf meal (7.15 %) as reported by Ojabo et al. (2012); Alagbe (2018) and Shittu et al. (2020). This is an indication that DWMOP cannot be used as a protein supplement because it has less than 20% CP (NRC, 1994). The ash content of a sample is a measure of minerals in a sample (Ojewuyi et al., 2014). The ash obtained is in agreement with the reports of Atamgba et al. (2015) and Olanipekun et al. (2016). Energy values obtained is contrary to the reports of Madubuike and Ekenyem (2006) and Alagbe and Omokore (2019). The performance characteristic of growing rabbits given different levels of DWMOP is presented in Table 3. Final live weight (LW), weight gain (WG), average daily gain (ADG), feed intake (FI), average daily feed intake (ADFI) and feed conversion ratio (FCR) range between 1389.2 – 1461.0g , 757.5 – 830.7g , 10.82 – 11.86g , 4804.8 – 4810.9 g , 66.81-68.60 g and 5.79 – 5.88 respectively. The parameters were not significantly influenced ($P > 0.05$) across the treatments. Mortality was highest in T1 (0%) and none was recorded in the other treatments ($P < 0.05$). This is a clear indication that the nutritional requirement of the animals was met to ensure optimal production. The result obtain is in agreement with the findings of Hadiza (2019) on growing rabbits fed with mixtures of brewers dry grain and sorghum brewers grain diet but contrary to the findings of Shehu et al. (2014) on waeaner rabbits supplemented with varying levels of baker's yeast. Similar result was recorded by Olatunji et al. (2015); Salisu et al. (2011); Shaanu et al. (2014) who reported a significant difference ($P < 0.05$) in rabbit fed raw and processed Lablab purpureus seed in diet of rabbits. No mortality was recorded in T2, T3, T4 and T5; this could be attributed to the presence of phytochemicals in sweet orange peel and water melon rind peel. According to Olafadehan et al. (2020); Alagbe et al. (2017), phytochemicals contains several bioactive chemicals (tannins, flavonoids, alkaloids, saponins, phenols, glycosides, terpenoids etc.) which perform multiple biological activities such as anti-inflammatory, antifungal, antiviral, antimicrobial, anti-helminthic and antioxidant properties. Table 4 shows the effect of treatments on nutrient retention of growing rabbits. Dry matter, CP, CF, EE and nitrogen free extract (NFE)

range between 88.15 – 88.50 %, 64.71 – 65.11 %, 50.88 – 53.98 %, 44.01-45.84 % and 70.00 – 71.03 % respectively. No significant difference (P >0.05) was observed among the treatments. This result is contrary to the findings of Osakwe and Nwose (2008) but in agreement with the findings of Adeyemi et al. (2014) when diets were fed diets containing fermented and unfermented cassava leaf:peel meal mix as replacement for maize.

V.CONCLUSION

The findings in this study revealed that dried water melon and sweet orange peels meal mixture has a reasonable amount of energy content, implying that the test ingredient can support growth in the diets of weaner rabbits. There was no significant increase in feed intake, final body weight and weights of the organs of the rabbits when compared to a control diet. Though, the feed intake recorded for rabbits fed 5% dried water melon and sweet orange peels meal mixture had a better feed conversion ratio. Dried water melon peel and sweet orange peel meal mixtures could be included in the diet of weaner rabbits up to 20% without any deleterious effect on the health and general performance of rabbits.

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