PROXIMATE COMPOSITION AND ENERGY VALUES OF SOME CHAFFS, LEAVES AND PEELS AS FEED RESOURCES FOR RUMINANTS

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ABSTRACT
This study was to determine the proximate composition and energy values of twenty (20) feedstuffs (consisting chaffs, leaves and peels) ordinarily considered 'waste' and prone to being discarded with environmental consequences. Fresh samples of leaves and peels were washed, sun-dried, milled, sieved and packaged for laboratory analysis. Results showed that among chaffs, highest values of CP, fat, DM, NFE and ME were found in Palm Kernel Cake (19.83%), Groundnut Testa (6.35%), Maize Cob (94.63%), *Burukutu* Waste (56.61%) and Maize Offal (3072.13 Kcal/kg) respectively; Rice Milling Waste had the highest ash (19.81%) and CF (27.05%). For leaves, highest values of CP 27.44% was found in Sweet Potato Leaves while ash of 14.93% and CF of 25.10% were both found in Maize Leaves; cassava Leaves had the highest fat (6.52%), DM (92.81%), NFE (60.66%) and ME (2829.81 Kcal/kg). Among peels, CP (28.11%) and ash (17.60%) were highest in Cabbage Waste, while DM (95.30%), NFE (75.51%) and ME (3147.04% Kcal/kg) were highest in Sweet Potato Peels; fat (4.74%) and CF (30.36%) were highest in watermelon peels and Groundnut Shells respectively. From this study, it is clear that these unconventional feedstuffs can meet the nutrient requirements of ruminant especially protein fibre and fat and adequately supply energy for metabolic and productive activities ,These 'wastes' when harnessed and mixed in required proportions and used as feed for ruminants will help to reduce environmental pollution, reduce feed cost, reduce competition between man and livestock for conventional feeds, increase farmers' profitability and bring about sustainable agriculture.
Keywords: Proximate composition, energy values, chaffs, leaves and peels.

INTRODUCTION
Nutrition is a basic aspect of animal production. Thus, feeding farm animals with balanced diet is essential for success in the livestock industry. Most literature materials on the proximate and energy compositions of feed stuffs are not current and that for some non-conventional feed stuffs do not even exist. There is a tendency that climate change over the years would have affected the composition of these feed stuffs. On the other hand, feed costs account for 65 - 70% of the total cost of production in the intensive system of animal production (Okpanachi *et al.*, 2022). A reduction in feed cost is achievable by use of unconventional feed resources to bring about improvement in ruminant production efficiency in developing countries like Nigeria (Okukpe *et al*., 2019).

Effects of Climate Change on the Nutrient Composition of Feedstuffs.
Climate Change refers to long-term shifts in temperatures and weather patterns (United Nations Report, 2022). Human activities since the 1800s such as energy production, industry, transportation and agriculture have been the main driver of climate change primarily due to burning fossil fuels which generate greenhouse gas emissions (CO_2 and CH_4) that act like a blanket wrapped around the earth, trapping the sun's heat and raising temperature. This also leads to intense drought, water scarcity, severe fires, flooding and declining biodiversity (United Nations Report, 2022). Drought stress and high temperature are important environmental factors which restrict plant growth and alter tissue chemical composition (Xu and Zhou, 2006). Under drought, alfalfa for instance accumulated starch, but lowered soluble sugars during vegetative growth (Erice *et al.,* 2006). Changes in weather conditions have been reported to affect the nutrient quality of forages consumed by ruminants, especially during the dry season in some parts of the country with the crude protein of grasses falling below 6% (Onwuka and Olatunji, 1996).

MATERIALS AND METHODS
Twenty (20) feedstuffs (consisting of 7 chaffs, 4 leaves and 9 peels) were collected, sorted, washed, sun-dried, milled using mortar and pestle, sieved to obtain finer particles, packaged in transparent containers and labelled properly. These were sent in triplicates to Priority Laboratory Services, Rukuba Road, Jos, Plateau State for proximate analysis and determination of energy values (Metabolizable Energy). Proximate analysis of samples

was carried out according to the method of AOAC (2006) while metabolizable energy was calculated as described by Pauzenga (1985). A completely randomized design (CRD) was used for this study. Data collected were subjected to a one-way analysis of variance (ANOVA). Means with significant differences were separated using Duncan Multiple Range Test contained in SPSS package (version 20).

RESULTS AND DISCUSSION

Table 1: Proximate Composition and Energy Values of some Chaffs, Leaves and Peels as feeds for Ruminants.

Feedstuffs	**Proximate Composition and Energy Values**						
	CP (%)	FAT (%)	ASH (%)	CF (%)	DM (%)	NFE (%)	ME (K Cal/Kg)
Chaffs							
OR	8.95^{e}	5.15^{b}	5.31^{b}	14.93^{c}	88.02^{d}	53.68^{c}	2661.72^{d}
BKTW	17.71^{b}	3.48^{c}	3.51^{e}	11.43^{e}	92.75^{b}	56.61^{a}	2949.99^{b}
MO	17.55^{b}	5.28^{b}	4.85^{c}	9.16^{f}	92.92^{b}	56.08^{ab}	3072.13^{a}
MC	9.99^{d}	2.01^{d}	4.05^{d}	23.24^{b}	94.63^{a}	55.34^{b}	2498.23^{e}
RMW	8.88^{e}	3.68^{c}	19.81^{a}	27.05^{a}	94.57^{a}	35.15^{e}	1877.14^{g}
GT	16.16^{c}	6.35^{a}	19.59^{a}	14.31^{d}	88.91^{c}	32.50^{f}	2270.95^{f}
PKC	19.83^{a}	2.02^{d}	5.28^{b}	15.10^{c}	94.37^{a}	52.14^{d}	2749.88^{c}
SEM	**0.98**	**0.35**	**1.53**	**1.33**	**0.57**	**2.15**	**85.01**
LoS	**	**	**	**	**	**	**
Leaves							
ML	15.37^{c}	3.78^{c}	14.93^{a}	25.10^{a}	91.31^{b}	32.14^{d}	2018.47^{d}
CL	3.88^{d}	6.52^{a}	9.07^{c}	12.68^{b}	92.81^{a}	60.66^{a}	2829.81^{a}
SPL	27.44^{a}	4.54^{b}	14.12^{b}	7.95^{d}	91.28^{b}	37.23^{b}	2708.16^{b}
CARL	23.77^{b}	3.44^{d}	13.85^{b}	11.90^{c}	88.78^{c}	35.84^{c}	2433.72^{c}
SEM	**2.73**	**0.36**	**0.70**	**1.94**	**0.44**	**3.39**	**94.08**
LoS	**	**	**	**	**	**	**
Peels							
CW	28.11^{a}	4.60^{a}	17.60^{a}	14.22^{d}	88.85^{e}	24.32^{h}	2279.84^{g}
OP	10.36^{e}	4.56^{a}	9.05^{c}	15.93^{c}	90.06^{d}	50.15^{e}	2536.62^{f}
CAP	10.58^{de}	2.43^{cd}	6.58^{f}	11.01^{e}	92.58^{b}	61.98^{c}	2790.38^{d}
SPP	8.91^{f}	1.67^{e}	4.30^{g}	4.91^{g}	95.30^{a}	75.51^{a}	3147.04^{a}
MP	4.34^{h}	4.63^{a}	6.99^{e}	11.21^{e}	87.64^{f}	60.47^{c}	2685.88^{e}
IPP	16.98^{b}	2.92^{b}	7.36^{d}	7.01^{f}	90.97^{c}	56.70^{d}	2880.36^{c}
GS	10.71^{d}	2.01^{de}	4.28^{g}	30.36^{a}	95.09^{a}	47.72^{f}	2254.60^{g}
YP	8.03^{g}	2.70^{bc}	4.28^{g}	4.17^{g}	90.68^{c}	71.50^{b}	3056.34^{b}
WP	15.99^{c}	4.74^{a}	13.09^{b}	26.09^{b}	89.74^{d}	29.83^{g}	2038.06^{h}
SEM	**1.29**	**0.24**	**0.84**	**1.69**	**0.49**	**3.20**	**70.72**
LoS	**	**	**	**	**	**	**

Key: OR: Orange Residue, BKTW: Burukutu Waste, MO: Maize Offal, MC: Maize Cob, RMW: Rice Milling Waste, GT: Groundnut Testa, PKC: Palm Kernel Cake, ML: Maize Leaves, CL: Cassava Leaves, SPL: Sweet Potato Leaves, CARL: Carrot Leaves, CW: Cabbage Waste, OP: Orange Peels, CAP: Cassava Peels, SPP: Sweet Potato Peels, MP: Mango Peels, IPP: Irish Potato Peels, GS: Groundnut Shells, YP: Yam Peels, WP: Watermelon Peel/rind, CP: Crude Protein, CF: Crude Fibre, DM: Dry Matter, NFE: Nitrogen Free Extract, ME: Metabolizable Energy, SEM: Standard Error Mean, LoS: List of Significance, **:$P<0.01$

For chaffs considered, results indicated that PKC had the highest CP (19.83%) followed by BKTW (17.71%), MO (17.55%) and GT (16.16%) while its lowest in RMW (8.88%). GT (6.35%) had the highest fat while MC (2.01%) was lowest in fat. RMW (19.81%) was highest for ash content while BKTW (3.51%) had the lowest. Crude Fibre was highest in RMW (27.05%), while the lowest was in MO (9.16%). DM was highest in maize cob (94.63%) while OR (88.02%) had the lowest. NFE of 56.61% was highest in BKTW, while it was lowest in GT (32.50%). ME was highest in MO (3072.13 Kcal/kg), and lowest in GT (2270.95 Kcal/kg).

From results for leaves, CP was highest in SPL (27.44%) and lowest in CL (3.88%). Meanwhile for fat, CL (6.52%) had the highest value, while CARL (3.44%) recorded the lowest. Ravidran (1991) found 21% CP, 5.5% fat, 20% CF, 8.5% ash and 93% DM in cassava leaves (CL). Ezeldin *et al.* (2013) reported carrot leaves to contain 9.35% protein, 2.8% fat, 21.16% ash, 7.8% fibre and 95.5% DM. Okpanachi *et al*. (2021a) also reported carrot leaves to have 27.05% protein, 2.67% fat, 14.71% ash, 6.23% fibre and 96.28% DM. These values are closer in range with the present experiment. Ash was highest in ML (14.93%), while it was lowest in CL (9.07%). Crude fibre was highest in ML (25.10%) but lowest in SPL (7.95%). CL (92.81%) had the highest DM, while CARL (88.78%) had the lowest. NFE was highest in CL (60.66%) but lowest in ML (32.14%). ME was highest in CL (2829.81 Kcal/kg) but lowest in ML (2018.47 Kcal/kg). The energy value of 2668.36 Kcal/kg reported for SPL by Unigwe (2011) is similar to (2708.16 Kcal/kg) obtained in this study.

From the results on peels, CP was highest in CW (28.11%) but lowest in YP (8.03%). The CP value (27.11% protein, 2.83% fat, 14.54% ash, 6.04% fibre and 96.36% DM) for CW reported by Okpanachi *et al.* (2021a) is very close to that obtained in this study. This may be due to the fact that the cabbage waste was collected within the same geographical area though at difference times and analysed in different laboratories. Aduku (2012) reported the following for yam peel; 11.21% CP, 1.17% fat, 9.76% ash and 9.47% CF. In this study, fat was highest in WP (4.74%) but lowest in SPP (1.67%). CW is very rich in ash (17.60%) as they have a rich deposit of minerals, while GS and YP recorded the lowest value (4.28%). The values of fat (4.00%) and ash (16.61) for WP as reported by Okpanachi *et al.* (2021b) is similar to those of this study. Crude fibre was highest in GS (30.36%) but lowest in YP (4.17%). DM was highest in SPP (95.30%) but lowest in MP (87.64%). Also, ME was highest in SPP (3147.04 Kcal/kg), but lowest in WP (2038.06 Kcal/kg). SPP and YP are good energy sources. From this study, it is clear that these unconventional feedstuffs can meet the nutrient requirements of ruminants. However, feeding ruminants should be done discreetly with a level of knowledge on the nutrient composition. Cassava leaves and peels for example can be toxic to ruminants when fed in large quantities. Thus, a level of processing to reduce such toxins should be carried out before feeding livestock. Some of the variations that exist when the result of this study is compared with those of previous studies could be as a result of climate change over time, variety of crops from which samples were obtained by different authors, different approaches used during processing of samples for laboratory analysis, varied laboratory procedures carried out par time.

CONCLUSION AND RECOMMENDATION

The feedstuffs considered can all be utilized to feed ruminants. Protein is vital for ruminants as it boosts their produ PKC (19.83%) is a useful protein source alongside BKTW (17.71%), MO (17.55%), GT (16.16%), SPL (27.44%), CARL (23.77%), ML (15.37%) and RMW (8.88%). These should be collected from reliable sources for feed formulation. Feedstuffs rich in fats such as CL (6.52%), GT (6.35%), MO (5.28%), OR (5.15%) and SPL (4.54%) should be utilized. Stored fats in the ruminants' bodies can be reused when to provide energy when carbohydrates are not readily available. This is very helpful to growing ruminants. Ruminants require fibre for proper functioning of their rumen, thus RMW (27.05%), ML (25.10%), MC (23.24%), PKC (15.10%), CL (12.68%), CARL (11.90%), GS (30.36%), WP (26.09%), OP (15.93%) and CW (14.22%) are good sources of crude fibre. The Feedstuffs RMW, GT, OR, PKC, ML, CARL, CW, WP and OP are rich in ash. According to Aduku (2012), Yam Peel contains appropriate protein content of 11.21% with 9.76% ash. For SPL, Unigwe (2011) reported 2668.36 Kcal/kg as energy value similar to the present study thus, SPL among others should be harnessed as an energy source. 27.05% protein, 14.71% ash and 6.23% fibre in carrot Leaves given by Okpanachi *et al* (2021a) agrees with the current result, so, CARL is recommended for feeding ruminants Proper understanding of nutrient composition and their interplay is required to feed ruminants in the right quantity for optimum production. Money will be saved and environmental balance will be maintained when these ‘wastes’ are harnessed and utilized for the ultimate benefit of the ever increasing population instead of being disposed off as waste or garbage. This approach will make for sustainable agriculture.

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