NUTRITIONAL AND ANTINUTRITIONAL SCREENING OF *Chrysobalanus icaco, Thespesia garckeana* AND *Tetrapleura tetraptera* AS ADDITIVES IN RUMINANT DIET

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ABSTRACT
The study was carried out to evaluate the chemical, phytochemical antioxidant and mineral compositions of Chrysobalanus icaco, Thespesia garckeana and Tetrapleura tetraptera. The fruits were opened up and the seeds were harvested and milled. Milled samples were subjected to laboratory analyses. Data were analysed using SAS (2010) package and means were separated using Duncan's Multiple Range F-test. Results obtained indicated that Tetrapleura tetraptera had the highest dry matter (92.81%), fibre (44.18 %) contents. Protein and energy values ranged from 3.33- 4.16% and 15.19 -22.73 MJ/kg respectively. The phytochemical components revealed that phytate was remarkably higher than other antinutrients with a range of 20.99- 45.35 %. However, Tetrapleura tetraptera was superior in tannin (2.55 mg/100) phenol (2.37 mg/100), phytate (45.35 mg/g), Alkaloids (3.88 %), Flavonoids (7.54 mgRE/kg) as well as antioxidants (68.42%). Thespesia garckeana was significantly ($p<0.05$) highest in saponin (12.03%). Tetrapleura tetraptera was utmost in calcium (8840.00 pm), iron (4810 ppm) and sodium (1000 pm). Manganese varied from 4-23 ppm and phosphorus ranged from 0.01-0.06 ppm. In conclusion, the spices could be used as natural feed supplement in ruminant nutrition for improved animals' health and productivity as they contain significant concentration of nutrients, phytochemicals, minerals and antioxidant.
Keywords: **Spices, Ruminants, Nutrient, Antinutrient, Additives**

INTRODUCTION

Chrysobalanus icaco or rough- skinned plum, locally known in Nigeria as "Gbafilo" by the Itsekiris, *Tetrapleura tetraptera* locally called Aidan fruit, *Thespesia garckeana* commonly known as African chewing gum, snot apple or "Gorontula" are fruits native to tropical regions and are known for their therapeutic values hence used for their medicinal properties in the treatment of some ailments and used as spices in foods. They contain high levels of tannins, polyphenols and flavonoids. These bioactive compounds influence feed intake, digestibility and overall performance of the animals **(Ibhaze, 2017).** This is a vital feature that could necessitate their inclusion in livestock feeding. Although, it has been reported by various researchers that these fruits are rich in bioactive compounds, there is paucity of adequate documentation of the chemical, phytochemical, antioxidant and mineral constituents of these fruits investigated in this study.

MATERIALS AND METHODS

The three fruits were purchased from a spice shop in a major market in Akure. They were selected based on their known medicinal properties. The seeds of each fruit were removed from their outer covering and finely ground using a high powered blender. All samples were kept in tightly closed plastic containers and stored in a dry, dark and cool place. The proximate, minerals and antioxidants were determined using (AOAC, 2002) methods while the fibre fractions were determined according to the method of Van Soest *et al*. (1991). Carbohydrate was obtained by subtracting moisture, protein, fat, and ash from 100%. The energy content of the samples was estimated using the bomb calorimeter. Tannin and Phenol were determined according to the method of Makkar and Goodchild (1996), Phytate (Wheeler and Ferrel, 1971), Oxalate (Mathams and Sutherland 1992), Saponin (Obadoni and Ochuko, 2001), Alkaloids (Harborne, 1973).

Experimental design and statistical analysis

The experimental design was the completely randomized design and data obtained was analyzed using a one – way analysis of variance (ANOVA) at $p<0.05$, Where significant differences occurred, the means were separated using Duncan multiple range F-test of the SAS, 2010.

RESULTS AND DISCUSSION

Table 1 shows that Dry matter content ranged from 79.72- 92.81 % with *Tetrapleura tetraptera* having the highest dry matter content of 92.81 %. The relatively high dry matter content is an indication of good storability. *Thespesia*

garckeana was notable for its high fat content of 22.75%, which was significantly higher than the fat content in *Chrysobalanus icaco* (10.88%) and *Tetrapleura tetraptera* (8.37%). These variations in fat content could affect the flavor and potential health impacts of these spices, as opined by Carney *et al.* (2018), who highlighted the role of fat content in influencing sensory attributes and nutritional quality. However, *Chrysobalanus icaco* was superior in carbohydrate (61.66%) suggesting is relevance as energy source as reflected in its highest energy concentration (22.73 MJ/kg). The variations in carbohydrate content influence the energy provision and glycemic impacts of the spices. Abd El-Hakim *et al*. (2021) reported that carbohydrate content affects metabolic energy and blood sugar levels. The low protein values obtained in these spices (3.33-4.16 %) is an indication that they are not adequate source of protein hence could be used with other protein source for improved nutritional benefits. The fibre constituent found in these spices is adequate to aid digestion thereby preventing constipation in the consumer.

Table 1: Chemical constituents (%) of *Chrysobalanus icaco*, *Thespesia garckeana*, and *Tetrapleura tetraptera*

Parameters	*Chrysobalanus icaco*	*Thespesia garckeana*	*Tetrapleura tetraptera*	SEM
Moisture	20.30[a]	13.26[b]	7.22[c]	0.91
Dry matter	79.72[c]	86.77[b]	92.81[a]	0.97
Protein	3.33[b]	4.16[e]	3.46[b]	0.26
Fats	10.88[b]	22.75[a]	8.37[c]	0.98
Fibre	2.42[c]	35.35[b]	44.18[a]	2.73
Ash	1.43[c]	4.39[b]	6.95[a]	0.52
Carbohydrate	61.66[a]	20.12[c]	29.84[b]	2.75
Lignin	26.99[c]	30.45[b]	32.00[a]	0.68
Hemicellulose	19.67[a]	18.52[b]	0.57[c]	1.81
Cellulose	21.39[b]	18.26[c]	22.49[a]	2.26
Energy MJ/kg	22.73[a]	15.19[c]	16.77[b]	0.77

Means in the same row with different superscripts are significantly different at P<0.05

Generally, phytochemicals play significant roles in promoting health and preventing diseases due to their antioxidant properties. Among the phytochemicals investigated (Table 2), phytate concentration was superior to other phytochemicals in all the test materials with *Tetrapleura tetraptera* having the highest value (45.35 mg/g) followed by oxalate which ranged from 7.18- 22.00 mg/g. Phytate has antioxidant properties thereby protecting against oxidative stress. It also binds to minerals like iron, calcium and zinc thereby decreasing their absorption and bioavalability.

Table 2: Phytochemical and antioxidant composition of *Chrysobalanus icaco, Thespesia garckeana,* and *Tetrapleura tetraptera*

Parameters	*Chrysobalanus icaco*,	*Thespesia garckeana*	*Tetrapleura tetraptera*	SEM
Tannin mg/100	2·06[b]	1.87[c]	2.55[a]	0.15
Phenol mg/100	1.90[b]	1.77[c]	2.37[a]	0.08
Saponin %	1.34[c]	12.03[a]	6.81[b]	0.92
Phytate mg/g	20.99[c]	25.19[b]	45.35[a]	6.85
Oxalate mg/g	7.20[c]	22.00[a]	19.22[b]	1.12
Alkaloids %	3.54[a]	2.73[b]	3.88[a]	0.42
Flavonoids mgRE/kg	4.76[c]	5.27[b]	7.54[a]	0.15
Dpph %	51.33[c]	50.48[c]	68.42[a]	0.61

Means in the same row with different superscripts are significantly different at P<0.05

However, saponin was significantly (P<0.05) highest (12.03 mg/g) in *Thespesia garckeana.* and least (1.34 %) in *Chrysobalanus icaco*. Saponins are recognized for their ability to lower cholesterol and enhance the immune response, making them valuable additions to livestock diets (Huang *et al*., 2022). High Tannins decrease feed intake and protein digestibility and microbial enzyme activities. The DPPH which shows the antioxidant property of the test materials varied from 50.48- 68.42 % where *Tetrapleura tetraptera* was superior in concentration (68.42 %), *Chrysobalanus icaco* (51.33 %) and *Thespesia garckeana* (50.48 %). This indicates that *Tetrapleura tetraptera* has a better free radical scavenging potential than other spices compared. Table 3 revealed that in all the test materials, calcium which ranged from 8740 - 8840 mg/kg was the highest mineral concentration followed by iron (4450 – 4810 mg/kg). *Tetrapleura tetraptera* had the highest calcium, iron and sodium contents. This high

calcium content in *Tetrapleura tetraptera* suggests its potential as a valuable dietary source for promoting bone health. Kumar *et al*. (2022), opined that calcium is vital for skeletal development and overall metabolic function in livestock. Also, the substantial presence of calcium in *Tetrapleura tetraptera* could make it a veritable medium in the prevention of hypocalcaemia in lactating animals. Iron is essential for oxygen transport and energy metabolism in livestock, and its bioavailability is critical for preventing deficiencies that can lead to poor growth and performance, as emphasized by Jahan *et al*. (2020). The lower levels of iron observed indicates that when these spices are consumed solely without other sources of iron, an anaemic condition could arise in the animal. The high level of sodium in *Tetrapleura tetraptera* makes it a good dietary additive in electrolyte balancing during hot weather conditions. Rojas *et al*. (2021) noted that adequate sodium intake is necessary for optimal feed intake and digestion. Manganese plays a crucial role in enzyme function and metabolic processes, which are essential for optimal growth and reproduction in ruminants. Phosphorus is essential for energy metabolism and skeletal health, making its presence in adequate amounts in livestock diets crucial for optimal growth and productivity.

Table 3. Some mineral constituents (ppm) **of *Chrysobalanus icaco, Thespesia garckeana, and Tetrapleura tetraptera*.**

Parameters	*Chrysobalanus icaco*,	*Thespesia garckeana*	*Tetrapleura tetraptera*	SEM
Calcium	8740.00^{b}	8350.00^{c}	8840.00^{a}	556.8
Iron	4450.00^{c}	4590.00^{b}	4810.00^{a}	168.23
Manganese	10.00^{b}	23.00^{a}	4.00^{c}	3.27
Sodium	950.00^{b}	720.00^{c}	1000.00^{a}	60.41
Phosphorus	0.02^{b}	0.06^{a}	0.01^{c}	0.00

Means in the same row with different superscripts are significantly different at P<0.05

CONCLUSION

The chemical, phytochemical, antioxidant and mineral compositions analyses obtained from the three medicinal plants provides a detailed information of their nutritional and potentials as multipurpose feed resources in ruminant nutrition.

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