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Comparison of Nutritional and Anti-Nutritional Qualities of *Grewia forbesii* Hav. Ex Mast and *Grewia bicolor* Juss Fruits from Kitapilimwa Forest Reserve in Iringa District

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Abstract

The *Grewia forbesii* and *Grewia bicolor* fruits were collected from Kitapilimwa Forest Reserve and were analysed for proximate, nutrients and anti-nutrients compositions. Results showed low moisture contents in *G. forbesii* and *G. bicolor* amounting to 14.14 and 13.98 percent, respectively. Crude fibre percent was slightly higher in *G. bicolor* (33.15%) than *G. forbesii* (31.95%). Lipid content was slightly higher in *G. bicolor* (1.37%) compared to *G. forbesii* (1.28%). The crude protein content of *G. forbesii* (7.44%) was slightly higher than *G. bicolor* (7.00%). Total carbohydrate content of *G. forbesii* (68.9%) was higher than that of G. *bicolor* (70%). Mineral analysis indicated substantial amounts of potassium 898 mg/100 g in *G. forbesii* and 879 mg/100 g in *G. bicolor*. Calcium content was high in *G. forbesii* and *G. bicolor* amounting to 453 mg/100 g and 582 mg/100 g, respectively. Iron was high in both species (20.73–24.45 mg/100 g). Manganese, copper and zinc were substantially low. The results revealed low levels of tannin (< 1.7%) and phylates (< 0.3%). The presence of substantial amounts of nutrients and low anti-nutrients revealed that the studied species may be potential sources of nutritional food.

Keywords: Proximate analysis, mineral nutrients, anti-nutritional qualities, *Grewia* species, Kitapilimwa Forest Reserve.

Introduction

One of the greatest challenges facing thousands of people in Iringa District is that almost half of the region is semi-arid land, in which agriculture upon which the livelihoods of the people depend is greatly affected by erratic and unreliable rainfall regime and extreme poverty (Njau 2005, Tairo et al. 2011). Declining agricultural productivity and consequently food security is a result of climatic changes, poverty, diseases, and rainfall-dependent agriculture in such a way that the increasing population pressure has compelled people to switch to the use of wild food plants to cope with the situation of low food security (FAO 2000, Feyssa et al. 2011). While every livelihood option is being taken to increase food production by conventional agricultural production, a lot of attention is currently being focused on the potential of exploiting the huge numbers of familiar plant resources existing in the wild environment (FAO 2010, Tairo 2011).

Although utilization of such wild plants has been sufficiently documented, there is still a formidable lack of reports on their chemical

compositions. Edible food plants could be good sources of nutrients, and many have the potential of broadening the present narrow food base of the human population (Elhassan and Yagi 2010). In Iringa District, fruits from the *Grewia* genus were commonly used to supplement other food sources (Tairo 2011). The *Grewia* is a genus of flowering plant belonging to the family Malvaceae. The *Grewia* species that were most commonly used included *Grewia forbesii* Hav. ex Mast and *Grewia bicolor* Juss (Tairo 2011). These species are known as *mkole* or *mkone* in Swahili, and also known as *mkole* or *mperemehe* in Hehe language (Ruffo et al. 2002).

Grewia forbesii is a multi-stemmed shrub or tree up to 12 m high, leaves are broadly elliptic, flowers and fruits are shallowly 2-4 lobed or none-lobed. *Grewia bicolor i*s also a multi-stemmed shrub with 7 to 14 m high (Heuzé et al. 2015). Their barks are dark grey, deeply fissured and scaly in older trees. The phylotax of the leaves are alternate and shapes can be either elliptic or lanceolate. According to the Heuzé et al. (2015) the leaves are wide and bicoloured in which the upper surface is uninteresting green, while the lower one is silvery white. *Grewia forbesii* Hav. ex Mast and *Grewia bicolor* Juss fruits are the common fruits consumed by the people when they are ripe. In the dryland of Iringa District, *Grewia* fruits are used to make drinks when soaked and sweetened. Fruits flour is used to prepare porridge and served for young and adult ones during the day. Elhassan and Yagi (2010) reported that *Grewia* drinks can be taken regularly by the lactating mothers to improve their health and lactating abilities. In addition, the *Grewia* fruits can be fermented and served as an alcoholic drink. Also, there is an increasing demand of the fruits from these species because they are used as sources of traditional cures against malaria and iron deficiency anaemia (Elhassan and Yagi 2010, Heuzé et al. 2015). Although the fruits of *Grewia* species have high nutritional and nutraceutical potentials, limited or no investigation has been carried out on exploitation and utilization of the fruits as prospective food sources (Heuzé et al. 2015). Therefore, this study aimed at determining potential chemical components (nutrients and nutraceuticals) from the fruits of the *Grewia* species that may help to provide a logical data to the profile of this plant frequently used in the area.

Materials and Methods

The study was carried out in the communities located around Kitapilimwa Forest Reserve in Iringa District, Iringa Region. The forest reserve is located between latitude 7°28'0" S and longitude 35°43' 0" E and 1,245 m above sea level. The temperature of the area ranges from 12 to 30 °C and annual precipitation less than 1000 mm (URT 2001). The important resources available in the forest include medicinal plants, fruits, dry fuel wood, wild vegetables animals such as birds and insects, honey and minerals. The village is situated 8 km from the junction of the Iringa–Dodoma road, 40 km from Iringa.

The *Grewia* plants were identified in the field by botanist form Tanzania Tree Seeds Agency by comparing with herbarium specimens and then fruits of *Grewia forbesii* Hav. ex Mast and *Grewia bicolor* Juss were collected from Kitapilimwa Forest Reserve from April to June in 2020. For every species, fruits were collected in different locations in the forest reserve and pooled together and one kilogram of fruits for each species were washed with running water and then passed through distilled water to remove dirt and foreign materials and dried in the shade for four days and passed in hot air for three days. Finally, fruits were ground, sieved through mesh screen and stored in air tight containers for laboratory analysis.

The samples were analysed in triplicates for proximate analysis. The parameters analysed included moisture, total ash, crude protein, crude lipid, crude fibres and carbohydrates contents using standard methods as outlined by AOAC (2000).

The minerals were determined after sample wet digestion with a mixture of nitric acid (HNO_3), perchloric acid ($HClO_4$) and sulphuric acid (H_2SO_4) and calcium, potassium, copper, zinc and manganese were determined by using atomic absorption spectrophotometer (AOAC 2000) in the laboratory of Food Technology, Nutrition and Consumer Sciences at Sokoine University of Agriculture. Anti-nutritional agents such as tannins and phylates were determined as described by Singleton et al. (1999) and Ola and Oboh (2000).

Data analysis of proximate composition, minerals and anti-nutritional factors were estimated in triplicates and the means were separated and compared across the *Grewia* species using multivariate analysis in IBM SPSS Statistics ver. 15 developed by Norman H. Nie, St Louis, Missouri, USA.

Results and discussion

The evaluation of nutrient composition involved the evaluation of moisture content, crude fibres, ash, crude proteins, lipids and carbohydrates of edible mushroom varieties that are shown in Table 1. Notably, there was a significant difference ($p < 0.05$) in proximate parameters in *G. forbesii* and *G. bicolor*. The values of moisture content reported in this study corroborate with the values of 13–15% in other *Grewia* species reported by Elhassan and Yapi (2010). However, Murray et al. (2001) recorded higher moisture content of 26% for Grewia *bicolor* fruits. According to Tairo et al. (2011), the low moisture content suggests that the fruits had higher dry matter yields as that can be a sign of their long shelf life. Crude fibre content was slightly higher in *G. bicolor* with 33.15% compared with 31.95% in *G. forbesii*. The values obtained in this study were in line with the values of 20-42% crude fibre reported by Elhassan and Yapi (2010). On the other hand, Yadav (1999) reported low fibre content amounting to 5.3% in *G. asiatica.*

The ash content was higher in *G. bicolor* (4.3%) than that of 3.86% in *G. forbesii.* The results are comparable to the values of 3.4–5.2% reported by Elhassan and Yapi (2010). Pundlik (2020) reported high values of 5–13% ash content for some species in the *Grewia* genus. The range of ash content reported in this study signifies that ash is essential to a food's nourishment and longevity (Tairo 2011). *G. forbesii* had slightly higher protein content (7.44%) compared to that of 7% in *G. bicolor*. Murray et al. (2001) recorded a protein content of 7.1% in *G. villosa*. Lipid contents of 1.28% and 1.37% were recorded for *G. forbesii* and *G. bicolor*, respectively. The results are in line with the earlier study by Pundlik (2020) that recorded more than 3% lipid content for other species in the genus *Grewia*. The lipid contents reported in this study are essential because they provide the body with maximum energy (Tairo 2011). Also the low level of lipid content implies that they play crucial roles as enzyme cofactors and hydrophobic anchors for proteins (Fahy et al. 2005).

Table 1: Proximate composition of *Grewia forbesii* Hav. ex Mast and *Grewia bicolor* Juss from Kitapilimwa Forest Reserve

Parameters (%)	***Grewia* species***	
	Grewia forbesii	*Grewia bicolor*
Moisture content	14.14 ± 0.65	13.98 ± 0.64
Crude fibres	31.95 ± 4 .82	33.15 ± 4.83
Ash content	3.86 ± 0.54	4.3 ± 0.83
Protein content	7.44 ± 0.53	7.00 ± 0.62
Lipids	1.28 ± 0.18	1.37 ± 0.16
Carbohydrates	68.90 ± 5.34	70.00 ± 4.95

*Mean values ± standard deviation of the triplicate; expressed in %.

The carbohydrate content was higher in *G. bicolor* (70%) than in *G. forbesii* (68.9%). These results are comparable to the values of 61.21% and 77% reported by Tairo (2011) for fruits producing plants such as *Vangueria infausta* and *Vitex mombassae*, respectively. Pundlik (2020) reported low values of 20-45% carbohydrates contents for species of the genus *Grewia*. The higher values reported in this study suggest that *Grewia* fruits have high calorific value and can be considered as one of the high energy-rich foods.

Mineral content composition

The mineral nutrients composition of *G. forbesii* and *G. bicolor* are given in Table 2. The results revealed that there was a significant difference ($p < 0.05$) in the mineral nutrients in *G. forbesii* and *G. bicolor*. As shown in the table, *G. forbesii* has low calcium content (453 mg/100 g) compared with 582 mg/100 g in *G. bicolor*. The level of calcium content is higher than the range of 179-180 mg/100 g reported by Feyssa et al. (2011) in *G. flavescens*. These results support the fact the selected species have nutritional potentetials than other species in the genus. *G. forbesii* has high manganese, copper and zinc content compared with *G. bicolor*. Earlier study by Elhassan and Yapi (2010) showed low concentrations (less than 2.5 mg/100 g) of manganese, copper and zinc in most of the studied species. The recent study showed that iron concentration was high in *G. forbesii* (24.45%) than in *G. bicolor* (20.73 mg/100 g). These values showed extremely high iron content in the studies species. Presence of high amounts of iron implies that *Grewia* fruits favour iron absorption when consumed. Traditionally use of *Grewia* fruits can support to treat anaemia. Previous study by Elhassan and Yapi (2010) showed that the plant species iron content ranged from the lowest 20.8 mg/100 g to the highest 29.6 mg/100 g.

The results from analysis revealed that there was no significant difference in levels of anti-nutrients in both *G. forbesii* and *G. bicolor*. The levels of anti-nutrients are shown in Table 3. Tannin content was slightly low (1.64%) in *G. forbsii* than in *G. bicolor* (1.69%). The results are in line with the findings of a previous study by Chung et al. (1998) that reported tannin content of species form the genus *Grewia* ranging from 1.13% to 2.46%. Phylates were almost the same (0.13%). The levels of phylates were within the range of 0.08% to 0.17% as reported by Sati and Ahmed (2018). The low levels of anti-nutrients suggest that Grewia fruits can contribute to the human nutrient requirements.

Table 2: Mineral nutrient content of *Grewia forbesii* Hav. ex Mast and *Grewia bicolor* Juss from Kitapilimwa Forest Reserve

Parameters (mg/100 g)	***Grewia* species***	
	Grewia forbesii	*Grewia bicolor*
Ca	453.00 ± 17.80	582.00 ± 17.80
K	898 ± 8.49	879.00 ± 8.49
Mn	3.60 ± 0.17	3.20 ± 0.16
Fe	24.45 ± 0.53	20.73 ± 0.53
Cu	1.32 ± 0.17	1.23 ± 0.17
Zn	0. 68 ± 0.25	1.59 ± 0.34

*Mean values ± standard deviation of the triplicate.

Table 3: Some anti-nutritional contents of *Grewia forbesii* Hav. ex Mast and *Grewia bicolor* Juss from Kitapilimwa Forest Reserve

Parameters (%)	***Grewia* species***	
	Grewia forbesii	*Grewia bicolor*
Tannins	1.64 ± 0.31	1.69 ± 0.22
Phylates	0.13 ± 0.11	0.13 ± 0.12

*Mean values ± standard deviation of the duplicate.

Conclusion and recommendations

Based on the results, fruits of the studied *Grewia* spp locally consumed by the majority of the people living in Iringa District contain enough essential nutrients like carbohydrates, lipids, proteins and mineral nutrients such as calcium, potassium, manganese, copper and zinc that can serve as potential sources of food. The levels of anti-nutrients (tannins and phylates) are below the threshold levels. It can therefore, be concluded that the *Grewia* fruits can contribute to the human nutrient requirements and could be used as sources of nutrients supplements. Further research is needed to explore more on the bioactive compounds in *Grewia* species.

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