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Medicinal Value of Some Bioactive Compounds from Three Species of *Striga* Grass (*S. hermontheca, S. aciatica* and *S. gesnerioides*) Extractions

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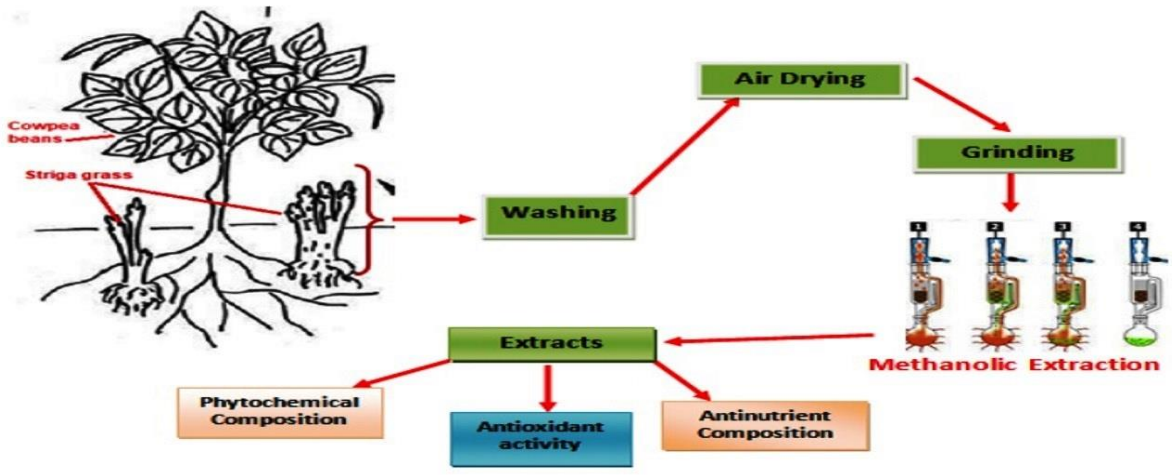
ABSTRACT

The control of Striga infestation in agricultural produce proved to be difficult especially in Africa. This study therefore aimed at finding a way of making the plant useful. The results revealed that all the plants contain flavonoids, glycosides, tannins, phenols, oxalate and carbohydrates. Alkaloid and saponnins were only found to be present in *S. gesnerioides*. A relative high amount of flavonoids (6.86±0.42 mgRutin/g) and phenols in the stem (9.36±0.55 mgGAE/g) of *S. gesnerioides* closely followed by leaves of *S. hermontheca* 4.06±0.25 mgRutin/g, 13.06±0.32 mgGAE/g respectively. The presence of these bioactive components indicates the plant's potential as a source of major secondary metabolites that may serve as novel medicines. The percentage inhibition concentration at 50% (IC_{50}) of *S. hermontheca* stem, root and leaves were 73.13 µg/g, 41.39 µg/g and 207.01 µg/g respectively. The stem, roots and haustorium of *S. gesneriodes* indicated an IC_{50} of 70.39 µg/g, 55.33 µg/g and 55.07 µg/g respectively while *S. aciatica* 52.35 µg/g, and 72.71 µg/g respectively. Compared to standard ascorbic acid with IC_{50} of 57.78 µg/g, the three species have relative significant antioxidant activity. Further successive extraction, purification and characterization of the bioactive components found present in this research will make further research interesting.

GRAPHICAL ABSTRACT



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Introduction

Striga grass is a parasitic plant with attractive flowers, whose beauty belies its noxiousness [1]. There are various species of *Striga* grass that parasitized most cultivated crops and legumes, such as maize, sorghum, and rice, leading to enormous economic losses [1, 2]. Some of the species are dangerous pathogens of cereals affecting savanna agriculture causing, considerable crop losses in Africa and other regions [3,4], and are generally hemi-parasites of roots plants roots [5]. *Striga asiatica*, *S. gesnerioides*, and *S. Hermonthica* were identified as the species that cause the most damage resulting into complete damage to crop [6, 7] and their control proved to be difficult especially in Africa [3, 8, 9, 28]. Most common control method used is intercropping, being natural and friendly to atmosphere [10, 15].

Most researches on these three most devastating species were directed toward control of their parasitic effect which proved to be difficult. Previous studies revealed that *Striga hermonthica* is traditionally used in African treat pneumonia, dermatosis, leprosy ulcer, diabetes and jaundice [11]; however, there is no known literature on the medicinal value the other two (*S. aciatica* and *S. gesnerioides*). This study will contribute in further exploiting the medicinal value; phytochemical composition and antioxidant properties on these parasitic grasses especially *S. gesnerioides and S. aciatica*.

Experimental

Sample collection, preparation and analysis

Three species (*Striga asiatica*, *S. gesnerioides*, and *S. hermonthica*) were randomLy collected between August and September, 2018 (during rainy season) from various farm lands within Yobe State University Damaturu where susceptible plants/crops were planted. The samples were collected by digging dip down the ground close to host plants' root and removing the *Striga* from the hosts root. Immediately after which the *Striga* plant were washed with distilled-deionised water, separated into leaves, stem and root and then transported to the laboratory. The samples were air-dried and stored in a dry cabinet (FSM 140) under controlled humidity prior to analysis.

Figure 1. Sample collection (Striga gesneriodes root)

Figure 2. Striga gesneriodes

Sample extraction

The plant parts were separately extracted using methanol via soxhlet extraction method. 100 g of each plant part was weighed and transferred into 250 mL soxhlet extraction chamber and extracted with 200 mL of methanol for about 2 h. The extracts were recovered through distillation in rotary evaporator machine (Stuart Model RE 300) [20].

Qualitative phytochemical screening

Phytochemical screening to detect the presence of secondary metabolites was carried out using the methods employed by [12-16, 27].

Quantitative determination of saponnins

The samples extracts (1.0 g) were grounded and 100 mL of ethanol (20%) was added. The mixture was heated at 60 °C with continuous stirring in water bath (Stuart RE300DB) for 3 h and then filtered. Another 20% ethanol (100 mL) was added to the residue and re-extracted. The overall extracts were pre-concentrated to 30 mL over water bath, transferred into a 125 mL separator funnel followed by addition of diethyl ether (20 mL). The mixture was shaken vigorously and then allowed to settle. The aqueous layer was collected, purified and then 60 mL of n-butanol was added. 10 mL of aqueous Sodium chloride (5%) was added heated in a water bath to evaporated excess solvents. The mixture was finally dried in an oven and the saponins contents were calculated [17, 27].

Estimation of phenolic content

The total phenolic content was evaluated using Folin–dennis reagents and standard gallic acid. 10 mL of deionized water was added to 1.0 mL of extract solution (0–500 mg/L) followed by 1.0 mL of Folin–Ciocalteu phenol reagents. The mixture was kept for 5 min and 20% sodium carbonate (2.0 mL) was added and kept dark cupboard for 1 h. The absorbance was measured at 750 nm using a spectrophotometer (UV/752 UV/Vis Spectrophotometer, PEC Medical USA). Total Phenolic content were calculated using gallic acid calibration curve and expressed as garlic acid equivalents (GAE) g/g of dry plant matter [18, 19, 27].

Total flavonoid content

A solution mixture containing 5% (w/w) sample, $NaNO_2$ (0.7 mL) and 30% (v/v) ethanol (10 mL) was prepared and kept for mixed for 5 min. 1.0 mL of the mixture was added to a test tube containing 0.7 mL of 10% $AlCl_3$ (w/w) and kept for six (6) min, and then 1 mol/L NaOH (5 mL) was added followed by 30% (v/v) ethanol to a total volume of 25 mL and kept for further 10 min. The absorbencies of the solutions were measured at 430 nm with a spectrophotometer (UV/752 UV/Vis Spectrophotometer, PEC Medical USA). A standard curve was plotted using different concentrations quercetin (in 80% ethanol) as a standard. The results were expressed in mg quercetin/g dry weight of sample [20, 21].

Estimation of alkaloid

Five (500 mg) of the sample were weighed into a 250 mL beaker and 200 mL of 20% acetic acid in ethanol was added and covered to stand for 4 h. This was filtered and the extract was concentrated using a water-bath to one quarter of the original volume. Concentrated ammonium hydroxide was added drop wise to the extract until the preparation was complete. The whole solution was allowed to settle and the precipitate was collected by filtration and weighed [17, 27].

Tannin determination

The sample (500 mg) was weighed into 100 mL plastic bottle. 50 mL of distilled water was shaken for one hour in a mechanical shaker. This was filtered into a 50 mL volumetric flask and

made up to the mark. Then 5 mL of the filtrate was pipette out into a tube and mixed with 3 mL of 0.1M $FeCl_3$ in 0.1 N HCl and 0.008 M potassium ferrocyanide. The absorbance was measured in a spectrophotometer at 120 nm wavelengths, within 10 min alongside a blank sample. Calibration standards were prepared using tannic acid and used to calibrate the equipment [17].

Measurement of antioxidant activities

The antioxidant activities of three *Striga species* were determined on the basis of their scavenging activity of stable 2, 2-diphenyl-1-picryl hydrazyl (DPPH) free radical [22]. To 1.0 mL of each solution of different concentrations (1-500 µg/mL) of the extracts 3 mL of 0.004% ethanolic DPPH were added. After 30 min the absorbance of the preparations was taken at 517 nm by UV spectrophotometer and then compared with the corresponding absorbance of standard ascorbic acid concentrations (1-500 µg/mL). The % inhibition was calculated by the following Equation:

$$\textbf{\% Radical Scavenging Activity} = \frac{\text{(absorbance of blank – absorbance of sample)}}{\text{(absorbance of blank)}} \times 100\%$$

The inhibitory concentration at 50% (IC_{50}) which denotes the concentration of sample required to scavenge 50% of the DPPH free radicals [22] from the graph of %inhibition.

Results and Discussion

Table 1, 2 and 3 reveal the phytochemical components of the methanolic extract s of leaves and stem of *S. hermontheca, S. aciatica* and *S. gesnerioides* respectively. All the extracts contain flavonoids, glycosides, tannins, phenols, oxalate and carbohydrates. However, quinones, terpenoids and sterols were found absent in all parts of the plant extracts. Alkaloid and saponnins were only found to be present in *S. gesnerioides*.

Table 4, 5 and 6 reveal the quantitative phytochemical composition of the leaves and stem extracts the three samples. The results indicated a high amount of flavonoids (6.86±0.42 mgRutin/g) and phenols in the stem (9.36±0.55 mgGAE/g) of *S. gesnerioides* closely followed by leaves of *S. hermontheca* 4.06±0.25 mgRutin/g, 13.06±0.32 mgGAE/g respectively.

Table 1. Qualitative analysis of various parts of *S. hermontheca*

S/No.	Phytochemical	Test Reagent/type of test	*S. hermontheca*		
			Root	***Leaves***	***Stem***
1	Alkaloids	Mayers Reagents Test	-	-	-
2	Flavonoids	a) NaOH	+	+	+
		b) Mg and H_2SO_4	+	+	+
3	Saponins	a) Frothing Test	-		-
		b) Foam Test	-		-
4	Glycosides	Keller Kellani's Test	+	-	+
5	Oxalate	Acetic acid	+	+	+
6	Quinones	Conc HCl	-	-	-
7	Terpenoids	Salkowki's test	-	-	-
8	Tannins	Braymer's Test	+	+	+
9	Sterols	Libermann-Burchard Test	-	-	-
10	Phenols	$FeCl_3$	+	+	+
11	Carbohydrates	Molisch's Test	+	+	+

Table 2. Qualitative analysis of various parts of *S. aciatica*

S/No.	Phytochemical	Test Reagent/type of test	*S. aciatica*		
			Root	*Leaves*	*Stem*
1	Alkaloids	Mayers Reagents Test	-	-	-
2	Flavonoids	c) NaOH	+	+	+
		d) Mg and H_2SO_4	+	+	+
3	Saponins	c) Frothing Test	-	-	+
		d) Foam Test	-	-	-
4	Glycosides	Keller Kellani's Test	+	+	+
5	Oxalate	Acetic acid	-		-
6	Quinones	Conc HCl	-		-
7	Terpenoids	Salkowki's test	-		-
8	Tannins	Braymer's Test	+	_	+
9	Sterols	Libermann-Burchard Test	-	-	-
10	Phenols	$FeCl_3$	+	+	+
11	Carbohydrates	Molisch's Test	+	+	+

Table 3. Qualitative analysis of various parts of *S. gesnerioides*

S/No.	Phytochemical	Test Reagent/type of test0	*S. gesnerioides*		
			Root	*Houstorium*	*Stem*
1	Alkaloids	Mayers Reagents Test	+	-	+
2	Flavonoids	e) NaOH	+	+	+
		f) Mg and H_2SO_4	+	+	+
3	Saponins	e) Frothing Test	-	-	-
		f) Foam Test	-	-	-
4	Glycosides	Keller Kellani's Test	+	+	+
5	Oxalate	Acetic acid	+	+	+
6	Quinones	Conc HCl	-	-	-
7	Terpenoids	Salkowki's test	-	-	-
8	Tannins	Braymer's Test	+	+	+
9	Sterols	Libermann-Burchard Test	-	-	-
10	Phenols	$FeCl_3$	+	+	+
11	Carbohydrates	Molisch's Test	+	+	+

Table 4. Quantitative analysis of various parts of *S. hermontheca*

S/No.	Phytochemical	*S. hermontheca*		
		Root	*Leaves*	*Stem*
1	Flavonoids (mgRutin/g)	2.84±0.05	4.06±0.25	3.13±0.11
2	Tannins (mg/g)	1.56±0.02	0.96±0.05	0.78±0.002
3	Phenols (mgGAE/g)	9.96±0.02	13.06±0.32	11.52±0.52

Table 5. Quantitative analysis of various parts of *S. aciatica*

S/No.	Phytochemical	*S. aciatica*		
		Root	*Leaves*	*Stem*
1	Flavonoids (mgRutin/g)	3.17±0.24	4.93±0.12	2.39±0.21
2	Tannins (mg/g)	1.56±0.02	0.85±0.08	0.97±0.17
3	Phenols (mgGAE/g)	6.36±0.52	16.18±0.47	8.36±0.12

Table 6. Quantitative analysis of various parts of *S. gesnerioides*

S/No.	Phytochemical	*S. gesnerioides*		
		Root	***Houstorium***	***Stem***
1	Alkaloids (mg/g)	0.88±0.18	ND	0.27±0.13
2	Flavonoids (mgRutin/kg)	4.17±0.11	2.08±0.33	6.86±0.42
3	Saponnins (mg/kg)	3.31±0.16	4.28±0.25	2.53±0.81
4	Tannins (mgTA/kg)	1.86±0.13	0.83±0.21	0.88±0.22
5	Phenols (mgGAE/g)	7.25±0.26	3.61±0.29	9.36±0.55

The presence of alkaloids, flavonoids, saponins and tannins in the extracts show that the plant is a potential antibiotic since they act as antibiotics and also inhibits the translation process of cellular and organs level in animals. The extracts therefore can serve as antimicrobial, antihelmintic and anti-diarrheal [12]. Flavonoids has the ability to modify allergens, viruses and carcinogens and also have potential biological response modifier effects such as anti-allergic, anti-inflammatory, anti-microbial and anti-cancer activities were reported from invitro studies [23-27].

Results of antioxidant assay

DPPH is widely used for testing preliminary radical scavenging activity of a compound. In this study, methanolic extracts of three different *Striga species* analyzed revealed potential free radical scavenging activity.

Figure 3 demonstrates the percentage inhibition of the stem roots and leaves of *S. hermontheca* respectively. The 50% inhibitory concentration of the standard ascorbic acid, stem, root and leaves were 57.78 µg/g, 73.13 µg/g, 41.39 µg/g and 207.01 µg/g respectively. This shows that the *Specie* has relative significant antioxidant activity; with the root having the highest antioxidant activity.

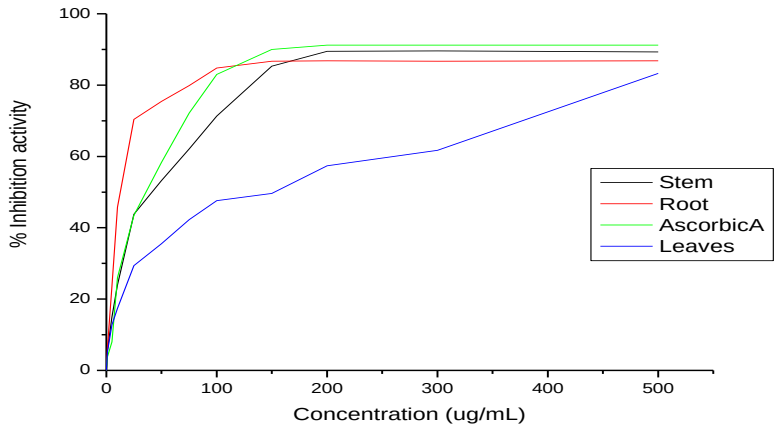

Figure 3. Percentage Inhibition of Methanolic extract of various parts of *S. hermontheca* compared to standard ascorbic acid

Figure 4 reveals the percentage inhibition of the stem, roots and haustorium of *S. gesneriodes*. The percentage inhibition concentration at 50% (IC_{50}) of the standard ascorbic acid, stem, root and haustorium were 57.78 µg/g, 70.39 µg/g, 55.33 µg/g and 55.07 µg/g, respectively. This shows that the *Specie* has relative significant antioxidant activity. When compared with standard ascorbic acid, the root and haustorium

were relatively the same while the stem has low antioxidant activity.

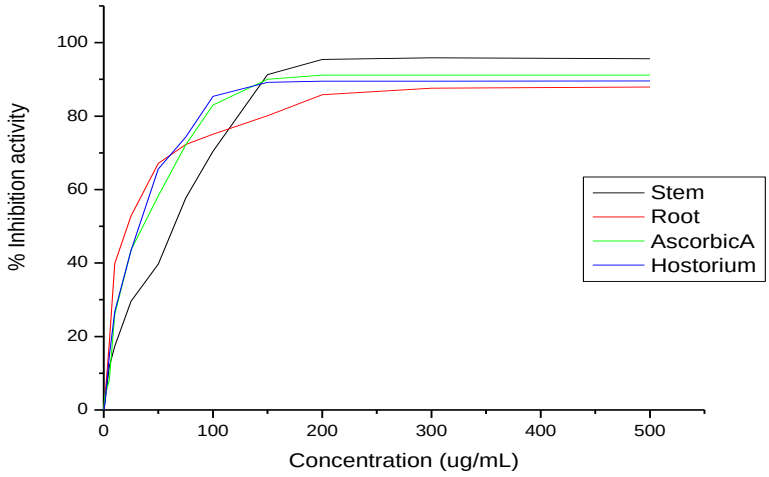

Figure 4. Percentage Inhibition of Methanolic extract of Stem and Root of *Striga gesneriodes*

Figure 5 represents the percentage inhibition of the stem and leaves of *S. aciatica*. The percentage inhibition concentration at 50% (IC_{50}) of the standard ascorbic acid, stem and leaves were 57.78 µg/g, 52.35 µg/g, and 72.71 µg/g, respectively. This shows that the *Specie* has relative significant antioxidant activity. When compared with standard ascorbic acid; the stem is relatively the same with ascorbic acid, while the leaves have low antioxidant activity.

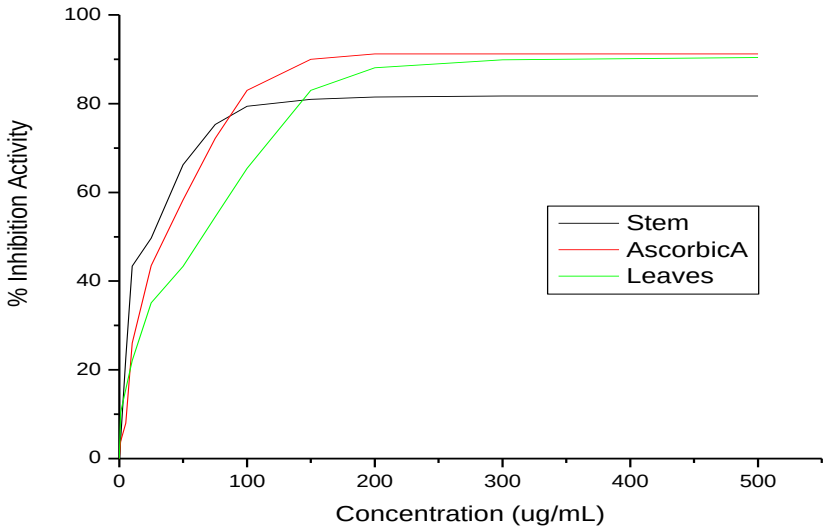

Figure 5. Percentage Inhibition of Stem and Leaves of *S. aciatica*

Conclusion

The plant extracts (leaves, root and stem) of *S. hermontheca, S. aciatica* and *S. gesnerioides* contain phenols, flavonoids, tannins, oxalate, cardiac glycosides, and carbohydrate. Alkaloid and saponnins were only found to be present in *S. gesnerioides* root and stem. *S. hermontheca* has

2.84±0.05, 4.06±0.25, 3.13±0.11 mgRutin/g flavonoids in root, leaves and stem respectively; Tannins, 1.56±0.02, 0.96±0.05, 0.78±0.002 mgTA/g and Phenols 9.96±0.02, 13.06±0.32, 11.52±0.52 mgGAE/g.

S.aciatica has 3.17±0.24, 4.93±0.12, 2.39±0.21 (mgRutin/g) Flavonoids, 1.56±0.02, 0.85±0.08, 0.97±0.17 mgTA/g and 6.36±0.52, 16.18±0.47, 8.36±0.12 mgGAE/g Phenols in root, leaves and stem respectively. *S. gesnerioides* has 0.88±0.18, 0.27±0.13 mg/g alkaloid root and stem only; flavonoids 4.17±0.11, 2.08±0.33, 6.86±0.42 mgRutin/kg, Saponnins 3.31±0.16, 1.86±0.13, 4.28±0.25, 2.53±0.81 mg/kg, Tannins (mgTA/g), 1.86±0.13, 0.83±0.21, 0.88±0.22 and Phenols (mgGAE/g), 7.25±0.26, 3.61±0.29, 9.36±0.55mgGAE/g in root, Houstorium and stem respectively.

The inhibition concentration at 50% scavenging activity (IC_{50}) of *S. hermontheca* gives 73.13, 41.3 and 207.01 µg/L in stem, root and leaves respectively. *S. aciatica has* 52.35 and 72.71 µg/L in stem and leaves only, while *S. gesnerioides* has 70.39, 55.33 and 55.07 µg/L in root, stem and hostorium respectively as compared to standard ascorbic acid with 57.78 µg/L.

Compliance with ethical standards

The authors declare that they have no conflict of interest.

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