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RESEARCH ARTICLE

PHARMACOLOGY

STUDY OF PRIMARY METABOLITES AND ANTIMICROBIAL ACTIVITY OF GOMPHRENA CELOSIOIDES MART.

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ABSTRACT

The quantification of primary metabolites and antimicrobial activities of medicinal plant *Gomphrena celosioides* Mart. against clinical isolates, *Escherichia coli, Pseudomonas aeroginosa* and *Staphylococcus aureus* were investigated. The maximum levels of soluble sugars, lipids and phenols were found to be higher in *stem*, starch and proteins in roots, as compared to other parts of the plant. The methanolic extract of leaf, stem and root were found to be most effective against the three tested bacteria. The stem and leaf extract were found to have maximum zone of inhibition against *E. coli.* Root extract showed significant activity against *P. aeroginosa*. The activity index of the stem and leaf extracts were recorded maximum for *E. coli* and the root and leaf extracts showed minimum activity index against *P. aeruginosa*. This research supports the local use of this plant for therapeutic purposes against bacterial infection.

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KEY WORDS

Gomphrena celosioides Mart., primary metabolites, antimicrobial activity, activity index.

INTRODUCTION

Most microorganisms are unable to colonize living plant tissue. The failure of microorganisms to do so, have been attributed to the presence of inhibitory compounds within the challenged tissues[1, 2].

Though many possible sources of antibiotics have been explored, the search for better and safer drug (s) is still continued. As plants are considered to be the best source for antimicrobial agents, an attempt has been made by us towards the screening of crude methanolic extracts of selected plant species. With the development of antimicrobials, microorganisms have adapted and become resistant to previous antimicrobial agents. The old antimicrobial technology was based either on poisons or heavy metals, which may not have killed the microbe completely, and has allowed the microbe to change and become resistant to the poisons or heavy metals. Modern Phytomedicine is a timely and original handbook paving the way to success in plant-based drug development; systematically addressing the issues facing a pharmaceutical scientist who wants to turn a plant compound into a safe and effective drug.

The primary metabolites have countless benefits to humans, which are exploited as natural pesticides, flavoring, fragrances, fibers and beverages[3] and also acts as a precursor for bioactive compounds used as therapeutic drugs[4]. Therefore, in the present study primary metabolites from leaves, stems, roots and nuts of *Gomphrena celosioides* Mart. have been evaluated. However no studies of primary metabolites and antimicrobial have been reported on this plant.

G. celosioides Mart. (Amaranthaceae) is commonly known as *Gomphrena* Weed or Soft Kharki Weed. Flowers are 1-4cm long sessile between two leaves and pale in color. It is a prostrate or erect herb to about 25cm tall. It is widely distributed in Uttar Pradesh, Haryana and Rajasthan[5]. The extract of this plant is effective and commonly used in the treatment of urinary tract disorders and kidney stones[6]. The leaf paste is used to treat Malaria[7]. The whole plant is used in the treatment of skin diseases in Nigeria[8]

MATERIAL AND METHODOLOGY

***Plant material*:** Healthy plants of *G. celosioides* were collected from the University of Rajasthan campus and authenticated by the Herbarium, University of Rajasthan, Jaipur, Rajasthan, India.

Chemicals: All the chemicals and growth regulators used are analytical grade and purchased from Hi Media Pvt. Ltd., Mumbai, India.

Primary Metabolite Estimation:

The root, stem and leaf parts of *G. celosioides* were evaluated quantitatively to estimate the total levels of soluble sugars, starch, proteins, lipids and phenols following the established methods for the sugars, starch[9], lipid[10], protein[11] and phenol[12]. All experiments were repeated five times for precision and values were expressed in mean ± standard deviation in terms of shade dried material.

Preparation of Extracts:

The stem, leaf and roots of *G. celosioides* were cut into small pieces, dried and powdered. The resultant was then subjected to extraction with methanol in Soxhlet apparatus. The extracts were then concentrated in vacuum under

reduced pressure using rotary flash evaporator, dried in desiccators and stored in refrigerator at 4°C till further use[13].

***Disc Preparation*:** The 6mm (diameter) discs were prepared from Whatman No. 1 filter Paper. The discs were sterilized by autoclave at 121°C. After the sterilization the moisture discs were dried on hot air oven at 50°C.Then various solvent extract discs and control discs were prepared.

Antimicrobial Activity of Gomphrena celosioides:

The antibacterial activity studies were carried out by disc diffusion technique[14]. The sterile nutrient agar plates were prepared. The bacterial test organisms like *Staphylococcus aureus, Pseudomonas aeroginosa* and *Escherichia coli* were spread over the nutrient agar plates by using separate sterile cotton buds. After the microbial lawn preparation three different extracts of plant disc were placed on the organism inoculated plates with equal distance control discs were also prepared. All bacterial plates were incubated at 27°C for 24 hrs and fungal plates at 24°C for 72hrs. The diameter of the minimum zone of inhibition was measured in mm. For each test, three replicates were performed.

Test organisms:

Human pathogenic bacteria *Escherichia coli, Staphylococcus aureus and Pseudomonas aeruginosa* were obtained from SMS Medical College, Jaipur, Rajasthan.

RESULTS

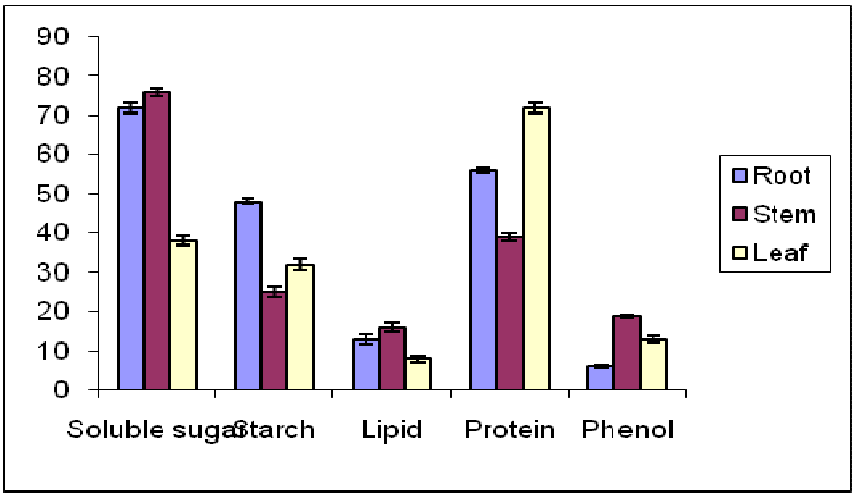
G. celosioides were evaluated quantitatively for the total levels of soluble sugars, starch, proteins, lipids and phenols by described methods. Total levels of soluble sugars were found to be higher in *G. celeosioides* stem (76±1.01 mg/gdw), as compared to its leaves and root. Total levels of starch were found to be higher in roots (48±0.69 mg/gdw), as compared to its leaves and stem. Total levels of proteins were found to be higher in roots (56±0.69 mg/gdw), as compared to its leaf and stem. Total levels of lipids and phenols were found to be higher in *stem* (16±1.07 mg/gdw, 19±0.33 mg/gdw) as compared to its root and leaves (Table1; Graph1).

Primary metabolites:

Table 1
Primary metabolite study of Gomphrena celosioides

Plant part	Soluble sugar	Starch	Lipid	Protein	Phenol
Root	72±1.43	48±0.69	13±1.14	56±0.69	6±0.45
Stem	76±1.01	25±1.41	16±1.07	39±1.01	19±0.33
Leaf	38±1.21	32±1.49	8±0.91	72±1.41	13±0.69

Graph 1
Primary metabolites in Gomphrena celosioides



Antimicrobial activity:

This is the first attempt to investigate the antibacterial activity (Table 2; Figure 1) of methanolic extracts of plant parts of *G. celosioides*. The methanolic extracts of leaf, stem and root were found to be most effective against the three tested bacteria (*S. aureus, P. aeruginosa and E. coli).* The stem and leaf extract were found to have maximum zone of inhibition against *E. coli* (15.5 and16mm) while the minimum zone of inhibition against *S. aureus was* (10 and 12.5 mm). The root extract was found maximum zone of inhibition against *P. aeroginosa* (12mm). The activity index of the stem and leaf extracts were recorded maximum (1.19 and 1.23 respectively) for *E. coli* and the root and leaf extracts showed minimum activity index (0.72) against *P. aeruginosa*.

Table 2
Antibacterial activity of different plant parts of Gomphrena celosioides

S. No.	Plant parts	*Escherichia coli*		*Staphylococcus aureus*		*Pseudomonas aeroginosa*	
		IZ (mm)	AI	IZ (mm)	AI	IZ (mm)	AI
1.	Root	11	0.85	11	0.85	12	0.92
2.	Stem	15.5	1.19	10	0.77	14	1.07
3.	Leaf	16	1.23	12.5	0.96	15	1.15

IZ: Zone of Inhibition; AI: Activity Index; Standard Antibiotic: Amoxylline (10 mcg/disc)

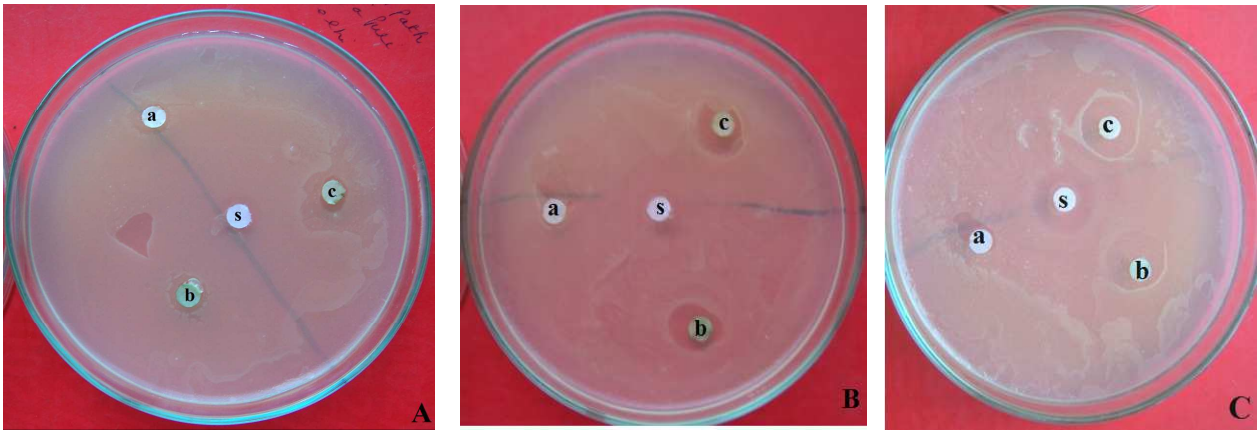


Figure: 1
Antibacterial activity of Gomphrena celosioides a. Root b. Leaf c. Stem and s. standard. A. Staphylococcus aureus B. Pseudomonas aeruginosa C. E. coli

DISCUSSION

Plants are an important source of potentially useful structures for the development of new chemotherapeutic agents. The first step towards this goal is the *in vitro* antibacterial activity assay[15]. Many primary metabolites lie in their impact as precursors or pharmacologically active metabolites in pharmaceutical compounds[16]. Plant synthesizes primary metabolites (lipid, protein, starch, sugars, phenol etc.) for the normal growth and development of itself. Polysaccharides extracted from Chinese medicinal herbs possess immunomodulatory and antimicrobial activity[17]. Bioactivity of carbohydrates derivatives have also been reported[18].

Further work to isolate and characterize the active compounds responsible for this activity in the plant is recommended. To our knowledge from literature, this is the first time, a report on the extraction of primary metabolites and antimicrobial properties of methanolic extracts of *G. celosioides* are being scientifically documented.

CONCLUSION

The results of the present investigation clearly indicate that the study of primary metabolites and antibacterial activity of this plant could consider it as a natural herbal source. Thus, the study ascertains the value of plants used in ayurveda, which could be of considerable interest to the development of pharmaceutical drugs.

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