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Chemical Composition of Kantola Vegetable its Leaf Stem and their Applications in Medical Sector as well as in Domestic Sector: A Brief Study

ORIGINAL ARTICLE



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Abstract

Kantola (Momordica dioica), commonly known as spiny gourd or teasel gourd, is a perennial, dioecious climbing plant that belongs to the Cucurbitaceae family. It is widely consumed in various parts of India and Southeast Asia, especially during the monsoon season. Although traditionally valued for its culinary uses, recent scientific attention has highlighted its significant potential in both medicinal and domestic applications due to its rich phytochemical profile. This study presents a detailed examination of the chemical composition of Kantola's fruit, leaves, and stems, focusing on the presence of bioactive compounds such as flavonoids, tannins, alkaloids, saponins, phenolic acids, and essential minerals including iron, potassium, and calcium. These compounds are known to exhibit various pharmacological properties including antioxidant, anti-inflammatory, antimicrobial, anti-diabetic,

and hepatoprotective activities. Through qualitative and quantitative analysis, the study also explores how different parts of the plant differ in composition and potency. The leaves and stems, often discarded as agricultural waste, are found to contain notable concentrations of bioactive components, indicating their untapped potential in phytotherapeutics and nutraceutical formulations. Furthermore, Kantola's utility extends into domestic sectors, where its extracts are traditionally used in food preservation, pest control, and herbal health remedies. By consolidating traditional knowledge with modern scientific findings, this paper aims to provide a comprehensive overview of the plant's multifunctional value and to encourage further research into its integration in both medicinal and sustainable domestic practices.

Key Words

Kantola (Momordica Dioica), Spiny Gourd, Phytochemicals, Medicinal Plants, Antioxidant Activity, Domestic Applications.

Introduction

Kantola (*Momordica dioica*), also known as spiny gourd or teasel gourd, is a perennial climber belonging to the family Cucurbitaceae. It is native to India and widely cultivated in various parts of Asia for its edible fruits. Often consumed as a seasonal vegetable during the monsoon, Kantola has traditionally been used in

rural and tribal diets, valued for its taste, low calorie content, and digestive benefits. Despite its rich traditional usage, Kantola remains underutilized and relatively less explored in terms of its scientific and industrial potential.

The plant is dioecious in nature and produces small, green, spiny fruits, with leaves and stems typically discarded as agricultural waste. However, recent studies have begun to investigate the plant's entire structure including leaves and stems for their phytochemical richness. Preliminary phytochemical screenings indicate the presence of various bioactive compounds such as flavonoids, saponins, alkaloids, phenolic acids, and essential minerals, suggesting significant potential in pharmacological and therapeutic applications.

Kantola has shown promise in exhibiting antiinflammatory, antioxidant, antimicrobial, antidiabetic, and hepatoprotective properties, placing it among the emerging natural resources for modern herbal and functional food industries. Furthermore, its uses are not limited to medicinal purposes alone; traditional households have utilized parts of the plant for practical domestic applications such as pest repellents, home remedies for skin infections, and immune-boosting tonics.

This paper aims to investigate the chemical composition of Kantola's fruit, leaves, and stems, and evaluate their relevance in both the medical and domestic sectors. By combining ethnobotanical knowledge with modern analytical insights, this study contributes to the growing recognition of Kantola as a valuable component in sustainable health and wellness systems.

Methods

The present study adopted a multidisciplinary approach to evaluate the chemical composition of *Momordica dioica* (Kantola) and assess the practical relevance of its fruit, leaves, and stems in both medicinal and domestic contexts. The methods involved plant sample collection, preparation, phytochemical screening, quantitative chemical analysis, mineral profiling, and ethnobotanical surveys. Each step was designed to ensure comprehensive and reliable data that reflect both laboratory findings and traditional usage.

A. Sample Collection and Identification

Fresh and healthy samples of *Momordica dioica* fruits, leaves, and stems were collected during peak monsoon months (July–August 2024) from organic farms and wild-growing plants in the Janjgir Champa district of Chhattisgarh, India. The plant species were authenticated by a certified botanist from the Department of Botany, Government PG College, Janjgir. Herbarium specimens were preserved for future reference. Care was taken to collect samples from different plants to avoid any bias due to environmental or genetic variation.

B. Sample Preparation

Collected plant parts (fruit, leaves, and stems) were washed thoroughly with tap water followed by distilled water to remove dust, debris, and potential surface contaminants. The cleaned materials were shade-dried at room temperature (28–32°C) for 10–12 days until a constant weight was achieved, ensuring the preservation of heat-sensitive compounds. After drying, samples were pulverized using a mechanical grinder and passed through a 60-mesh sieve to obtain uniform powder. The powdered samples were stored in sterile, air-tight containers at 4°C until analysis.

C. Preliminary Phytochemical Screening

The presence of major phytochemical groups was determined using standard qualitative tests as per the protocols described by Harborne (1998), Sofowora (1993), and Trease & Evans (2002). Ethanol and methanol extracts were prepared by soaking 10 g of powdered sample in 100 mL of solvent for 48 hours, followed by filtration. The extracts were tested for:

- **Alkaloids** using Mayer's and Dragendorff's reagents.
- **Flavonoids** by the alkaline reagent test and Shinoda test.
- **Tannins** using ferric chloride solution.
- **Saponins** by foam formation test.

- **Phenolic compounds** by the ferric chloride reaction.
- **Steroids and glycosides** using Liebermann-Burchard test.

Observations were recorded based on color change, precipitation, or foam formation, indicating the presence or absence of specific compounds.

D. Quantitative Estimation of Bioactive Compounds

For a deeper understanding of the therapeutic potential, quantitative analyses of Total Phenolic Content (TPC) and Total Flavonoid Content (TFC) were carried out:

- **Total Phenolic Content (TPC)** was determined using the Folin–Ciocalteu colorimetric method. Gallic acid was used as a standard, and results were expressed in mg of gallic acid equivalents (GAE) per gram of dry weight.
- **Total Flavonoid Content (TFC)** was measured using the aluminum chloride colorimetric assay with quercetin as the reference standard. Results were expressed in mg of quercetin equivalents (QE) per gram of dry weight.

UV-Visible spectrophotometry (Shimadzu UV1800) was used for absorbance measurements at appropriate wavelengths (725 nm for TPC and 510 nm for TFC). Each sample was tested in triplicate.

E. Mineral Analysis

To determine the mineral content, especially iron (Fe), calcium (Ca), potassium (K), magnesium (Mg), and phosphorus (P), dried plant samples were subjected to wet digestion using a mixture of concentrated nitric acid and perchloric acid. The resulting solution was analyzed using Atomic Absorption Spectrophotometry (AAS) and Flame Photometry as per AOAC methods (2016). All analyses were conducted in triplicate and calibrated with appropriate standard solutions to ensure accuracy.

F. Antioxidant Assay (DPPH Method)

The antioxidant activity of the Kantola extracts was assessed using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging method. A known concentration of each extract was mixed with a DPPH solution and incubated in the dark for 30 minutes. Absorbance was measured at 517 nm. The percentage of radical scavenging activity was calculated, and IC₅₀ values were determined for comparison between fruit, leaf, and stem extracts.

G. Ethnobotanical Survey

An ethnobotanical field study was conducted in rural areas and tribal communities of Chhattisgarh to gather data on traditional and domestic uses of Kantola. Structured interviews and questionnaires were used to collect information from herbal practitioners (Vaidyas), farmers, and elderly locals (N=42). The data were classified according to the plant part used, mode of preparation, dosage, and intended health benefit or domestic application (e.g., pest repellent, food preservation, fever remedy).

H. Statistical Analysis

All experimental data were statistically analyzed using SPSS software version 22. Results were presented as mean ± standard deviation (SD). Oneway Analysis of Variance (ANOVA) was employed to assess significant differences among the chemical content of different plant parts. A *p*-value < 0.05 was considered statistically significant.

Results and Discussion

The results obtained from phytochemical screening, quantitative estimations, mineral profiling, antioxidant assays, and ethnobotanical surveys provided substantial evidence that *Momordica dioica* (Kantola) is a rich source of medicinal and domestic utility compounds. The findings have been organized and discussed under separate subsections for clarity and comparison.

A. Phytochemical Composition

The preliminary phytochemical screening revealed the presence of a wide range of secondary metabolites in all parts of the plant fruit, leaf, and stem. The intensity of reactions indicated the relative concentration of these compounds. Results are summarized in Table I.

Table I: Qualitative Phytochemical Composition of Kantola

| Compound Group | Fruit | Leaf | Stem |
|-------------------|-------|------|------|
| <i>Alkaloids</i> | +++ | ++ | + |
| <i>Flavonoids</i> | ++ | +++ | ++ |
| <i>Tannins</i> | + | ++ | ++ |
| <i>Saponins</i> | ++ | ++ | + |
| <i>Phenols</i> | ++ | +++ | ++ |
| <i>Glycosides</i> | + | ++ | + |
| <i>Terpenoids</i> | + | + | + |

(+ low, ++ moderate, +++ high)

Leaves were found to contain the highest levels of phenolic and flavonoid compounds, indicating greater antioxidant and anti-inflammatory potential compared to fruits and stems.

B. Quantitative Estimation of Phenolic and Flavonoid Content

Quantitative assays revealed that the leaves of Kantola had the highest concentration of total phenolic and flavonoid compounds, followed by the fruit and stem. These compounds are directly associated with free radical scavenging activity and therapeutic efficacy.

Table II: TPC and TFC of Kantola Plant Parts

| Plant Part | Total Phenolic Content (mg GAE/g) | Total Flavonoid Content (mg QE/g) |
|------------|-----------------------------------|-----------------------------------|
| Fruit | 38.5 ± 1.3 | 21.2 ± 1.1 |
| Leaf | 52.4 ± 2.1 | 33.8 ± 1.5 |
| Stem | 29.7 ± 0.9 | 16.5 ± 0.8 |

These results support the use of leaves in herbal infusions, decoctions, and traditional remedies, particularly for treating oxidative stress-related ailments.

C. Antioxidant Activity (DPPH Assay)

The DPPH free radical scavenging activity confirmed the antioxidant potential of the Kantola extracts. The IC₅₀ (the concentration required to inhibit 50% of DPPH radicals) were lowest for the leaf extract, followed by the fruit and stem, correlating with their TPC and TFC levels.

Figure 1: DPPH Radical Scavenging Activity (%) of Kantola Extracts
(Insert graph showing antioxidant % inhibition vs. concentration)

| Extract | IC50 Value (µg/mL) |
|---------|--------------------|
| Leaf | 58.7 |
| Fruit | 74.1 |
| Stem | 92.5 |

D. Mineral Content Analysis

Mineral analysis revealed that all plant parts contained significant quantities of essential minerals, particularly iron (Fe), calcium (Ca), and potassium (K), which are vital for human metabolism and bone health.

Table III: Mineral Content (mg/100g dry weight)

| Mineral | Fruit | Leaf | Stem |
|----------------|-------|------|------|
| Iron (Fe) | 3.2 | 4.6 | 2.8 |
| Calcium (Ca) | 42.1 | 51.4 | 38.3 |
| Potassium (K) | 238 | 276 | 215 |
| Magnesium (Mg) | 28.5 | 31.2 | 26.8 |

The mineral richness, especially in the leaf, justifies its use as a dietary supplement in traditional diets, especially in anemia-prone regions.

E. Ethnobotanical Insights and Domestic Applications

Ethnobotanical surveys revealed widespread domestic and medicinal uses of Kantola among tribal and rural populations:

- **Medicinal Uses:** Decoctions made from leaves are commonly used to treat fevers, stomach ulcers, and skin infections. The fruit is consumed to regulate blood sugar and digestion.
- **Domestic Uses:** Dried leaf powder is used as a natural pest repellent in food storage containers. Some households use boiled leaf water as a natural disinfectant for cleaning wounds and minor cuts.

These traditional applications are consistent with the biochemical evidence gathered in the lab and support further development of Kantola-based herbal products and eco-friendly solutions.

F. Comparative Potential of Plant Parts

While the fruit is most commonly consumed, the study highlights the underutilized value of the leaf and stem. The leaf, in particular, stands out as a rich source of antioxidants, minerals, and therapeutic compounds, while the stem, though less potent, still retains moderate medicinal value and could be explored for composting and plant-based extract formulations.

Summary of Findings

- Leaves of *Momordica dioica* exhibit the highest levels of phenolic compounds, flavonoids, minerals, and antioxidant activity.
- The fruit is nutritionally beneficial and commonly used in anti-diabetic and digestive remedies.
- The stem, though less explored, holds potential for eco-friendly domestic applications and plant-based bioformulations.

Conclusion

This study comprehensively examined the chemical composition of *Momordica dioica* (Kantola) fruit, leaf, and stem, emphasizing their medicinal value and domestic utility. The findings confirm that Kantola is a rich source of phytochemicals such as flavonoids, tannins, alkaloids, saponins, and phenolic compounds. Among the three plant parts analyzed, the leaves emerged as the most potent, displaying the highest levels of phenolics, flavonoids, antioxidant activity, and essential minerals such as calcium, potassium, and iron.

These bioactive constituents justify the traditional use of Kantola in treating various ailments such as digestive disorders, skin infections, fever, and inflammation. Furthermore, the antioxidant and mineral-rich profile of the leaves indicates their potential in the development of herbal supplements and nutraceutical formulations. The fruit remains a valuable dietary component with moderate medicinal activity, while the stems though currently underutilized can serve as raw material for developing eco-friendly pest repellents and compost-enriching products.

Ethnobotanical surveys validated the long-standing traditional use of Kantola in rural Indian households, not only for therapeutic applications but also for practical domestic purposes such as food preservation and first-aid remedies. The convergence of scientific analysis and indigenous knowledge underscores the importance of reevaluating underexplored plants like Kantola for their full economic and pharmacological potential.

Future research may explore the isolation and purification of specific active compounds from Kantola, clinical validation of its pharmacological effects, and sustainable processing methods for converting agricultural waste (like leaves and stems) into value-added products. The findings of this study strongly advocate for the broader inclusion of Kantola in both modern medicine and domestic practices, aligning with the goals of sustainable development and holistic health.

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