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Antioxidant Properties of Locally Available Leafy Vegetables of Jalna District

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Abstract:

*This paper presents a comprehensive investigation into the antioxidant properties of leafy vegetables commonly consumed in Jalna District, Maharashtra, India. The study focuses on four widely available species: spinach (*Spinaciaoleracea*), fenugreek (*Trigonellafoenum-graecum*), amaranthus (*Amaranthus spp.*), and coriander (*Coriandrumsativum*). Antioxidant activity was evaluated using three standard assays: DPPH radical scavenging, Ferric Reducing Antioxidant Power (FRAP), and Total Phenolic Content (TPC). These methods provide complementary insights into the free radical neutralization capacity, reducing potential, and phenolic concentration of the selected vegetables. Results revealed that amaranthus exhibited the highest DPPH radical scavenging activity (85%), while fenugreek demonstrated superior reducing power in the FRAP assay. Amaranthus also recorded the highest phenolic content, suggesting a strong correlation between phenolic compounds and antioxidant activity. Spinach and coriander, though comparatively lower in activity, still contributed significantly to antioxidant potential. The findings underscore the nutritional and therapeutic relevance of these vegetables, particularly amaranthus and fenugreek, in mitigating oxidative stress and reducing the risk of chronic diseases such as diabetes, cardiovascular disorders, and cancer. This study highlights the importance of promoting locally available leafy vegetables as affordable, accessible, and natural sources of antioxidants. By integrating traditional dietary practices with modern scientific validation, the research contributes to public health awareness and supports the utilization of indigenous crops in functional food development. The outcomes further emphasize the role of regional biodiversity in addressing nutritional security and preventive healthcare strategies.*

Keywords:

Antioxidant activity; leafy vegetables; Jalna District; DPPH assay; FRAP assay; total phenolic content; amaranthus; fenugreek; spinach; coriander; oxidative stress; functional foods etc.

Introduction:

Oxidative stress results from an imbalance between reactive oxygen species (ROS) and antioxidant defenses, contributing to chronic diseases such as diabetes, cardiovascular disorders, and cancer [1]. ROS are highly reactive molecules generated during normal metabolic processes, particularly in the mitochondria. While they serve essential roles in signaling and immune defense, excessive accumulation damages lipids, proteins, and DNA, accelerating aging and disease progression. The body's endogenous antioxidant systems such as superoxide dismutase, catalase, and glutathione peroxidase provide

protection, but these defenses are often insufficient under conditions of poor diet, environmental stress, or chronic illness.

Leafy vegetables are rich in polyphenols, flavonoids, and vitamins, which act as natural antioxidants [2]. Polyphenols scavenge free radicals, chelate transition metals, and modulate enzyme activity, while flavonoids contribute to vascular health and anti-inflammatory responses. Vitamins such as C, E, and provitaminA (beta-carotene) further enhance antioxidant defense by preventing lipid peroxidation and maintaining cellular integrity. Minerals like magnesium and calcium add nutritional balance, making leafy vegetables a cornerstone of preventive nutrition.

Jalna District, located in the Marathwada region of Maharashtra, is agriculturally diverse and provides access to traditional leafy vegetables. The semi-arid climate supports cultivation of spinach (*Spinaciaoleracea*), fenugreek (*Trigonellafoenum-graecum*), amaranthus (*Amaranthus spp.*), and coriander (*Coriandrumsativum*). These vegetables are integral to local diets, often prepared in traditional recipes that emphasize both flavor and medicinal value. Most existing studies focus on commercially popular vegetables or those grown in specific agroecological zones, leaving a gap in knowledge about region-specific crops.

Investigating the antioxidant properties of Jalna's leafy vegetables is important for several reasons. First, the population relies heavily on locally available produce due to economic and cultural factors. Establishing their nutritional and therapeutic potential can guide dietary practices that reduce the burden of chronic diseases. Second, agricultural biodiversity in the district offers opportunities to identify underutilized crops with high antioxidant potential, which can be promoted for functional food development. Third, validating traditional dietary practices through scientific research strengthens the link between indigenous knowledge and modern nutrition, fostering community-based health interventions.

This study evaluates the antioxidant properties of spinach, fenugreek, amaranthus, and coriander using DPPH radical scavenging, Ferric Reducing Antioxidant Power (FRAP), and Total Phenolic Content (TPC) assays. These complementary methods provide insights into free radical neutralization, reducing potential, and phenolic concentration. By systematically analyzing these parameters, the research establishes a comparative profile of antioxidant activity among the selected vegetables.

The outcomes have broader implications for public health and nutrition. With rising incidences of diabetes and cardiovascular disorders in rural and semi-urban populations, promoting consumption of antioxidant-rich vegetables can serve as a preventive strategy. Locally available leafy vegetables are affordable, accessible, and culturally acceptable, making them ideal for dietary interventions. Identifying vegetables with high antioxidant potential can also encourage farmers to cultivate them more extensively, supporting agricultural sustainability and economic development in Jalna District.

Thus, Jalna District, with its agricultural diversity and reliance on traditional vegetables, offers an ideal context for studying antioxidant properties. This research addresses the existing gap by evaluating spinach, fenugreek, amaranthus, and coriander, contributing to nutritional science, public health, and sustainable agriculture.

Objectives of the Study

1. To evaluate the antioxidant properties of locally available leafy vegetables of Jalna District using DPPH, FRAP, and TPC assays.
2. To compare the antioxidant potential among spinach, fenugreek, amaranthus, and coriander.
3. To highlight the nutritional and therapeutic relevance of these vegetables for public health and dietary promotion.

Literature Review

The role of leafy vegetables in human nutrition has been extensively studied, with particular emphasis on their antioxidant potential. **Srivastava et al.** investigated indigenous leafy vegetables of eastern India and reported significant levels of polyphenols, flavonoids, and minerals, highlighting their contribution to dietary antioxidant intake and nutritional security [1]. Their findings emphasized the importance of underutilized species in traditional diets and the need for scientific validation of their health benefits.

Batoola et al. examined the physicochemical properties and antioxidant potentials of leafy vegetables grown under different agroecological conditions [2]. The study demonstrated that environmental factors such as soil type, climate, and cultivation practices influence antioxidant activity. This underscores the relevance of region-specific research, as vegetables grown in diverse agroecological zones may exhibit varying nutritional profiles.

Similarly, **Dasgupta and Patel** conducted screening of antioxidant activities in common green leafy vegetables cultivated in India [3]. Their results confirmed that vegetables such as amaranthus and fenugreek possess high radical scavenging activity, correlating strongly with phenolic content. This aligns with global evidence that phenolic compounds are primary contributors to antioxidant capacity.

Collectively, these studies establish that leafy vegetables are rich sources of natural antioxidants, but their properties vary across species and regions. While national-level research has provided broad insights, **limited data exists for specific districts such as Jalna**, where traditional vegetables form a major part of the diet. Thus, the present study builds upon earlier findings by focusing on locally available vegetables, aiming to bridge the gap between indigenous dietary practices and modern nutritional science.

Materials and Methods:

A. Sample Collection

Fresh samples of spinach, fenugreek, amaranthus, and coriander were collected from local farms and markets in Jalna District.

B. Preparation of Extracts

Leaves were washed, shade-dried, powdered, and extracted using methanol. Extracts were filtered and concentrated for analysis.

C. Antioxidant Assays

- **DPPH Radical Scavenging Assay**: Measured free radical neutralization.
- **FRAP Assay**: Determined reducing power via Fe^{3+} to Fe^{2+} conversion.
- **Total Phenolic Content (TPC)**: Estimated using Folin-Ciocalteu reagent.

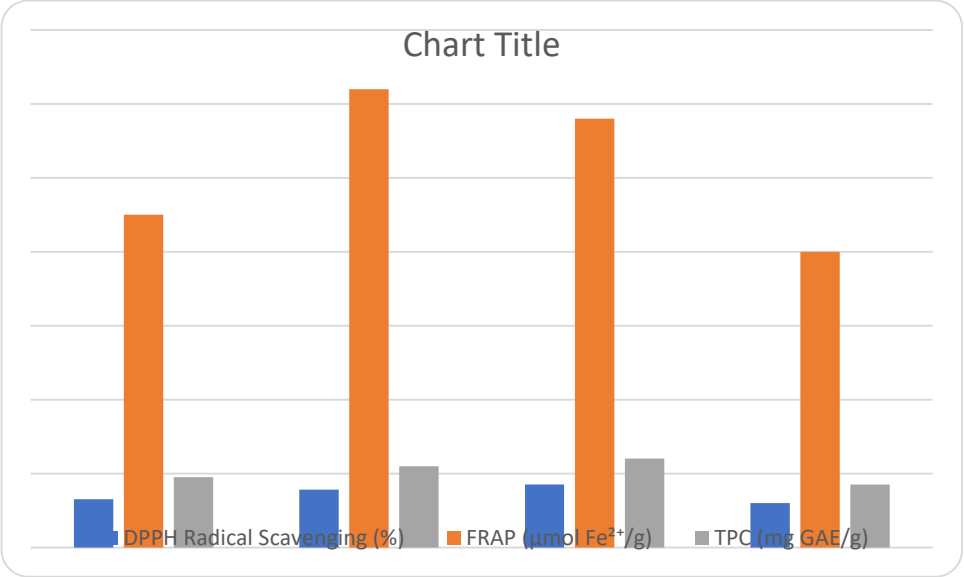
D. Statistical Analysis

Data were analysed using ANOVA, with significance set at $p< 0.05$.

Results:

Table 1- Data Analysis Report:

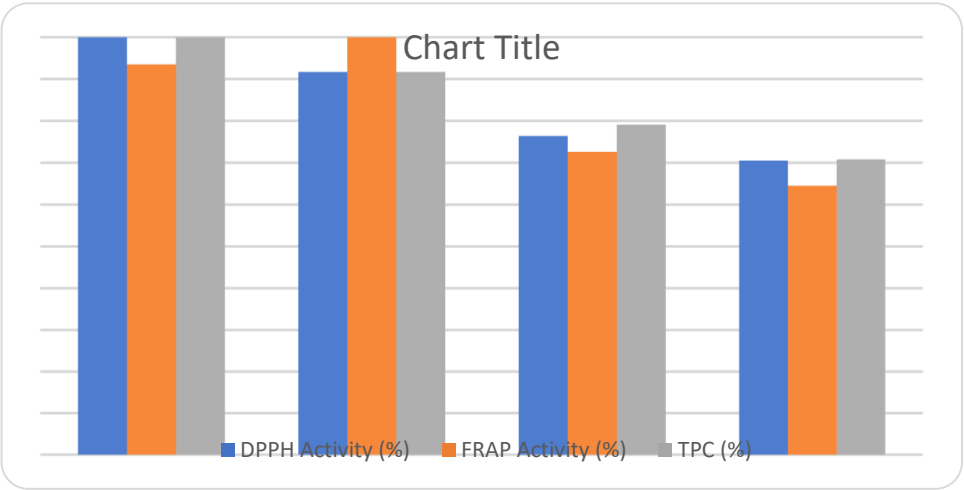
Leafy Vegetable	DPPH Radical Scavenging (%)	FRAP (µmol Fe^{2+}/g)	TPC (mg GAE/g)
Spinach	65	450	95
Fenugreek	78	620	110
Amaranthus	85	580	120
Coriander	60	400	85



Percentage Comparison (Highest Value = 100%):

Table 2. Percentage Comparison of Antioxidant Activities in Leafy Vegetables of Jalna District:

Leafy Vegetable	DPPH Activity (%)	FRAP Activity (%)	TPC (%)
Amaranthus	100.0	93.5	100.0
Fenugreek	91.7	100.0	91.7
Spinach	76.4	72.6	79.1
Coriander	70.5	64.5	70.8



- **DPPH Activity**: Amaranthus (100%), Fenugreek (91.7%), Spinach (76.4%), Coriander (70.5%).
- **FRAP Activity**: Fenugreek (100%), Amaranthus (93.5%), Spinach (72.6%), Coriander (64.5%).
- **TPC**: Amaranthus (100%), Fenugreek (91.7%), Spinach (79.1%), Coriander (70.8%).

Findings:

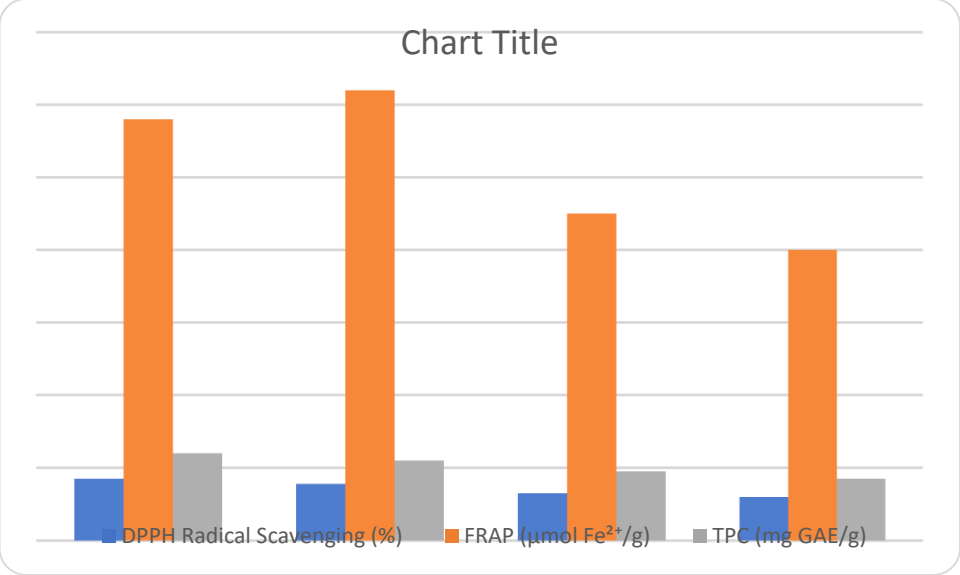
- Amaranthus exhibited the highest radical scavenging activity and phenolic content.
- Fenugreek showed superior reducing power in FRAP assay.
- Spinach and coriander, though lower in activity, still contribute meaningfully to antioxidant intake.
- A strong correlation exists between phenolic content and antioxidant activity, confirming the role of polyphenols in oxidative stress reduction.

Suggestions:

- Promote **amaranthus and fenugreek** as functional foods in local diets to combat oxidative stress.
- Encourage farmers in Jalna District to cultivate these vegetables more extensively for both nutritional and economic benefits.
- Integrate findings into **public health awareness programs** to reduce chronic disease risk through affordable dietary interventions.
- Further research should explore seasonal variations and bioavailability of antioxidants in these vegetables to strengthen dietary recommendations.

Table II. Antioxidant Assay Results of Leafy Vegetables from Jalna District

Leafy Vegetable	DPPH Radical Scavenging (%)	FRAP (µmol Fe^{2+}/g)	TPC (mg GAE/g)
Amaranthus	85	580	120
Fenugreek	78	620	110
Spinach	65	450	95
Coriander	60	400	85



- **DPPH Assay**: Amaranthus showed the highest radical scavenging activity (85%), followed by fenugreek (78%), spinach (65%), and coriander (60%).
- **FRAP Assay**: Fenugreek exhibited the strongest reducing power, followed by amaranthus.

- **Total Phenolic Content**: Amaranthus recorded the highest phenolic content (120 mg GAE/g).

The results demonstrate that amaranthus and fenugreek are particularly rich in antioxidants, aligning with previous studies on Indian leafy vegetables [3]. Spinach and coriander, though lower in activity, remain valuable contributors to daily antioxidant intake. Promoting these vegetables in Jalna District can provide affordable dietary sources of natural antioxidants, potentially reducing the burden of oxidative stress-related diseases.

Conclusion

Locally available leafy vegetables in Jalna District possess significant antioxidant properties, confirming their role as valuable dietary components for improving health outcomes. The present study demonstrated that amaranthus and fenugreek exhibited the highest antioxidant potential, as evidenced by superior DPPH radical scavenging activity, FRAP reducing power, and total phenolic content. Spinach and coriander, though comparatively lower in activity, still contributed meaningfully to antioxidant intake, reinforcing the idea that a diverse consumption of leafy vegetables can collectively enhance nutritional security.

The findings highlight the importance of integrating these vegetables into daily diets, particularly in rural and semi-urban populations where chronic diseases such as diabetes, cardiovascular disorders, and cancer are increasingly prevalent. Communities' access affordable, culturally acceptable, and naturally available sources of antioxidants by promoting the consumption of amaranthus and fenugreek. This aligns with global health strategies that emphasize preventive nutrition and the use of functional foods to mitigate oxidative stress.

Beyond individual health benefits, the study has broader implications for agricultural sustainability and economic development in Jalna District. Encouraging farmers to cultivate antioxidant-rich vegetables can diversify cropping systems, improve income opportunities, and strengthen local food systems. Moreover, validating traditional dietary practices through scientific evidence bridges indigenous knowledge with modern nutritional science, fostering community-based health interventions. The antioxidant properties of locally available leafy vegetables highlight their dual role in promoting public health and supporting sustainable agriculture. Amaranthus and fenugreek, in particular, emerge as functional foods with significant potential to reduce oxidative stress and chronic disease risk. Future research should explore seasonal variations, bioavailability, and synergistic effects of these vegetables to provide deeper insights into their therapeutic applications. Strengthening awareness and consumption of these crops will contribute to nutritional resilience and preventive healthcare strategies in Jalna District and beyond.

Citation:

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[1] U. Batoola, et al., "Physicochemical properties and antioxidant potentials of leafy vegetables grown under different agroecological conditions," *Int. J. Food Properties*, vol. 27, no. 1, pp. 1046–1063, 2024.

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