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## Microgreens as a Nutritional Intervention for Malnutrition: A Study on Fenugreek, Moringa, and Spinach

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### Abstract:

Malnutrition is insistent public health task in India, with children and pregnant women being the most vulnerable groups. Traditional supplementation schemes frequently fall short due to cost, convenience and compliance issues. **Microgreens**, harvested 7–21 (DAS) days after sowing, are nutrient-rich important foods that can provide a sustainable dietary solution. This paper investigates the nutritional potential of three microgreens—**Fenugreek** (*Trigonella foenum-graecum*), **Moringa** (*Moringa oleifera*), and **Spinach** (*Spinacia oleracea*) - that are locally available in the regions of Maharashtra. Nutrient profiling reveals exceptionally high concentrations of **protein, calcium, iron, folate, and antioxidants**, all of which are critical for maternal and child health. The study highlights the feasibility of integrating microgreens into **community health programs** such as ICDS, Anganwadi, and mid-day meal schemes.

**Keywords:** Child Nutrition, Fenugreek, Maharashtra, Malnutrition, Maternal Health, Microgreens, Moringa, Spinach.

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### Introduction:

Our country accounts for nearly 36 % of the world's malnourished children and a significant proportion of anemic women (UNICEF, 2019). In the state of Maharashtra, the National Family Health Survey (NFHS-5, 2021) reported that 54.2% of women (15–49 years) are anemic and 35% of children under five are underweight. Malnutrition in pregnancy is associated with preterm births, low birth weight, and developmental delays, while in children, it contributes to stunting, wasting, and cognitive impairment (Bhutta *et al.*, 2013).

**Microgreens**, young edible seedlings of vegetables and herbs harvested at the first true leaf stage, are gaining attention as “**functional foods**” due to their superior nutrient content compared to mature plants (Xiao *et al.*, 2012; Kyriacou *et al.*, 2016). They are easy to grow, require minimal inputs, and can be harvested within 7–15 days (Choe *et al.*, 2018).

This research focuses on **Fenugreek, Moringa and Spinach microgreens**. These species were chosen because:

1. They have a **short growth cycle**.

2. They are **nutritionally rich**, particularly in micronutrients vital for maternal and child health.
3. They are **locally available in Maharashtra**.
4. They are locally acceptable and already part of the local diet.

### Materials and Methods:

#### 1. Selection of Microgreens:

- **Fenugreek (*Trigonella foenum-graecum*)**: Known for its role in improving hemoglobin levels (Ramesh *et al.*, 2020).
- **Moringa (*Moringa oleifera*)**: Traditionally used as a nutritional supplement in rural India (Gopalakrishnan *et al.*, 2016; Leone *et al.*, 2015).
- **Spinach (*Spinacia oleracea*)**: Widely consumed leafy vegetable, excellent source of folate and iron (Sharma *et al.*, 2020).

#### 2. Cultivation Protocol:

Microgreens were cultivated in **trays using cocopeat as a medium**. Seeds were soaked overnight (except spinach), spread evenly, and covered lightly. Regular misting was provided. Harvest was carried out **7–15 days post-sowing** depending on the species (Patil & Kadam, 2019).

#### 3. Community-Based Cultivation Method for Rural Women:

Microgreen cultivation can be adapted as a **household or community-level practice** requiring minimal resources. A low-cost and accessible

method suitable for **rural women** is described below:

##### 1. **Materials Required:**

- Used plastic trays, bamboo baskets, or even discarded earthen pots (locally available).
- Growth medium: **cocopeat, sand or moist cloth**.
- Locally available seeds of **fenugreek, moringa, and spinach**.
- A small shaded area in the courtyard, balcony, or rooftop.

##### 2. **Procedure:**

- **Seed preparation:** Soak seeds (fenugreek, moringa, spinach) in clean water for 6–8 hours to promote germination.
- **Bed preparation:** Spread 2–3 cm layer of cocopeat (or clean sand/soil mixture) in the container.
- **Sowing:** Scatter soaked seeds evenly and press lightly for soil contact.
- **Covering:** Keep the tray covered with a thin cloth or jute sack for 2–3 days to maintain humidity.
- **Watering:** Spray water lightly twice daily using a simple hand sprayer.
- **Harvesting:** Within 7–12 days, cut microgreens 2–3 cm above the medium using a clean knife or scissors.

##### 3. **Advantages:**

- **Low cost:** Uses recycled containers and locally available seeds.

- **No land requirement:** Can be grown in courtyards, rooftops, or even windowsills.
- **Women-friendly:** Requires only 15–20 minutes of daily care.
- **Income generation:** Surplus microgreens can be sold in local markets or SHGs (Self-Help Groups).

#### 4. Integration with Programs:

Training can be provided through **Anganwadi centers, SHGs, and Farmer Producer Organizations (FPOs)**. Women can form **community microgreen clusters**, ensuring both **household nutrition security** and **additional income** (Patil & Kadam, 2019; FAO, 2018).

#### 2. Nutritional Composition (per 100 g fresh weight):

| Microgreen | Protein (g) | Iron (mg) | Vitamin A (µg) | Vitamin C (mg) | Calcium (mg) | Folate (µg) | References                                                      |
|------------|-------------|-----------|----------------|----------------|--------------|-------------|-----------------------------------------------------------------|
| Fenugreek  | 3.7         | 5.4       | 340            | 44             | 101          | 108         | Ramesh <i>et al.</i> , 2020; Patil & Kadam, 2019                |
| Moringa    | 4.6         | 6.9       | 760            | 57             | 140          | 115         | Leone <i>et al.</i> , 2015; Gopalakrishnan <i>et al.</i> , 2016 |
| Spinach    | 3.2         | 6.4       | 510            | 27             | 82           | 96          | Sharma <i>et al.</i> , 2020; Bhardwaj & Jain, 2017              |

#### 3. Comparative Advantage:

- **Fenugreek:** Best source of folate and iron → combats **maternal anemia**.
- **Moringa:** Highest in calcium, protein, and vitamin A → prevents **stunting in children**.
- **Spinach:** Rich in iron and folic acid → prevents **neural tube defects** in newborns.

#### 4. Nutritional Analysis:

Nutritional composition data was compiled from published sources including **FAO (2018)**, **ICMR (2020)**, and peer-reviewed studies (Xiao *et al.*, 2012; Bhardwaj & Jain, 2017).

#### Results:

##### 1. Growth and Yield:

- **Fenugreek:** Harvest ready in 8 days. Yield: 120 g per 25 × 25 cm tray.
- **Moringa:** Harvest ready in 11 days. Yield: 100 g per tray.
- **Spinach:** Harvest ready in 14 days. Yield: 130 g per tray.

#### Discussion:

The nutrient-dense composition of microgreens makes them **ideal supplements for pregnant women and malnourished children**.

- **Pregnant Women:** Iron and folate deficiencies contribute to anemia and birth defects. Fenugreek and spinach microgreens directly

address these deficiencies (Patil & Kadam, 2019; Sharma et al., 2020). Moringa adds calcium for fetal skeletal development (Leone et al., 2015).

- **Children:** Protein-energy malnutrition is widespread. Moringa microgreens offer high-quality protein and essential micronutrients (Gopalakrishnan et al., 2016).
- **Bioavailability:** Microgreens have been shown to possess **higher bioactive compounds and antioxidants** than mature greens (Xiao et al., 2012; Choe et al., 2018).
- **Socio-economic relevance:** Since they can be cultivated at **household level with minimal investment**, microgreens can strengthen **government programs** such as ICDS, mid-day meal scheme, and Poshan Abhiyaan (NFHS-5, 2021).

### Conclusion:

This study concludes that **Fenugreek, Moringa, and Spinach microgreens** are highly effective, low-cost, and sustainable nutritional interventions for **pregnant women and malnourished children in Maharashtra**. They are rich in iron, folate, calcium, and protein, essential for preventing anemia, stunting, and developmental disorders.

### Recommendations:

1. Conduct **clinical trials** to assess their impact on maternal

hemoglobin levels, infant birth weight, and child growth indices.

2. Encourage household-level cultivation of microgreens through **Anganwadi centers**.
3. Incorporate microgreens into **maternal health programs and school mid-day meals**.

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