



## Organic Agri-Practices and Pharmacognostic Evaluation of Off- Seasoned Cultivated Madhulika: A Wonder Herb

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**Abstract:** The faulty and mechanical lifestyle is causing various physical, mental and psychosomatic disorders today. It causes approximately 5.8 million death tolls every year in India. Diseases and disorders such as cardiovascular disorders (CVDs), osteoporosis, anaemia, diabetes, obesity and irritable bowel syndrome (IBS) are escalating very rapidly. This research paper explores and unveils the organic agri-practices of the Madhulika (*Eleusine coracana* (L.) Gaertn.) cultivated in off-season along with pharmacognostic evaluation. WHO-GACP and GHPP practices also followed along with organic cultivation practices. Madhulika; a wonder herb, belonging to the Poaceae family was organically cultivated in our herbal field laboratory (no. 4) by our indigenous seeds sown line to line in experimental blocks. The field experimental work was conducted from the first week of October, 2018 to the last week of January, 2019 in the Department of Medicinal Plants Sciences at Dev Sanskriti Vishwavidyalaya, Haridwar (U.K), India. The crop duration was increased during off season cultivation but the yield of the crop remained unaffected. The crop showed a high germination percentage (92%) in off season. The results of different physical evaluation parameters are given as total Ash (4.267 % w/w), Acid-insoluble Ash (0.433 % w/w), Water-soluble Ash (1.666 % w/w), Alcohol soluble extractive (12.8 % w/w) and Water soluble extractive (4 % w/w). On the basis of the findings of the result, it is concluded that the crop was organically cultivated without change in quality and yield even in the off season. The processed products from these organic produce may prove as an elixir in curing lifestyle related health problems. Further, it was found that secondary metabolites are highly biosynthesized during organic agri-practices and resulting in least accumulation of adverse effect precipitating agents.

**Keywords:** IBS, Osteoporosis, Anaemic, CVDs, GHPP

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## 1. INTRODUCTION

The herbs have been very significant sources of medicine from the very beginning of human civilization under different systems of healing including Ayurveda, Unani, Siddha and Homoeopathy<sup>1</sup>. Madhulika (*Eleusine coracana* (L.) Gaertn) is a wonderful source for health benefiting micronutrients. It is commonly known as Finger millet/ Ragi/ Mandua in India<sup>2</sup>. It has been categorized as an underutilized crop by the International Plant Genetic Resources Institute. Underutilized plants are domesticated/ wild plant species; which have been used for centuries or even millennia for their food, fibre, essential oils or medicinal properties, but have been reduced to utility and importance over time owing to particular supplies and use constraints<sup>3</sup>. Medicinal potential of the plant needs to be explored through enticing research and development activities. WHO-GACP (Good agriculture and collection practices) and GHPP (Good harvest processing practices) were practiced along with organic off-season cultivation of the crop<sup>4</sup>. WHO has already established that the quality of finished products is the resultant of the good quality crude drugs. For fetching better quality products the crude drugs used for this purpose should be procured from authentic sources<sup>5,6</sup>. The organic cultivation practices promoted the biosynthesis of secondary metabolites that further, results in higher therapeutic index of the drug. Madhulika is a very rich source of calcium (10-fold higher than brown rice, wheat and maize), iron, amino acids including methionine, digestible starches and antioxidants (polyphenols). It has promising health promoting effects including anti-diarrhoeal, antiulcer, anti-inflammatory, anti-tumorigenic and antimicrobial activities. Further, it is a rich source of lipid soluble Vitamin-E and other antioxidants. These antioxidants show free radical scavenging and lipid peroxidation activities<sup>6,7,8</sup>. Its' therapeutic potential is imperative for combating lifestyle related disorders and diseases such as cardiovascular disorders (CVDs), diabetes, osteoporosis, obesity, rheumatic disorders, anaemia, irritable bowel syndrome (IBS), erysipelas and other miscellaneous afflictions<sup>9-12</sup>. Lifestyle related disorders and diseases are major concerns which need to be addressed for developing nations like ours. The huge amount of exchequer may be saved through rational exploration of the potential of the medicinal plants through sustainable promotion of cultivation and conservation of the endangered and underutilized medicinal plants species. About 5.8 million deaths tolls are the outcome of lifestyle related disorders and diseases in our country<sup>6,13,14</sup>.

### 1.1 Details of the Plant

Hindi Name: Madhulika, Ragi, Madua  
Common Name: Finger millet  
Botanical Name: *Eleusine coracana* (L.) Gaertn.  
Family: Poaceae

### 1.2 Geographical distribution

It is found in the tropical and temperate climatic zone of the country. It can be successfully grown up to 1900 m asl.

### 1.3 Plant part used

Seeds with or without kernel can be used. It is a gluten-free, non-allergic and digestive stimulant that is helpful in curing IBS (Irritable Bowel Syndrome) patients.<sup>6,9,15-17</sup>

## 2. MATERIALS AND METHODS

### 2.1 General experimental procedure

The experimental block was located in the organic field laboratory (no. 4) in the Department of Medicinal Plants Sciences at Dev Sanskriti Vishwavidyalaya, Haridwar (U.K), India. Crop was propagated by seeds. Indigenous seeds were used for sowing (propagation) in the experimental block (600 X 100 cm) in the first week of October. The experiment was conducted from October, 2018 to January, 2019. The experimental block was properly tilled and levelled. For manuring 20 kg vermicompost (It acts as a significant agent for enhancing soil fertility along with pesticidal and insecticidal potency) was added and thoroughly mixed up with the topsoil. The seeds were manually sown line to line in the experimental block with spacing of 30 X 10 cm. 200 seeds were manually sown in the block. 50 seeds were sown in each line. The irrigation was given just after sowing of the seeds. 4-5 irrigations were given during the crop gestation period. The weeding and hoeing were done at proper intervals. The crop was matured up to 115<sup>th</sup> d and harvested on 121<sup>th</sup> d (Caution: Delayed harvesting may lead to seed shedding)<sup>13,14,18,19</sup>.

### 2.2 Post harvest handling

The crop was dried in the sunlight before threshing. For storage in airtight containers, the moisture content was reduced up to 10% for the maintenance of the quality<sup>13,14,20-23</sup>.

### 2.3 Pharmacognostic Evaluation

The Pharmacognostic studies includes, the determination of ash value, water soluble extractive value, alcohol soluble extractive value, water soluble ash value and acid insoluble ash value were equally performed. The millet was grounded properly and made powder (sieve # 80). These studies were performed by following standard procedures of Indian Pharmacopoeia (I.P.), and Ayurvedic Pharmacopoeia of India (A.P.I.). The following quality parameters were tested-

### 2.4 Determination of total ash

The ash value was determined by incinerating about 2-3g of the powdered air-dried crude drug material, in a previously weighed crucible at gradually increasing temperature up to 500-600°C until it was carbon free. It was cooled in a desiccator and reweighed. The percentage of the total ash was calculated and represented as % w/w of air dried crude drug material<sup>6,10</sup>.

### 2.5 Determination of water-soluble extractive value

The 5 g accurately weighed powder of the millet was macerated in a glass-stopper conical flask by 100 ml chloroform water (2.5 ml chloroform and volume make up to 1000 ml with distilled water) for 6 h, shaking frequently and then allowed to stand further for 18 h then it was filtered rapidly and 20 ml of the filtrate was transferred in to a tarred flat bottom evaporating dish and evaporated to dryness on a boiling water bath. Then the evaporating dish was dried at 105°C for 6 h, cooled in a desiccator and reweighed. From the weight of the residue the percentage of

water-soluble extractive was calculated and represented as % w/w with reference to air dried sample <sup>6,10</sup>.

## 2.6 Determination of alcohol-soluble extractive value

The 5 g accurately weighed powder of the millet was macerated in a glass-stoppered conical flask by 100 ml alcohol of specified strength (45%, 60%, 90%) for 6 h, shaking frequently and then allowed to stand further for 18 h, then it was filtered rapidly and 20 ml of the filtrate was transferred in to a tarred flat bottom evaporating dish and evaporated to dryness on a boiling water bath. The evaporating dish was dried at 105° C for 6-8 h, cooled in desiccator and reweighed. Finally, the percentage of alcohol-soluble extractive was calculated from the weight of residue which is represented as % w/w with reference to air dried sample <sup>6,10</sup>.

## 2.7 Determination of water-soluble ash

Boil the ash for 5 minutes with 25 ml of distilled water. Collect the insoluble matter in a gooch crucible, or on an ashless filter paper (Whatman 41), wash with hot water, dry on a hot plate and ignite for 15 minutes at a temperature not exceeding 450°C. Allow the residue to cool in a suitable desiccator for 30 minutes and weigh without delay. Subtract the weight of the insoluble matter from the weight of the ash, the difference in weight represents the water soluble ash. The water-soluble ash was calculated and represented as % w/w with reference to air dried samples <sup>6,10</sup>.

## 2.8 Determination of acid-insoluble ash

To the crucible containing total ash, add dropwise 25 ml of dil. hydrochloric acid. Collect the insoluble matter in a gooch crucible, or on an ashless filter paper (Whatman 41), dry on a hot plate and ignite for 15 minutes at a temperature not exceeding 450°C. Allow the residue to cool in a suitable desiccator for 30 minutes and weigh without delay. Subtract the weight of the insoluble matter from the weight of the ash, the difference in weight represents the acid-insoluble ash. The acid-insoluble ash was calculated and represented as % w/w with reference to air dried samples <sup>6,10,24-27</sup>.

## 3. RESULTS AND DISCUSSION

The researcher explored the off-season organic agri-practices and pharmacognostic studies for quality evaluation of the drug. The Madhulika has great potential to cure various disorders and diseases of human body which are related to faulty lifestyle. *Eleusine coracana*(L.) Gaertn is predicted in the wild/ cultivation web under temperate and tropical climates up to an altitude of 1900 m asl. The crop was organically cultivated in the off-season by indigenous seeds and successful results were reported. The gestation period of the crop was around four months and was increased as compared to the crop sown in in-season (kharif). Although, it was observed that the crop showed a high germination percentage even in off-season (92%). The productivity and yield of the crop was unaffected and reported almost the same as of the in-season cultivated crop. During the gestation period no infestation was reported in the crop, it shows high resistance and resilience of the crop. The different stages of growth and duration in days are given as under-Table 1.

Table 1: Physiological growth stage of the crop ( <i>Eleusine coracana</i> ) during off-season cultivation in days (d)		
S.N.	State of the Plant	Crop duration in days (d)
1.	Sowing	0 <sup>th</sup> d
2.	Seedling	Up to 15 <sup>th</sup> d of sowing
3.	2-4 leaf stage	23 <sup>th</sup> d
3.	2-4 leaf stage	23 <sup>th</sup> d
4.	Vegetative growth	34 <sup>th</sup> d
5.	Flowering	62 <sup>th</sup> d
6.	Dough stage	75 <sup>th</sup> d
7.	Seed filling	89 <sup>th</sup> d
8.	Maturity	115 <sup>th</sup> d
9.	Harvesting	121 <sup>th</sup> d

The crop also showed fair and significant results of morpho-physiological parameters as shown in the table 2.

Table 2: Morpho-Physiological observations of the crop ( <i>Eleusine coracana</i> ).		
S.N.	Observations	Characteristics
1.	Plant growth habit	All erect
2.	Plant pigment at leaf juncture	Present
3.	Leaf sheath pubescence	Present
4.	Days to 50% flowering	52-57 days
5.	Glume: colour	Light green
6.	Stem: culm branching	Present
7.	Flag leaf: Blade length	55-57 cm
8.	Flag leaf: Blade breadth	1.5-2cm
9.	Peduncle length	22.5-24 cm
10.	Ear shape	Open
11.	Finger branching	Absent
12.	Finger multiple whorl	Present
13.	Ear head length	7.5-8.5 cm

14.	Finger length	6.5-7.2 cm
15.	Finger width	1.2-1.5 cm
16.	Finger: Number on main ear	5-7
17.	Number of productive tillers/ plant	4-6
18.	Average plant height at maturity	67 cm
19.	Seed shattering	Absent
20.	Seed covering by glumes	Intermediate
21.	Seed colour	Light brown
22.	Seed shape	Ovoid shape
23.	Seed surface	Smooth

The Pharmacognostic evaluation of the crude drug (Madhulika powder) was done in triplicate and the average of the following parameters are given as follows-

Total Ash:	4.267 % w/w
Acid-insoluble Ash:	0.433 % w/w
Water-soluble Ash:	1.666 % w/w
Alcohol-soluble extractive:	12.8 % w/w
Water-soluble extractive:	4 % w/w

The higher percentage of total ash, acid-insoluble ash, water-soluble ash, alcohol-soluble extractive, and water-soluble extractive values have clearly established the higher biosynthesis of secondary metabolites (therapeutic agents) during the off-seasoned organic cultivation when compared the results with non-organically cultivated/ collected from the wild sources<sup>21</sup>. The good agriculture and collection practices (WHO-GACP) along with good harvest processing practices (WHO-GHPP) are very helpful in preserving and protecting the therapeutic agents found in the crops<sup>3</sup>. The processing products fabricated from such herbal materials by following WHO-GMP guidelines would be of highest quality<sup>4</sup>. This potential underutilized medicinal plant may be worked out for curing lifestyle-related diseases and disorders. But for better therapeutic benefits more impetus should be given to the sources of the crude drugs. Quality of raw material (crude drug) determines the quality of finished products as already established by WHO<sup>6</sup>. There is ample scope for investigation of other members of the Poaceae family for the novel drug discovery and development. There is need for development, advancement and innovation of new formulations for combating the several other lifestyle-related disorders and diseases. The demand for *functional foods* and *nutraceuticals* is rapidly increasing day-by-day due to sudden swift in approaches of the people from curative to preventive approach since last decades. These *nutraceuticals* not only The current research paper opens up a new vistas for the The current research paper opens up a new vistas for the

The current research paper opens up a new vistas for the provides energy but are crucial sources of immune-modulators, antioxidants, antiaging, and therapeutic agents.

## 5. CONCLUSION

There is a humongous scope for the researchers to carry out researches on the underutilized medicinal plants through organic cultivation practices so that it can effectively contribute to the nation building and economic development of the country along with sustainable management of resources by formulating good quality, safer, efficacious, and potent herbal preparation meeting out national and international standards.

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## 7. AUTHORS CONTRIBUTION STATEMENT

Both authors have made a substantial, direct and intellectual contribution to the work, and approved it for the publication. Both authors have read and agreed to the published version of the manuscript. However, the idea generation for the work was catapulted by Professor K. Singh and executed by Dr. L.R. Singh. Study design, writing and submission, editing and approval work was done together.

## 8. CONFLICT OF INTEREST

Conflict of interest declared none.

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