Comparative Histo-Pharmacagnostical Studies
of Chenopodium album Linn under the impact
of Atlas Cycle Industry Effluent

Kavita Tyagi, Sandhya Kaushik, Shahidul khair and Rajat Rashmi

Abstract—Chenopodium album Linn. (Bathua) belongs to the
family Chenopodiaceae, is an important medicinal plant in Ayurveda
used in diseases of blood, heart, spleen, eye and in biliousness
conditions. The plant contains essential oils, besides alkaloids,
trigonelline and chenopodine. Leaves are rich in potassium &
vitamin C. Comparative histo-pharmacognostic studies of
Chenopodium album Linn., growing in industrial (Atlas Industry,
Ghaziabad) & in control land (ALTT Centre, Ghaziabad) areas have
been done and observations were enumerated. The effluent was
analysed for colour, pH, TS, TDS, TSS, BOD, COD, heavy metals
etc were studied and their variations were noted. Morphological
characters of stem and leaves (colour, apex, base, margin, texture,
etc.), parameters of surface (stomata, stomatal index, palisade ratio,
trichomes, epidermal cells and their cuticularization etc.), secondary
xylem and secondary phloem when studied under the microscope
were found to be decreasing; Anatomical characters like
chlorenchyma, endodermis and pericycle were absent in stem, and in
leaves presence of collenchyma, palisade single layered and single
vascular bundle in midrib were observed in those plant samples
which were collected from polluted sites. Preliminary colour reaction
tests showed degree of change in polluted plant samples. TLC
observations indicated less number of spots in polluted plant
samples. Histo-pharmacognostic studies of this plant drug which is
the present object of our study commonly used in Indian System of
Medicine could not be found on record when reviewed. A comparative histo-
pharmacognostic studies of Chenopodium album were
accomplished with a view to ascertain genuineness the quality of
the under study drug and to lay down correct botanical parameters
for its value as a quality crude drug.

Keywords—Chenopodium album, Histo-Pharmacognosy,
Industrial effluent.

I. INTRODUCTION

GHAZIABAD has many industries. In the vicinity of these
industries, many medicinally important plants are
growing. These plants play a vital role in human and animal
life as source of food and medicine. But due to heavy
industrialization plants are bound to absorb industrial polluted
water, which adversely effects their growth, quality and
medicinal values. After absorbing the polluted water of
industries their growth becomes stunted and their medicinal
value also get reduced. These plants are used as such in
medicine or as sources for commercial use, by drug industries
or for export. The pharmaceutical industries are facing a
constant problem of shortage of quality raw materials. It is
therefore essential to ascertain the quality of medicinal plants
material before it is employed for the preparation of drugs.
Histo-pharmacognostical study therefore, plays a very
important role in determination of authentication, purity and
quality of crude plant drugs or their parts.

The study has been carried out for histo-pharmacognostical
characteristics of Chenopodium album Linn. a medicinally
important plant growing in the vicinity of such industries.
Chenopodium is an important medicinal plant of Indian
System of Medicine, used in many diseases like intestinal
ulcer, piles, throat and eye troubles “as discussed by
Anonymous [2]”.

To study the impact of industrial effluent on selected plant,
Atlas Cycle Industry at Ghaziabad UP, India was selected.
This on an industry is discharging approximately 400-
kiloliters effluent per day.

II. MATERIALS AND METHODS

The effluent was analyzed by “as discussed by APHA [1]
and and Trivedi & Goel [27]”. The fresh material was
collected from both sites non-polluted (ALTT Centre) and
polluted (Atlas Industry, Ghaziabad) area of selected. For
anatomical studies twig samples of 3rd internode were used
and fixed in F.A.A. For anatomical studies were consulted
“as discussed by Metacalf and Chalk [21]”, for powder studies
“as discussed by Jackson & Snowdon [16]” was followed for
chemical analysis “as discussed by Johanson [17], Youngken
[29], Cromwell [7] & Trease and Evans [26]”were followed.
The extraction of plant powder is carried out with ethyl
alcohol using a rapid extraction method (Quality control
methods for medicinal plant materials: “as discussed by

III. RESULTS

Effluent Analysis: The effluent was analyzed “as discussed
by APHA [1] and and Trivedi & Goel [27]” given below
### Table I

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Parameters</th>
<th>Characteristic of Effluents</th>
<th>Maximum Concentration</th>
<th>Authority/Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Colour</td>
<td>Yellowish</td>
<td>Should be absent</td>
<td>I.S.I. : 2490</td>
</tr>
<tr>
<td>2.</td>
<td>Odour</td>
<td>--</td>
<td>Odourless</td>
<td>I.S.I. : 2490</td>
</tr>
<tr>
<td>3.</td>
<td>pH</td>
<td>14-6</td>
<td>5.5-9.0</td>
<td>I.S.I. : 2296</td>
</tr>
<tr>
<td>4.</td>
<td>Suspended Solids</td>
<td>200 mg/l</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>5.</td>
<td>Total Dissolved Solids (mg/l)</td>
<td>810 mg/l</td>
<td>2100.0</td>
<td>I.S.I. : 3307</td>
</tr>
<tr>
<td>6.</td>
<td>Total Suspended Solids (mg/l)</td>
<td>1010 mg/l</td>
<td>600.0</td>
<td>I.S.I. : 3306</td>
</tr>
<tr>
<td>7.</td>
<td>Dissolved Solids</td>
<td>720 mg/l</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>8.</td>
<td>Total Solids (mg/l)</td>
<td>840 mg/l</td>
<td>2700.0</td>
<td>-----</td>
</tr>
<tr>
<td>9.</td>
<td>BOD (mg/l)</td>
<td>16.0 mg/l</td>
<td>30.0</td>
<td>I.S.I. : 2490</td>
</tr>
<tr>
<td>10.</td>
<td>COD (mg/l)</td>
<td>200 mg/l</td>
<td>250.0</td>
<td>I.S.I. 2490,1982</td>
</tr>
<tr>
<td>11.</td>
<td>Oil and Grease (mg/l)</td>
<td>Nil</td>
<td>10.0</td>
<td>I.S.I. : 2490</td>
</tr>
<tr>
<td>12.</td>
<td>Chloride (mg/l)</td>
<td>Nil</td>
<td>600</td>
<td>I.S.I. : 2490</td>
</tr>
<tr>
<td>13.</td>
<td>Sulphide</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>14.</td>
<td>Chromium (Cr)</td>
<td>5 mg/l</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>15.</td>
<td>Nickel (Ni)</td>
<td>12 mg/l</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>16.</td>
<td>Zinc (Zn)</td>
<td>15 mg/l</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>17.</td>
<td>Cadmium (Cd)</td>
<td>4 mg/l</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>18.</td>
<td>Copper (Cu)</td>
<td>4 mg/l</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>19.</td>
<td>Temperature</td>
<td>50°C</td>
<td>-----</td>
<td>-----</td>
</tr>
</tbody>
</table>

Macromorphology: The plant was an erect or ascending, green or reddish, herb, up to 3.50 meter in height. Stem was angular, rarely slender often striped green red or purple in non-polluted areas, whereas in polluted areas, stem was purple or red in colour. Leaves in non-polluted areas were variable in size, shape and dark green in colour. These were rhomboid, deltoid to lanceolate, upper entire, lower toothed or regularly lobed; petioles long slender, often equal or longer than the blade, petiole is 10-15 cm long; leaf was 1.30-4.00 x 5.00-7.54 cm². But in case of polluted area the colour of leaves was yellow green with white patches, petiole is 4-6 cm long and leaf was 1.50-3.50x4.00-6.50cm.

Flowers in clusters were forming complex or lax paniculate often mealy spikes in axils; utricles with round, compressed, shining black seeds, and containing sharp margins. The spikes were more in number. But in polluted plants the spikes were lower in numbers and shows retardation in growth. The seeds were 1.5 mm in diameter (Plate 1). The main differences are tabulated in table 2.

### Table II

<table>
<thead>
<tr>
<th>S.N.</th>
<th>Parameters</th>
<th>Non polluted</th>
<th>Polluted</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Leaf Colour</td>
<td>Dark green</td>
<td>Yellow Green</td>
</tr>
<tr>
<td>2.</td>
<td>Stem Colour</td>
<td>Green</td>
<td>Purple Red</td>
</tr>
<tr>
<td>3.</td>
<td>Height of Plant (cm)</td>
<td>73.500± 4.769;CV = 10.672</td>
<td>27.500 ± 3.590***;CV = 13.054</td>
</tr>
<tr>
<td>4.</td>
<td>No. of Leaves/ Plant</td>
<td>289.290 ± 17.600;CV = 6.085</td>
<td>226.210 ± 6.710;CV = 3.019</td>
</tr>
<tr>
<td>5.</td>
<td>Leaf Area (cm²)</td>
<td>13.250 ± 1.590;CV = 12.099</td>
<td>10.10 ± 0.620;CV = 6.138</td>
</tr>
<tr>
<td>8.</td>
<td>Lamina (cm)</td>
<td>L = 4.275 ± 0.526;CV = 12.308</td>
<td>L = 2.275 ± 0.571***;CV = 25.131</td>
</tr>
<tr>
<td></td>
<td>W = 2.775 ± 0.192;CV = 6.919</td>
<td>W = 1.750 ± 0.112*;CV = 6.388</td>
<td></td>
</tr>
</tbody>
</table>

Significant at 0.1% -- * 1.0% -- ** 5.0% -- ***
Odour:- Aromatic in nature in both the cases polluted as well non polluted.
Taste:- Acidic in nature in both the cases.

Microscopical Study:- The non polluted stem shows single layer of epidermis covered by thin cuticle and non glandular trichomes, hypodermis; 4-5 layers of collenchymatous cells, 4-5 layers of parenchymatous cortex; single layer of endodermis with casparian strip. Secondary vascular bundles are present in a ring and remain embedded in the prosenchyma (conjunctive tissue). Phloem was interxylary. Vascular bundles were conjoint, collateral, open and endarch. Pith cells were polygonal with intercellular spaces (Plate 3). But in case of polluted stem there were 5-6 layers of collenchyma, 5-6 layers of parenchyma where as ruptured endodermis; phloem and cambium were in discontinuous manner. Vascular bundles were smaller in size. Micro and rosette crystals were present in parenchymatous cells (Plate 2).

Non-polluted leaf shows single layer of epidermis bearing glandular and non glandular trichomes covered with cuticle. Stomata were anisocytic and anomocytic present on both the surfaces of leaf and more frequent on lower surface 1-2 layers of collenchyma in the upper region and lower region, 4 vascular bundles in midrib and presence of micro and rosette crystals of calcium oxalate in parenchymatous cells. Mesophyll was differentiated into 3-4 layers of palisade, 2-3 layers of spongy parenchyma, (Plate 4). But the polluted leaf was isobilateral in nature containing 2-3 layers of collenchyma present in upper region and 1-3 layers of collenchyma in lower region. 7-9 layer of palisade with a duct and a continuous layer of rosette crystals of calcium oxalate Lamina. In polluted leaves the glandular trichomes and spongy parenchyma were absent (Plate 3).

**Powder Analysis:** The colour of the powder was green of non-polluted plants and pale yellow green of polluted plants having strong unpleasant odour and acidic taste. Epidermal cells were tangentially elongated. Anomocytic and anisocytic stomata were present. Some parenchymatous cells were observed with rosette crystals. Glandular hairs were single celled and sessile. Non-glandular trichomes were simple with warts and multicellular. Vessels with annular thickening with simple perforation rims were observed. Tracheids few, pitted and elongated with narrow tapering ends were present. Occasional xylem fibres present. In polluted samples the rosette crystal and glandular trichomes were absent (table 3).

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Powder Analysis of Chenopodium album Lin. growing in non-polluted and polluted areas.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Characters</td>
</tr>
<tr>
<td>1.</td>
<td>Cuticle (mm)</td>
</tr>
<tr>
<td>2.</td>
<td>Epidermis (mm)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Xylem Vessel (mm)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Diameter of Xylem Pore (mm)</td>
</tr>
<tr>
<td>5.</td>
<td>Xylem Tracheid (mm)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Xylem Fibre (mm)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Palisade Cell (mm)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
9. Spongy Parenchyma (mm)  
   \( L = 0.081 \pm 0.005; CV = 6.173 \)  
   \( W = 0.047 \pm 0.003; CV = 6.383 \)  
   Absent

10. Rosette Crystal (mm)  
   \( L = 0.093 \pm 0.023; CV = 24.731 \)  
   \( W = 0.047 \pm 0.009; CV = 19.148 \)  
   \( L = 0.130 \pm 0.014; CV = 10.76 \)  
   \( W = 0.036 \pm 0.003; CV = 8.333 \)

11. Guard Cell (mm)  
   \( L = 0.140 \pm 0.024; CV = 7.894 \)  
   \( W = 0.038 \pm 0.003; CV = 8.333 \)  
   \( L = 0.112 \pm 0.025; CV = 22.321 \)  
   \( W = 0.076 \pm 0.012; CV = 15.789 \)

12. Stomatal Pore (mm)  
   \( L = 0.086 \pm 0.003; CV = 3.488 \)  
   \( W = 0.032 \pm 0.001; CV = 3.125 \)  
   \( L = 0.063 \pm 0.002; CV = 3.174 \)  
   \( W = 0.030 \pm 0.002; CV = 6.666 \)

13. Upper Surface (Stomatal Index)  
   \( R = 18.811 - 23.157 \)  
   \( SD = 22.269 \pm 0.819; CV = 3.677 \)  
   \( R = 17.842 - 19.711 \)  
   \( SD = 18.481 \pm 0.615; CV = 3.327 \)

14. Lower Surface (Stomatal Index)  
   \( R = 20.000 - 22.661 \)  
   \( SD = 21.604 \pm 1.030; CV = 4.767 \)  
   \( R = 18.032 - 22.253 \)  
   \( SD = 21.303 \pm 1.900; CV = 8.918 \)

15. Trichomes  
   Unicellular and Warty (mm)  
   \( F = 3 - 4 / \text{unit area} \)  
   \( L = 0.135 \pm 0.012; CV = 8.888 \)  
   \( W = 0.029 \pm 0.006; CV = 20.680 \)  
   \( F = 2 - 3 / \text{unit area} \)  
   \( L = 0.129 \pm 0.014; CV = 10.852 \)  
   \( W = 0.025 \pm 0.009; CV = 36.000 \)

   Multicellular (mm)  
   \( F = 7 - 8 / \text{unit area} \)  
   \( L = 0.168 \pm 0.026; CV = 15.476 \)  
   \( W = 0.036 \pm 0.003; CV = 8.333 \)  
   \( F = 8 - 9 / \text{unit area} \)  
   \( L = 0.139 \pm 0.025; CV = 17.985 \)  
   \( W = 0.030 \pm 0.002; CV = 6.666 \)

   Glandular (mm)  
   \( F = 2 - 3 / \text{unit area} \)  
   \( L = 0.043 \pm 0.002; CV = 4.651 \)  
   \( W = 0.037 \pm 0.001; CV = 2.702 \)  
   Absent

16. Vein Islets Number  
   \( R = 4 - 20 \)  
   \( SD = 13.333 \pm 1.798; CV = 13.485 \)  
   \( R = 16 - 48 \)  
   \( SD = 29.000 \pm 4.236; CV = 14.608 \)

17. Vein Termination Number  
   \( R = 44 - 68 \)  
   \( SD = 51.666 \pm 2.884; CV = 5.582 \)  
   \( R = 68 - 72 \)  
   \( SD = 70.333 \pm 2.364; CV = 3.361 \)

Preliminary Colour Reaction Tests: The result shows the presence of saponin, tannin, lignin, protein, carbohydrates, suberin, glucoside, flavin, and traces amount of oil and absence of alkaloids & sugars in both the cases. Degrees of changes in colour reaction tests are tabulated in table 4.

**TABLE IV**  
COLOUR REACTION TESTS OF *CHENOPODIUM ALBUM* LINN. GROWING IN NON POLLUTED AND POLLUTED AREAS.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Reagents</th>
<th>Test For</th>
<th>Nature of Colour</th>
<th>Degree of Changes Non-polluted</th>
<th>Polluted</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Dragonorff’s Reagent {Cromwell (1955)}</td>
<td>Alkaloid</td>
<td>Negative</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>2.</td>
<td>Mayer’s Reagent</td>
<td>Alkaloid</td>
<td>Negative</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>4.</td>
<td>Tannic Acid</td>
<td>Alkaloid</td>
<td>Negative</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>5.</td>
<td>Hager’s 60Reagent</td>
<td>Alkaloid</td>
<td>Negative</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>6.</td>
<td>Phloroglucinol + HCl</td>
<td>Lignin</td>
<td>Dark Red</td>
<td>+++</td>
<td>++</td>
</tr>
<tr>
<td>7.</td>
<td>FeCl₃</td>
<td>Tannin</td>
<td>Black</td>
<td>+++</td>
<td>++</td>
</tr>
<tr>
<td>8.</td>
<td>Molisch Test</td>
<td>Carbohydrates</td>
<td>Red</td>
<td>++++</td>
<td>++</td>
</tr>
<tr>
<td>9.</td>
<td>Millon’s Reagent</td>
<td>Protein</td>
<td>Red ppt</td>
<td>+++</td>
<td>+</td>
</tr>
<tr>
<td>10.</td>
<td>Xanthoproteic Test</td>
<td>Protein</td>
<td>Yellow</td>
<td>++++</td>
<td>+++</td>
</tr>
<tr>
<td>11.</td>
<td>Bendict’s Reagent after Heating</td>
<td>Sugars</td>
<td>Negative</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>12.</td>
<td>Sample + Heating with Strong KOH + H₂SO₄</td>
<td>Suberin</td>
<td>Red Black</td>
<td>++++</td>
<td>++</td>
</tr>
<tr>
<td>13.</td>
<td>Molisch Test after Hydrolysis</td>
<td>Glucoside</td>
<td>Yellow</td>
<td>+++</td>
<td>++</td>
</tr>
<tr>
<td>14.</td>
<td>Plant Powder + H₂O + Shake</td>
<td>Saponin</td>
<td>Large Froth (W)</td>
<td>++++</td>
<td>++</td>
</tr>
<tr>
<td>15.</td>
<td>Mg Powder + Conc. HCl</td>
<td>Flavin</td>
<td>Green - Black</td>
<td>++++</td>
<td>++</td>
</tr>
<tr>
<td>16.</td>
<td>Libermann’s Buchard Reagent</td>
<td>Steroids</td>
<td>Violet</td>
<td>++++</td>
<td>++</td>
</tr>
<tr>
<td>17.</td>
<td>Sudan IV</td>
<td>Oils</td>
<td>Red</td>
<td>++++</td>
<td>++</td>
</tr>
</tbody>
</table>
TLC: The numbers of spots were 4-8 in non-polluted plants while 2-4 spots in polluted plants (Plate 4). The Rf values are tabulated in table 5.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Wavelengths</th>
<th>Non – Polluted Rf values</th>
<th>Polluted Rf values</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Sunlight(Visible)</td>
<td>0.30, 0.42, 0.85, 0.89</td>
<td>0.42, 0.89,</td>
</tr>
<tr>
<td>2.</td>
<td>U.V. Light(264nm)</td>
<td>0.30, 0.34, 0.42, 0.85, 0.89</td>
<td>0.34, 0.36, 0.42, 0.89</td>
</tr>
<tr>
<td>3.</td>
<td>U.V. Light (365nm)</td>
<td>0.30, 0.42, 0.85, 0.89</td>
<td>0.34, 0.42, 0.89</td>
</tr>
</tbody>
</table>

Plate 4

Physical Evaluation:
Fluorescence Behaviour of Plants: There were no significant results observed with fluorescence behaviour of plant powder and its extracts except some difference in colours which are tabulated in table 6.

<table>
<thead>
<tr>
<th>S. No</th>
<th>Extracts</th>
<th>Visible(Sunlight)</th>
<th>U.V. Light (254nm)</th>
<th>U.V. Light (365nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Powder as Such</td>
<td>Green</td>
<td>Brown Green</td>
<td>Blue Green</td>
</tr>
<tr>
<td>5.</td>
<td>Acetone</td>
<td>Yellow</td>
<td>Greenish Yellow</td>
<td>Green</td>
</tr>
<tr>
<td>6.</td>
<td>P. Ether</td>
<td>Colour-less</td>
<td>Colourless</td>
<td>Silver Green</td>
</tr>
<tr>
<td>7.</td>
<td>E. Acetate</td>
<td>Pale Yellow</td>
<td>Green</td>
<td>Green</td>
</tr>
<tr>
<td>8.</td>
<td>Methanol</td>
<td>Yellow</td>
<td>Green</td>
<td>Green</td>
</tr>
</tbody>
</table>

Extractive Values and Ash Values: The percentage of water and alcoholic soluble extractives were lower in those plants collected from polluted sites, but LOD was higher in polluted plant samples. Total ash, acid insoluble and sulphated ash were higher in those samples which are collected from the polluted areas. The mean values are tabulated in table 7.

<table>
<thead>
<tr>
<th>Table 7 : EXTRACTIVE VALUES AND ASH VALUES OF CHENOPODIUM ALBUM LINN. GROWING IN NON-POLLUTED AND POLLUTED AREAS.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extractive Values(%) and Ash Values(%)</td>
</tr>
<tr>
<td>S.No.</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>1.</td>
</tr>
<tr>
<td>2.</td>
</tr>
<tr>
<td>3.</td>
</tr>
<tr>
<td>4.</td>
</tr>
<tr>
<td>5.</td>
</tr>
<tr>
<td>6.</td>
</tr>
</tbody>
</table>

Significant at 0.1% - *, 1.0% - **, 5.0% - ***

IV. DISCUSSION
The effluent samples collected from the selected industry was analysed for different physico-chemical parameters which showed higher values as compared to the standard values recommended “as discussed by the Indian Standard Institute (I.S.I.) [12’13’ & 14]”. Similar results were also obtained by “as discussed by Kumar, et al. [20] and Vijayavathi et al. [31]”. A critical observation on the data studied clearly indicate that plants growing at polluted sites were badly affected and there were a significant reduction in number of parameters studied as compared to the plants growing at the control sites.

Morphological characters such as height of plant, number of leaves/ plant, leaf area, laminar area, petiole size and flowers or spikes/plants) were found to be decreased in the selected plant collected from polluted areas. Similar observations were recorded by “as discussed by Anderson, et al. [3]”. “As discussed by Angadi and Mathad [4]” who have studied the effects of Copper, Cadmium and Mercury on the morphological, physiological and biochemical characteristics of Scenedesmus quadricauda (Turp) de Breb. and found maximum inhibition in the growth, chlorophylls, total DNA, total RNA and protein contents of cells at the sites of higher metal concentrations. Therefore, it is observed from various studies that the same species respond differently under different conditions Ipolluted and nonpolluted. In a similar study As discussed by Gupta [11]” reported that Solanum melongena growing in the vicinity of a power plant complex resulted in poor growth and reduced productive capacity due to various air pollutants.

The stem anatomy of plants collected from polluted sites when compared with those growing at the control sites showed common characteristics viz. both type of trichomes, collenchymas, parenchyma, pericycle, medullary vascular bundles open and endarch vascular bundles, but the ruptured endodermises present only in polluted plant samples. Reduced secondary growth observed in present findings in most of the selected plants collected from polluted areas goes in
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conformity with the result of “as discussed by Jabeen and Abraham [15]”. They showed less secondary tissue in Largerstroemia reginae and Alstonia scholaris trees exposed to air pollutants. “As discussed by Chaudhari and Patil [6]” also observed the inhibition and stimulation in xylem and phloem in pith region of several plant species growing under the stress conditions of polluted water. Thick cuticle observed in transverse sections of the stem of plants collected from the polluted areas under present studies were also matched with the findings of “as discussed by Riederer et al. [22]”. Cuticle is the first point of attack of pollutants; our results indicated an increase in the thickness in cuticle at the polluted sites which indicates that the plants have an effective barrier for entry of pollutants. “As discussed by Setia and Rajni Bala [23]” have studied anatomical changes in root and stem of wheat (Triticum aestivum L.) in response to different heavy metals (Hg, Cd and Pb). “As discussed by Trivedi & Singh [28’29]” studied the epidermal features (stomatal density and index) of Amaranthus viridis Linn. and Croton bonplandianum Baill. under the impact of air pollution. Significant reduction in cell sizes of the polluted affected plants was also reported by “as discussed by Ansari and Iqbal [5]”. Reduced length and width of xylem vessels observed in the plant samples collected from polluted areas were found to be similar with the observations noted in Cajanas cajan by “as discussed by Ghouse, et al. [10]”. The reduced length of vessel elements coupled with their augmented frequency appears to be the significant adaptations to the stress of pollution.

Microscopical studies related with leaf anatomy of plants collected from polluted areas indicated that less trichomes frequency, less number of stomata, presences of collenchyma layers, reduced layer of spongy parenchyma with smaller cell sizes, lesser ground tissue, decreased ratio of stomatal index and palisade; more numbers of crystals with bigger size in leaves of polluted plant samples. “As discussed by Trivedi and Singh [29]” and Salgare & Acharekar [24]” have also reported a considerable decrease in size and frequency of stomata and epidermal cells of plants growing in polluted environment. Low stomatal frequency observed in the plants grown in polluted areas, may reflect adaptation of ecotypic significance in regulating the limited and controlled entry of harmful gaseous pollutants into the plants tissues, especially when the plant grown in polluted area. The response of plants varies in accordance to varying nature of pollutants their concentrations. Powder analysis of Chenopodium showed that elements of xylem and phloem were smaller in size in the samples collected from polluted areas. Reduction in the vessels width were observed in polluted samples of Polygonum glabrum and Zea mays by “as discussed by Khan et al [18’19]”. Although the pollution effect is very prominent in several aspects of growth and development of the plant, it significantly promotes the number of vessels and fibres in plants growing under pollution effect.

Physico-chemical of powdered drug evaluation include fluorescence behaviour, extractive and total ash values. The plant samples collected from polluted areas showed quick differentiations to fluorescence behaviour. Water and alcohol extractive values were found to be lowered collected from polluted areas. Ash values were comparatively higher in polluted plant samples. Similar observations were made by “as discussed by Sharma and Habib [25]”. Percentage of ash content was higher in the plant samples those collected from polluted areas as compared to the control one, because ash content of plants is the direct manifestation of bio-accumulation of minerals absorbed as macro and micronutrients which take up different functions. The colour reaction tests showed the degree of changes. The percentages of extractive values were lower and ash values were higher in polluted plants. From the observations some alteration in the bio-chemical parameters were recorded in the plants growing near the industrial effluent. The amount of chemical constituents found to have decreased in those plants which were growing in polluted areas.

From the observations of TLC, it was seen that the number of spots were decreased in the plant samples of polluted sites. From the findings of this investigation it may be safely asserted that there had been qualitative and quantitative alternations in the chemical constituents in the plants growing in industrial areas (polluted). It would not be unwise to state that industrial pollution might have also lowered the drug potency of the plants growing in the vicinity of industries. Almost similar observations were recorded by “as discussed by Dhar et al. [8] and Ghouse et al [9]”.

In order to determine the quality of medicinal plants with regard to its authenticity histo-pharmacognostical characters viz. macroscopical, anatomical, powder analysis, chemical analysis, TLC, fluorescence behaviour, extractive values and ash values are very important. Anatomy often proves very useful for individual identification of plants so microscopical methods are of great value towards their identification and authentication of the authenticity of plant drugs. They provide evidences concerning relationship of groups such as families or help to establish affinities of genera of uncertain taxonomic status. The number of stomata and epidermal cells, vein-islets and vein termination number per unit area, palisade ratio, stomatal index etc. give constant structure for different species of plants. Moreover, different types of stomata, crystals, fibers, trichomes etc. present in powdered drug help in the identification of plants or differentiation in comparison of same plant species, which are collected from the industrial and non-industrial localities.

V. CONCLUSION

We are accordingly inclined to conclude that the plants from non polluted areas should be taken for bulk and quality production of raw drugs, since majority of parameters reflect decreasing data values in plants taken from polluted area.

VI. ABBREVIATIONS OF PLATES

B.S.- Bundle Sheath; Ca.- Cambium; Chl - Chlorenchyma;
REFERENCES


