Chapter - VI

Results and Discussion

RESULTS AND DISCUSSION

The morphological features of the whole plant is a reliable feature. However in the drug industry whole plant is rarely supplied to manufacturers They rely on suppliers who supply part of plant, and in case of plants under study, it's leaves. To make sure whether the material is authentic or not ,in case of unpowedered material the anatomical, dermatological along with vein islet and vein termination features can authenticate the material to a greater extent.

However, real problems are with powdered material. For confirming the authenticity any one parameter of phytochemical analysis viz. dry matter, nitrogen, water soluble nitrogen, crude protein, crude fat, crude fiber, total ash, acid insoluble ash, acid soluble ash, phosphorus, calcium, gross energy, total sugar, reducing sugar, non-reducing sugar, bulk density, cellulose is inadiquet. However all these parameters taken together are helpful in determining the authenticity of raw materials.

The extractive values in different solvents appear to be much reliable and quick method to establish the authenticity of powdered material However it is felt that instead of depending on any one solvent, extractive values in all solvents taken together will be the most reliable test.

Various parameters for standardizing test for authenticity of a drug is provided for each plant which have been studied.

1. *Abrus precatorius* L. :

Plant morphological features are quite distinctive and anatomically the features like single row of palisade, presence of collenchyma in the midrib, dimensions of epidermal cells are 13.32 X 8.325 to 19.98 X 16.65µ and 4.99 X 6.66 to 9.99 X 13.32µ of upper and lower epidermis can be utilized for primary screening for authenticity of raw materials. The other features like 133.28 to

399.81µ long unicellular trichomes on both surfaces, hypostomatic, anomocytic stomata with stoma length 23.32 µ; leaf constants like stomatal number 64 to 144, stomatal index 2.14 to 9.37, palisade ratio 1: 5.75 to 1: 8, vein-islet number 8 to 16, veinlet termination number 3 to 13 helps further in confirming the authenticity of the material.

The parameters like dry matter 59.69 %, bulk density 0.289 mg/cm^3, ash 3.80 %, acid insoluble ash 0.90 %, acid soluble ash 2.88 %, water soluble ash 2 %, water insoluble ash 1.8 %, nitrogen 3.25 %, 0.875 %, water soluble nitrogen, crude proteins 20.31 %, reducing sugar 1.905 %, total sugar 3.01 %, non reducing sugar 1.105 %, crude fats 15.5 %, crude fibers 23.2 %, cellulose 18.3 %, gross energy 3.96 K cal/ gm, calcium 1.45 %, phosphorous 0.22 % and presence of alkaloids, saponin, steroids, tannins taken together can be exploited for making certain that raw material is genuine for predicting quantum of adulteration.

The extractive values in different solvents are: 12.8 % in water, 3.6% in acetone, 4 % in butanol, 2.8 % in chloroform, 1.4 % in diethyl ether, 7.6 % in ethyl alcohol, 15.4 % in methanol, 0.6 % in petroleum ether, 4.8 % in propanol and 1.4 % in toluene. Presence of phenolic acids viz. Caffeic acid, Melilotic acid and Sinapic acid can also be used as a criterion.

2. *Adhatoda vasica* Nees. :

Leaves when found whole are distinctive. Anatomical features like two layered palisade, presence of collenchyma, cystolith and calcium oxalate crystals in the midrib, dimensions of epidermal cells are 26.64 X 13.32 to 29.97 X 16.65µ and 13.32 X 4.99 to 16.62 X 6.66µ of upper and lower epidermis; dermatological features like 15 to 25µ wide glandular trichomes, 60 to 125µ multicellular uniseriate trichomes on both surfaces, diacytic amphistomatic

stomata with stoma length for 21.64 µ upper epidermis and 19.98 µ lower epidermis; leaf constants like stomatal number 16 to 32 for upper epidermis, 144 to 224 for lower epidermis, stomatal index 3.44 to 4.34 for upper epidermis, 0.09 to 18.18 for lower epidermis, palisade ratio 1: 3 to 1:4 , vein-islet number 12 to 26, veinlet termination number 2 to 10 taken together forms primary parameter for authentication of materials.

In case of powdered material parameters like dry matter 30.56 %, bulk density 0.332 mg/cm^3, ash 11.3 %, acid insoluble ash 1 %, acid soluble ash 10.3 %, water soluble ash 7 %, water insoluble ash 4.3 %, 2.58 %, nitrogen, water soluble nitrogen 1.5 %, crude proteins 16.12 %, reducing sugar 1.585 %, total sugar 2.919 %, non reducing sugar 1.334 %, crude fats 5.4 %, crude fibers 17.05 %, cellulose 21 %, gross energy 3.76 K cal/ gm, calcium 3.494 %, phosphorous 0.46 % and presence of alkaloids, anthraqinone ,iridoids ,saponins ,steroids, tannins taken together can be exploited for making certain that raw material is genuine for predicting quantum of adulteration.

The extractive values in different solvents are: 13.4 % in water, 0.4 % in acetone, 3.4 % in butanol, 3.4 % in chloroform, 1.8 % in diethyl ether, 5.2 % in ethyl alcohol, 14.8 % in methanol, 1.2 % in petroleum ether, 1.4 % in propanol and 1.6 % in toluene. Presence of 2·OH·6-OCH_3-benzoic acid and Melilotic acid can also be used as a criterion.

3. *Bacopa monnieri* (L.) Wettst.**: -**

Leaf morphology determines authenticity to some extent while anatomical features like isobilateral structure, dimensions of epidermal cells are 26.64 X 13.32 to 29.97 X 16.65µ and 19.98 X 9.99 to 26.64 X 11.65µ of upper and lower epidermis; starch containing spongy mesophyll cells; dermatological features like 40 to 60µ wide glandular trichomes, on both surfaces, anisocytic,

amphistomatic stomata with stoma length for 26.64µ upper epidermis and 24.97µ lower epidermis; leaf constants like stomatal number 80 to 112 for upper epidermis, 56 to 112 for lower epidermis, stomatal index 6.66 to 13.33 for upper epidermis, 11.11 to 22.22 for lower epidermis, palisade ratio 1: 1.5 to 1: 2.5 , vein-islet number 4 to 9, veinlet termination number 2 to 12 form the criteria for the standardization of leaf.

The parameters like dry matter 13.8 %, 0.388 mg/cm^3, bulk density ash 13.2 %, acid insoluble ash 2.75 %, acid soluble ash 10.45 %, water soluble ash 6 %, water insoluble ash 7.2 %, nitrogen 2.16 %, water soluble nitrogen 2 %, crude proteins 13.5 %, reducing sugar 1.74 %, total sugar 3.436 %, non reducing sugar 1.696 %, crude fats 14.5 %, crude fibers 11.25 %, cellulose 29.2 %, gross energy 3.33 K cal/ gm, calcium 0.785 %, phosphorous 0.29 % and presence of alkaloids, saponins ,steroids ,tannins together can be exploited for making certain that raw material is genuine for predicting quantum of adulteration.

The extractive values in different solvents are: 13.6 % in water, 0.8 % in acetone, 4.2 % in butanol, 1 % in chloroform, 0.4 % in diethyl ether, 4.4 % in ethyl alcohol, 12.6 % in methanol, 0.4 % in petroleum ether, 2 % in propanol and 0.2 % in toluene are conclusive parameters. Presence of 2·OH·6-OCH_3-benzoic acid and P-coumaric acid can also be used as a criterion.

4. *Barleria prionitis* L.: -

Leaf morphology is distinctive to some extent however anatomical features presence of cystoliths, double row of palisade, presence of collenchyma in the midrib, dimensions of epidermal cells are 33.10 X 23.31 to 59.94X 29.97µ and 29.97 X 16.65 to 36.63 X 23.31µ of upper and lower epidermis; dermatological features like 93.31 to 399.9µ long unicellular and 26.66 to

53.32µ wide glandular trichomes on both surfaces, diacytic, hypostomatic stomata with stoma length 31.63 µ; leaf constants like stomatal number 64 to 84, stomatal index 10.52 to 13.88, palisade ratio 1: 7 to 1: 12, vein-islet number 4to 8, veinlet termination number 0 to 3 are primary features for authenticity of material.

The parameters like dry matter 35.97 %, bulk density 0.449 mg/cm^3, ash 7.7 %, acid insoluble ash 0.75 %, acid soluble ash 6.95 %, water soluble ash 3 %, water insoluble ash 4.7 %, nitrogen 3.25 %, water soluble nitrogen 1.25 %, crude proteins 20.31 %, reducing sugar 0.82 %, total sugar 1.632 %, non reducing sugar 0.812 %, crude fats 17 %, crude fibers 17.75 %, cellulose 17.8 %, gross energy 2.94 K cal/ gm, calcium 3.626 %, phosphorous 0.23 % and presence of alkaloids, anthraqinone, iridoids, steroids, tannins together can be exploited for making certain that raw material is genuine for predicting quantum of adulteration.

The extractive values in different solvents are: 17.6 % in water, 1.2 % in acetone, 4.2 % in butanol, 1.8 % in chloroform, 1.8 % in diethyl ether, 5.6 % in ethyl alcohol, 11.4 % in methanol, 0.6 % in petroleum ether, 2.4 % in propanol and 1.2 % in toluene are conclusive parameters. Presence of Chlorogenic acid and Sinapic acid can also used be as a criterion.

5. *Cymbopogon citratus* (DC.) Stapf.**: -**

Plant morphological features are quite distinctive and anatomically the features like oil containing mesophyll cells, sclerenchymatous tissues attached to vascular bundle, dimensions of epidermal cells are 19.98 X 13.32 to 23.31 X 16.65µ and 13.32 X 6.66 to 16.65 X 9.99 µ of upper and lower epidermis; dermatological features like 173.29 to 199.95µ long unicellular trichomes, on both surfaces, paracytic, amphistomatic stomata with stoma length 26.64µ for

upper epidermis and 13.32 µ for lower epidermis; leaf constants like stomatal number 16 to 64 for upper epidermis, 78 to 128 for lower epidermis, stomatal index 3.44 to 11.76 for upper epidermis, 8.47 to 13.55 for lower epidermis are primary features for authenticity of material.

The parameters like dry matter 39.86 %, bulk density 0.202mg/cm^3, ash 6.85 %, acid insoluble ash 2.2 %, acid soluble ash 4.65 %, water soluble ash 1.5 %, water insoluble ash 5.3 %, nitrogen 2.75 %, water soluble nitrogen 1 %, crude proteins 17.18 %, reducing sugar 0.995 %, total sugar 1.655 %, non reducing sugar 0.558 %, crude fats 17 %, crude fibers 37.2 %, cellulose 34.1 %, gross energy4.35 K cal/ gm, calcium 0.440 %, phosphorous 0.17 % and presence of alkaloids, anthraqinone ,iridoids, saponins ,steroids ,tannins together can be exploited for making certain that raw material is genuine for predicting quantum of adulteration.

The extractive values in different solvents are: 8 % in water, 1 % in acetone, 3 % in butanol, 1.6 % in chloroform, 0.6 % in diethyl ether, 5.8 % in ethyl alcohol, 13.6 % in methanol, 0.8 % in petroleum ether, 1.4 % in propanol and 1.2 % in toluene are conclusive parameters. Presence of Ferulic acid and Melilotic acid can also be used as a criterion.

6. *Gymnema sylvestre* (Retz.) R. Br. Ex Schult.:-

Leaves when found whole are distinctive. Anatomical features single row of palisade, presence of collenchyma in the midrib, dimensions of epidermal cells are 9.98 X 13.32 to 26.64 X 23.31µ and 13.32 X 6.66 to 19.98 X 16.65µ of upper and lower epidermis; dermatological features like 106.64 to 333.25µ long bicellular and multicelluar uniseriate trichomes on both surfaces, anomocytic, hypostomatic stomata with stoma length 23.31µ; leaf constants like stomatal number 112 to 228, stomatal index 3.61 to 10.52, palisade ratio 1: 3.25 to 1:

5.75, vein-islet number 7 to 19, veinlet termination number 8 to 20 are primary features for authenticity of material.

The parameters like dry matter 14.9 %, bulk density 0.435 mg/cm^3, ash 7.15 %, acid insoluble ash 0.45 %, acid soluble ash 6.7 %, water soluble ash 1 %, water insoluble ash 6.15 %, nitrogen 2.16 %, water soluble nitrogen 1.625 %, crude proteins 13.5 %, reducing sugar 1.35 %, total sugar 1.908 %, non reducing sugar 0.558 %, crude fats 12.4 %, crude fibers 17.45 %, cellulose 15.9 %, gross energy 4 K cal/ gm, calcium 1.663%, phosphorous 0.16 % and presence of alkaloids, saponin, steroids and tannins together can be exploited for making certain that raw material is genuine for predicting quantum of adulteration.

The extractive values in different solvents are: 19 % in water, 2.2% in acetone, 2.8 % in butanol, 2.2 % in chloroform, 3.4 % in diethyl ether, 8.2 % in ethyl alcohol, 19.2 % in methanol, 1.2 % in petroleum ether, 4.6 % in propanol and 1.8 % in toluene are conclusive parameters. Presence of Ferulic acid, Protocatechuic acid , P-hydroxybenzoic acid and Sinapic acid can also be used as a criterion.

7. *Leonotis nepetifolia* (L.) R. Br.: -

Leaf morphology determines authenticity to some extent while anatomical features like, single layered palisade, presence of collenchyma in the midrib, dimensions of epidermal cells are 23.31 X 8.325 to 39.96 X 18.31µ and 29.97 X 16.65 to 36.63 X 23.31µ of upper and lower epidermis; dermatological features and like 23.31 to 43.29µ wide glandular trichomes, 83.25 to 113.22µ bicellular trichomes on both surfaces, diacytic, amphistomatic stomata with stoma length for 18.31 µ upper epidermis and 16.65µ lower epidemis; leaf constants like stomatal number 110 to 160 for upper epidermis, 114 to 480 for lower epidermis, stomatal index 5.26 to 11.11 for upper epidermis, 12.5 to 22.85 for

lower epidermis, palisade ratio 1: 11 to 1: 13.25 , vein-islet number 34 to 59, veinlet termination number 1 to 15 are primary features for authenticity of material.

The parameters like dry matter 31.21 %, bulk density 0.377 mg/cm^3, ash 9.8 %, acid insoluble ash 0.15 %, acid soluble ash 9.65 %, water soluble ash 3 %, water insoluble ash 6.8 %, nitrogen 2.25 %, water soluble nitrogen1.125 %, crude proteins 14.06 %, reducing sugar 4.39 %, total sugar 6.724 %, non reducing sugar 2.334 %, crude fats 6 %, crude fibers 14.65 %, cellulose 13.2 %, gross energy 3.82 K cal/ gm, calcium 1.458 %, phosphorous 0.28 % and presence of alkaloids, iridoids ,saponins ,steroids, tannins together can be exploited for making certain that raw material is genuine for predicting quantum of adulteration.

The extractive values in different solvents are: 12.2 % in water, 5 % in acetone, 5.2 % in butanol, 6 % in chloroform, 4.8 % in diethyl ether, 7.2 % in ethyl alcohol, 15.8 % in methanol, 1 % in petroleum ether, 6.2 % in propanol and 4.4 % in toluene are conclusive parameters. Presence of 2·OH·4-OCH_3-benzoic acid and Phloretic acid can also be used as a criterion.

8) ***Pergularia daemia*** (Forsk) Choiv: -

Leaf morphology is distinctive to some extent however anatomical features, two layered palisade, presence of collenchyma in the midrib, dimensions of epidermal cells are 29.97 X 6.66 to 36.63 X 13.32 and 19.98 X 3.33 to 26.64 X 9.99µ of upper and lower epidermis; dermatological features like 66.65 to 133.3µ multicellular uniseriate trichomes, 93.31 to 159.96µ long multicellular multiseriate trichomes, on both surfaces, anomocytic amphistomatic stomata with stoma length for 23.31 µ upper epidermis and 19.98µ lower epidermis; leaf constants like stomatal number 46 to 68 for upper

epidermis, 224 to 304 for lower epidermis, stomatal index 5.55 to 11.11 for upper epidermis, 6.66 to 22.22 for lower epidermis, palisade ratio 1: 3 to 1:4 , vein-islet number 12 to 19, veinlet termination number 3 to 8 are primary features for authenticity of material.

The parameters like dry matter 19.44 %, bulk density 0.394 mg/cm^3, ash 15.6 %, acid insoluble ash 1.5 %, acid soluble ash 14.1 %, water soluble ash 5.5 %, water insoluble ash 12.1 %, nitrogen 3.66 %, water soluble nitrogen 1.25 %, crude proteins 22.87 %, reducing sugar 1.68 %, total sugar 2.595 %, non reducing sugar 0.915 %, crude fats 13.3 %, crude fibers 19.75 %, cellulose14.8 %, gross energy 4.1 K cal/ gm, calcium 2.224 %, phosphorous 0.45 % and presence of alkaloids, anthraqinone , steroids together can be exploited for making certain that raw material is genuine for predicting quantum of adulteration.

The extractive values in different solvents are: 18.2 % in water, 1.4 % in acetone, 3.6 % in butanol, 5.2 % in chloroform, 4.2 % in diethyl ether, 5.8 % in ethyl alcohol, 13.4 % in methanol, 3.2 % in petroleum ether, 3.6 % in propanol and 4.8 % in toluene are conclusive parameters.Presence of Ferulic acid, O-coumaric acid , P-hydroxybenzoic acid and Sinapic acid can also be used as a criterion.

9. *Tylophora indica* (Burm.f.) Merr.: -

Leaf morphology is distinctive to some extent however anatomical features three rows of palisade, dimensions of epidermal cells are 29.97 X 19.98 to 49.95 X 26.64µ and 23.31 X 13.32 to 43.29 X 29.98µ of upper and lower epidermis; dermatological features like 186.62 to 399.9µ long multicellular uniseriate trichomes on both surfaces, paracytic, hypostomatic, stomata with stoma length 21.64µ; leaf constants like stomatal number 142 to 226, stomatal index 5.26 to 16.66, palisade ratio 1: 10.25 to 1: 14.75, vein-islet number 5 to

18, veinlet termination number 7 to 18 are primary features for authenticity of material.

The parameters like dry matter 22 %, bulk density 0.282 mg/cm^3, ash 7.45 %, acid insoluble ash 1.25 %, acid soluble ash 6.2 %, water soluble ash 5.5 %, water insoluble ash 1.95 %, nitrogen 2.33 %, water soluble nitrogen 1.5 %, crude proteins 14.56 %, reducing sugar 0.82 %, total sugar 3.735 %, non reducing sugar 2.915 %, crude fats 11.9 %, crude fibers 27.65 %, cellulose 23.3 %, gross energy 4.08 K cal/ gm, calcium 1.763 %, phosphorous 0.2 % and presence of alkaloids, saponin, steroids and tannins together can be exploited for making certain that raw material is genuine for predicting quantum of adulteration.

The extractive values in different solvents are: 13 % in water, 1.8% in acetone, 3.2% in butanol, 4 % in chloroform, 3.2 % in diethyl ether, 5.4 % in ethyl alcohol, 15.4 % in methanol, 2.4 % in petroleum ether, 3.4 % in propanol and 3.2 % in toluene are conclusive parameters. Presence of 2·OH·5-OCH_3-benzoic acid, Melilotic acid and Sinapic acid can also be used as a criterion.

10. *Woodfordia fruticosa* (L.) Kurz***: -***

Leaf morphology is distinctive to some extent however anatomical features two layered palisade, presence of sclerenchyma in the midrib, dimensions of epidermal cells are 23.31 X 6.66 to 39.96 X 9.99µ and 19.98 X 3.33 to 23.31 X 6.66 µ of upper and lower epidermis; dermatological features like 26.64 to 96.57µ unicellular or bicellular trichomes on both surfaces, anisocytic, amphistomatic stomata with stoma length for 16.65 µ upper epidermis and 13.32 µ lower epidermis; leaf constants like stomatal number 176 to 288 for upper epidermis, 256 to 306 for lower epidermis, stomatal index 6.66 to 14.81 for upper epidermis, 9.37 to 16.66 for lower epidermis, palisade ratio 1:

15 to 1:33 , vein-islet number 48 to 78, veinlet termination number 8 to 24 are primary features for authenticity of material.

The parameters like dry matter 68.51 %, bulk density 0.399 mg/cm^3, ash 9.2 %, acid insoluble ash 1.65 %, acid soluble ash 7.55 %, water soluble ash 2 %, water insoluble ash 7.2 %, nitrogen 2.53 %, water soluble nitrogen 0.75 %, crude proteins 15.81 %, reducing sugar 1.925 %, total sugar 3.068 %, non reducing sugar 1.143 %, crude fats 18.5 %, crude fibers 13.85 %, cellulose 22 %, gross energy 3.69 K cal/ gm, calcium 1.398 %, phosphorous 0.12 % and presence of alkaloids, iridoids ,saponins, steroids, tannins together can be exploited for making certain that raw material is genuine for predicting quantum of adulteration.

The extractive values in different solvents are:18.6 % in water, 3.4 % in acetone, 3.6 % in butanol, 2.2 % in chloroform, 2.6 % in diethyl ether, 9.8 % in ethyl alcohol, 15.6 % in methanol, 0.6 % in petroleum ether, 6.8 % in propanol and 2 % in toluene are conclusive parameters. Presence of 2·OH·6-OCH_3-benzoic acid, Melilotic acid and Phloretic acid can also be used as a criterion.