



E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(1): 284-290
Received: 14-11-2018
Accepted: 18-12-2018

Vishal U Kalebar

a. Department of Biotechnology and Microbiology, Karnatak University, Dharwad, Karnataka, India

b. Department of Biotechnology and Microbiology, P.C. Jabin Science College, Vidyanagar, Hubballi -580031, Karnataka, India.

Joy H Hoskeri

Department of Bioinformatics, Akkamahadevi Women's University, Vijaypur - 568108, Karnataka, India

SV Hiremath

Department of Biotechnology and Microbiology, P.C. Jabin Science College, Vidyanagar, Hubballi -580031, Karnataka, India

Riya V Kalebar

Abdul Kalaam College of Pharmacy, Navanagar, Hubballi, Karnataka, India

AB Sonappanavar

Department of Botany, P.C. Jabin Science College, Vidyanagar, Hubballi -580031, Karnataka, India

Kulakarni LC

Department of Botany, P.C. Jabin Science College, Vidyanagar, Hubballi -580031, Karnataka, India

Agadi BS

Department of Botany, P.C. Jabin Science College, Vidyanagar, Hubballi -580031, Karnataka, India

Hiremath MB

Department of Biotechnology and Microbiology, Karnatak University, Dharwad, Karnataka, India

Correspondence**Hiremath MB**

Department of Biotechnology and Microbiology, Karnatak University, Dharwad, Karnataka, India

Pharmacognostical and phytochemical analysis of *Solanum macranthum* (Dunal) Fruits

Vishal U Kalebar, Joy H Hoskeri, SV Hiremath, Riya V Kalebar, AB Sonappanavar, Kulakarni LC, Agadi BS, Hiremath MB

Abstract

Solanaceae family is known for possessing a wide range of therapeutic properties, therefore it remains promising to explore the pharmacognostical and phytochemical profile of the *Solanaceae* family species. *Solanum macranthum* Dunal also known as 'giant potato tree', have been recognized for its various bioactivities. The present study was undertaken to screen the pharmacognostical and phytochemical profile of *Solanum macranthum* Dunal. Sequential phytochemical extraction of the shade dried fruits was carried out using four different solvents viz., petroleum ether, chloroform, methanol and water. The qualitative phytochemical analysis of methanol and water extract showed the presence of alkaloids, flavonoids, terpenoids, steroids, tannins, saponins and glycosides. The ash values obtained signified low amount of inorganic constituents indicating that the fruit contains less amount of metallic constituents. This study indicates that *Solanum macranthum* fruit possesses various bioactive phytoconstituents and low ash value making it a remarkable choice for its therapeutic applications in treating various human ailments.

Keywords: *Solanaceae*; *Solanum macranthum*; pharmacognostical analysis; phytochemical analysis

Introduction

Solanaceae family comprises of about 98 genera and around 2700 species possessing a great variety of habitat diversity, morphology and ecology. The name *Solanaceae* has been drawn from the genus *Solanum*. Some species of *Solanum* are also termed by the word 'sun berry' as the solanaceous flowers resembles to the sun and its rays. Most of the *Solanaceae* species are either erected or climbers, annual or perennial [1]. *Solanum macranthum* Dunal (synonyms: *Solanum crinitum* Lam., *Solanum wrightii* Benth) is a tropical perennial large shrub or medium-sized tree, grown for its ornamental beauty also known as 'giant potato tree' belonging to the genus *Solanum* L. and family *Solanaceae*. It's a native of Brazil, but is also cultivated in the tropical region. It is probably only one of the potato families that grow into a tree like structure (15 feet in height and 15' wide) with woody trunk and many major branches. The leaves are approximately upto 60 cm long and 30 cm wide having deeply lobbed and undulated edges when compared to the uniqueness of typical leaf blades. Since being an ornamental tree it is evergreen and ever blooming throughout the year. It produces star shaped clusters of flowers and each flower has five fused petals and prominent orange-yellow anthers in the center. The colour of the flower starts with deep purple colour and fades to lavender (lilac) and then to white, this spectacular display of different colour of flowers will appear altogether in each flower cluster. The fruit of the plant is roundish berry like shaped with thorny crown, when ripened the colour of the fruit appears to be orange – yellowish in colour. The propagation of the plant is done by using seeds as well vegetative proration and grafting [2, 3, 4]. *Solanaceae* family is widely known to possess various bioactive phytochemicals such as solasodine, solasonine, solamargine, glycoalkaloids, sesquiterpenoids, cisplatin, doxorubicin, and docetaxel etc [5, 6], which have anti-epileptic, larvicidal, antioxidant, antimicrobial, analgesic, anti-inflammatory, hepatoprotective, anti-ulcer, anticancer and anti-fungal activities [7, 8, 9]. The present study was focused on screening pharmacognostical and quantitative phytochemical profile of *Solanum macranthum* in order to unmask the active principles present in this plant that are responsible for the bioactivity. We report the pharmacognostical and phytochemical profile of *Solanum macranthum* fruit and its calyx.

Methods**1. Plant source**

The *S. macranthum* fruits were collected from medicinal garden of P.C. Jabin Science College, Hubballi, Karnataka. The titled plant was taxonomically authenticated

by Dr. Harsha Hegde, ICMR- National Institute of Traditional Medicine and plant specimen was deposited in the same with herbarium accession number RMRC-1402.



Fig 1: *Solanum macranthum* fruit

2. Macro and Microscopic analysis of the fruit

The fruit appears green in colour with the calyx over it. The transverse and longitudinal section of the fruit was carried out, the fruit tend to posses strong odor with the tiny seeds in a spatial orientation. The transverse section of the epidermal layer was observed under microscope and the cells were stained using iodine ^[10].

3. Phytochemical extraction

The *S. macranthum* fruits were collected and shade dried, before the sequential extraction the fruits were separated from their calyx. 100 gm of the dried fruits and 10 gm of dried calyx was subjected for sequential phytochemical extraction using four different solvents viz., petroleum ether, chloroform, methanol and water which was kept on rotary shaker with 180 rpm for 6 days in each solvent successively, this method of extraction was followed in order to retain the volatile compounds of the fruit which could have been eliminated through soxhlet extraction. Further the each solvent extracts were dried at room temperature in dark.

4. Fluorescence analysis

For the study of fluorescence characteristics, a small quantity of the dried and powdered fruit sample was mixed with different freshly prepared reagents and observed under visible light and UV light (254 nm, 365nm) ^[11].

5. Phytochemical analysis

The crude extracts of *S. macranthum* fruit and calyx obtained from the different organic solvents and water, where subjected to qualitative phytochemical analysis for different phytoconstituents such as alkaloids, flavonoids, glycosides, phenols, saponins, tannins, terpenoids, sterols using standard methods ^[10].

5.1 Test for Alkaloids

The dried solvent extract of fruit and calyx were treated with dilute HCl separately and shaken well and filtered. The filtrate was used to perform the following test.

Wagner's Test: To the 2-3 ml of above filtrate few drops Wagner's reagent was added. Formation of reddish brown precipitate indicated the presence of alkaloids.

Dragendorff's Tests: To the 2-3 ml of above filtrate few drops Dragendorff's reagent was added. An orange brown precipitate confirmed the presence of alkaloids.

5.2 Test for Flavonoids

Pew's Tests: To the 2-3 ml of solvent extract zinc powder was added and concentrated HCl was added along walls of the test tube. Emergence of purple red or cherry colour indicated the test was positive ^[12].

Shinoda Tests: To the 2-3 ml of solvent extract, drop wise concentrated HCl was added followed by addition of magnesium turnings. The development of magenta colour confirmed the test positive for flavonoids ^[12].

Ferric chloride test: To the solvent extract few drops of 1% Ferric chloride solution was added. The result in the formation of blackish red color indicated the presence of flavonoids ^[12].

Alkaline reagent Test: For 2-3 ml of solvent extract, few drops of sodium hydroxide solution was added. The increase in the intensity of yellow color which would become colorless on addition of few drops of dilute HCl indicated the presence of flavonoids ^[13].

Lead acetate solution Test: For 2-3 ml of solvent extracts, few drops of lead acetate (10%) solution was added. The appearance of yellow colour precipitate confirmed the test positive for the presence of flavonoids ^[12].

5.3 Test for Glycosides

Keller-Kiliani Test: To 2 ml solvent extract glacial acetic acid added, followed by one drop 5% FeCl₃ and conc. H₂SO₄. The appearance of reddish brown color at the junction of the two liquid layers and upper layer appears bluish green confirmed the positive for the presence of glycosides.

5.4 Test for Phenols

Ellagic Acid Test: To the solvent extract few drops of 5% (w/v) glacial acetic acid was added followed by 5% (w/v) NaNO₂ solution. A muddy or Niger brown precipitate indicated the test as positive for phenols.

FeCl₃ test: 5% FeCl₃ solution was added to the solvent extract which was followed by the appearance of deep blue-black colour indicated the presence of phenols ^[14].

Lead acetate test: white precipitate appears when lead acetate solution was added to the solvent extract which indicated the positive for phenols ^[12].

5.5 Test for Saponin

Foam Test: The solvent extract was diluted with 20 ml of distilled water and it was shaken in a graduated cylinder for 15 minutes. A one cm layer of foam formation indicated the presence of Saponin.

5.6 Test for Tannins

Gelatin Test: to the solvent extract liquid gelatin was added. An appearance of white precipitate confirms the test indicated the presence of tannins.

5.7 Test for terpenoids

Salkowski Tests: To 2 ml of solvent extract, 2 ml chloroform

and 2 ml concentrated H₂SO₄ was added and shaken well. Formation of reddish brown color indicated the test as positive for presence of terpenoids.

5.8 Test for steroids

Salkowski Tests: To 2 ml of solvent extract 2 ml chloroform and 2 ml concentrated H₂SO₄ was added. The chloroform layer appears red and acid layer will form greenish yellow fluorescence indicated the test positive for steroids.

5.9 Test for carbohydrates

Molisch's test: To the solvent extract few drops of α -naphthol solution was added shaken and concentrated HCl was added from the sides of the test tube. A violet ring appears at the junction of the two liquids which confirmed the test positive for carbohydrates.

Benedicts test: Equal volume for benedicts reagent was added to the solvent extract, heated in boiling water bath for 5 min. The solution turning into green, yellow or red colour depending upon the amount of reducing sugar present confirmed the test positive for reducing sugars.

6. Evaluation of physico-chemical constants

For the determination of physico-chemical constants of the *S. macranthum* fruit and calyx each parameters mentioned below were carried out until two successive weighing did not differ by less than 0.5 mg.

6.1 Determination of total ash value

The empty silica crucible was heated and cooled, before weight of the empty was determined. 3 grams of the dried fruit was weighed and incinerated in silica crucible using electrical burner. The charred matter was heated in muffle furnace at 600-650 °C. The ash formed was cooled and weighed [10].

6.2 Determination of total acid-insoluble ash value

The ash obtained was boiled with 25 ml of dilute HCl. The insoluble matter was collected on ash less filter paper ignited and weighed. The weight of the insoluble matter was subtracted from the weight of the total ash value which revealed the amount of total insoluble ash present [10, 6].

6.3 Determination of water-soluble ash value

Water soluble ash value was obtained by boiling the total ash in 25ml of distilled water. The water containing the ash was

filtered on ash less filter paper ignited and weighed. The final weight of the insoluble matter was subtracted from the total ash. The difference of the value obtained between them represented water soluble ash [10, 6].

6.4 Determination of Sulphated ash value

Sample of 3 gm was taken in crucible and heated until it was thoroughly charred. After cooling, 1 ml of concentrated sulphuric acid was added and heated again until no fumes evolved and was further ignited at 800°C \pm 25°C until all the carbon particles disappeared. [10].

6.5 Determination of moisture content

3 gm of the dried fruit and calyx were weighed separately and transferred to empty procelain dish (pre-weighed) and dried at 105°C in oven until two consecutive weighing were not more than 0.5 mg. After cooling the loss of weight was recorded as moisture content [11].

6.6 Determination of inorganic constituents

The powdered *S. macranthum* fruit and calyx sample was used for the inorganic analysis. The parameters and the standards along with sample were analyzed according to the protocol mentioned in the APHA 22nd edition through Atomic Absorption Spectroscopy (AAS) [15].

6.7 Total alkaloids of *S. macranthum* fruit

150 ml of 20% glacial acetic acid was added to 6 gm of *S. macranthum* dried fruit and calyx separately was incubated for 4 hrs at room temperature. The solution containing the mixture was filtered and reduced to one fourth of its volume by using water bath. The solution was cooled. Concentrated ammonium hydroxide was added drop wise until precipitation was completed. The solution was allowed to settle down and filtered. The filtrate was dried and weighed. The percentage of the alkaloids was calculated by using the formula [12].

Percentage of total alkaloids (%) = $\frac{\text{Weight of residue} \times 100}{\text{Weight of sample taken}}$

7. Results

7.1 Phytochemical extraction

The dried fruit and calyx of *S. macranthum* were subjected to sequential extraction method (low polar to high- polar solvents) viz., petroleum ether, chloroform, methanol and water, the total crude extracts obtained using solvents and the parameters used are mentioned below (Table 1).

Table 1: Percentage of extract yield in different solvent

| Parameters | FRUIT | | | |
|-----------------------------|------------------|------------------|------------------|------------------|
| | Petroleum Ether | Chloroform | Methanol | Water |
| Amount of sample | 100gm | 100gm | 100gm | 100gm |
| Total hours of extraction | 144 hrs (6 days) | 144 hrs (6 days) | 144 hrs (6 days) | 144 hrs (6 days) |
| Yield | 0.288 gm | 1.184gm | 31.030gm | 7.523gm |
| Percentage of extract yield | 0.28% | 1.18% | 31.03% | 7.52% |
| Colour of extract | Green-yellowish | Yellow-brownish | Dark brown | Dark brown |
| | | CAYLX | | |
| Amount of sample | 10gm | 10gm | 10gm | 10gm |
| Total hours of extraction | 144 hrs (6 days) | 144 hrs (6 days) | 144 hrs (6 days) | 144 hrs (6 days) |
| Yield | 0.075gm | 0.520gm | 1.705gm | 1.303gm |
| Percentage of extract yield | 0.75% | 5.20% | 17.05% | 13.03% |
| Colour of extract | Greenish | Yellowish | brownish | Dark brown |

7.2 Macro and Microscopic analysis

The greenish fruit is covered by thick epidermis (Flavedo) which also contributes to the aromatic feature of the fruit. The endocarp region encompasses placenta tissue, seed and locule

Fig 2A and 2B. The transverse section of the epidermal layer of the fruit was observed under microscope (10x and 40x). The presence of oil globules, calcium oxalate crystals and starch granules were observed Fig 3.

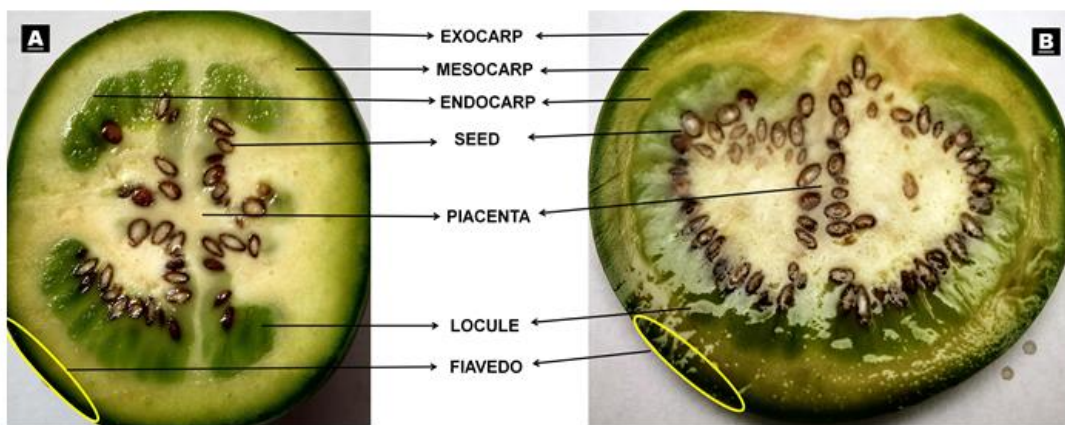


Fig. 2A:- Transverse section of *Solanum macranthum* fruit

Fig. 2B:- Longitudinal section of *Solanum macranthum* fruit

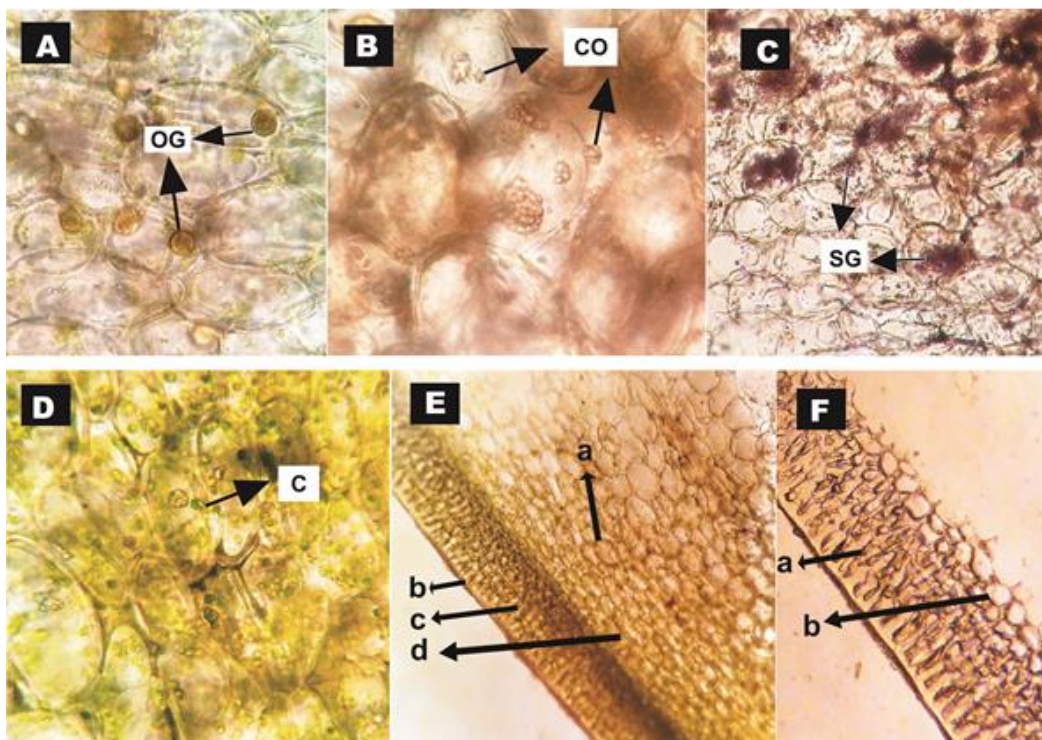


Fig 3: Microscopic analysis of *Solanum macranthum* fruit. A:-oil globules (OG) in parenchyma cells. B:-calcium oxalate crystals(CO). C:-starch granules(SG). D:-spongy parenchyma cells with chloroplast(C). E:-TS of epidermis:- (a) epidermis with sclerieds, (b) coats of epidermis, (c) epidermal layer, (d) hypodermis of collenchyma cells. F:- TS of epidermis:- (a) palisade parenchyma, (b) hypodermis of collenchyma cells

7.3 Fluorescence analysis

The fluorescence properties exhibited by the powdered fruit sample of *Solanum macranthum* mixed with different reagents have been noted in the Table:-2. The qualitatively evaluated fluorescent characteristics of the powdered fruit in

UV (short 254nm, long 365nm) and visible light depicts the certain compounds under experimental condition which becomes a useful parameter in identifying the marker components and also in standardization of crude drug.

Table 2: Fluorescence analysis of *Solanum macranthum* fruit

| Powder drug | Visible light | 254 nm | 365 nm |
|---------------------------------|-------------------|-----------------|-------------|
| Powder drug as such | Dark brown | Brown | Dark brown |
| Powder + distill water | Light Brown | Green | Brown |
| Powder + Methanol | Light green | Light green | Brown |
| Powder + 1% glacial acetic acid | Light Brown | Green | Dark brown |
| Powder +10% NaOH | Brown | Brown | Black |
| Powder + dil. NH ₃ | Dark Brown | Brown | Black |
| Powder + Conc. HNO ₃ | Fluorescent green | Yellowish green | Light brown |

| | | | |
|--|----------------|-----------------------|-------------|
| Powder+ dil.NH ₃ +Conc.HNO ₃ | Yellowish | Light Yellowish green | Light brown |
| Powder +1M H ₂ SO ₄ | Greenish brown | Light green | Light Black |
| Powder +1M HCl | Gray | Black | Light Black |
| Powder + 10% FeCl ₃ | Grayish green | Greenish black | Black |
| Powder +Acetone | Colourless | Light pink | Colourless |
| Powder + ethanol | Colourless | Creamish | pink |
| Powder +Acetone + Methanol | Light yellow | Light green | Light brown |

7.4 Physiochemical constituents

The ash constituents are made up of inorganic such as silicates of sodium, potassium, magnesium, calcium etc., some of them can be removed by treating with acid. The ash values of the fruit were found to be lower than that of calyx, while the moisture content and the total alkaloids of the fruit of the fruit was considerably higher than that of calyx (Table 3) the readings obtained are mean values of each parameters undertaken.

Table 3: Physio-chemical constants of *S. macranthum* fruit and calyx

| Parameters | Fruit | Calyx |
|---------------------|-------|-------|
| Total ash | 4.05% | 8.65% |
| Water soluble ash | 3.7% | 4.7% |
| Acid insoluble ash | 4.1% | 4% |
| Sulphated ash value | 3.8% | 4.7% |
| Moisture content | 9.6% | 6% |
| Total alkaloids | 9.92% | 1.5% |

7.5 Inorganic analysis

The inorganic analysis of the crude drug helps to identify the amount of minerals present in the drug. The parameters used for the analysis are known for their pharmacognostical importance, which were depicted to be at lower concentration in the fruit than calyx (Table 4).

Table 4: Inorganic analysis constituents of *S. macranthum* fruit and calyx

| Parameters | Fruit (gm/kg) | Calyx (gm/kg) |
|-------------|---------------|---------------|
| Calcium | 0.05 | 0.08 |
| Magnesium | 0.05 | 0.06 |
| Iron | 0.0025 | 0.0125 |
| Phosphorous | 0.325 | 0.285 |
| Potassium | 3.3 | 5.77 |
| Cadmium | 0.0001 | 0.0005 |

7.6 Phytochemical analysis

The phytochemical screening of the *S. macranthum* fruit and calyx from the solvents used, revealed diverse phytoconstituents. The methanol extract of the fruit showed the presence of alkaloid, flavonoids, glycosides, tannins, terpenoids sterols, phenols and saponins. While the water extract of the fruit was found to be positive for alkaloid, flavonoids, phenols and saponins Table 5. Similarly the phytochemical screening of calyx of the fruit did not show much of phytoconstituents. However, glycosides (chloroform extract), phenols (methanol extract) and saponins (methanol and water extract) were present at very less concentration Table 5.

Table 5: Phytochemical screening *S. macranthum* Fruit and Calyx extract

| Phytoconstituents | Test | Fruit | | | | Calyx | | | |
|-------------------|----------------------------|-------|----|----|----|-------|----|----|----|
| | | PE | CH | ML | WR | PE | CH | ML | WR |
| Alkaloids | Wagner's Test | - | - | ++ | ++ | - | - | - | + |
| | Dragendorff's Tests | - | - | + | + | - | - | - | - |
| Flavonoids | Pew's Tests | - | - | - | - | - | - | - | - |
| | Shinoda Tests | - | - | + | - | - | - | - | - |
| | Ferric chloride test | - | - | ++ | - | - | - | - | - |
| | Alkaline reagent Test | - | - | ++ | - | - | - | - | - |
| | Lead acetate solution Test | - | - | + | - | - | - | - | - |
| Glycosides | Keller-Kiliani Test | - | + | ++ | - | - | + | - | - |
| Phenols | Ellagic Acid Test | - | - | ++ | - | - | - | + | - |
| | FeCl ₃ test | - | - | ++ | + | - | - | + | - |
| | Lead acetate test | - | - | ++ | + | - | - | - | - |
| Saponin | Foam Test | - | - | ++ | ++ | - | - | + | + |
| Tannins: | Gelatin Test | - | - | + | - | - | - | - | - |
| Terpenoids | Salkowski Tests | - | + | + | - | - | - | - | - |
| Steroids | Salkowski Tests | - | - | + | - | - | - | - | - |
| Carbohydrates | Molisch's test | - | - | + | - | - | - | - | - |
| | Benedict's test | - | - | + | - | - | - | - | - |

Solvents:- PE:- Petroleum ether, CH:- Chloroform, ML:- Methanol, WR:- Water.
 ++:- Strongly positive, +:- Positive, -:- Absent

Discussion

The fruit of *Solanum macranthum* Dunal appears round green in colour with the hard calyx on the upper part of the fruit. The fruit also appears to possess aromatic properties. The transverse and longitudinal section of the *S. macranthum* fruit reveals the arrangement of integral components which is moderately similar to the integral arrangement of *Solanum lycopersicum* fruit [16]. The outer part of the *S. macranthum* fruit is sealed by a thick exocarp followed by mesocarp. The

fleshy part of the fruit containing the seeds is surrounded by the endocarp. The juicy part, locule is been present beneath endocarp surrounding the seeds. The flavedo region of the *S. macranthum* fruit signifies the presence oil sacs. The microscopic analysis of the fruit revealed distinctive characteristics elements, such as the prismatic calcium oxalate crystals were observed in clusters associated with the members or chambers within the parenchyma cells of the fruit. Oil globules oval in shape mainly found as lipid

deposition in the plant, where identified brownish in colour within the parenchyma cells, as well as clusters of starch granules which serve as stored energy source of the fruit were detected. It is evident that some of the natural products which could not be seen in visible light may appear fluorescent in the presence of UV light, and some of these compounds naturally, do not possess any fluorescence property in them can be converted to fluorescent derivatives by using different reagents [11]. The fluorescence analysis was carried out by observing the *S. macranthum* powdered fruit in Visible and UV light (254nm, 365nm) using different reagents. The powdered fruit in most of the reagents showed slight variation in their colour but in reagents such as acetone and ethanol, though they appeared colourless in visible light, but emitted different colour under UV light. Similar effect of different colour emittance was also observed with acetone + methanol reagent.

The ash value is an important qualitative parameter for determining the mineral constituents of the crude drug. The percentage of total ash value was found to be 4.05% and 8.65% of *S. macranthum* fruit and calyx, indicate that they are best suitable for drug action with optimum effects, however fruit extract may tend to have a better effect and drug action than that of calyx. Determination of water soluble ash, acid insoluble ash and sulphated ash value enables to detect the amount of inorganic compounds present on the drug, the water soluble ash value of fruit and calyx obtained was 3.7% and 4.7%, while acid insoluble ash value was found to be 4.1% and 4% and sulphated ash value was 3.8% and 4.7% respectively, indicating that fruit extract has increased biological activity since it constitutes a lesser amount of inorganic compounds and contamination of earthly matter present than the calyx. The moisture content of the drug is a major factor for its deterioration as well as being contaminated with microorganisms. Low moisture content of the fruit forbids the growth of fungi and bacteria during storage period and higher stability of its phytoconstituents [11]. The moisture content of the *S. macranthum* fruit was slightly higher i.e., 9.6% than calyx i.e., 6%, but according to the literature moisture content of the *S. macranthum* fruit found to be considerably lower than the moisture content of *S. torvum* [17] (86.230 %), *S. nigrum* (79.49%) [18], *S. tuberosum* L (13-30%) [19], *S. lycocarpum* (3,18 %) fruit [20].

The *Solanum* family has been widely reported for the rich presence alkaloid content in them, at par with this the total alkaloid content in the *S. macranthum* fruit was remarkably higher in concentration i.e., 9.92% while calyx was found to possess lower concentration i.e., 1.5%.

The results of mineral constituents of the *S. macranthum* fruit revealed that calcium, magnesium, iron and cadmium were found to be at very low concentration i.e., <0.1 gm/kg, while phosphorous and potassium concentration was <0.33 gm/kg and <5.8 gm/kg respectively, in both fruit and calyx. These results correlate to the values of the water and sulphated ash values containing lower amount of inorganic constituents.

The sequential extraction of the *S. macranthum* fruit (100gm) and calyx (10gm) was carried out using the four different solvents:- petroleum ether, chloroform, methanol and water. The extraction yield calculated from the different solvents used, methanol extract showed a higher percentage of yield in both fruit and calyx of *S. macranthum*. This may be due to high polarity nature of the methanol to extract various plant constituents in it, when compared to the other solvents used. The phytoconstituents in calyx of *S. macranthum* fruit were: glycosides in chloroform extract, phenols and saponins in

methanol extract and alkaloids and saponins in water extract. While the qualitative preliminary phytochemical analysis of the *S. macranthum* fruit was found to be positive for many phytoconstituents such as: alkaloids, flavonoids, glycosides, phenols, saponins, tannins, terpenoids, steroids and carbohydrates. Majority of these compounds are found to be present in the methanol extract of the fruit than that of other aqueous and alcoholic solvents, for instance glycosides and terpenoids were positive in chloroform extract, while alkaloids, phenols and saponins were found to be positive in the water extract. These results obtained are in consonance with the earlier phytochemical analysis reports of *S. macranthum* [21]. Similarly as per the literature, ethanol fruit extract of *S. nigrum* constituted more number of phytoconstituents i.e., steroid, flavonoids, saponins, terpenoids and alkaloids when compared to its other solvents extracts [22], while the methanol fruit extract of *S. torvum* were found to be positive for alkaloids, flavonoids, saponins, tannins, and glycosides phytoconstituents at par with its other solvent extracts [23]. Based on the results obtained from it is evident that methanol extract of the *S. macranthum* fruit constitutes more phytoconstituents in comparison with the calyx and also with other reported *Solanum* sp. As stated above, the methanol fruit extract *S. macranthum* was positive for the presence of phenols which are known for their ability to retard the lipid oxidation in oils and fatty acids and therefore reducing the risk of cardiovascular diseases. Phenols are also noted to interfere in the propagation of cancer cells of various stages, thereby reducing risk of cancer occurrence in the individual [24]. The presence of alkaloid and saponins play a role in protecting the plant from various pathogens such as fungi, yeasts, bacteria and viruses. Tannins are well known for their antioxidant, antibacterial and anti-inflammatory properties. Therefore the presence of tannins in *S. macranthum* fruit yields for their astringents properties and also in treating wounds [24]. As per the earlier reports, terpenoids do possess antibacterial and antineoplastic properties which explains the antibacterial activity of the *S. macranthum* fruit against *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Escherichia coli*, *Bacillus subtilis* whilst *Candida albicans* and *Aspergillus niger* [21]. Apart from these activity, terpenoids were also studied for their anti-hepatotoxic properties thus reducing the risk of liver damage. The presence of these bioactive phytoconstituents in the *S. macranthum* fruit explains its use as traditional medicine in treating various diseases, thus making the plant fruit vulnerable to possess a wide range various medicinal uses [25] [26].

Conclusion

Solanaceae family although widely known for their ornamental as well as for their medicinal properties. Historically members *Solanaceae* were remarkably prized for their alkaloid content which was used for poisoning and psychotropic effects, currently evaluation of the bioactive compounds of the *Solanaceae* family have gain great importance for their therapeutic application [20]. Pharmacognostical and phytochemical analysis of *Solanum macranthum* (Dunal) fruit have provided a greater insight on presence of various phytoconstituents, in spite of its ornamental importance, thus making the plant vulnerably potential for its therapeutic applications.

Acknowledgement

The authors would like to acknowledge Karnatak University

Dharwad and P.C Jabin Science College Hubballi for providing the laboratory facility to carry out the research. The authors would also like to acknowledge the support rendered by Cytixon Biosolutions Pvt Ltd Hubballi.

References

- Griffin WJ, Lin GD. Chemotaxonomy and geographical distribution of tropane alkaloids. *Phytochemistry*. 2000; 53(6):623-37.
- Cooke T. Flora of the presidency of Bombay. Calcutta, 1906, 2:331
- Gamble JS. Flora of the presidency of Madars, BSI, Calcutta, 1956, 2:654 India plants.<http://www.indiaplants.com/plant-details.php?x=ZGS06MHGLCE=>. 4 June, 2015
- Cham BE, Meares HM. Glycoalkaloids from *Solanum sodomaeum* are effective in the treatment of skin cancers in man. *Cancer Letters*. 1987; 36(2):111-8.
- Momin RK, Kadam VB. Determination of ash values of some medicinal plants of genus *Sesbania* of marathwada region in Maharashtra. *Journal of phytology*. 2011; 3(12):52-54.
- Challal S, Buenafe OE, Queiroz EF, Zebrafish bioassay-guided microfractionation identifies anticonvulsant steroid glycosides from the Philippine medicinal plant *Solanum torvum*. *ACS Chemical Neuroscience*. 2014; 5(10):993-1004.
- Paulsamy S, Jeeshna MV. Preliminary phytochemistry and antimicrobial studies of an endangered medicinal herb *Exacum bicolor* Roxb. *Res J Pharm Biol Chem Sci*. 2011; 2(4):447-57.
- Peranganing JM, Soemadjj AA, Ketut AJ *et al*, Therapeutic potency of *Solanum torvum* Swartz on benign prostatic hyperplasia treatment: A review. *Int J Res Phytochem Pharmacol*. 2013; 3(3):121-7.
- KR Khandelwal. Practical pharmacognosy. Ed 27, Nirali prakashan, Pune, 2016, 23.8-25.6.
- Kumar M, Mondal P, Borah S, Mahato K. Physico-chemical evaluation, preliminary phytochemical investigation, fluorescence and TLC analysis of leaves of the plant *Lasia spinosa* (Lour) Thwaites. *Int J Pharm Pharm Sci*. 2013; 5(2):306-10.
- Senguttuvan Jamuna, Subramaniam Paulsamy, and Krishnamoorthy Karthika. Phytochemical analysis and evaluation of leaf and root parts of the medicinal herb, *Hypochoeris radicata* L. for in vitro antioxidant activities. *Asian Pacific journal of tropical biomedicine*. 2014; 1(4): S359-S367.
- Bhandary SK, Kumari S, Bhat VS, Sharmila KP, Bekal MP. Preliminary phytochemical screening of various extracts of *Punica granatum* peel, whole fruit and seeds. *J Health Sci*. 2012; 2(4):35-8.
- Ren Y, Shen L, Zhang DW, Dai SJ. Two new sesquiterpenoids from *Solanum lyratum* with cytotoxic activities. *Chemical and Pharmaceutical Bulletin*. 2009; 57(4):408-10.
- Eugene W. Rice, Rodger B, Standard Methods for the Examination of Water, Edn 22, American Public Health Association, Washington, D.C, 2012, 498-533.
- Hyodo H, Terao A, Furukawa J, Sakamoto N, Yurimoto H, Satoh S, Tissue specific localization of pectin-Ca²⁺ cross-linkages and pectin methyl-esterification during fruit ripening in tomato (*Solanum lycopersicum*). *PLoS One*. 2013; 8(11):e78949.
- Akoto O, Borquaye LS, Howard AS, Konwuruk N. Nutritional and mineral composition of the fruits of *Solanum torvum* from Ghana. *International Journal of Chemical and Biomolecular Science*. 2015; 222:6.
- Shallan MA, El-Baz GD, Ali Hannaa FM, Helmy YS. Antitoxicant effects against CCl₄-induced liver damage of ripe fruit ethanolic extract of Black Nightshades. *J Biol Chem Environ Sci*. 2008; 3(4):181-210.
- Puttongsiri T, Choosakul N, Sakulwilaingam D. Moisture content and physical properties of instant mashed potato. *International Conference on Nutrition and Food Science*. 2012; (39):92-95.
- Araújo MG, Galeane MC, Castro AD, Salgado HR, Almeida AE, Cunha WR *et.al.*, Moreira RR. Pharmacognostical Evaluation of Fruits of *Solanum lycocarpum* A. St.-Hill. (Solanaceae). *Pharmacognosy Journal*. 2010;25;2(9).248-253
- Essien EE, Ogunwande IA, Setzer WN, Ekundayo O. Chemical composition, antimicrobial, and cytotoxicity studies on *S. erianthum* and *S. macranthum* essential oils. *Pharmaceutical biology*. 2012; 50(4):474-80.
- Mazher M, Malik NZ, Riaz M, Hussain A, Ali Y, Noshad QQ. Phytochemistry and Antibacterial Assay of Fruit, Leaf and Stem Extracts of *Solanum nigrum* L. in Different Solvent. *Int. J. Biosci*. 2016; 9(6):129-136
- Yousaf Z, Wang Y, Baydoun E. Phytochemistry and pharmacological studies on *Solanum torvum* Swartz. *Journal of Applied Pharmaceutical Science*. 2013; 3(4):152-60.
- Oyeyemi SD, Ayeni MJ, Adebisi AO, Ademiluyi BO, Tedela PO, Osuji IB. Nutritional quality and phytochemical studies of *Solanum anguivi* (Lam.) Fruits. *J. Nat. Sci. Res*. 2015; 5(4):99-105.
- Benedec D, Vlase L, Oniga I. Polyphenolic composition, antioxidant and antibacterial activities for two Romanian subspecies of *Achillea distans* Waldst. et Kit. ex Willd. *Molecules*. 2013; 18(8):8725-39.
- Yadav R, Rathi M, Pednekar A, Rewachandani Y. A detailed review on Solanaceae family. *Euro J Pharm Med Res*. 2016; 3(1):369-78 eal samples showed TCS in some fish liver and fish gill samples at trace levels.