

Preliminary phytochemical analysis of leaf of *Garcinia gummi-gutta* from Western Ghats.

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Abstract: Preliminary phytochemical analysis of the secondary metabolites in the leaf of *Garcinia gummi-gutta* collected from various regions of Western Ghats was carried out. The location of these plants was tagged with the longitude and latitude co-ordinates on Google maps using i-touchmaps software on androidphone. *G.gummi-gutta* plants having broad leaves and narrow leaves were collected from Western Ghat regions of Kodagu, Dakshina Kannada, Uttara Kannada and parts of Kerala. Data on the Ethnobotanical properties of *G.gummi-gutta* were collected from indigenous people and households practicing medicines for animals and humans in these regions. The presumptive compound bringing out the action in other plants is also reported to understand the correlation. The fluorescent characteristic features of leaf of *G.gummigutta* in various extracts were conducted under UV light at 366nm. The leaf extracts of both broad and narrow types were prepared with distilled water, methanol, ethanol, acetone, chloroform, di-ethylether, petroleum ether and hexane. Qualitative analysis of phytochemicals in these extract were analysed. The investigation revealed that the leaf of *G.gummi-gutta* does contain medicinally active phytochemicals. The preliminary qualitative chemical tests showed that leaves collected from Western Ghats regions of Kodagu and Kerala have high content of alkaloids, tannins, phenolic flavonoids, flavonoids, carbohydrates and proteins. This justifies that environmental features do have variation in phytochemical content accumulation in plants. Steroids, terpenoids, phlobatannin and Cardiac glycosides were found in small quantities. Saponins, anthraquinones and anthocyanides were absent. This study provides a location key and scientific detail to investigate the phytochemicals in the leaf of *G.gummi-gutta*. The type of extraction solvents used in the investigation will help researchers decide on solvent compositions for further work on the above mentioned phytochemicals. The study also justifies the need for further research work on the leaf of *Garcinia gummi-gutta*.

Keywords: Ethnomedicinal properties, *Garcinia gummi-gutta*, location, phytochemical analysis, secondary metabolites.

I. Introduction

Pharmacological properties of plants have been extensively studied. Plant part extracts are used to isolate specific compounds that are targeted to the use of mankind. The basis of reporting compounds in plants is investigated from the fact that these plants have been used in traditional, folk and herbal medication. Many plant parts have been used in culinary purposes. It is evident from studies that chemicals do not act alone but most of the time it is in a combination of complexes. This property of a medicinally active biocompound is what is helping treatment of ailments with crude drug [1]. Isolation of compounds, its purification and its clinical study have shown that these chemicals behave differently in invitro conditions. So preliminary detection of phytochemicals in qualitative and quantitative traits should be analysed. The phytochemical investigation is related to the traditional knowledge of which plant part is used in crude drug administration [2]. Chemicals also hold the key to many taxonomical questions that arise in identification of species in the future [3]. The enormous variety of organic substances that have been accumulated by the plant is difficult to explore. Many challenges are faced with material availability, collection from sacred grooves, forest exploration and non availability of taxonomical map.

The plant *Garcinia gummi-gutta* {L.} Robson { *G.cambogia*, *G.quaesita* } belongs to the family Guttiferae {Clusiaceae}. It is a wild sub tropical and tropical plant. The plants are shrubs or trees with yellow or greenish juice. The fruits of the plant are commercially important for its valuable chemical components like hydroxyl citric acid, tartric acid, camogin, euxanthone, gucinol, reducing sugars and fats. The plant is commercially important as their fruit extracts are used for various treatments such as astringent, demulcent, rheumatism, bowel complaints and purgative [4]. Ongoing research for anti malarial drug from *Garcinia* varieties is also reported [5]. Mostly these species are forest products. Most of the plants are less cultivated in homes and extensively endemic to Western Ghats [6]. Karnataka forest publication 2011 has reported these plants as forest trees with medicinal aspects. Hence breeding of these trees has to be boosted. The fruit trade is at international level. The main component of the fruits is hydroxyl citric acid and is used in anti obesity drugs [7]. The fermented fruit extract is used as a souring agent in parts of Kodagu and Kerala. In justifying its

endemic property to Western Ghats, it is evident to do a complete analysis on these plants which will help justifying which region plants are qualitatively better. These plants in various regions of Western Ghats will show variations in their chemical content as they are influenced by climatic and edaphic features. The leaf of *G. gummi-gutta* also contains hydroxyl citric acid, and has not been as much explored as its fruit for medicinal properties [8]. There is a need for taxonomic maps that help in identifying location of the plants [9]. Researchers can use this tool to study, collect and visit these plants when needed. The plants do not show any type of pest infestation and this quality can support further work for detection of phytochemicals [10].

II. Materials and Methods

2.1 Collection, Traditional knowledge documentation, Extract preparation: *Garcinia gummi-gutta* plant leaves were collected from parts of Western Ghats. The main differences in size of leaves were taken as a source for collection from different areas {Table I}. *Garcinia gummi-gutta* having broad leaves and narrow leaves from different locations was collected. The average leaf size, the length between the veins and their weight were documented {Table I}. A maximum of 100 leaves were used and average values were taken for recording. The location of these plants was documented. The location of these plants was tagged with the longitude and latitude co-ordinates on Google maps using i-touchmaps software on android phone {Table II}. Data on the ethnomedicinal properties of extracts were collected from indigenous people and households practicing medicines for animals and humans in these regions {Table III}. The presumptive compound bringing out the action in other plants is also reported to understand the correlation {Table III}. The plant herbariums were documented in Department of Biotechnology St. Joseph's College. The authentications of plants were obtained from Forestry College, University of Agricultural Sciences, Ponnampet, Kodagu.

Fresh plant leaf material of *G. gummi-gutta* was washed with distilled water, air dried and made to fine powder using a sterile electrical blender. The fine powder was stored in amber bottles {airtight} at room temperature. 50gms of the plant sample was taken in 100 ml of the solvents mentioned below.

- a) Distilled water.
- b) Methanol
- c) Ethanol
- d) Acetone
- e) Chloroform
- f) Diethyl ether
- g) Petroleum ether
- h) Hexane.

Two extracts were prepared from each of the solvents. The extracts were filtered through Whatman's filter paper Grade 43:16 μ m. Qualitative tests were conducted on both the filtered and crude extracts. Fluorescent characteristic features of leaf of *G.gummi gutta* in various extracts were conducted under UV light at 360nm.

2.2. Phytochemical screening: The different qualitative chemical tests were carried out on the aqueous extract using standard procedures to identify the constituents as described by Trease and Evans [11], Sofawara [12] and Harborne [13].

2.2.1: Details of procedure for Qualitative analysis:

Alkaloids: To 1ml of the filtrate add 2ml of Drangendroff's reagent positive test shows turbid orange colour.

Tannins: To 1ml of filtrate add 2ml of Ferric chloride. Positive test gives dark green colour.

Saponins: To 1ml of filtrate add 2ml distilled water, it is shaken vigorously and allowed to stand for 10 minutes. Development of foam on the surface of the mixture, lasting for 10 minutes indicates the presence of saponins

Anthraquinones: To 1ml of the filtrate add 10ml benzene, filter and add 5ml of 10% {v/v} ammonia to the filtrate and shake well. Development of pinkish coloured solution indicates the presence of anthraquinones.

Anthocyanides: Add 1ml of filtrate add 5ml of dilute HCl, the appearance of pale pink colour indicates the presence of the above compound. .

Phenolic flavonoids: 1ml of filtrate add 2ml of 10% lead acetate .Positive test gives brown precipitate.

Flavonoids: 1ml of filtrate and add 2ml of dilute NaOH. Positive test shows development of golden yellow colour.

Carbohydrates: a. Take 1ml of the filtrate and add 5ml Benedict's reagent and boil for 5 minutes. Bluish green colour indicates the presence of carbohydrates.

b. To 1ml of filtrate add few drops of Molisch's reagent and few drops of conc. H₂SO₄, which gives purple colour.

c. To 1ml of filtrate add few drops of Fehling's 'A' which gives green colouration.

d. To 1ml of filtrate add few drops of Fehling's 'B' which gives brown colouration.

Proteins: To 1ml of filtrate add 5 to 6 drops of Millon's reagent. If develops white precipitate which turns red on heating than its positive for proteins.

Steroids: To 1ml of the filtrate add 10ml chloroform and 10ml of H₂SO₄ slowly by the sides of the test tube. Positive indication is if upper layer turns red and sulphuric acid layer showed yellow with green fluorescence.

Terpenoids: Take 1ml of the filtrate and add 2ml CHCl₃ and carefully add few drops of conc H₂SO₄. An interface with a reddish brown colouration is formed showing presence of terpenoids.

Cardiac glycosides: To 1ml of the filtrate add 1ml of FeCl₃ reagent {mixture of 1 vol of 5% FeCl₃ solution + 99 vol of glacial acetic acid} and a few drops of conc H₂SO₄. Greenish blue colour appears within few minutes indicating presence of cardiac glycosides.

Phlobatannins: To 1ml of the filtrate add few drops of 1% aqueous HCl. A Red precipitate is formed indicating the presence of phlobatannins.

III. Result and discussion

The results generated from the investigation are represented in the respective tables. The plant species showed leaf size variations. Narrow and broad leaf plants are seen across the Western Ghats. The average leaf size, the length between the veins and their weight were documented {Table I}. These results state that there must be grafted varieties introduced in these regions. The location of these plants was tagged with the longitude and latitude co-ordinates on Google maps using i-touchmaps software on androidphones. The plants were of different age groups. The locations revealed that *G.gummi-gutta* found in the regions of Western Ghats is endemic to these areas. The maps co-ordinates are depicted in table II with different areas where they were collected and named as collection point 1, 2 etc. The Map "fig 1" showing these locations with terrain regions of Western Ghats are also depicted. *G.gummi-gutta* plants having broad and narrow leaves were collected from Western Ghats regions of Kodagu, Dakshina Kannada, Uttara Kannada and parts of Kerala. The co-ordinates will help researchers in future to procure these plants from these places. Data on the ethnomedicinal properties of extracts and their presumptive compound bringing out the action were collected from indigenous people {Table III}. This literature suggests the fact that the leaf of *Garcinia gummi-gutta* can be used in further medicinal research as an ethnobotanical source. The fluorescent characteristic features of leaf of *G.gummigutta* in various extracts were conducted under UV light at 366nm {Table IV}. This will help further investigation of UV absorbent molecule analysis in these extracts.

The powdered leaf of *G.gummi-gutta* was subjected to phytochemical qualitative analysis. The results are discussed below.

3.1 Phytochemical screening-

Alkaloids are used medicinally. They provide information to determine lead structures of novel synthetic drugs. These compounds have antimicrobial activity by inhibiting DNA topoisomerase [14]. Screening of phytoconstituents from the leaves of *G. gummi gutta* showed Kodagu and Kerala varieties have higher amounts. The reason may relate to the soil constituents of this place. Methanol, ethanol and acetone extracts showed the presence of alkaloids. Water extract did not show alkaloids after filtration.

Tannins are potential toxic agents to fungi bacteria and viruses in plants. They are currently investigated for human medicinal use [15], to help reduce the risk of coronary heart diseases [16]. It is present in high quantities in methanol, ethanol, extracts of leaves of *Garcinia gummi gutta*. All solvent extracts showed presence of tannins. Tannis quantity varied in species, with materials collected from Uttara Kannada and Dakshina Kannada regions showing higher concentrations. "Temperature facilitates the microbial infections towards these trees in this region" may be a suggestive theory.

Saponins, present in plants, have been suggested as possible anti-carcinogens. However, the anticarcinogenic effects of saponins from commonly consumed plant foods have not been studied [17]. No saponins were detected in leaves of *G.gummi -gutta* from various regions.

Anthraquinones are absent in all leaf extracts of *G.gummi-gutta*.

Anthocyanosides are also absent in all the extracts of all the types of leaves of *G.gummi-gutta*.

Phenolic compounds are one of the largest and most ubiquitous groups of plant metabolites [18]. Naturally antioxidant in plants is in the form of phenolic compounds such as flavonoids, phenolic acids, tocopherols etc [19]. Biological activities of phenolic compounds involves free radical scavenging in cells [20] [21] [22]. Phenolic flavonoids are present in water and methanolic extracts of the leaves of *G.gummi-gutta*.

Flavonoid compounds have proved of greater general interest to the plant taxonomist, both in respect of general angiosperm taxonomy and for detailed studies of gene flow at the specific and intra-specific levels. Extraction, separation and identification of these substances need to be assessed [23]. Flavonoids are seen in water extracts and shows reduced presence across the solvents. The nature of quantity is similar in all regions of the plants.

Benedict's test shows that high amounts of carbohydrates are present in the leaves from all regions. Water, methanol, ethanol and acetone extract showed positive results for carbohydrates. Molisch's test was positive in leaves from all regions but only in water, methanol and ethanol extracts. Fehling's A test for carbohydrates was positive only in water, methanol, ethanol and acetone. Fehling's B test was positive in methanol, ethanol and acetone extracts. Filtering using Whatman's filter paper did show variations in water extract.

Proteins are present in water, methanol, ethanol, acetone, chloroform diethyl ether. The maximum amount of protein was seen in the acetone extract. Leaves showed average amount of proteins in all samples. Steroids have their potential in pharmaceutical research. Steroids have been targeted as anti-inflammatory and analgesic agents [24]. In the investigation steroid was present in the acetone extract where as moderately in methanol, ethanol and chloroform extracts.

Terpenoids are important for plant survival and also possess biological properties that are beneficial to humans [25]. Terpenoids were positive in water, ethanol and chloroform extracts. Filtering the extract showed negative results. The test results were similar for all the plants collected from various regions. Cardiac glycosides were found positive in only acetone and petroleum ether. Water extracts showed little presence of these compounds.

Phlobatannins have diuretic property [26]. Only ethanol extract showed presence of phlobatannins. The leaves from all the regions showed similar positive results. Filtered extract did not show presence of phlobatannins indicating the fact that other grade filters must be used for the analysis. Thus *G.gummi-gutta* leaf can be explored as a potential medicinal source for future investigation.

TABLE I- Types of plant collected and their details of leaf sizes

| SI NO | Name of the plant and description. | Average size of leaf in cm. | Average size between veins in cm. | Average weight of the fresh leaf before drying in mg. |
|-------|--|----------------------------------|-----------------------------------|---|
| 1 | <i>Garcinia gummi-gutta</i> Type of leaf -Broad Region- Western Ghats- (Kodagu) | Length -14.1 cm Breath 5.1 cm | 1.9cm | 2.440g |
| 2 | <i>Garcinia gummi-gutta</i> Type of leaf -Narrow Region- Western Ghats- (Kodagu) | Length -11.2 cm Breath 3.4 cm | 1.3cm | 1.230g |
| 3 | <i>Garcinia gummi-gutta</i> Type of leaf -Broad Region- Western Ghats- (Kerala) | Length -14.0 cm Breath 5.0cm | 1.6cm | 2.344g |
| 4 | <i>Garcinia gummi-gutta</i> Type of leaf -Narrow Region- Western Ghats- (Kerala) | Length -10.7 cm Breath 2.8 cm | 1.3cm | 1.346g |
| 5 | <i>Garcinia gummi-gutta</i> Type of leaf -Broad Region- Western Ghats- (Dakshina Kannada region) | length -14.1 cm breath 4.9 cm | 1.6cm | 2.330g |
| 6 | <i>Garcinia gummi-gutta</i> Type of leaf -Narrow Region- Western Ghats- (Dakshina Kannada) | Length -11.1 cm Breath 2.9 cm | 1.3cm | 1.212g |
| 7. | <i>Garcinia gummi-gutta</i> Type of leaf -Broad Region- Western Ghats- (Uttara Kannada) | Length -12.7 cm Breath 4.8 cm | 1.7cm | 2.322g |

TABLE II- Location coordinates of the plants.

| SI NO | Name of the plant and description. | Age of the plant | Location |
|-------|---|------------------|---|
| 1 | <i>Garcinia gummi-gutta</i> Type of leaf -Broad Region- Western ghats-(Kodagu) | 30 YEARS | Collection point 1: Latitude- -12.090552 Longitude-76.034135 |
| | | 65 YEARS | Collection point 2: Latitude- 12.306230 Longitude-75.684289 |
| | | 52 YEARS | Collection point 3: Latitude- 12.313903 Longitude- 75.739135 |
| | | 95 YEARS | Collection point 4: Latitude- 12.187166 Longitude- 75.796748 |
| 2 | <i>Garcinia gummi-gutta</i> Type of leaf -Narrow Region- Western ghats-(Kodagu) | 20 YEARS | Collection point 5: Latitude- 12.08816 Longitude-75.937157 |
| | | 35 years | Collection point 6: Latitude- 12.197967 Longitude- 75.928574 |
| 3 | <i>Garcinia gummi-gutta</i> Type of leaf -Broad Region- Western ghats-(Kerala) | 22 years | Collection point 7: Latitude- 9.574047 Longitude-76.570249 |
| 4 | <i>Garcinia gummi-gutta</i> Type of leaf -Narrow Region- Western ghats-(Kerala) | 22 years | Collection point -8: Latitude- 9.567844 Longitude- 76.561646 |
| 5 | <i>Garcinia gummi- gutta</i> Type of leaf –Broad Region- Western ghats-(Dakshina Kannada) | 28 years | Collection point -9: Latitude- 13.009785 Longitude- 75.353508 |
| 6 | <i>Garcinia gummi-gutta</i> Type of leaf – Narrow Region- Western ghats- (Dakshina Kannada) | 25 years | Collection point 10: Latitude- 13.001756 Longitude- 75.336428 |
| 7. | <i>Garcinia gummi-gutta</i> Type of leaf -Broad Region- Western ghats-(Uttara Kannada) | 25 years | Collection point 11: Latitude- 15.048378 Longitude- 74.932648 |

TABLE III- Data on the Ethnomedicinal properties of extracts collected from Western Ghats region and their presumptive compound bringing out the action as reported in other plants.

| SI NO | Ethnomedicinal property | Plant part | Presumptive compound bringing out the action in other plants |
|-------|--|----------------------------|--|
| 1 | Used as Astringent | Fruit | Tanins [27] |
| 2 | Used for treatment of Rheumatism | Leaf and fruit | Secondary alkaloids [27] |
| 3. | Used for treatment of Bowel complaints | Bark and leaf | Alkaloids [28] |
| 4. | Used for treatment of Piles | Leaf and fruit | Combination of phytochemicals [28] |
| 5. | Used as Bilious affections | Fruit and leaf | Combination of phytochemical [29] |
| 6. | Used as Antioxidant | Leaf and fruit | Alkaloids, glycosides, tannins, and flavonoids.[30] |
| 7. | Used as Anticatarrhal | Fruit extract | Combination of phytochemicals [31] |
| 8. | Used as Demulcent | Seed, fruit, root and leaf | Combination of phytochemicals [32] |
| 9. | Used for treatment of Edema | Fruit extract and leaf | Combination of phytochemicals [33] |
| 10. | Used as Thermogenic | Fruit extract | Acids [34] |
| 11. | Used as Anti- Cancer | Stem and roots | Xanthones [35] |

| | | | |
|-----|--|------------------------|------------------------------------|
| 12. | Used as Cardi tonic | Fruit | Combination of phytochemicals [36] |
| 13. | Intestinal Parasites or Antihelminthic | Fruit and leaf extract | Acids [37] |
| 14. | Used for treatment of Constipation | Fruit and leaf extract | Acids and other phytoenzymes [38] |
| 15. | Used for Delayed menstruation | Fruit extract | Phytochemicals [39] |
| 16. | Used as Wound healing | Root and leaf pastes | Combination of phytochemicals [40] |
| 17. | Used for animal wound treatment | Leaf and fruit | Combination of phytochemicals |

Table IV-Fluorescent characteristic features of the leaf of *Garcinia gummi-gutta* in various extracts.

| Si no | Particular of treatment of leaf | Under ordinary light | Under uv light(366nm) |
|-------|---------------------------------|----------------------|-----------------------|
| 1 | Powder +water | Brown | Brownish red |
| 2 | Powder +methanol | Dark green | Brown |
| 3 | Powder +ethanol | Dark green | Brown |
| 4 | Powder +acetone | Dark green | Brown |
| 5 | Powder +chloroform | Dark green | Reddish brown |
| 6 | Powder +di ethylether | Green | Yellowish green |
| 7 | Powder +petroleum ether | Light green | Yellowish green |
| 8 | Powder +hexane | Light green | Orange |
| 9 | Powder +HCl | Red | Brownish red |
| 10. | Powder | Dark green | Brown |

TABLE V- Qualitative analysis of various phyto-constituents in the leaf extract of *Garcinia gummi-gutta* collected from Western Ghats of Kodagu region (Broad leaves).

| SI NO | Name of test | Water extract | | Methanol extract | | Ethanol extract | | Acetone extract | | Chloroform extract | | Diethyl ether extract | | Petroleum ether extract | | hexane extract | |
|-------|---------------------|---------------|----|------------------|----|-----------------|----|-----------------|----|--------------------|----|-----------------------|----|-------------------------|----|----------------|----|
| | | F | C | F | C | F | C | F | C | F | C | F | C | F | C | F | C |
| 1 | Alkaloids | 0 | ++ | ++ | ++ | + | + | ++ | ++ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | Phenolics /Tanins | + | ++ | ++ | ++ | + | + | + | + | + | + | + | + | + | + | + | + |
| 3 | Saponins | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | Antraquinones | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | Anthocyanoids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | Phenolic flavonoids | ++ | ++ | + | + | + | + | + | + | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | Flavonoids | ++ | ++ | ++ | + | + | + | + | + | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8 | Carbohydrates | Benedicts | | + | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ |
| | | Molischs | | ++ | ++ | ++ | ++ | ++ | ++ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | Fehlings | A | + | ++ | 0 | + | ++ | ++ | + | + | 0 | 0 | 0 | 0 | 0 | 0 |
| B | 0 | | 0 | + | + | ++ | ++ | ++ | ++ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 9 | Proteins | + | ++ | + | ++ | + | + | ++ | ++ | + | + | + | + | 0 | 0 | 0 | 0 |
| 10 | Steroids | 0 | 0 | + | + | + | + | ++ | ++ | + | + | 0 | 0 | 0 | 0 | 0 | 0 |
| 11 | Terpenoids | + | + | 0 | ++ | 0 | + | 0 | 0 | + | + | 0 | 0 | 0 | 0 | 0 | 0 |
| 12 | Cardiac glycosides | 0 | + | 0 | 0 | 0 | 0 | ++ | ++ | 0 | 0 | 0 | 0 | + | + | 0 | 0 |
| 13 | Phylobatannins | 0 | 0 | 0 | 0 | 0 | + | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Absent-0; Moderately present-+; Present -++; Filtered- F; Crude- C

TABLE VI- Qualitative analysis of various phyto-constituents in the leaf extract of *Garcinia gummi-gutta* collected from Western Ghats of Kodagu region (Narrow leaves).

| SI No | Name of test | Water extract | | Methanol extract | | Ethanol extract | | Acetone extract | | Chloroform extract | | Di ethyl ether extract | | Petroleum ether extract | | Hexane extract | | |
|-------|---------------------|---------------|----|------------------|----|-----------------|----|-----------------|----|--------------------|----|------------------------|----|-------------------------|----|----------------|----|----|
| | | F | C | F | C | F | C | F | C | F | C | F | C | F | C | F | C | |
| 1 | Alkaloids | 0 | ++ | ++ | ++ | + | + | ++ | ++ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 2 | Phenolics /Tanins | + | ++ | ++ | ++ | + | + | + | + | + | + | + | + | + | + | + | + | |
| 3 | Saponins | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 4 | Antraquinones | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 5 | Anthocyanoids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 6 | Phenolic flavonoids | ++ | ++ | + | + | + | + | + | + | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 7 | Flavonoids | ++ | ++ | ++ | + | + | + | + | + | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 8 | Carbohydrates | Benedicts | | + | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ |
| | | Molischs | | ++ | ++ | ++ | ++ | ++ | ++ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | Fehlings | A | + | ++ | 0 | + | ++ | ++ | + | + | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | B | 0 | 0 | + | + | ++ | ++ | ++ | ++ | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9 | Proteins | + | ++ | + | ++ | + | + | ++ | ++ | + | + | + | + | 0 | 0 | 0 | 0 | |
| 10 | Steroids | 0 | 0 | + | + | + | + | ++ | ++ | + | + | 0 | 0 | 0 | 0 | 0 | 0 | |
| 11 | Terpenoids | + | + | 0 | ++ | 0 | + | 0 | 0 | + | + | 0 | 0 | 0 | 0 | 0 | 0 | |
| 12 | Cardiac glycosides | 0 | + | 0 | 0 | 0 | 0 | ++ | ++ | 0 | 0 | 0 | 0 | + | + | 0 | 0 | |
| 13 | Phylobatannins | 0 | 0 | 0 | 0 | 0 | + | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

Absent-0; Moderately present-+; Present -++; Filtered- F; Crude- C

TABLE VII- Qualitative analysis of various phyto-constituents in the leaf extract of *Garcinia gummi-gutta* collected from Western Ghats of Kerala region (Broad leaves).

| SI NO | Name of test | Water extract | | Methanol extract | | Ethanol extract | | Acetone extract | | Chloroform extract | | Di ethyl ether extract | | Petroleum ether extract | | Hexane extract | | |
|-------|---------------------|---------------|----|------------------|----|-----------------|----|-----------------|----|--------------------|----|------------------------|----|-------------------------|----|----------------|----|----|
| | | F | C | F | C | F | C | F | C | F | C | F | C | F | C | F | C | |
| 1 | Alkaloids | 0 | ++ | ++ | ++ | + | + | ++ | ++ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 2 | Phenolics /Tanins | + | ++ | ++ | ++ | + | + | + | + | + | + | + | + | + | + | + | + | |
| 3 | Saponins | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 4 | Antraquinones | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 5 | Anthocyanoids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 6 | Phenolic flavonoids | ++ | ++ | + | + | + | + | + | + | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 7 | Flavonoids | ++ | ++ | ++ | + | + | + | + | + | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 8 | Carbohydrates | Benedicts | | + | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ |
| | | Molischs | | ++ | ++ | ++ | ++ | ++ | ++ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | Fehlings | A | + | ++ | 0 | + | ++ | ++ | + | + | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | B | 0 | 0 | + | + | ++ | ++ | ++ | ++ | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9 | Proteins | + | ++ | + | ++ | + | + | ++ | ++ | + | + | + | + | 0 | 0 | 0 | 0 | |
| 10 | Steroids | 0 | 0 | + | + | + | + | ++ | ++ | + | + | 0 | 0 | 0 | 0 | 0 | 0 | |
| 11 | Terpenoids | + | + | 0 | ++ | 0 | + | 0 | 0 | + | + | 0 | 0 | 0 | 0 | 0 | 0 | |
| 12 | Cardiac glycosides | 0 | + | 0 | 0 | 0 | 0 | ++ | ++ | 0 | 0 | 0 | 0 | + | + | 0 | 0 | |
| 13 | Phylobatannins | 0 | 0 | 0 | 0 | 0 | + | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

Absent-0; Moderately present-+; Present -++; Filtered- F; Crude-C

TABLE VIII- Qualitative analysis of various phyto-constituents in the leaf extract of *Garcinia gummi-gutta* collected from Western Ghats of Kerala region (Narrow leaves).

| SI NO | Name of test | Water extract | | Methanol extract | | Ethanol extract | | Acetone extract | | Chloroform extract | | Di ethyl ether extract | | Petroleum ether extract | | Hexane extract | | |
|-------|---------------------|---------------|----|------------------|----|-----------------|----|-----------------|----|--------------------|----|------------------------|---|-------------------------|---|----------------|---|---|
| | | F | C | F | C | F | C | F | C | F | C | F | C | F | C | F | C | |
| 1 | Alkaloids | 0 | ++ | ++ | ++ | + | + | ++ | ++ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 2 | Phenolics /Tanins | + | ++ | ++ | ++ | + | + | + | + | + | + | + | + | + | + | + | + | |
| 3 | Saponins | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 4 | Anthraquinones | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 5 | Anthocyanoids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 6 | Phenolic flavonoids | ++ | ++ | + | + | + | + | + | + | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 7 | Flavonoids | ++ | ++ | ++ | + | + | + | + | + | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 8 | Carbohydrates | Benedicts | | + | ++ | ++ | ++ | ++ | ++ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | | Molischs | | ++ | ++ | ++ | ++ | ++ | ++ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | | Fehlings | A | + | ++ | 0 | + | ++ | ++ | + | + | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | B | 0 | 0 | + | + | ++ | ++ | ++ | ++ | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9 | Proteins | + | ++ | + | ++ | + | + | ++ | ++ | + | + | + | + | 0 | 0 | 0 | 0 | |
| 10 | Steroids | 0 | 0 | + | + | + | + | ++ | ++ | + | + | 0 | 0 | 0 | 0 | 0 | 0 | |
| 11 | Terpenoids | + | + | 0 | ++ | 0 | + | 0 | 0 | + | + | 0 | 0 | 0 | 0 | 0 | 0 | |
| 12 | Cardiac glycosides | 0 | + | 0 | 0 | 0 | 0 | ++ | ++ | 0 | 0 | 0 | 0 | + | + | 0 | 0 | |
| 13 | Phylobatannins | 0 | 0 | 0 | 0 | 0 | + | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

Absent-0; Moderately present-+; Present -++; Filtered- F; Crude-C

TABLE IX- Qualitative analysis of various phyto-constituents in the leaf extract of *Garcinia gummi-gutta* collected from Western Ghats of Dakshina Kannada region (Broad leaves).

| SI No | Name of test | Water extract | | Methanol extract | | Ethanol extract | | Acetone extract | | Chloroform extract | | Di ethyl ether extract | | Petroleum ether extract | | Hexane extract | |
|-------|---------------------|---------------|----|------------------|----|-----------------|----|-----------------|----|--------------------|----|------------------------|---|-------------------------|---|----------------|---|
| | | F | C | F | C | F | C | F | C | F | C | F | C | F | C | F | C |
| 1 | Alkaloids | 0 | ++ | ++ | ++ | + | + | ++ | ++ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | Phenolics /Tanins | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | + | + | + | + | + | + | + | + |
| 3 | Saponins | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | Anthraquinones | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | Anthocyanoids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | Phenolic flavonoids | ++ | ++ | + | + | + | + | + | + | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | Flavonoids | ++ | ++ | ++ | + | + | + | + | + | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8 | Carbohydrates | Benedicts | | + | ++ | ++ | ++ | ++ | ++ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | Molischs | | ++ | ++ | ++ | ++ | ++ | ++ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | Fehlings | A | + | ++ | 0 | + | ++ | ++ | + | + | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | B | 0 | 0 | + | + | ++ | ++ | ++ | ++ | 0 | 0 | 0 | 0 | 0 | 0 |
| 9 | Proteins | + | ++ | + | ++ | + | + | ++ | ++ | + | + | + | + | 0 | 0 | 0 | 0 |
| 10 | Steroids | 0 | 0 | + | + | + | + | ++ | ++ | + | + | 0 | 0 | 0 | 0 | 0 | 0 |
| 11 | Terpenoids | + | + | 0 | ++ | 0 | + | 0 | 0 | + | + | 0 | 0 | 0 | 0 | 0 | 0 |
| 12 | Cardiac glycosides | 0 | + | 0 | 0 | 0 | 0 | ++ | ++ | 0 | 0 | 0 | 0 | + | + | 0 | 0 |
| 13 | Phylobatannins | 0 | 0 | 0 | 0 | 0 | + | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Absent-0 ; Moderately present-+ ; Present -++ ; Filtered- F ; Crude-C

TABLE X- Qualitative analysis of various phyto-constituents in the leaf extract of *Garcinia gummi-gutta* collected from Western Ghats of Dakshina Kannada region (Narrow leaves)

| SI NO | Name of test | Water extract | | Methanol extract | | Ethanol extract | | Acetone extract | | Chloroform extract | | Diethyl ether extract | | Petroleum ether extract | | Hexane extract | | |
|----------|---------------------|---------------|----|------------------|----|-----------------|----|-----------------|----|--------------------|----|-----------------------|----|-------------------------|----|----------------|----|----|
| | | F | C | F | C | F | C | F | C | F | C | F | C | F | C | F | C | |
| 1 | Alkaloids | 0 | ++ | ++ | ++ | + | + | ++ | ++ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 2 | Phenolics /Tanins | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | + | + | + | + | + | + | + | + | |
| 3 | Saponins | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 4 | Anthraquinones | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 5 | Anthocyanoids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 6 | Phenolic flavonoids | ++ | ++ | + | + | + | + | + | + | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 7 | Flavonoids | ++ | ++ | ++ | + | + | + | + | + | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 8 | Carbohydrates | Benedicts | | + | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ |
| | | Molischs | | ++ | ++ | ++ | ++ | ++ | ++ | ++ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | Fehlings | A | + | ++ | 0 | + | ++ | ++ | ++ | + | + | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | B | 0 | 0 | + | + | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ |
| 9 | Proteins | + | ++ | + | ++ | + | + | ++ | ++ | + | + | + | + | 0 | 0 | 0 | 0 | |
| 10 | Steroids | 0 | 0 | + | + | + | + | + | + | + | + | 0 | 0 | 0 | 0 | 0 | 0 | |
| 11 | Terpenoids | + | + | 0 | ++ | 0 | + | 0 | 0 | + | + | 0 | 0 | 0 | 0 | 0 | 0 | |
| 12 | Cardiac glycosides | 0 | + | 0 | 0 | 0 | 0 | + | + | 0 | 0 | 0 | 0 | + | + | 0 | 0 | |
| 13 | Phylobatannins | 0 | 0 | 0 | 0 | 0 | + | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

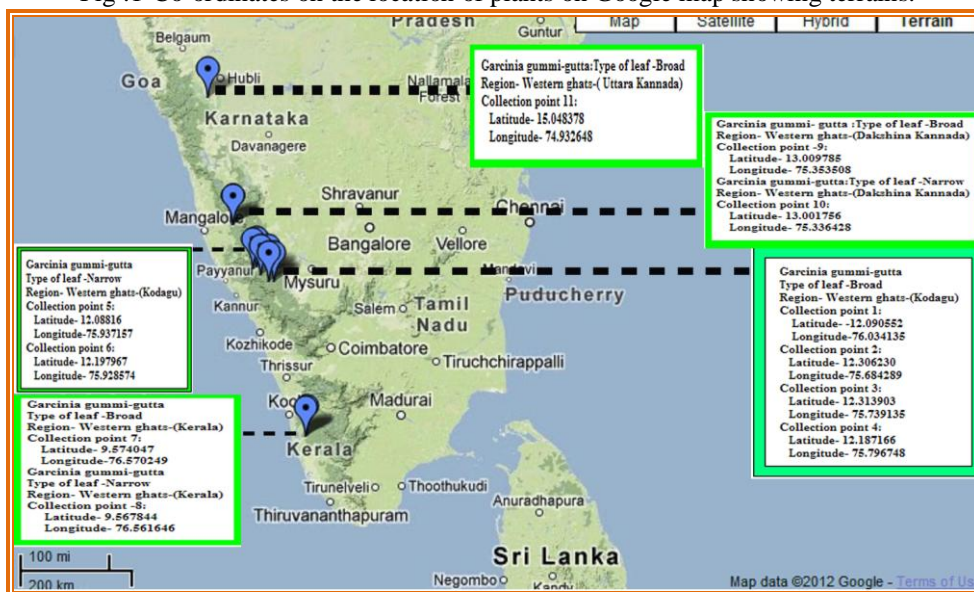
Absent-0 ; Moderately present-+ ; Present -++ ; Filtered- F ; Crude- C

TABLE XI- Qualitative analysis of various phyto-constituents in the leaf extract of *Garcinia gummi-gutta* collected from Western Ghats of Uttara Kannada region (Broad leaves).

| SI No | Name of test | Water extract | | Methanol extract | | Ethanol extract | | Acetone extract | | Chloroform extract | | Diethyl ether extract | | Petroleum ether extract | | Hexane extract | | |
|----------|---------------------|---------------|----|------------------|----|-----------------|----|-----------------|----|--------------------|----|-----------------------|----|-------------------------|----|----------------|----|----|
| | | F | C | F | C | F | C | F | C | F | C | F | C | F | C | F | C | |
| 1 | Alkaloids | 0 | ++ | ++ | ++ | + | + | ++ | ++ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 2 | Phenolics /Tanins | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | + | + | + | + | + | + | + | + | |
| 3 | Saponins | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 4 | Anthraquinones | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 5 | Anthocyanoids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 6 | Phenolic flavonoids | ++ | ++ | + | + | + | + | + | + | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 7 | Flavonoids | ++ | ++ | ++ | + | + | + | + | + | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 8 | Carbohydrates | Benedicts | | + | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ |
| | | Molischs | | ++ | ++ | ++ | ++ | ++ | ++ | ++ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | Fehlings | A | + | ++ | 0 | + | ++ | ++ | ++ | + | + | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | B | 0 | 0 | + | + | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ |
| 9 | Proteins | + | ++ | + | ++ | + | + | ++ | ++ | + | + | + | + | 0 | 0 | 0 | 0 | |
| 10 | Steroids | 0 | 0 | + | + | + | + | ++ | ++ | + | + | 0 | 0 | 0 | 0 | 0 | 0 | |
| 11 | Terpenoids | + | + | 0 | ++ | 0 | + | 0 | 0 | + | + | 0 | 0 | 0 | 0 | 0 | 0 | |
| 12 | Cardiac glycosides | 0 | + | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 13 | Phylobatannins | 0 | 0 | 0 | 0 | 0 | + | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

Absent-0 ; Moderately present-+ ; Present -++ ; Filtered- F ; Crude-C

Fig :1-Co-ordinates on the location of plants on Google map showing terrains.



IV. Conclusion

The plants observed in these areas are up to 90 years old. From the ethnomedicinal data it is clear that this plant has a lot of potential as a medicinal plant. The phytochemical evaluation can be used for further assessment of plant leaf chemicals. Researchers can use map co-ordinates to reach collection points. Researchers can use the application of Google maps using i-touchmaps software on androidphones. This will help scientist to build a data base of co-ordinates of plants in the Western Ghat region. This investigation will help in further extraction analysis of compounds from plant parts of *Garcinia gummi-gutta*.

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