Review Article

COCCINIA GRANDIS: A PHARMACEUTICAL REVIEW

Y. Harshitha*, NL. Prasanthi and N. Ramarao

Department of Pharmaceutics, Chalapathi Institute of Pharmaceutical Sciences, Guntur, Andhra Pradesh, India.

ABSTRACT

The present society of diseases requires an ultimate drug which gives utmost cure, no reoccurrence, no side effects and better health. One of the requirement or some of the requirements may be reached by the present drugs. But completely achieving all the requirements is only by the traditional medicine. The ancient traditional medicines have wide range of curing any kind of ailment. One of which that ancient plant ,but also using in present days is *COCCINIA GRANDIS*. The plant *Coccinia Grandis* having pharmacological activities like analgesic, antipyretic, anti inflammatory, antimicrobial, antiulcer, anti diabetic, antioxidant, hypoglycaemic, hepatoprotective, antimalarial, antidyslipidemic, anticancer, antitussive, mutagenic.

Keywords: *Coccinia Grandis*, Traditional Medicine, Ailment.

INTRODUCTION

As per the present scenario of medicines, people mostly requires a kind of medicine which does not show any adverse effects. This could be possible only by the traditional plant medicines that has complete positive activity towards persons and complete pharmacological activity towards diseases. Every plant is a boon to all life kind given by god. But the problem lies in, coming to know the activity of every plant towards diseases .There are about 7,000 plant species found in India. The WHO estimates that about 80% of the population living in the developing countries depends almost on traditional medicines for their primary health care. The family of *Coccinia Grandis* is Cucurbitaceous, comprises 960 species. The family is predominantly distributed around the tropics. Most of the plants in Cucurbitaceae family are annual plants. *Coccinia Grandis* is used by humans mostly as a food crop in several countries in Australia, Asia, Caribbean, and the southernUnited States, Pacific Islands.

Nomenclature: The name is derived from the latin coccineus, meaning scarlet, in reference to the fruit colour[1].

kingdom	**Plantae**
order	**Cucurbitales**
family	**Cucurbitaceae**
genus	**Coccinia**
species	**Coccinia grandis**

Nutritional value per 100g of edible portion of *Coccinia Grandis*[2]

Components	Amount
Energy	21 K.Cal
Protein	1.4g
Carbohydrates	3.4g
Fat	0.2g
Calcium	25mg
Iron	0.9mg

CHEMICAL CONSTITUENTS[3]

It contains many chemical constituents in every of its part.They include:

I. **Aerial part:-** Heptacosane, Cephalandrol, β -sitosterol, Alkaloids Cephalandrins A and B,

II. **Fruits:-** β- Amyrin Acetate, Lupeol, Cucurbitacin B, Taraxerone, Taraxerol, β-carotene, Lycopene, Cryptoxanthin, Xyloglucan,Carotenoids, β-sitosterol, Stigma-7-en-3one.

III. **Root:** - Resin, Alkaloids, Starch, Fatty Acids, Carbonic acid,Triterpenoid, Saponin Coccinoside, Flavonoid Glycoside, Lupeol, β-amyrin, β-sitosterol, Taraxerol (Deokate *et al.,* 2011).

MEDICINAL VALUE FOR VARIOUS PARTS OF COCCINIAGRANDIS[4]

Leaf

The leaves of coccinia grandis helps to treat various diseases like:

Antidiabetic, oxidant, larvicadal, GI disturbances, Cooling effect to the eye, Gonorrhea,

hypolipidemic, skin diseases, urinary tract infection.

Fruit

The fruits of coccinia grandis helps to treat various diseases like:

Hypoglycemic, analgesic, antipyretic, Hepatoprotective, tuberculosis, eczema. anti-inflammatory.

Stem

The stem of coccinia grandis helps to treat various diseases like:

Expectorant, antispasmodic, asthma, bronchitis, GIT disturbances, urinary tract infection, skin diseases,

Root

The roots of coccinia grandis helps to treat various diseases like:

Hypoglycemic, antidiabetic, skin diseases, removes pain in joint, urinary tract infection.

Extraction Procedure

The plant part which is needed to be extracted , should collect from based upon its availability in various regions. Then the collected plant part should be dried under shade till all the moisture has removed. Then the dried plant parts are powdered finely, sieved to get very fine powder. Suitable solvent has to be selected based upon the need whether it may be aqueous, non-aqueous, alcoholic etc. Type of extraction is based upon the need. The obtained extract should be dried under reduced pressure at room temperature.

Chemical Group Tests[5]

The chemical group tests should be conducted for any type of extract of coccinia grandis.For the chemical group tests, we need to prepare 10% (w/v) solution of extract in suitable solvent.

I. Test for Alkaloids

[i] Mayer's test

2 ml solution of the extract and 0.2 ml of dilute hydrochloric acid were taken in a test tube. Then 1 ml of Mayer's reagent was added. Formation of yellow colour precipitate indicates the presence of alkaloids

[ii] Dragendroff's test

2 ml solution of the extract and 0.2 ml of dilute hydrochloric acid were taken in a test tube. Then 1 ml of Dragendroff's reagent was added. Formation of orange brown precipitate indicates the Presence of alkaloids.

II. Tests for Glycosides

A small amount of an alcoholic extract of the fresh or dried plant material was taken in 1 ml of water. Then, a few drops of aqueous sodium hydroxide were added. An yellow color is considered as an indication for the presence of glycosides.

.

III. Test for Steroids

Sulphuric acid test

1 ml solution of chloroform extract was taken and then added 1 ml sulphuric acid. Red color indicates the presence of Steroids.

IV. Tests for tannins

Ferric Chloride Test

5 ml solution of the extract was taken in a test tube. Then 1 ml of 5% Ferric chloride solution was added. Formation of greenish black precipitate indicates the presence of tannins.

V. Test for Flavonoids

A few drops of concentrated hydrochloric acid were added to a small amount of an alcoholic extract of the plant material. Immediate development of a red color indicates the presence of Flavonoids.

VI. Test for Saponins

1 ml solution of the extract was diluted with distilled water to 20 ml and shaken in a graduated cylinder for 15 minutes. One centimeter layer of foam indicates the presence of saponins.

Qualitative analysis of phytochemicals in Coccinia grandis extract

Alkaloids	+
Steroids	+
Tannins	+
Saponins	+
Glycoside	+
Flavonoids	+

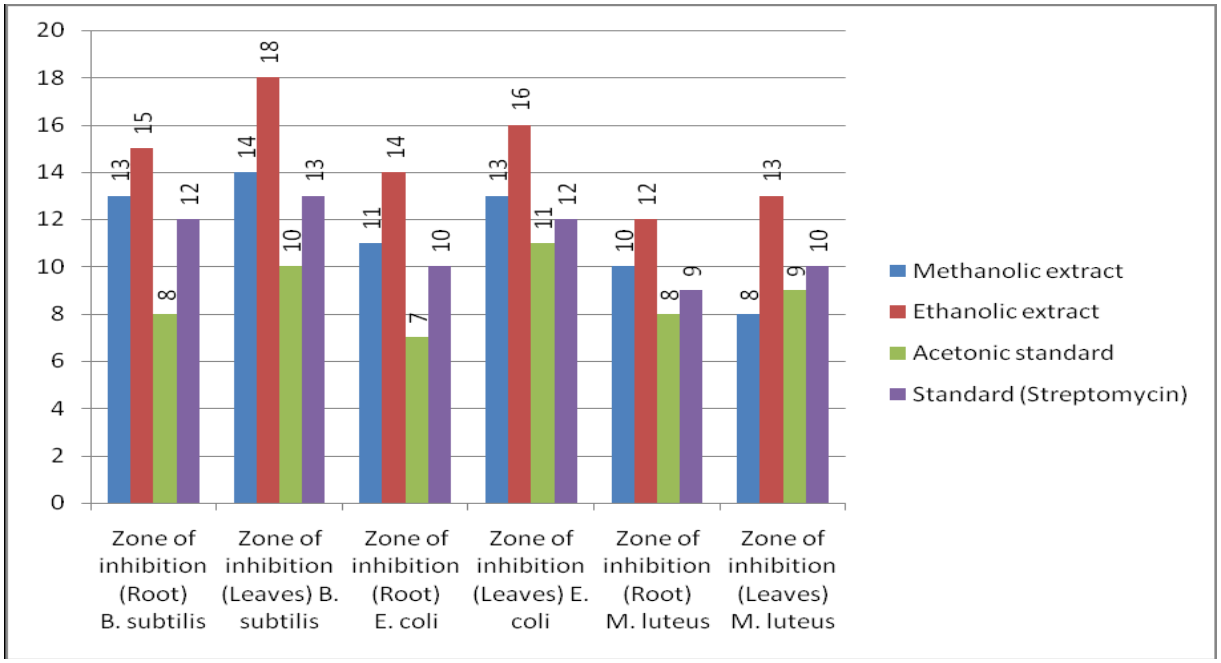
+ : indicates the presence of phyto chemicals

Pharmacological Activities of various parts of coccinia grandis using different type of extracts

PLANT PART	TYPE OF EXTRACT	PHARMACOLOGICAL ACTIVITY
Leaves	Aqueous Extract	Anti-Malarial Activity
Leaves and Stem	Aqueous Extract	Anti-Inflammatory activity
Roots	Ethanolic Extract	Anti-oxidant activity
Leaves	Methanolic Extract	Analgesic Activity
Leaves	Ethanolic Extract	Anti-ulcer Activity
Leaves	Aqueous Extract	Anti-Cancer Activity
Leaves	Ethanolic Extract	Anti-Fungal Activity
Fruit	Alcoholic Extract	Hepato Protective Activity
Leaves	Chloroform Extract	Antidyslipidemic Activity
Leaves	Aqueous Extract	Mutagenic Effect

Antimicrobial activity

The antibacterial properties of Coccinia grandis was investigated via in vitro approach. The experiment was done with methanolic leaf extracts of Coccinia grandis which showed inhibitory effect on S. aureus, P. aeruginosa, E. coli and K. pneumonia[6,7]. In this study leaf and root extract of this plant in acetone, methanol and ethanol solvents acts against E.coli, Bacillus subtilis, Micrococcus luteus. The ethanolic leaf extract has been found superior for all microorganism comparatively to root extract and it is more effective than other two solvents[8].



Hepato-protective avtivity

Alcoholic extract of the fruits of *C. Grandis* Linn was evaluated in CCl4 induced hepato-toxicity in rats and levels of AST, ALT, ALP, total proteins, total and direct bilirubin were evaluated. The alcoholic extract significantly ($p<0.05$) decreased at a dose level of 250 mg/kg. The activities of serum enzymes (AST, ALT and ALP) and bilirubin which were comparable to that of silymarin revealing its hepato-protective effect[9].

Antihyperglycemic activity

Antihyperglycemic activity study was done through oral glucose tolerance tests in glucose-loaded mice. The methanol extract of the leaf when injected to mice at doses of 50, 100, 200 and 400 mg extract per kg body weight demonstrated significant dose-dependent antihyperglycemic activity. The highest level of serum glucose reduction was observed with an extract dose of 400 mg per kg body weight, when serum glucose level was found to be reduced by 56.3%. In comparison, the standard antihyperglycemic drug, glibenclamide, when administered at a dose of 10 mg per kg body weight reduced serum glucose level in mice by 55.5%.Hence it was proved that the leaf extract of *Coccinia* has significant antihyperglycemic properties[10].

Antidiabetic activity

Scientist evaluated combined extracts of Musa paradisiaca and *C. Grandis* aqueous extract of leaf for antidiabetic activity in streptozotocin induced diabetes rats. The ethanolic extract of the aerial part decreases blood glucose levels and lipid parameters in streptozotocin induced diabetic rats at 100 or 200 mg/kg. Chronic administration of fruit extract 200 mg/kg for 14 days reduces the blood glucose level in alloxan induced diabetic rat[11]. The aqueous extract of *C. Grandis* reduced the blood glucose level; also reduced the cholesterol, protein and urea with prolonged treatment.

Antinociceptive activity

Antinociceptive activity tests were conducted in acetic acid-induced gastric pain writhing in the same mouse model. The number of writhings was induced by intraperitoneal administration of acetic acid in mice. When the lowest dose of extract tested (100 mg per kg body weight) the number of writhings was reduced by 36.4%. When a dose of 400 mg per kg body weight was given, the extract reduced the number of writhings by 47.5%. The result obtained was significantly higher when observed with a standard antinociceptive drug, aspirin[12]. The methanolic extract of leaf also demonstrated significant and dose-dependent antinociceptive activity.

Antioxidant activity

The antioxidant activities of the various fractions of the hydromethanolic extract of the roots of *C. Grandis* was investigated. The antioxidant activities of the fractions was evaluated by using in vitro assays and were compared to standard antioxidants such as ascorbic acid, α-tocopherol, curcumin and butylated hydroxyl toluene (BHT). All the fractions showed effective H donor activity, reducing power, free radical scavenging activity etc. The free radical scavenging and antioxidant activities may be attributed to the presence of phenolic and flavonoid compounds present in the fractions. The results obtained indicate that the roots of *C. Grandis* have a potential source of natural antioxidant[13].

Antihepatotoxic Activity

Ethanolic extract of fruit and leaves of *C. Grandis* revealed the presence of saponins. The purified fraction Ci from ethanolic extract by gradient silica gel column chromatography in the dose 25 mg/kg (Ci-1) and 50 mg/kg (Ci-2) (p.o.) showed significant dose dependent reduction in SGPT,SGOT, bilirubin, total protein, liver weight and lipid peroxide levels with reference to the standard, silymarin (25 mg/kg, p.o).The Ci compound also revealed significant dose dependent reduction in the hepatic antioxidant enzyme activities such as super oxide dismutase, glutathione, catalase, and peroxidase. The structural characterization of Ci compound by microanalysis, UV, IR, H NMR, C NMR spectroscopy and Mass spectrometry revealed structure with molecular formula C H O (beta-sitosterol). Hepatoprotective potential of Ci compound, sitosterol was inferred from its antihepatotoxic activities on serum transaminases and hepatic antioxidant enzymes in CCl4 intoxicated rats[14].

Antitussive activity

C. Grandis has been extensively used to get relief from asthma and cough by the indigenous people of India. The antitussive effect of aerosols of two different concentrations (2.5%,
5%w/v) of methanol extract of *C.Grandis* fruits were tested by counting the numbers of coughs produced due to aerosols of citric acid, 10 min after exposing the male guinea pigs to aerosols of test solutions for 7 min. In another set of experiment methanol extract was investigated for its therapeutic efficacy on a

cough model induced by sulfur dioxide gas in mice. The results showed significant reduction of cough number obtained in the presence of both concentrations of methanol extract as compared to the prototype antitussive agent codeine phosphate. Also, methanol extract exhibited significant antitussive effect at 100, 200 and 400 mg/kg, per orally by inhibiting the cough by 20.57, 33.73 and 56.71% within 90 min of performing the experiment[15]. From this investigation, it can be concluded that on preliminary screening the extract of *C. Grandis* produced a significant anti-tissue effect and thus the claim of using the plant as an anti-cough agent in ancient folklore medicine was established.

Anti-inflammatory activity

Initially petroleum ether extract, 60% methanolic extract and aqueous extracts of the whole plant were made using hot extraction procedure using soxhlet apparatus. The qualitative phyto-chemical screening procedure was performed on each extract. Phyto-chemical study reveals that flavonoid was only present in the methanolic extract. The anti-inflammatory activity of each extract and that of a standard drug, diclofenac sodium were studied using Carageenan induced rat paw oedema model. The extracts and the standard drug were administered orally. It was observed that 60%methanolic extract of *C. Grandis* produced maximum anti-inflammatory activity even more than the standard drug, diclofenac sodium after 3 hours. Petroleum ether extract and the aqueous extract produced less percentage of inhibition in comparison the standard drug[16].

Anti-ulcer activity

Anti-ulcer activity of the three extracts was studied in rats by using pylorous ligated ulcer model. Methanol extract (2g/kg), aqueous extract (2g/kg) and powder (0.5-2 g/kg) of leaves of *C. Grandis* were tested for antiulcer activity in Wistar albino rats. Aspirin (200mg/kg bw) in 1% sodium was used as control, famotidine (20mg/kg bw) in 1% sodium was used as standard drug. Powder of leaf and methanol extract showed significant decrease of ulcer, while aqueous extract showed no significant decrease[17]. In another study ethanolic, aqueous, total aqueous extracts (200 and 400 mg/kg) of leaves of *C. Grandis* (Linn.) were used for anti-ulcer activity. Omeprazole (2mg/kg) was used as standard drug. The ethanolic extract 400 mg/kg showed comparable anti-ulcer activity as that of standard omeprazole[18].

Antidyslipidemic activity

Golden syerian hamsters (Mesocricetus auratus), male, 12- week –old, (110-120 g) body weight were used for the investigation of antidyslipidemic activity. Ethanol extract of *C. Grandis* showed significant triglyceride and cholesterol-lowering effect in dyslipidemic hamster model. Ethanolic extract was fractioned into chloroform, n-butanol and water-soluble fractions (25mg/kg bw) which were used. Standard drug fenofibrate at the dose of 108mg/kg was used. Chloroform fraction was found to possess significant lipid lowering activity followed by increase in high-density lipoprotein –cholesterol and total cholesterol ratio. Chloroform soluble fraction which act as active component was subjected to repeated column chromatography for the isolation of a polyphenol compound and characterized as C60 –polyphenol. Polyphenol was the first compound isolated from is plant. The polyphenols which were isolated from chloroform fraction, showed antidyslipidemic activity[19,20].

Antipyretic activity

Scientist evaluated methanolic extract of *C. Grandis* for antipyretic activity at the doses of 100 and 200 mg/kg in yeast-induced fever. The extract showed antipyretic activity by elevating the prostaglandin biosynthesis. Prostaglandin is considered as a regulator of body temperature. *C. Grandis* extract contains glycosides, alkaloids, flavonoid, terpenoids, phenols and tannins[21,22].

Antimalarial activity

Extract of *C. Grandis* shows excellent antiplasmodial activity against the Plasmodium falciparum[23]. Aqueous leaf extract of *C. Grandis* decreases the SGPT, SGOT, ALP, total protein, blood urea nitrogen concentration. Hydrophilic moiety of *C. Grandis* extract is responsible for antimalarial activity. The extract reduces the significantly the Plasmodium berghei parasite count in mice[24].

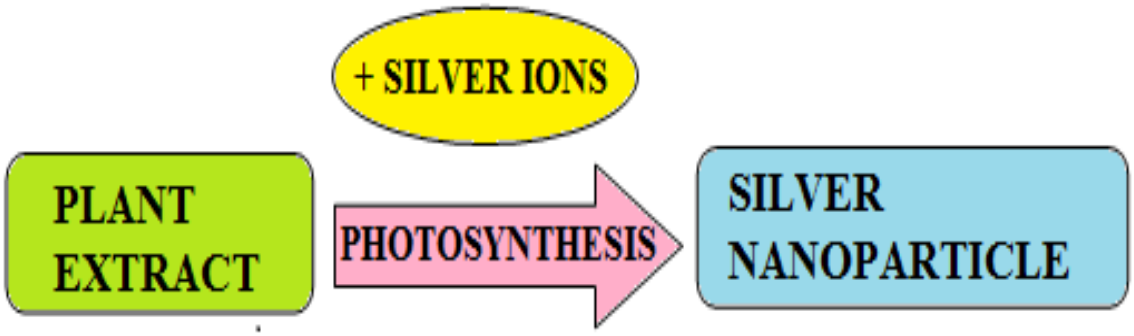
Anticancer activity

There are a number of vegetables are known which possesses anti-cancerous properties. One of them is *C. Grandis* . It is considered that anticancer activity of the *C. Grandis* is due to the antioxidant nature. The antioxidant nature of *C. Grandis* reduces the ferrocynaide to ferrous. Hydrogen peroxide scavenged from *C. Grandis* neutralizes to water[25] Scientists[26] evaluated the aqueous extract of leaves of *C. Grandis* for anticancer activity. In the pathogenesis of pain, inflammation nitric oxide

is a free radical which an important role. As *C. Grandis* possess an antioxidant activity which reduces nitrite generated by decomposition. But it was observed that the graded response produced by the cell was comparatively less. Vinblastine was the standard drug which was used. *C. Grandis* considerably reduced viable cell count and increased non viable cell count confirming the presence of anticancer property with that of the reference drug Vinblastine[27].

Mutagenic effect

Aqueous extract of leaves of *C. Grandis* showed inhibition of growth and mutagenesis on Neurospora crassa by a gradual decrease of growth of mycelia. This result indicates that *C. Grandis* plant shows mutagenic effect on Neurospora crassa[28]. For the first time another research was done on silver nanoparticles using leaf extract of *C. grandis*.



For the first time, the use of *C. Grandis* L. leaf extract in the phytosynthesis of silver nanoparticles was described. The extract is a new and renewable capping, as well as reducing agent. Nanoparticles with crystallite size of 20–30 nm were obtained. The Ag nanoparticles exhibit photo catalytic activity under UV light. As these silver nanoparticles were successfully synthesized from aqueous AgNO3 through a simple green route using the leaf extract of *C. Grandis* .The results obtained from UV–vis spectrum, X-ray diffraction (XRD), scanning electron microscopy (SEM), energy dispersive spectroscopy (EDS) and Fourier-transform infra red spectroscopy (FTIR) and high-resolution transmission electron microscopy (HRTEM). These revealed that the biosynthesis of silver nanoparticles were in the size range of 20–30 nm and is crystallized in face centered cubic symmetry. Further, the thermal stability of nanoparticles was studied using thermo gravimetric analyzer (TGA) and differential scanning calorimeter (DSC). Photo catalytic property of the Ag nanoparticles was investigated by degradation of Coomassie Brilliant Blue G-250 under UV light. The results show that Ag nanoparticles have suitable activity for the degradation of Coomassie Brilliant Blue G-250[29]. The TG–DSC results establish the thermal stability of the silver NPi.

CONCLUSION

Thus how the plant *Coccinia Grandis* is showing various benefits to all mankind suffering from many diseases or ailments .The various plant parts are producing various beneficial activities to treat diseases. Developing different type of formulations, based on patient compliance by using these type of plant extracts will produce tremendous changes in pharma industry and society will be free from many diseases.

REFERENCES

1. Wagner WL, Herbst DR, Sohmer SH. Manual of the flowering plants of Hawaii (bishop museum special publication). Honolulu: University of Hawaii and Bishop Museum Press; 1999.
2. Sanskriti Gautam, Anju Meshram, Nidhi Srivastava.(A Brief Study On Phytochemical Compounds Present In *Coccinia Cordifolia* for their Medicinal, Pharmacological and Industrial Applications). World Journal of Pharmacy And Pharmaceutical Sciences.2014;3(1):1995-2016.
3. Deokate U. A. and Khadabadi S. S. (Pharmacology and photochemistry of Coccinia indica). Journal of Pharmacognosy and Phytotherapy. 2011; 3(11): 155-159.
4. Pekamwar S. S, Kalyankar T.M., and Kokate S.S. (Pharmacological Activities of Coccinia Grandis). Journal of Applied Pharmaceutical Science : 2013;3(5):114-119.
5. Sk. Amir Hossain , Sr. N. Uddin , Md. Abu Salim, Razaul

Haque.(Phytochemical and Pharmacological screening of *Coccinia grandis* Linn). Journal of Scientific & Innovative Research.2014; 3(1): 65-71.
6. Dewanjee S, Kundu M, Maiti A, Majumdar R, Majumdar A, Mandal SC.(.*In vitro* evaluation of antimicrobial activity of crude extract from plants *Diospyros peregrina*, *Coccinia grandis* and *Swietenia macrophylla)*. Trop J Pharm Res, 2007; 6: 773-78.
7. Farrukh U, Shareef H, Mahmud S, Ali SA, Rizwani GH. (Antibacterial activities of *Coccinia grandis* L). Pak J Bot, 2008; 40:1259-62.
8. Hussain A, Wahab S, Zarin I, Hussain MDS. (Antibacterial Activity of the Leaves of *Coccinia indica* (W. and A) W of India). Advan Biol Res, 2010; 4(5): 241-48. 48.
9. Kumar A. (A review on hepatoprotective herbal drugs). IJRPC**,** 2012; 2(1): 2231-2781.
10. Sutradhar BK, Islam MJ, Shoyeb MA, Khaleque HN, Sintaha M, Noor FA, Walid N, Mohammed R.(An Evaluation of Antihyperglycemic and Antinociceptive Effects of Crude Methanol Extract of *Coccinia grandis* (L.) J. Voigt. (Cucurbitaceae) Leaves in Swiss Albino Mice). Adv. in Nat. Appl Sci**,** 2011; 5(1) : 1-5.
11. Gunjan M, Goutam KJ, Jha AK.(Pharmacognostic and antihyperglycemic study of *Coccinia indica*). International J of Phytomedicine, 2010; 2: 36-40.
12. Sutradhar BK, Islam MJ, Shoyeb MA, Khaleque HN, Sintaha M, Noor FA, Walid N, Mohammed R. (An Evaluation of Antihyperglycemic and Antinociceptive Effects of Crude Methanol Extract of *Coccinia grandis* (L.) J. Voigt. (Cucurbitaceae) Leaves in Swiss Albino Mice). Adv. in Nat. Appl Sci**,** 2011; 5(1) : 1-5.
13. Bhadauria P, Arora B, Vimal B, Kulshrestha A. (In vitro Antioxidant Activity of *Coccinia grandis* Root Extracts). Indo Global J Pharm Sci, 2012; 2(3): 230-38.
14. Gawade SP, Rao MVC. (Antihepatotoxic Activities of Ci Compound: ß Sitosterol Isolated from Fruits and Leaves of *Coccinia indica*). Ind J Pharm Edu Res, 2012; 46(1) :7-11.
15. Pattanayak PS, Priyashree S. (In vivo antitussive activity of *Coccinia grandis* against irritant aerosol and sulfur dioxide induced cough model in rodents). Bangladesh J Pharmacol, 2009; 4: 84-7.
16. Chatterjee A, Chatterjee S. (Proximate analysis, phyto-chemical screening and anti-inflammatory activity of *Coccinia indica*). IJPCBS*,* 2012; 2(3): 299-304.
17. Papiya MM, Sasmal D, Arivudi NR. (Antiulcerogenic and antioxidant effects of *Coccinia grandis* (Linn). Voigt leaves on aspirin-induced gastric ulcer in rats). Nat Prod Radiance, 2008; 7(1): 15-18.
18. Preeth M, Shobana J, Upendarrao G , Thangathirupathi A. (Antiulcer effect of *Coccinia grandis* (Linn.) on pylorus ligated (albino) rats). Int J Pharm Res Dev, 2010; 2(5): 1-9.
19. Singh G, Gupta P, Rawat P, Puri A, Bhatia G, Maurya R. (Antidyslipidemic activity of polyprenol from *Coccinia grandis* in high fat diet fed hamster model). Phytomedicine**,** 2007; 14(12) :792-98.
20. Bhatia G, Rizvi F, Saxena R, Puri A, Khanna A K, Chander R Wulff EM, Rastogi AK. (In vivo model for dyslipidemia with diabetes mellitus in hamster). Indian J Exp Biol, 2003; 41: 1456-59.
21. Pekamwar SS, Kalyankar TM and Kokate SS. (Pharmacological Activities of *Coccinia grandis*: Review). J App Pharm Sci, 2013; 3 (05): 114-9.
22. Aggarwal AS, Suralkar UR, Chaudhari G, Deshpande SV, Garud AA. Talele SG, (Analgesic and antipyretic activity of methanolic extract of *Coccinia grandis* L. leaves in experimental animals). Res J Pharm Biol Chem Sci, 2011; 2:175-82.
23. Ravikumar S, Inbaneson SJ, Suganthi P. (In vitro antiplasmodial activity of ethanolic extracts of South Indian Medicinal plants against Plasmodium falciparum). Asian Pac J Trop Med, 2012 ;180-3.
24. Samanta A, Bhattacharya B, Ghosh S, Gouranga D. (In vivo antimalarial activity of the plant *Coccinia grandis*). Ijprd, 2011; 3(4) : 73-9.
25. Behera SK, Dash V. (Some Indian vegetable used as an anticancer agent). IJAPBS, 2012;2 : 250-64.
26. Bhattacharya B, Pal P, Lalee A, Mal DK, Samanta A. (In-vivo and in-vitro anticancer activity of *Coccinia grandis* (L.) Voigt. (Family: Cucurbitaceae) on

Swiss albino mice). J Pharm Res 2011; 4(3): 567-9.
27. Nanasombat S, Teckchuen N. (Antimicrobial, antioxidant and anticancer activities of Thai local vegetables). J Med Plants Res, 2009; 3950: 443-9.
28. Bhuiyan MNI , Mozmadr TIMA, Houqe MA, Akhtar S, Islam MR. (Mutagenic effect of *Coccinia cordifolia* leaf extract on n. crassa fungus). Bangladesh J Sci Ind, 2009; 44:215-20.
29. Arunachalam R, Dhanasingh S, Kalimuthu B, Uthirappan M, Rose C, Mandal AB. (Phytosynthesis of silver nanoparticles using *Coccinia grandis* leaf extract and its application in the photocatalytic degradation). Colloids Surf B, 2012; 94 : 226-30.