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› Cytotoxic giant-cell induction & phytoconstituents of Yellow Oleander



Cytotoxic giant-cell induction & phytoconstituents of Yellow Oleander

Cascabela thevetia (L.) L.
[Apocynaceae]

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Blurb/Shorttext:

This book entitled "Cytotoxic giant-cell induction & phytoconstituents of Yellow Oleander, *Cascabela thevetia* [Apocynaceae]" reveals the cytotoxicity of *C. thevetia*, its phytochemical analysis and in situ visualization by blue assay. Yellow oleander, a tropical evergreen shrub is a native of West Indies, Southern Mexico and the Caribbean. It contains various phytoconstituents like alkaloids, flavonoids, phenols, terpenoids, saponins, phlobatannins, steroids, tannins, and amino acids. A wide spectrum of clastogenic abnormalities like the giant cells, the strap cells, nuclear shrinkage & vacuolation, nuclear & chromosome erosion, apoptotic bodies, nuclear disintegration & fragmentation, apoptotic fragmentation of chromatin, nuclear peak formation, pulverization, multiple nuclei, etc. were observed. The non-clastogenic abnormalities scored include micronucleus, bi- & tri-nucleate cells, abnormal arrangement of chromosomes, tripolar anaphase, etc. The study unveils the potential cytotoxic and phytoconstituents of *thevetia*.

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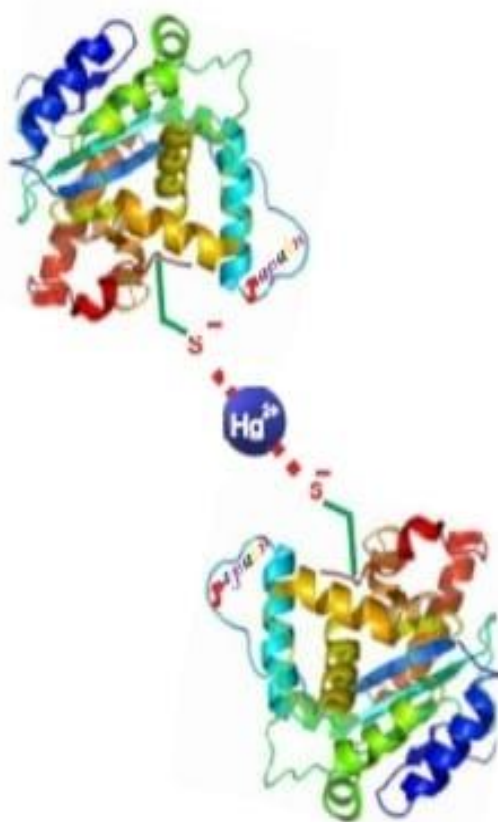
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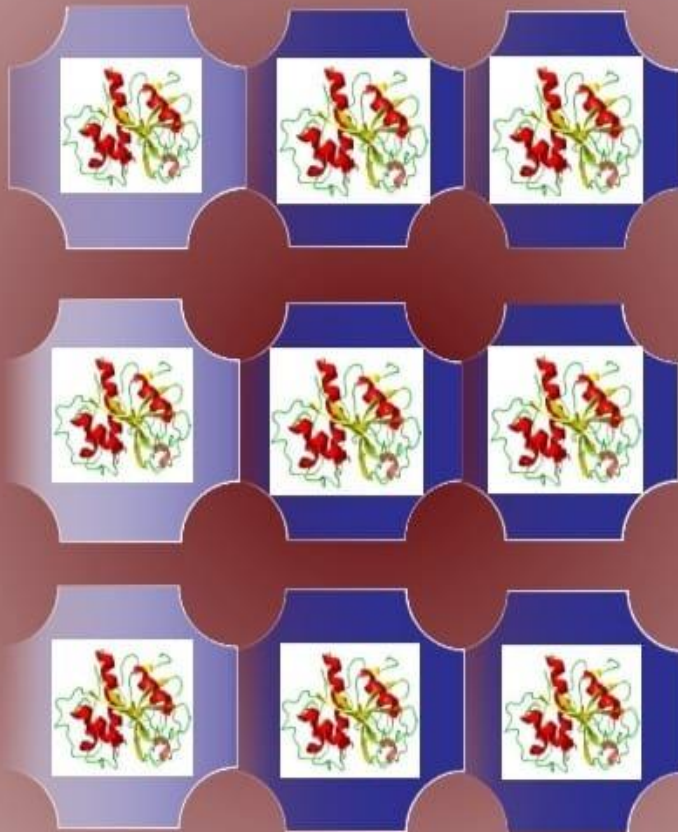
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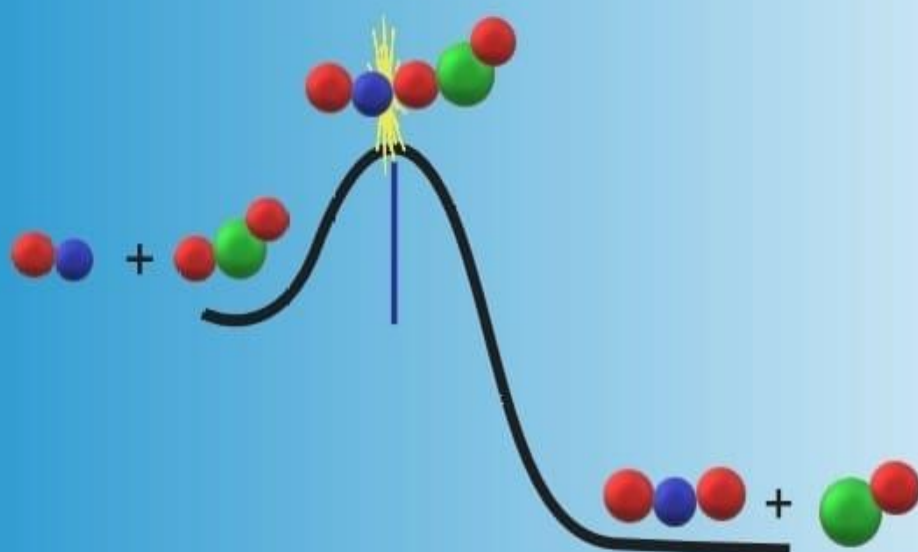
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Chapter

Nature's Green Catalyst for Environmental Remediation, Clean Energy Production, and Sustainable Development

By *Benny Thomas, Divya Mathew, K. S. Devaky*

Book [Chemistry and Chemical Engineering for Sustainable Development](#)

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ABSTRACT

Green chemistry is the design and application of chemical processes to reduce the practice and generation of materials hazardous to human health and the environment. The exclusion of widely dispersed anthropogenic pollutants is one of the main concerns for a sustainable improvement for our planet. Comparing to traditional physicochemical methods, bioremediation is the safest, least troublesome, and most economic treatment. Enzymatic bioremediation has risen as an attractive alternative to traditional methods. Nowadays exciting new opportunities for biocatalysis toward the production of renewable and clean energy sources are rapidly emerging. Based on the premise that these alternatives can contribute to a cleaner environment, especially when using renewable agricultural products, the demand for these energies is increasing.

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Chapter

Green Catalysis, Green Chemistry, and Organic Syntheses for Sustainable Development

By Divya Mathew, Benny Thomas, K. S. Devaky

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ABSTRACT

Green catalysts offer an environmentally attractive catalyst–solvent system under mild reaction conditions for chemo-, regio-, and stereoselective design of products and processes. The fundamental pillars of green chemistry thus reduce the practice and generation of hazardous materials. The design and application of new catalytic systems achieve the dual goals of environmental protection and economic benefit. Green catalysis offers benefits like lower energy requirements, increased selectivity, decreased practice of processing agents, and platform for less toxic materials. Green catalysis and synthesis addresses environmentally benign process by providing the ease of separation of product and catalyst, thereby eliminating the necessity for separation through distillation or extraction.

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In Vitro Antioxidant And Cytotoxic Efficacy Of *Cucurbita maxima*: From The Medicinal Plant Wealth Of Peninsular India

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Abstract : Tropical India and Peninsular India is famous for its rich medicinal plant wealth and the tradition of indigenous system of therapy, Ayurveda. Plants have been used for the cure of various diseases in Ayurveda and is extensively used by the elder generation. The present study is to evaluate the phytochemical composition, and to screen for the in vitro antioxidant and cytotoxicity effects of leaves of *Cucurbita maxima*, a potential plant which is culturally and medicinally significant to the people of Kerala. Among all the extracts methanolic leaf extract of *Cucurbita maxima* showed higher phenolic and flavonoid content and significant DPPH scavenging activity. The in vitro cytotoxicity was tested against Hep G2 (hepatocellular liver carcinoma) in which methanolic extract of *Cucurbita maxima* showed an IC₅₀ 108.72 µg/ml at 48hr. Our study confirmed that the leaves of *Cucurbita maxima* has better antioxidant and anticancer properties and hence consuming of its leaves as food will definitely rejuvenate our body.

Index Terms: Phytochemical analysis, Antioxidant, Cytotoxicity, Traditional medicinal plants.

I. INTRODUCTION

Peninsular India is famous for its indigenous medicinal practice, Ayurveda and as the source of several potential medicinal plants. Ayurvedic medicinal system is a well-established medicinal practice in India with a sound literature background originated approximately 5000 years ago. Traditional medicinal plants are endless source for therapeutic drugs for various ailments like antimicrobial, anti-inflammatory, anticancer, antioxidants, antiulcer and so on. The classical Indian textbooks like Rigveda, Yajurveda, Atharvaveda, Charaka Samhita and Susrutha Samhita discuss about various diseases and their treatment, medicinal herbs and their efficiency for removing the ailments.

The World health organisation (WHO) estimated that about 80 percent of the world's population still realize on plant based medicines for their primary health care. This is in fact is a clear indication of the role of medicinal plants in the maintenance of health and treatment of diseases as therapeutic alternatives throughout the world, still in the late 20th and early 21st century (WHO, 2002).

The demand on plant based therapeutics is increasing in both developing and developed countries due to the growing recognition that, they are natural products, non-narcotic, easily biodegradable, cause minimum environmental hazards, have no adverse side effects and are easily available at affordable prices. Medicinal plants have the capacity to produce a large number of organic phytochemicals with complex structural diversity known as secondary metabolites. Some of these secondary metabolites are produced for self-defence. Literature reviews show that over the last 20 years, large of secondary metabolites from different plant species have been evaluated for their bioactivities.

As per Ayurveda and the tradition of Kerala, in the Malayalam month of "Karkkidakam" and "Aadi" in Tamil (the Monsoon season of Kerala and Tamilnadu) in olden days our elder people consume various herbal preparations to rejuvenate the body and cure diseases. Elder women in Kerala and Tamilnadu are rich in ethno biological knowledge which has been transmitted from one generation to another. One such knowledge is the traditional cooking recipes of the leaves of various medicinal plants including that of *Cucurbita maxima*.

C. maxima (Pumpkin) belongs to the family Cucurbitaceae. It has received considerable attention in recent years because of the nutritional and health benefits of the bioactive components obtained from its seeds and fruit. Literature reviews show that less focus has been given to explore the bioactive compounds present in the leaves of this plant by researchers and hence this study.



Figure 1: *Cucurbita maxima*

The present study is to evaluate the phytochemicals present, antioxidant and anticancer potentials of *Cucurbita maxima* which is considered to be a potential plant which is culturally and medicinally significant to the people of Kerala in India.

II. MATERIAL AND METHODS

2.1 Plant collection and extraction

The seeds of *Cucurbita maxima* were collected from Kerala Agriculture University, Thrissur, Kerala. The University has released an improved variety "Ambily" in the year 1988. The seeds were seeded properly and the young leaves were used as samples. The leaves were chopped into small pieces and shade dried. The samples are pulverized in an electric blender and the powdered samples are used for further extraction. Extraction was done using the solvents petroleum ether (PE) Chloroform, methanol (ME) and aqueous (AQ). All the extracts were stored in air tight container until use. (Ikram et al., 1984)

2.2 Phytochemical screening

Preliminary phytochemical screening of the four extracts of *Cucurbita maxima* were performed by Trease and Evans, 2002; Harborne, 1999.

2.2.1 Test for Carbohydrates

Molisch's Test: To 2ml of plant extract, 1ml of molich's reagent and few drops of concentrated sulphuric acid were added. Formation of purple or reddish ring indicates the presence of carbohydrate.

2.2.2 Test for Tannins

Ferric chloride test: To 1ml of plant extract, 2 ml of 5% ferric chloride was added. Formation of dark blue or greenish black indicates the presence of tannins.

2.2.3 Test for Saponins:

Foam test: To 1ml of plant extract, 5-10 ml of distilled water was added and shaken in a graduated cylinder for 15 minutes lengthwise.

Formation of 1cm layer of foam indicates the presence of saponins.

2.2.4 Test for Flavonoids:

Sulphuric acid test: A fraction of the extract was treated with concentrated sulphuric acid and observed for the formation of orange colour.

2.2.5 Test for Alkaloids:

Mayers test: To 2 ml of plant extract, 2ml of concentrated hydrochloric acid was added. Then few drops of Mayer's reagent were added. Presence of green colour or white precipitate indicates the presence of alkaloids.

2.2.6 Test for Anthocyanin and Betacyanin:

Sodium Hydroxide Test: To 2ml of plant extract, 1 ml of 2N sodium hydroxide was added and heated for 5 minutes at 100°C. Formation of bluish green colour indicates the presence of anthocyanin and formation of yellow colour indicates the presence of betacyanin.

2.2.7 Test for Glycosides:

Sulphuric Acid Test: To 2ml of plant extract, 1ml of glacial acetic acid and 5% ferric chloride was added. Then few drops of sulphuric acid were added. Presence of greenish blue colour indicates the presence of glycosides.

2.2.8 Test for Proteins and Aminoacids:

Ninhydrin test: To 2ml of plant extract, few drops of 0.2% Ninhydrin was added and heated for 5 minutes. Formation of blue colour indicates the presence of proteins.

2.2.9 Test for Steroids and Phytosterols:

Sulphuric acid test: To 1ml of plant extract, equal volume of chloroform and few drops of concentrated sulphuric acid were added. Formation of brown ring indicates the presence of steroids and formation of bluish green colour indicates the presence of phytosterols.

2.2.10 Test for Phenols:

Ferric chloride test: To 1ml of the extract, 2 ml of distilled water followed by few drops of 10% ferric chloride was added. Formation of blue or green colour indicates presence of phenols.

2.3 Antioxidant activity

2.3.1 DPPH assay: free radical scavenging activity

2.3.1.1 Procedure:

The antioxidant activity of *Cucurbita maxima* methanolic leaf extract and standard ascorbic acid were assessed on the basis of the radical scavenging effect of the stable 2,2-diphenyl-1-picrylhydrazyl (DPPH) free radical activity according to the method described by Brand-William et al., 1995. The ethanol extract with different concentrations (10, 50, 100, 200, 400, 600 µg/ml) were prepared using methanol. Ascorbic acid was used as the standard in 1-100 µg/ml solution. 0.004% of DPPH solution was prepared in ethanol and 5 ml of this solution was mixed with 5 ml of extract solution and standard solution distinctly. These solution mixtures were kept in dark for 30 minutes. The degree of DPPH purple decolourisation to DPPH yellow indicated the scavenging effectiveness of the extract. The absorbance of the combination was determined at 517 nm using UV-Visible Spectrophotometer and ascorbic acid was served as a positive control. Lower absorbance of the reaction mixture indicated higher free radical scavenging activity. The percentage of scavenging was calculated as follows:

$$\% \text{ DPPH radical Scavenging} = \frac{\text{Absorbance of control} - \text{Absorbance of test sample}}{\text{Absorbance of control}} \times 100$$

2.3.2 Cell culture and treatment

Human cancer cell lines HepG2 (hepatocellular liver carcinoma) were obtained from National Centre for Cell Sciences (NCCS), Pune. Cells were maintained in DMEM media supplemented with 10% FBS 100 U/ml penicillin and 100 µg/ml streptomycin with 5% CO₂ at 37°C in CO₂ incubator. The cultured cells were harvested, counted and used for further assays.

2.3.3 In vitro cytotoxicity assay/Anti-proliferative activity

The cells were seeded in 96 well plates (5000 cells/well) and then kept for incubation for 24 hours at 37°C. Different concentrations of plant extracts were added to the wells. Controls were maintained to determine the control cell survival and the percentage of live cells after culture. After that kept in an incubator for 24 hours at 37°C. Removed the medium completely and added 100 µl of MTT reagent to it. Then kept in incubator for 2 hours at 37°C and observed for formazan crystal formation under microscope. The yellowish MTT is reduced to dark coloured formazan by viable cells only. Removed the medium completely and added 100 µl of isopropanol and kept for 10 minutes and incubated at 37°C. The colour developed was quantified with an ELISA plate reader at 570 nm. The cell survival (CS) is expressed as percentage cell survival % CS = (T/C) X 100, where T is the OD of test and C is the OD of control. Cell survival percentage using MTT assay was calculated using the following equation: % cell survival = $\frac{\text{Absorbance in drug treated wells} - \text{Absorbance in blank}}{\text{Absorbance in control well} - \text{Absorbance of Blank}} \times 100$

From this the percentage of cytotoxicity was calculated.

III. RESULTS AND DISCUSSION

3.1 Phytochemical analysis

Preliminary qualitative analysis of the four extracts confirmed the presence of phyto constituents like tannin, phenolics, flavanoids, steroids, glycosides, terpenoids, and reducing sugar in various extracts of *Cucurbita maxima*. The methanolic extract was rich with wide range of plant compounds like phenolic, tannin, saponin, flavonoids, terpenoids, glycosides and sugars. The presence of phenolics, tannin, steroids, flavonoids, terpenoids and glycosides were confirmed in the methanolic extract of *Curculigo orchoides* (Table 1).

Table 1 : Phytochemical analysis of leaves extracts of *Cucurbita maxima*

Sl no	Secondary metabolite	Alcohol extract	Acetone extract	Chloroform extract	p.E	Water extract
1	carbohydrates	+	+	+	+	+
2	saponin	+(slightly)	-	+	-	+
3	tannins	+	-	+	-	-
4	flavonoids	+	+	+	+	+
5	Alkaloids	+	-	+	-	+
6	Anthocyanide and betacyanide	+	+	-	+	+

7	Glycosides	-	-	-	-	-
8	protein	-	-	-	-	-
9	Phytosterols and steroids	+	+	+	+	+
10	phenols	+	-	+	+	+

3.2 Antioxidant activity

Free radicals are molecules or atoms that have at least one unpaired electron which usually increases the chemical reactivity of the molecule. Free radicals can react with other molecules to cause cell damage or DNA mutation. Molecules called antioxidants protect against free radical damage and their action permit to ensure a balance between production and destruction of free radicals. Antioxidant capacity of the methanolic extracts were evaluated by DPPH assay. DPPH radical scavenging assay shows that the ethanolic extracts of the plant have potential antioxidant activity which increases with the concentration of the extract with the lowest Effective Concentration which scavenges 50% radical (EC50) of 60 µg/mL (Fig. 1).

Table 2: Percentage of scavenging activity of *Cucurbita maxima* in different extracts

Concentration (µg/ml)	% of scavenging activity				
	Ethanol extract	Acetone extract	Petroleum ether extract	Chloroform extract	Water extract
100	77.8	66.66	64	65.9	63.63

Table 3: Percentage of scavenging activity of *Cucurbita maxima* in ethanol extract at various concentrations

Concentration(µg/ml)	% of scavenging activity of Ascorbic acid	% of scavenging activity of <i>cucurbita maxima</i> (ethanol extract)
10	40.63	38.6
50	60.59	58.2
100	80.25	77.8
200	87.64	89.2
400	90.26	86.8
600	93.5	91.4

3.3 Anti-proliferative activity

Even though there is remarkable development in the field of molecular mechanism of cancer, the development of chemotherapeutic agents still remains ineffective and costly. 33 Medicinal plants showing potential activity are important sources of bioactive molecules which can be developed as potent chemotherapeutic agents. 34 The cytotoxicity of the plant was measured against human cancer cell lines HepG2 cells using the MTT (3-[4, 5- dimethylthiazol-2-yl]-2, 5- diphenyltetrazolium) assay. Different concentrations (50- 250µg/ml) were used for the assay. 10% DMSO was used as negative control. Methanolic extract showed significant cytotoxicity activity with an IC50 108.72 µg/ml at 48hr. Further studies are required to identify the potential compounds and their mechanism of action.

Table 4: Percentage of cell survival

Concentration(µg/ml) <i>Cucurbita maxima</i> (ethanol extract)	% cell survival
6.25	74.9
12.5	56.9
50	55.8
100	45.5

IV.CONCLUSION

Methanolic extracts of *Cucurbita maxima* found to be more potential compared to the other extracts which may be attributed to the high phenolic and flavanoid content of the extract. Further studies are required to isolate and characterize the bioactive compounds and their mechanism of action which may lead to the development of novel compounds. The outcome of the present studies indicates the presence of powerful and potential bioactive compounds for the development of new 'leads' to combat various lifestyle diseases of the present era.

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REFERENCES

- [1] Sreena Raj, Karthikeyan S, Gothandam KM. 2011. Ayurveda - A glance, Research in Plant Biology, 1, 1-14.
- [2] Jiny VK, Anila, J, Nagalekshmi R, Resiya S, Sonu J. 2010. Dasapushpam: the traditional uses and the therapeutic potential of ten sacred plants of Kerala state in India, International journal of pharmaceutical sciences and research, 1(10), 50-59.
- [3] Iwu MW, Duncan AR, Okunji CO. 1999. "New antimicrobials of plant origin," In: Perspectives on New Crops and New Uses, J. Janick (Ed.), ASHS Press, Alexandria, USA, 457-462.
- [4] Damiki L and Alakh NS. 2011. Antioxidant activities of three Indian commercially available Nagakesar: An in vitro study, Journal of Chemical and Pharmaceutical Research, 3(1), 277-283.
- [5] Vivek KG and Surendra KS. 2006. Plants as a natural antioxidants, Natural Product Radiance, 5(4), 326-334.
- [6] Schuler P. 1990. Natural antioxidants exploited antioxidant activity and phenolic content in plant extracts commercially, In Food Antioxidants, Ed., Hudson In contrast, relationship was not observed between B.J.F., Elsevier, London, 99-170.
- [7] Verma M, Singh SK, Bhushan S, Sharma VK, Datt P, Kapahi BK Saxena AK. 2008. In vitro cytotoxic potential of Polyalthia longifolia on human cancer cell lines and induction of apoptosis through mitochondrial-dependent pathway in HL-60 cells, Chemico-Biological Interactions, 171, 45-56.
- [8] Trease GE and Evans WC .2002. Pharmacognosy, 15th Ed. London: Saunders Publishers.
- [9] Harborne JB. 1984. Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis, Chapman and Hall, London, UK.
- [10] Javanmardi J, Stushnoff C, Locke E, Vivanco JM. 2003. Antioxidant activity and total phenolic content of Iranian Ocimum accessions, Food Chemistry, 83(4), 547- 550.
- [11] Park YS, Jung ST, Kang SG, Heo BK, Arancibia AP, Toledo F, Drzewiecki J, Namiesnik J, Gorinstein S. 2008. Antioxidants and proteins in ethylene-treated kiwifruits, Food Chemistry, 17, 640-648.
- [12] Sulaiman A, Milton W, Khalid A. 2012. Antibacterial potential of honey from different origins: A comparison with manuka honey, Journal of Microbiology, Biotechnology and Food Sciences, (1)5, 1328-1338.
- [13] Silvia M, Elba LC, Amorim, Tadeu JS, Peixoto S, Antonio MS, Maria NCP, Cristóbal NA, José AT, Solange IM. 2013. Antibacterial activity of crude methanolic extract and fractions obtained from Larrea tridentata leaves, Industrial Crops and Products, 41, 306-311.
- [14] Ali-Shtayeh MS, Al-Nuri MA, Yaghmour RM, Faidi YR, Antimicrobial activity Micromeria nervosa from the Palestine area, Journal of Ethnopharmacology, 58(3),
- [15] Azlim AAA, Ahmed JK, Syed Zahir I, Mustapha SK, Aisyah MR, Kamarul RK. 2010. Total phenolic content and primary antioxidant activity of methanolic and ethanolic extracts of aromatic plants leaves, International Food Research Journal, 17, 1077-1084.
- [16] Ebrahimzadeh MA, Nabavi SF, Nabaviand SM, Pourmorad F. 2010. Nitric oxide radical scavenging potential of some Elburz medicinal plants. African Journal of Biotechnology, 9(32), 5212-5217.
- [17] Sonia M and Mohamed D. 2008. In Vitro antioxidant activities of Aloe Vera leaf skin. Journal de la Société Chimique de Tunisie, 10,101-109.
- [18] Kalaivani T and Lazar M. 2010. Free radical scavenging activity from leaves of Acacia nilotica(L.) Wild.ex Delile,an Indian medicinal tree, Food and Chemical Toxicology, 48, 298-305.
- [19] Iris FF, Benzie YT, Szeto. 1999. Total Antioxidant Capacity of Teas by the Ferric Reducing/Antioxidant Power Assay, Journal of Agricultural and Food Chemistry, 47, 633-636.
- [20] Mosmann T. 1983. Rapid colorimetric assay for cellular growth and survival: application to proliferation and cytotoxicity assays, Journal of Immunological Methods, 65, 55- 63.

- [21] Lau CS, Ho CY, Kim CF, Leung KN, Fung KP, Tse TF, Chan HL, Chow MS., 2004. Cytotoxic activities of *Coriolus versicolor* (Yunzhi) extract on human leukemia and lymphoma cells by induction of apoptosis, *Life Sciences*, 75, 797-808.
- [22] Yan QJ, Li YX, Jiang ZQ, Yan S, Zhu LF, Ding ZF. 2009. Antiproliferation and apoptosis of human tumor cell lines by a lectin (AMML) of *Astragalus mongholicus*, *Phytomedicine*, 16, 586-593.
- [23] Rashmi P and Linu M. 2012. Antimicrobial activity of leaf extracts of *Justicia adhatoda* L. in comparison with vasicine, *Asian Pacific Journal of Tropical Biomedicine*, S1556- S1560.
- [24] Agoramoorthy G, Chandrasekaran M, Venkatesalu V, Hsu MJ. 2007. Antibacterial and antifungal activities of fatty acid methyl esters of the Blind-your-eye mangrove from India, *Brazilian Journal of Microbiology*, 38, 739-742.
- [25] Bagchi K and Puri S. 1998. Free radicals and antioxidants in health and diseases, *Eastern Mediterranean Health Journal*, 4, 350-360.
- [26] National Cancer Institute, Antioxidants and cancer prevention: Fact sheet, Retrieved September 11, 2009
- [27] Kumaran A and Karunakaran RJ. 2007. In vitro antioxidant activities of methanol extracts of five *Phyllanthus* species from India, *LWT- Food Science and Technology*, 40(2), 344-352.
- [28] Srinivasan R, Chandrasekar MJN, Nanjan MJ, Suresh B. 2007. Antioxidant activity of *Caesalpinia digyna* root *Journal of Ethnopharmacology*, 113(3), 284-291.
- [29] Gulçin I, Elias R, Gepdiremen A, Chea A, Topal F, Antioxidant activity of bisbenzylisoquinoline alkaloids from *Stephania rotunda*: cepharanthine and fangchinoline, *Journal of Enzyme Inhibition and Medicinal Chemistry*, 25,
- [30] Samia O, Riadh K, Hanen F, André P, Chedly A, Jean L. 2012. Phenolic content, antioxidant, anti-inflammatory and anticancer activities of the edible halophyte *Suaeda fruticosa* Forssk, *Food Chemistry*, 132, 943-947.
- [31] Socha R, Juszczak L, Pietrzy S, Fortuna T. 2009. Antioxidant activity and phenolic composition of herb honeys, *Food Chemistry*, 113(2), 568-574.
- [32] Zhang Y and Wang ZZ. 2009. Phenolic composition and antioxidant activities of two *Phlomis* species: a correlation study, *Comptes rendus Biologies*, 332(9).
- [33] Kaufmann SH and Earnshaw WC. 2000. Induction of apoptosis by cancer chemotherapy, *Experimental Cell Research*, 256, 42-49.
- [34] Zhao M, Yang B, Wang J, Liu Y, Yu L, Jiang Y. 2007. Immunomodulatory and anticancer activities of flavonoids extracted from litchi (*Litchi chinensis* Sonn.) pericarp, *International Immunopharmacology*, 7, 162-166.