Antioxidant Properties of Plant Extracts

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Abstract
There is a continued interest to screen plant extracts for their antioxidant properties, in light of the fact that antioxidant activities parallel anticancer activities, amongst their ability to combat other diseases. Cancer is one of the diseases that has a high mortality status in developed countries and is on the rise in developing countries. Plant extracts have been tested for their antimicrobial, anticancer, Antidiabetic, insect repellent and a range of other biological activities. Since 1990s, antioxidant research has expanded significantly, due to its potential benefits in disease prevention and health promotion. Guyana, a country located on the mainland of South America and whose rich diverse flora needs continual screening for plants with a range of pharmaceutical and medicinal activities of which, antioxidant is one. In addition, the isolation of known and unknown natural antioxidants may contribute to novel drug discovery. This article is a mini review of plants/plant extracts that have exhibited antioxidant properties.

Keywords: Screen plant extracts, Antioxidant activities, Anticancer activities, Antidiabetic activities.

Introduction
Antioxidants are chemical compounds or mixture of compounds, which when present in low concentrations are used to prevent the oxidation of lipids, sugars and proteins and DNA that can generate aldehydes, ketones, esters and other products that can be harmful to living systems. Antioxidants can be synthetic or natural. Synthetic antioxidants include Butylated Hydroxy Anisole (BHA), Butylated Hydroxy Toluene (BHT), Tert-Butyl Hydroquinone (TBHQ) and Propyl Gallate (PG) etc [1]. Natural antioxidants are those that can be obtained from fruits, vegetables and plant extracts. There is an increasing interest to use plant extracts as antioxidant agents.

Table 1 shows some plants that have rich antioxidant profile, whereas Table 2 shows the chemical constituents of some antioxidant plants. Natural antioxidants may function (a) as reducing agents, (b) as free radical scavengers, (c) as complexers of pro-oxidant metals, and (d) as quenchers of the formation of singlet oxygen. However, the major value is in their primary antioxidant activity as free radical acceptors and as chain breakers. Free radicals are usually produced in normal or pathological cell metabolism. Reactive Oxygen Species (ROS) react with free radicals to become free radicals themselves. ROS include free radicals such as superoxide anion radicals, hydroxyl radicals, non-free radical species and singlet oxygen [2-5].

Excess generation of ROS, induced by various stimuli and which exceed the antioxidant capacity of the organism can lead to various pathophysiological processes such as diabetes, cancer, inflammation, genotoxicity, alzheimer disease and cataracts, retinopathy, rheumatism, skin disease porphyria and senile dementia stroke [6-8]. Antioxidants usually react with reactive free radicals to destroy them by accepting or donating electron(s) to eliminate the radical or they may indirectly decrease the formation of free radicals. Antioxidants also act by forming complexes with metals.

Human cells protect themselves against enzymatic and non-enzymatic antioxidant systems against free radical damage. However, these protective antioxidant mechanisms may not be enough to prevent severe or continued antioxidant stress [9]. Hence, natural or synthetic antioxidants are necessary. In nature, there is a wide variety of natural antioxidants which are different in their chemical composition, physical and chemical properties.

These include enzymes such as Superoxide dismutase, catalase etc. High molecular weight compounds such as protein like albumin, transferrin, ceruloplasmin, low molecular weight compounds such as tocopherol, quinines, bilirubin, ascorbic acid, uric acid etc. Minerals such as selenium, copper, manganese, zinc etc. Vitamins such as vitamin A, C and E and plant antioxidants. Also the flavonoids (flavanols, isoflavones, flavones, catchins, flavonones), cinnamic acid derivatives, coumarins, tocopherols, and polyfunctional organic acids. Some of these are shown in Figure 1 Screening of plants for antioxidant activities can be established via various in vitro methods such as DPPH, Nitric oxide method, DMPD, ABTS, ORAC, TBARS assays [1-8], [20-25] etc.

Guyana has a richly biodiversified flora and medicinal studies such as antimicrobial [10-18], antidiabetic [19] have received increasing attention. However, there are few unpublished work on antioxidant and anticancer activities. It’s highly imperative that research proliferate with regards to anticancer and antioxidant activities as there are an alarming increase in the deadly cancer disease worldwide and in Guyana. Plant parts such as stems, leaves and fruits rich in antioxidant properties are good in combat against cancer. Also, the chromatographic purification of the crude plant extracts from the Guyanese flora can lead to known and unknown natural products, whose antioxidants properties can be investigated and compared with the crude plant extracts. This forms the basis for novel antioxidant drugs discovery.
Few researches in Guyana have done on the isolation of natural products from plants of the Guyanese flora. The isolation of natural products from Montricardia arborescens and Passiflora edulis, two plants from the Guyanese flora, suspected to have antioxidant properties has been pursued. Table 3 shows some plants with suspected antioxidant properties, based on folklore from the flora of Guyana. There chemical constituents needs investigation.

The antioxidant activities of plant extracts, fruits and vegetables are well documented [1-9], [20-25]. Thirty (30) plants aqueous extracts were investigated for their antioxidant properties via several methods such as DPPH, ABTS radical scavenging capacity assay, Oxygen Radical Absorbance Capacity (ORAC) assay, Superoxide Dismutase (SOD) assay, and Ferric Reducing Antioxidant Potential (FRAP) [20]. In addition, the Total phenolic content was determined by the Folin-Ciocalteu Method (FCM). Results showed that oak (Quercus robur), pine (Pinus maritima), and cinnamon (Cinnamomum zeylanicum) aqueous extracts possessed the highest antioxidant activities and thus could be potential rich sources of natural antioxidants. A significant relationship existed between antioxidant capacity and total phenolic content, indicating that phenolic compounds are the major contributors to the antioxidant properties of these plants [20].

The antioxidant activities of the methanol extracts from the leaves and stems of Celtis africana (Ulmaceae) were assessed in an effort to validate the medicinal potential of the subtropical part of the herb. The antioxidant activity and phenolic contents of the stem as determined by the DPPH, proanthocyanidins, total phenols, the ferric reducing antioxidant potential (FRAP) assay, and Spectrophotometer method indicate that the antioxidant activity of the stem increases with increasing extraction time. The results from this study suggest that these plants could be potentially useful in the treatment of diseases associated with oxidative stress.

Figure 1: Some antioxidants isolated from plants.

![Antioxidants](image)

| Name of Plants | Family | Part used |
|----------------|--------|-----------|
| 1 Allium sativum Linn | Liliaceae | Bulb |
| 2 Asparagus racemosus Wild | Liliaceae | Shoot |
| 3 Baccharis cordifolia DC | Asteraceae | Aerial parts |
| 4 Bryonia alba Linn | Cucurbitaceae | Root |
| 5 Cichorium intybus Linn | Asteraceae | Leaf |
| 6 Cinnamomum zeylanicum Breyn | Lauraceae | Bark |
| 7 Crithmum maritimum Linn | Apiaceae | Essential Oil |
| 8 Cynara scolymus Linn | Asteraceae | Leaf |
| 9 Emilia sonchifolia DC | Asteraceae | Leaf |
| 10 Eucalyptus camaldulensis Dehnh. | Myrtaceae | Leaf |
| 11 Eucommia ulmoides Oliver | Eucommiaceae | Leaf |
| 12 Garcinia biloba Heckel | Clusiaceae | Leaf |
| 13 Ginkgo biloba Linn | Ginkgoaceae | Leaf |
| 14 Lavandula angustifolia Mill | Lamiaceae | Aerial parts |
| 15 Lycium barbarum Linn | Solanaceae | Fruit |
| 16 Melissa officinalis Linn | Lamiaceae | Aerial parts |
| 17 Marrubium vulgare Linn | Scrophulariaceae | Leaf |
| 18 Myrica gale Linn | Myricaceae | Fruit |
| 19 Panax ginseng Mey | Araliaceae | Root |
| 20 Picrorrhiza kurroa Roxb ex Benth | Scrophulariaceae | Rhizome, Root |
| 21 Piper nigrum Linn | Piperaceae | Fruit |
| 22 Plantago asiatica Linn | Plantaginaceae | Seed |
| 23 Prunus domestica Linn | Rosaceae | Fruit |
| 24 Rhinza stricta Decne | Apocynaceae | Leaf |
| 25 Rhamnus catharticus Linn | Rhamnaceae | Aerial parts |
| 26 Salvia officinalis Linn | Lamiaceae | Aerial parts |
| 27 Salvia tricipita Linn, F | Lamiaceae | Leaf |
| 28 Solanum melongena Linn | Solanaceae | Fruit |
| 29 Solanum tuberosum Linn | Solanaceae | Tuber |
| 30 Syzygium caryophyllatum (Linn) | Myrtaceae | Flower buds |
| 31 Tomato sylvestri M & Sm | Lamiaceae | Aerial parts |
| 32 Tylopus cordifolia (Wild) | Menispermaceae | Root |
| 33 Uncaria tomentosa DC | Rubiaceae | Bark |
| 34 Zinger officinalis Rosc | Zingiberaceae | Rhizome |

Table 1: Some medicinal plants with antioxidants activity.

| Botanical/Family | Common name | Part used |
|------------------|-------------|-----------|
| 1 Abrus precatorius (Leguminosae) | Crab eyes | Leaf and bark |
| 2 Caesalpinia decora (Leguminosae) | Turmeric | Leaf and bark |
| 3 Ceratonia siliqua (Fabaceae) | Carob | Seed |
| 4 Citrus aurantium (Rutaceae) | Bitter Orange | Leaf and fruit |
| 5 Curcuma longa Linn (Zingiberaceae) | Turmeric | Roots |
| 6 Diospyros kaki (Ebenaceae) | Mandarin Plum | Fruit |
| 7 Emblica officinalis (Gourun) | Bilberry | Leaf |
| 8 Ficus carica (Moraceae) | Fig | Leaf |
| 9 Ginkgo biloba Linn | Ginkgo | Leaf |
| 10 Indian jujube (Solanaceae) | Jujube | Root |
| 11 Jatropha curcas (Euphorbiaceae) | Castor | Seed |
| 12 Litchi chinensis (Litchi) | Dragon fruit | Fruit |
| 13 Longan (Dimocarpus longan) | Longan | Fruit |

Table 2: Antioxidant plant and chemical constituents.

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Three plant foods, namely, drumstick leaves (Moringa oleifera), mint leaves (Mentha spicata) and carrot tuber (Daucus carota) ethanolic extracts were analyzed for their antioxidant activity. The antioxidant activity of extracts was evaluated according to the amount of Malonaldehyde (MDA) formed by the FeSO₄-induced oxidation of linoleic acid and a high PUFA oil (sunflower oil) at 37 °C in Trizma-buffer (pH 7.4). The antioxidant activity of the extracts from mint leaves and carrot was higher at pH 9 than pH 4, while that of drumstick extract remained the same under both pH conditions [22].

The acidic methanolic extract of PA, induced the best conjugated diene formation inhibition percentage. For TEAC, the best antioxidant activity was generated from the acidic methanolic extract of HC [24].

Extracts from Brazilian plants, belonging to 16 species of 5 different families (71 extracts) were tested for their antioxidant activities. Ginkgo biloba and rutin, commonly used as antioxidants for medical purposes, were used as standards.

The ethanol extracts of plants belonging to the Verbenaceae family showed lower EC₅₀ values than the other plant extracts. It was found that the more polar partitions (ethyl acetate and n-butanol) are those that generally have higher antioxidant activity [25].

**Conclusion**

Plant extracts, fruits and vegetables have indeed shown to possess antioxidant activities. Research needs to be continued for the search of plant with interesting antioxidant effects. In addition, the isolation of known and unknown natural antioxidants will form the platform for novel drug discovery. In this regards, diverse rainforest tropical flora in Guyana, needs further herbal exploration and commercialization, in addition to their impetus for eco-tourism. Only a couple of reports on the isolation of natural products from two plants suspected to have antioxidant properties have been reported here. Apart from antioxidant drugs, new drugs such as anti-AIDS, anti-cancer, anti-diabetes, anti-arthritis and anti-alzheimers still awaiting discovery.

**References**

1. Jayathilakan K, Sharma GK, Rathakrishna K and Bawa AS. Antioxidant potential of synthetic and natural antioxidants and its effect on warmed-over-flavour in different species of meat (2007) Food Chem 105: 908-916.  
https://doi.org/10.1016/j.foodchem.2007.04.068

2. Halliwell B. How to characterize an antioxidant: an update (1905) Bioch Soc Sym 61: 85-91.  
https://doi.org/10.1042/bss0610073

3. Squadrito GL and Peyor WA. Oxidative Chemistry of nitric oxide: the role of superoxide, peroxynitrite, and carbon dioxide (1998) Free radicals Biol Med 25: 392-403.  
https://doi.org/10.1016/s0891-5849(98)00095-1

4. Yildirim A, Oktay M and Bilaloglu V.The antioxidant activity of the leaves of Cydonia vulgaris (2001) Turkish J Med Sci 31: 23-27.

5. Gulcin I, Oktay M, Kufrevioglu IO and Aslan A. Determination of antioxidant activity of lichen Cetraria islandica (L) (2002) Acht.J Ethnopharmacol 79: 325-329.  
https://doi.org/10.1016/s0378-8741(01)00396-8

6. Kourounakis AP, Galanakis D, and Tsiaikitzis K. Synthesis and pharmacological evaluation of novel derivatives of anti-inflammatory drugs with increased antioxidant and anti-inflammatory activities (1999) Drug Dev Res 47: 9-16.  
https://doi.org/10.1002/(sici)1098-2299(199905)47:1<9::aid-ddr2>3.0.co;2-9

7. Gulcin I, Buyukokuroglu ME, Oktay M and Kufrevioglu IO. On the in vitro antioxidant properties of melatonin (2002) J Pineal Res 33: 167-171.  
https://doi.org/10.1034/j.1600-079x.2002.20920.x

8. Gulcin I, Buyukokuroglu ME, M. Oktay and I.O. Kufrevioglu. Antioxidant and analgesic activities of turpentine of Pinus nigra Arn. Subsp. Pallissiana (Lamb) (2003) Holmboe J Ethnopharmacol 86: 51-58.  
https://doi.org/10.1016/j.epsl.2007.08.031(03)00036-9

9. Lu JM, Lin PH, Yao Q and Chen C. Chemical and molecular mechanisms of Antioxidants: Experimental approaches and model systems (2010) J Cell Mol Med (Berl) 14: 840-860.  
https://doi.org/10.1111/j.1582-4934.2009.00897.x
10. Jagessar RC and Mohamed N, Antimicrobial activity of selected plants extracts from Guyanas flora (2010) J Pure and Appl Microbio 4: 533-540.

11. Jagessar RC and Allen R. Antimicrobial Potency of the Aqueous Extract of leaves of Terminalia catappa (2011) Aca Res Int 362-371. https://doi.org/10.20959/wjpps20179-10010

12. Jagessar RC, Mars A, and Gomathiaygam S. Selective Antimicrobial properties of Leaf extract of Samanea Saman against Candida albicans, Staphylococcus aureus and Escherichia coli using several microbial techniques(2011) J American Sci 7: 108-119. http://dx.doi.org/10.13040/IJPSR.0975-8232.46(6).2114-20

13. Jagessar RC, Mars A, Gomes G, Leaf extract of Smilax schomburgkiana exhibit selective antimicrobial properties against pathogenic microorganisms (2009) Life Sci J 6: 76-83.

14. Jagessar RC, Mohammed A and Gomes G, An evaluation of the antibacterial and antifungal activity of leaf extracts of Momordica Charantia against Candida albicans, Staphylococcus aureus and Eschericia Coli (2008) J Nature and Sci 6: 1-14.

15. Jagessar RC, Rodrigues A, Prasad K, Husain A, Kanhai V et al., An investigation of the hypoglycemic effect of the aqueous extract of the fruits of Psidium Guajava, Averrhoa bilimbi and the peel of Tamarindus indica in normoglycemic guinea pigs( 2018) WJPPS 7: 77-101. https://doi.org/10.4172/2325-9604-C3-032

16. Jagessar RC, Ramchartar N and Spencer O. Fruits and Edible Plants, in Fruit and Pomace Extracts: Biological Activity, Potential Applications and Beneficial Health Effects (2015) Jason P. Owen (Ed) Nova Science Publisher, USA.

17. Jagessar RC, Hafeez, Chichester, Crepaul Y. Antimicrobial Activity of the Ethanolic and Aqueous Extract of Passion Fruit (Passiflora edulis Sims), in the absence and presence of Zn (OAc)2.H2O (2017) World J Pharm Pharmaceuti Sci 6: 230-246. https://doi.org/10.20959/wjpps20179-10010

18. Jagessar RC and Hope S. Antimicrobial Activity of the Uncombined and Combined Aqueous Extract of Phyllanthus Acidus, Sphagnoticola Trilobata Leaves and Dolichocarpus Dentatus Bark against Selective Pathogenic Microorganisms in the absence and presence of Zn2+ cations (2016) World J Pharm Pharmaceuti Sci 5: 58-71. http://DOI.org/10.4172/2325-9631-22-C2-029

19. Jagessar RC, Rodrigues A, Prashad K, Husain A, Kanhai V et al., (2018) An investigation of the hypoglycemetic effect of the aqueous extract of the fruits of Psidium Guajava, Averrhoa bilimbi and the peel of Tamarindus indica in normoglycemic guinea pigs (2018) World J Pharm Pharmaceuti Sci 7: 77-101. 10.4172/2325-9604-C3-032

20. Dudonné S., Vitrac X, Coutière P, Woillez M and Mérillon JM. Comparative Study of Antioxidant Properties and Total Phenolic Content of 30 Plant Extracts of Industrial Interest Using DPPH, ABTS, FRAP, SOD, and ORAC Assays (2009) J. Agric. Food Chem 57: 1768-1774. https://doi.org/10.1021/jf803011r

21. Adedapo AA, Jimoh FO, Afolayan AJ and Masika PJ. Antioxidant Properties of the Methanol Extracts of the Leaves and Stems of Celtis Africana (2009) Rec Nat Prod 3: 23-31.

22. Arabshahi DS, Devi DV and Urooj A. Evaluation of antioxidant activity of some plant extracts and their heat, pH and storage stability (2007). Food Chem 100: 1100-1105. https://doi.org/10.1016/j.foodchem.2005.11.014

23. Kalkönen MP, Hoijka AJ, Vuorela HJ, Rauha JP, Pihlaja K et al., Antioxidant Activity of Plant Extracts Containing Phenolic Compounds (1999). 47: 3954–3962. https://doi.org/10.1021/jf990146l

24. Lin KH, Yang YY, Yang CM, Huang MY, Lo HF, Liu KC, Lin HS, Chao PY. Antioxidant activity of herbaceous plant extracts protect against hydrogenperoxide-induced DNA damage in human lymphocytes (2013). BMC Res Notes 6: 490. https://doi.org/10.1186/1756-0500-6-490

25. Luciana L, Mensor FS, Menezes GG, Leitão AS, Reis T C et al., Screening of Brazilian plant extracts for antioxidant activity by the use of DPPH free radical method (2001) 15: 127-130. https://doi.org/10.1002/ptr.687.