HERBAL REMEDIES AS ANTIOXIDANTS: AN OVERVIEW

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Abstracts
The primary cause of degenerative disease is not due to damaging free radicals, but rather it is due to the requirement of highly ordered cell biochemistry becoming disordered due to insufficient cellular energy to maintain the normal state of order. There is a complex defense system in the body, in which vitamins, minerals, amino acids and certain enzymes play a central role called the antioxidant system. Antioxidants are weapons for combating free radicals and mop up damaging chemicals in the body and guard against many chronic diseases. Heart disease, arthritis, cancer and many other common chronic diseases derive from the same source: fortuitous mutations caused largely by free radicals. Under optimum conditions, cells are protected against free radicals and lipid per oxidation. Antioxidants are substances, which react chemically with free radicals and render them harmless and at the same time break the vicious circle, which involves the decomposition of fatty acids & proteins, the creation of new free radicals and eventual cell death. Because free radical damage accumulates with age, people should start supplementing with antioxidants early to achieve long-term benefits. The scientific community has begun to unveil some of the mysteries surrounding this topic, and the media has begun whetting our thirst for knowledge.

Keywords: Antioxidant; Vitamin C; Vitamin E

1. Introduction
Athletes have a keen interest because of health concerns and the prospect of enhanced performance and/or recovery from injury due to exercise. The purpose of this article is to serve as a beginner’s guide to what antioxidants are and to briefly review their role in exercise and general health. Traditional knowledge of medicinal plants has always guided the search for cures. In traditional drugs due to presence of antioxidants, property them contributing in cures of many diseases. The human body posses innate defense mechanisms to counter free radicals in the form of enzymes such as superoxide dismutase, catalase, and glutathione peroxide. Vitamin C, vitamin E, selenium, β-carotene, lycopene, lutin and other carotinoids have been used as supplementary antioxidantsplants secondary metabolites such as flavonoids and terpenoids play an important role in the defence against free radicals. list of Plants produces large amount of antioxidants to prevent the oxidative stress, they represent a potential source of new compounds with antioxidant.

1.1 Antioxidant
Role of Antioxidants: An antioxidant is a chemical that prevents the oxidation of other chemicals. They protect key cell components by neutralizing the damaging effects of free radicals. Major source of antioxidants is traditional herbs which are taken by human in life. In a normal cell, there are appropriate oxidant : antioxidant balance can be sifled, when production of oxygen species is increased or when levels of antioxidants are diminished This state is called oxidative stress.
To counter the harmful effects of free radicals like Reactive oxygen species (ROS) and Reactive nitrogen species (RNS), antioxidant defense mechanism operates to detoxify or scavenge these ROS and RNS. Antioxidants, together with the substances that are capable of either reducing Reactive Oxygen Molecules (ROMs) or preventing their formation, from a powerful reducing buffer and affects the ability of the oxygen metabolites. All reducing agents, thereby form protective mechanisms, which maintain the lowest possible level of ROMs in the cell.
Antioxidant defense system against oxidative stress is composed of several lines, and the antioxidants are classified into four categories based on function as follows:\(^5\):

- **First line of defense** is the preventive antioxidants, which suppress formation of free radical (enzymes such as glutathione peroxidase, catalase, superoxide dismutase: carotenoids, selenoprotein, lactoferrin, etc.)
- **Second line of defense** is the radical scavenging antioxidants suppressing chain initiation and/or breaking chain propagation reactions, i.e., radical scavenging antioxidants.
- **Third category antioxidants** are repair and denovo antioxidants (some production enzymes, repair enzymes of DNA, etc.)
- **Fourth line** is an adaptation where the signal for production and reactions of free radicals induces formation and transport of the appropriate antioxidant to the right site.

Antioxidants act as radical scavenger, hydrogen donors, electron donor, peroxide decomposer, singlet oxygen quencher, enzyme inhibitor, synergist and metal-chelating agents.

### Table 1: Different types of free radicals and their defense system\(^5\)

| Type of Free Radical or Oxidants | Defense System                     |
|---------------------------------|-----------------------------------|
| Superoxide anion (O\(^2\))     | Superoxide dismutases             |
| Hydroxyl radical (OH)           | (SOD), Mn-SOD, Cu-Zn-SOD          |
| Peroxy radical(ROO)             | Tocopherols, Ubiquinone           |
| Singlet oxygen (\(\text{O}_2\)) | Carotenoids                       |
| Hydrogen peroxide (H\(_2\)O\(_2\)) | CATALASE, Seglutathione peroxide(GPx) |
| Hydroperoxides (HOO)            | GPx, Glutathione reductase        |
| Transition metals (Fe\(^{3+},\text{Cu}^{+}\)) | Chelators                        |

Both enzymatic and nonenzymatic antioxidants exist in the intracellular and extracellular environment to detoxify ROS.

#### 1.2 Enzymatic Antioxidants:\(^7,8\)

The first lines of defense against \(O_2\) and \(H_2O_2\) mediated injury are antioxidant enzymes like SOD, GPx, and CAT.

- **Superoxide dismutase (SOD):** Superoxide dismutase (SOS) is a family of metallo-enzymes that convert \(O_2\) and \(H_2O_2\) by the reaction:
  \[
  O_2 + O_2 \rightarrow H_2O_2 + O_2
  \]
  It is considered to be stress protein, which is synthesized in response to oxidative stress. SOD is the most important enzyme as it is found in all aerobic organisms and is also present in mitochondria & cytosol. There are four families of SODs: Cu-SOD, Cu-Zn-SOD, Mn-SOD and Fe-SOD enzyme and has been detected in a large number of tissues and organism, and is thought that it is present to protect the cell from damage caused by \(O_2\).

Increased plasma level of SOD has been reported in various diseases. Breast cancer patients have been reported to possess increased levels of plasma copper and zinc. Thus, increased production of SOD in various genetic diseases may be in response of higher production of free radicals in those diseases.

- **Glutathione peroxidase (GPx):** Glutathione peroxidase (GPx) is a selenium containing enzyme, which catalyses the reduction of \(H_2O_2\) and lipid hydroperoxide \((LO_2H)\), generated during lipid peroxidation, to water using reduced glutathione as substrate. It is found in both cytosol and mitochondria and is a well-known first line of defense against oxidative stress, which in turn requires glutathione as a cofactor. It is involved in the generation of nucleotide precursors of DNA via the reduction of ribonucleotides to deoxyribonucleotides. GPx catalyses the oxidation of Reduced Glutathione (GSH) to Oxidized Glutathione (GSSG) at the expense of \(H_2O_2\), by its selenium dependency. Since, selenium is an integral component of GOx, the measurement of this enzyme has been used as a functional index of selenium level.

Low levels of selenium have been associated with a high risk of cardiovascular diseases and cancer in humans. Plasma GPx activity was found to be significantly elevated with respect to the controls in breast cancer patients. The reason of higher GPx activity in breast cancer patients may be in response to higher production of ROMs.

- **Catalase (CAT):** Catalase (CAT) is present in most cells and catalyses the decomposition of hydrogen peroxide to water and oxygen. The mechanism of action is as follows:
  \[
  2H_2O_2 \rightarrow 2H_2O + O_2
  \]
CAT is found to act 104 times faster than peroxidase and is mainly localized in mitochondria and in subcellular respiratory organelles. CAT is found to be important in the inactivation of many environmental mutagens. Plasmid DNA strand scission causes by xanthine/xanthine oxidase (XO) has been reported to be prevented by both SOD and CAT enzymes. It also has a role in preventing chromosomal accompanied by significant...
increase in IL-2, which correlated with increased lymphocyte production. By using parenteral nutrition with w-3 fatty acids, following haemorrhagic shock, it was possible to prevent an increase in the release of PGE2, and maintain normal defensive functions of splenocytes and macrophages. A rise in IL-2, as well as maintenance of postoperative interferon-production could be shown for surgical patients on parenteral w-3 fatty acids nutrition. These results indicated the positive influence of parenterally administering w-3 fatty acids to weakened post-operative and post-traumatic defensive functions. An animal experiment on rabbits even showed that intravenous administration of 1.5gm fish oil per kg body weight per day increased the elimination of bacteria from blood, in comparison with soyabean oil.

Some internally generated sources of free radicals are:
- Mitochondria
- Phagocytosis
- Xanthene oxidase
- Inflammation
- Arachidionate pathways
- Exercise
- Ischemia/Reperfusion injury

Some externally generated sources of free radicals are:
- Cigarette smoke
- Radiation
- Industrial solvent
- Environmental pollutants
- Certain drugs and pesticides
- Ozone

The free radical diseases: Oxidative Or free radical injury is a fundamental mechanism of human diseases. Increasing evidence suggests that such injury is important in the pathogenesis of a diverse group of neurological disorders (Ebadi, 2001). Various diseases/disorders linked to free radical and reactive oxygen species were listed in table 1.

### Table 2: Major diseases/disorders linked to free radicals

| Disease                         | Free radical injury                                                                 |
|---------------------------------|--------------------------------------------------------------------------------------|
| Aging                           | Kidney diseases                                                                      |
| Cancer                          | Liver diseases                                                                       |
| Cardiac myopathy                | Lung diseases                                                                        |
| Cataract                        | Neurodegenerative diseases                                                            |
| Chronic granulomatous diseases  | Nutritional deficiencies                                                              |
| Diabetes mellitus               | Radiation injury                                                                     |
| Immune system disorders         | Skin disorders                                                                       |
| Ischemia/reperfusion injury     | Toxic states (xenobiotics, metal toxicity)                                            |

### Table 3: Central nervous system disorders associated with reactive oxygen species

| Disease                         | Disorder                                      |
|---------------------------------|-----------------------------------------------|
| Amyotrophic lateral sclerosis   | Multiple sclerosis                            |
| Alzheimer diseases              | Parkinson diseases                            |
| Downs syndrome                  |                                               |

Counteracting free radical damage: The human body has mechanisms to counteract damage by free radicals and other oxygen species. These act on different oxidants as well as in different cellular components. Various antioxidant defenses were listed in table

### Table 4: Natural antioxidant defenses

| Antioxidant enzymes | Antioxidants                  | Metal binding proteins |
|---------------------|------------------------------|------------------------|
| SOD                 | Vitamin C, E                 | Albumin                |
| Glutathione         | Carotenoids (β-carotene, lycopene, etc) | Ceruloplasmin          |
| Catalase            | Thiols, Bilirubin             | Haptoglobin            |
| Flavonoids          | Ubiquinol                    | Metallothionein        |
| Uric acid           | Trasferrin                   |                        |

Food rich in antioxidants: Antioxidants are abundant in fruits and vegetables as well as in nuts, grains and some meats, poultry and fish. The list below describes food sources of some antioxidants:
- Beta-carotenes is found in many foods that are orange in color, including sweet potatoes, carrots, cantaloupe, squash, apricots, pumpkin, and mangoes. Some green leafy vegetables including collard greens, spinach, and kale are also rich in beta-carotene.
- Lutein, better known for its association with healthy eyes, is abundant in green, leafy vegetables such as collard green, spinach, and kale.
- Lycopene is a potent antioxidant found in tomatoes, watermelon, guava, papaya, apricots, pink grapefruits, etc. Estimates suggest that 85% of American dietary intake of lycopene comes from tomatoes and tomatoes products.
- Selenium is a mineral but not an antioxidant nutrient. However, it is a component of antioxidant enzymes. Plants like rice and wheat are the major dietary source of selenium in most countries. The amount of selenium in soils, which varies by region, determines the amounts of selenium in the food grown in the soil.
- Animals the eat grains or plants grown in selenium-rich soil have higher levels of selenium in their muscle. In the United states, meat and bread are common sources of selenium.
sources of dietary selenium while brazil nuts also contain large quantities of selenium’s. **Vitamins A** is found in three main forms: retinol (vitamin A), 3,4-didehydroretinol (vitamins A2), and 3-hydroxyretinol (vitamins A3). Food rich in vitamin A include liver, sweet potatoes, carrots, like, egg yolk and mozzarella cheese.

**Vitamin C** or ascorbic acid can be found in high abundance in many fruits and vegetables and is also found in cereals, leafy vegetables, nuts, broccoli and other foods.

1.3 Plants Having Antioxidant Activity

**Table 5: List of Medicinal Plants Shown to Have Antioxidant Activity**

| Plant Name            | Part Used          | Method of Screening                  | Mechanism of action                  |
|-----------------------|--------------------|--------------------------------------|--------------------------------------|
| Acacia catechu        | Bark               | DPPH assay                           | Free Radical Scavenger               |
| Acanthus ilicifolius  | Leaves             | SOD, Hydroxy radical and lipid peroxidation assays | Free radical scavenger |
| Achyranthes aspera    | Whole plant        | DPPH assay                           | Free radical scavenger, scavenger, inhibition of lipid peroxidation |
| Aconitum heterophylum | Bark               | DPPH assay                           | Free radical scavenger               |
| Acorus calamus        | Rhizomes           | DPPH assay                           | Free Radical Scavenger               |
| Alchornea laxifolia   | Roots & leaves     | Thiocyanate method                   | Free Radical Scavenger               |
| Allium sativum        | Aerial parts, Roots | MDA, SOD, GSH Hydroxy radical assay  | Inhibits lipid peroxidation          |
| Allium visnale        | Aerial parts       | MDS, SOD, Hydroxy radical assay      | Free radical scavenger               |
| Aloe vera             | Leaf gel           | Hemolysis of RBC                     | Free radical scavenger               |
| Alpinia sp.           | Roots & Rhizomes   | Thiocyanate assay                    | Inhibits lipid peroxidation          |
| Anethum sowa Roxh.    | Seed               | DPPH assay                           | Free radical scavenger               |
| Anthriscus            | Std Extracts       | DPPH, lipid peroxidation assays      | Free radical scavenger, inhibition of lipid peroxidation |
| Artemisia abyssinica  | Essential oil      | DDPH, Lipid peroxidation assays      | Free radical scavenger               |
| Argemone mexicana     | Leaves             | DPPH assay                           | Free Radical Scavenger               |
| Aristolochia bracteata| Leaf, Stem, Pod    | DPPH assay                           | Free radical scavenger               |
| Artimisia afr.        | Essential oil      | DDPH, Lipid peroxidation assays      | Free radical scavenger               |
| Artimisia apiacea     | Entire plant       | MDA, SOD, GSH, TBA assay             | Free radical scavenger               |
| Artimisia arborescens | Aerial parts       | Oxidation of linoleic acid           | Free Radical Scavenger               |
| Asparagus recemousious| Roots              | SOD, TBARS assay                     | Membrane Protective                  |
| Azadirachta indica    | Stem bark          | Hemolysis of RBC                     | Inhibit lipid peroxidation           |
| Baccharis cordifolia  | Entire plant       | Hydroperoxide, TBARS assay           | Free radical scavenger               |
| Bacopa monniera       | Stem, Leaves       | SOD, CAT, GPX activity               | Free Radical Scavenger               |
| Ballota acetabulosa   | Aerial parts       | TBA Assay                            | Free Radical Scavenger               |
| Ballota pseudodictamus| Aerial parts       | TBA Assay                            | Free Radical Scavenger               |
| Boehmeria nivea       | Entire plant       | Lipid peroxidation assay             | Free radical scavenger               |
| Bombax malabaricum    | Gum                | DPPH assay                           | Free radical scavenger               |
| Brassica hancei       | Entire plant       | Hemolysis of RBC, SOD assay          | Free Radical Scavenger               |
| Brassica juncea       | Leaves             | DPPH, TBA assay                      | Free Radical Scavenger               |
| Burkea Africana       | Bark               | DPPH assay                           | Free Radical Scavenger, lipoxigenase inhibitor |
| Caesalpinia sappan    | Heart Wood         | DPPH assay                           | Free radical scavenger               |
| Calamintha gladulosa  | Entire plant       | Hydroxy radical assay                | Free radical scavenger               |
| Cassia auriculata     | Leaf, Flower       | DPPH assay                           | Free radical scavenger               |
| Cassia fistula        | Pod                | DPPH assay                           | Free radical scavenger               |
| Cassia tora           | Seed               | DPPH assay                           | Free radical scavenger               |
| Calycotome villosa    | Aerial parts       | Oxidation of linoleic acid           | Free radical scavenger               |
| Centaurea calcitrapa  | Whorls             | DPPH assay                           | Free Radical Scavenger, inhibition of lipid peroxidation |
| Centella asiatica     | Entire plant       | MDA, GSH, SOD, assays                | Inhibition of lipid peroxidation     |
| Cetraria islandica    | Lichen             | Thiocyanate, SOD, DPPH, methods      | Free radical scavenger               |
| Cinnamomum cassia     | Bark               | Anti-lipid peroxidation, SOD assay   | Free radical scavenger               |
| Commicarpus chinensis | Leaf               | DPPH radical scavenging activity     | Free radical scavenger               |
| Commophora mukul      | Guggulipid         | Lipid peroxidation assay             | Inhibition of lipid peroxidation     |
| Coriandrum sativum    | Seed               | DPPH assay                           | Free Radical Scavenger               |
| Corius stolonifera    | Entire plant       | DPPH, XO assay                       | Free radical scavenger               |
| Scientific Name               | Part Used                       | Assays/Protein Assayed                                      | Activity                                                                 |
|------------------------------|--------------------------------|-------------------------------------------------------------|--------------------------------------------------------------------------|
| *Coscinium fenestratum*      | Stem                           | TBARS, SOD, CAT, GSH, GPX & GST assay                       | Free radical scavenger, inhibition lipid peroxidation^8                   |
| *Costus discolor*            | Roots & Rhizomes               | Thiocyanate assay                                           | Inhibits lipid peroxidation^8                                             |
| *Cucurbita reflexum*         | Leaves                         | DPPH, lipid peroxidation assays                             | Free radical scavenging                                                  |
| *Cuminum cyminum*            | Seed                           | DPPH assay                                                 | Free radical scavenger                                                   |
| *Cynara longa*               | Rhizome                        | Lipid peroxidation assay                                   | Inhibition of lipid peroxidation^7                                       |
| *Daphne gnidium*             | Leaves                         | Oxidation of linoleic acid                                  | Free Radical Scavenger                                                   |
| *Dendrophthoe falcata*       | Leaves & roots                 | DPPH, Lipid peroxidation assays                             | Free radical scavenger                                                   |
| *Diopyros kaki*              | Entire plant                   | DPPH assay                                                 | Free radical scavenger                                                   |
| *Emilia sonchifolia*         | Fruits                         | SOD, CAT, GPX assays                                       | Free radical scavenger                                                   |
| *Eucalyptus globulus*        | Leaves                         | TBARS, SOD, hydroxy radical assay                           | Free radical scavenger                                                   |
| *Fagopyrum esculentum*       | Seeds                          | Peroxide radical, SOD assays                               | Free radical scavenger                                                   |
| *Ficus bengalensis*          | Bark                           | DPPH assay                                                 | Free radical scavenger                                                   |
| *Foeniculum vulgare*         | Seed                           | DPPH assay                                                 | Free radical scavenger                                                   |
| *Garcinia atroviridis*       | Root, Leaves, Trunk, Stem Bark | Thiocyanate, TBA assay                                     | Free radical scavenger                                                   |
| *Gaultheria shallon*         | Fruits                         | DPPH, assay                                                | Free radical scavenger                                                   |
| *Ginkgo biloba*              | Standardized extract           | TBARS, SOD assays                                          | Inhibition of lipid peroxidation^8                                        |
| *Ginkgo biloba*              | Leaves                         | DPPH, assay                                                | Free Radical Scavenger                                                   |
| *Glycyrriza glabra*          | Roots                           | DPPH, TBARS assays                                         | Free radical scavenger                                                   |
| *Gomronema latifolium*       | Leaves                         | SOD, GSH assays                                            | Inhibition of lipid peroxidation^8                                        |
| *Guiera senegalensis*        | Galls                          | DPPH assay                                                 | Free radical scavenger                                                   |
| *Gymnema sylvestre*          | Leaf                           | DPPH assay                                                 | Free radical scavenger                                                   |
| *Helichrysum arenarium*      | Flowers                        | DPPH, Hydroxy radical assay                                 | Free radical scavenger                                                   |
| *Hemidesmus indicus*         | Entire plant                   | XO, Hydroperoxide, activity                                | Inhibits lipid peroxidation^5                                              |
| *Hippophae rhamnoides*       | Leaves                         | GSH assay                                                  | Free radical scavenger                                                   |
| *Holarrhena antidysenterica* | Fruit                          | DPPH assay                                                 | Free radical scavenger                                                   |
| *Hypericum empetroilum*      | Aerial parts                   | TBA assay                                                  | Free radical scavenger                                                   |
| *Hypericum patulum*          | Whole plant                    | DPPH, Lipid peroxidation assays                             | Free radical scavenger, inhibition of lipid peroxidation^7                |
| *Hypericum perforatum*       | Shoots                         | SOD, hydroxy radical assay                                 | Free radical scavenger                                                   |
| *Hypericum rumeliacum*       | Aerial parts                   | TBA assay                                                  | Free radical scavenger                                                   |
| *Hypericum triquestrifolium* | Aerial parts                   | DPPH, TBA assays                                           | Inhibition of lipid peroxidation^8                                        |
| *Hypericum triquestrifolium* | Aerial parts                   | TBA assay                                                  | Free radical scavenger                                                   |
| *Liberis amara*              | Seeds                          | DPPH, assay                                                | Free radical scavenger                                                   |
| *Lagonis pacuari*            | Sperm bark                     | DPPH, XO assays                                            | Free radical scavenger                                                   |
| *Laminaria japonica*         | Entire plant                   | DPPH assay                                                 | Free radical scavenger                                                   |
| *Leopoldia comosa*           | Bulbs                          | DPPH assay                                                 | Free radical scavenger, inhibition of lipid peroxidation^6                |
| *Licania liciaeflore*        | Leaves                         | DPPH assay                                                 | Free radical scavenger                                                   |
| *Ligustrum lucidum*          | Fruits                         | Hemolysis of RBC                                           | Free radical scavenger                                                   |
| *Mangifera indica*           | Leaves, bark                   | Lipid peroxidation assay                                   | Free radical scavenger                                                   |
| *Mentha aquatica*            | Essential oil                  | DPPH and Hydroxy radical assays                            | Free radical scavenger                                                   |
| *Mentha longifolia*          | Essential oil                  | DPPH and Hydroxy radical assays                            | Free radical scavenger                                                   |
| *Micromeria graeca*          | Entire plant                   | Hydroxy radical assay                                      | Free radical scavenger                                                   |
| *Monordica charantia*        | Fruits                         | DPPH assay                                                 | Free radical scavenger                                                   |
| *Mucuna pruriens*            | Seeds                          | TBARS, GSH, SOD, Lipid peroxidation assays                 | Free radical scavenger                                                   |
| *Murraya Koenigi*            | Leaves                         | SOD, CAT, GSH, GPX, GST, G-6 PDH, MDA assay                | Free Radical Scavenger                                                   |
| *Myrestica fragrance*        | Seed                           | DPPH assay                                                 | Free radical scavenger                                                   |
| *Nigella sativa*             | Essential oil                  | DPPH, lipid peroxidation assay                             | Free radical scavenger                                                   |
| * Ocimum kilimandscharicum*  | Aerial parts                   | DPPH, Lipid peroxidation assays                            | Free radical scavenger, inhibition of lipid peroxidation^7                |
| *Ocimum sanctum*             | Leaves                         | Lipid peroxidation assay                                   | Free radical scavenger, membrane protection^7                            |
| Plant Name          | Part Used          | Assay/Activity Details                                                                 | Free Radical Scavenger/Inhibition of Lipid Peroxidation |
|---------------------|--------------------|----------------------------------------------------------------------------------------|--------------------------------------------------------|
| Olea Europeans      | Entire plant       | Hydroxy radical, TBARS assay                                                           | Free radical scavenger/Inhibition of lipid peroxidation |
| Origanum dictamnus  | Aerial parts       | TBA Assay                                                                              | Free Radical scavenger                                |
| Origanum heracleosicum | Flowering tops       | DPPH, assay                                                                           | Free Radical Scavenger, inhibition of lipid peroxidation |
| Osbeckia aspera     | Leaves             | DPPH, XO, TBA assays                                                                  | Free radical scavenger                                |
| Panax ginseng       | Entire plant       | SOD, Hydroxyl radical assays                                                           | Free radical scavenger                                |
| Paulinia cupana     | Entire plant       | Lipid peroxidation assay                                                               | Inhibits lipid peroxidation                            |
| Phellinus rimosus   | Wood inhabiting fungus | Lipid peroxidation assay                                                              | Free radical scavenger                                |
| Phlomis lanate      | Aerial parts       | TBA Assay                                                                              | Free radical scavenger                                |
| Phyllanthus emclia  | Fruits             | MDA, SOD assays                                                                        | Free radical scavenger                                |
| Pinus nigra Subli.  | Turpentine exudes  | Thiocyanate, DPPH, SOD, CAT assays                                                    | Free radical scavenger                                |
| Piper betle         | Leaves             | TBARS, SOD, CAT assays                                                                 | Free radical scavenger, Inhibition of lipid peroxidation |
| Podocarpus digitata | Roots, Stem, Leaves | TBA, DPPH, XO, Metal ion chelating assays                                              | Free radical scavenger, Metal ion chelating activities |
| Podocarpus tomentosa | Roots, Stem, Leaves | TBA, DPPH, XO, Metal ion chelating assays                                              | Free radical scavenger                                |
| Picea abies         | Entire plant       | DPPH, XO assays                                                                        | Free radical scavenger                                |
| Quercus alba        | Stem               | DPPH, SOD, Hydroxy radical assays                                                      | Free radical scavenger                                |
| Sinomenium acutum   | Rhizome            | GSH, Lipid peroxidation assays                                                          | Free radical scavenger                                |
| Sophora japonica    | Seeds              | DPPH, Lipid peroxidation assays                                                        | Free radical scavenger, Inhibition of lipid peroxidation |
| Spartium junceum    | Flowers            | SOD, activity                                                                          | Free radical scavenger                                |
| Stachys spruneri    | Aerial parts       | TBA Assay                                                                              | Free radical scavenger                                |
| Swertia chirata     | Aerial parts       | Lipid peroxidation assays                                                               | Free radical scavenger                                |
| Syzygium cumini     | Fruits             | DPPH, assay                                                                            | Free radical scavenger                                |
| Tamarix ramosissima | Entire plant       | DPPH                                                                                   | Free radical scavenger                                |
| Terminalia arjuna   | Bark               | DPPH, Lipid peroxidation assays                                                        | Free radical scavenger, Inhibition of lipid peroxidation |
| Terminalia bellerica| Bark               | DPPH, Lipid peroxidation assays                                                        | Free radical scavenger, Inhibition of lipid peroxidation |
| Tetracera loureiri  | Entire plant       | DPPH, assay                                                                            | Free radical scavenger                                |
| Teucrium polium     | Entire plant       | Hydroxy radical assay                                                                  | Free radical scavenger                                |
| Tinospora cordifolia| Root               | TBARS, GSH, CAT, SOD assays                                                            | Free radical scavenger, Inhibition of lipid peroxidation |
| Tordylium apulum    | Whorls              | DPPH assay                                                                             | Inhibition of lipid peroxidation                       |
| Uncaria tomentosa   | Entire plant       | TBARS, Hydro peroxide assays                                                           | Free radical scavenger                                |
| Undaria pinnatifida | Entire plant       | DPPH assay                                                                             | Free radical scavenger                                |
| Ursica dioica       | Leaves              | DPPH assay                                                                             | Inhibition of lipid peroxidation                       |
| Vaccinium myrtillus | Anthocyanodi extract | Lipid peroxidation, SOD assays                                                        | Free radical scavenger, Inhibition of lipid peroxidation |
| Valeriana officinalis | Root              | DPPH assay                                                                             | Free radical scavenger                                |
| Vitex negundo       | Leaf               | DPPH assay                                                                             | Free radical scavenger                                |
Conclusions
Currently there has been an increased interest globally to identify antioxidant compounds from plant sources which are pharmacologically potent and have low or no side effects for use in protective medicine and the food industry. Modern civilization, use of different chemicals, pesticides, pollutants, smoking and alcohol intake and even some of synthetic medicine increases the chance of disease due to free radicals. Plants produces large amount of antioxidants to prevent the oxidative stress, they represent a potential source of new compounds with antioxidant activity. More or less the free radicals plays a role in health of modern era and the diseases caused from free radical are becoming a part of normal life. Increasing knowledge in antioxidant phytoconstituents and include them in daily uses and diet can give sufficient support to human body to fight those diseases. Phytoconstituents and herbal medicine are also important to manage pathological conditions of those diseases caused by free radicals. Explore the antioxidant principles from natural resources; identification and isolation of those phytoconstituents are simultaneously presenting enormous scope for their better therapeutic application for treatment of human disease. Therefore it is time for us, to explore and identify our traditional therapeutic knowledge and plant sources and interpret it according to the recent advancements to fight against oxidative stress, in order to give it a deserving place. Science herbs are considered to have less or no toxic effects would be the best alternative methods when the normal level of antioxidant defense mechanism fails. Many herbal antioxidants are used in the form of nutraceutical products.

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