Antioxidant property of herbal formulation

Vaishnavi Sanjay Bhandawalkar[1], Dipali Manojkumar patil[2], Dhanashri Jagan Jagtap[3]

Abstract: ***The in vitro antioxidant potential of Triphala and its constituents was tested with the following systems: radical scavenging activity measured by DPPH reduction, and superoxide radical and peroxy radical scavenging properties measured by riboflavin/light/NBT reduction and linoleic acid peroxidation, respectively. Alcohol extracts of Triphala and its constituents were studied comparatively and found to be strong anti-oxidants. Triphala was also effective in preventing superoxide-induced haemolysis of red blood cells. The extracts also prevented lipid peroxidation induced by*** Fe^{3+}***/ADP/Ascorbate system in rat liver mitochondria. The major phenolic compounds of the alcohol extracts were confirmed as tannins.***

Keywords:

- ***Antioxidants***
- ***DPPH***
- ***peroxyradical***
- ***Clove***
- ***Portulaca***

INTRODUCTION

Free radical reactions have been implicated in the pathology of many human diseases including atherosclerosis, ischemic heart disease, ageing process, inflammation, diabetes, immunodepression, neurodegenerative condition and other disease conditions (Maxwell, 1995). These free radicals, which are atoms or molecules with an unpaired electron, are capable of reversibly or irreversibly damaging compounds of all biochemical classes, including nucleic acids, proteins and free amino acids, lipids and lipoproteins, carbohydrates and connective tissue macromolecules (Hemnani and Parihar, 1998).

Drugs with multiple mechanisms of protective action, including antioxidant properties, may be one way forward in minimising tissue injury in human disease (Barry, 1991). A number of plants have been reported to possess antioxidant effects. The antioxidant properties of *Bacopa monnieri* (Bhattacharya et al., 2000, Tripathi et al., 1996), *Emblica officinalis* (Bhattacharya et al., 1999, Mathur et al., 1996), *Glycyrrhiza glabra* (Hatano et al., 1991), *Mangifera indica* (Ghosal et al., 1996) and *Syzygium aromaticum* (Deans et al., 1995) were earlier investigated and were found to possess free radical scavenging property. Some of the ingredients were also found to produce significant induction in the levels of various endogenous antioxidant enzymes.

CLOVE

Clove (*Syzygium aromaticum)*, from the *Myrtaceae* family, is one of the most effective antimicrobial and antioxidant herbs. This herb is one of the traditional herbs primarily local to Asia and Africa. Based on the bioactive components of clove such as eugenol, eugenyl acetate, α-humulene, 2-heptanone, and β-caryophyllene, it can display many pharmacological activities such as antimicrobial, antioxidant, anti-inflammatory, antimutagenic, anticancer, and anti-allergic properties. These bioactive components allow clove to demonstrate one of the highest potent antioxidant activities among other herbal medicines. Previous studies have reported the sufficient antibacterial property of clove extract and oil against different strains of bacteria (Gram-positive and Gram-negative) [39,72]. Other researchers have shown that clove has antimicrobial activity against many bacteria including *Listeria monocytogenes*, *Klebsiella pneumoniae*, *S. aureus*, *E. coli* and *S. Typhimurium* [73,74,75]. Clove based on eugenol plays an antimicrobial role. The antimicrobial mechanism of action of eugenol is that, at first, the eugenol molecule with high solubility can participate in the cytoplasmic membrane. Then, it creates disturbance as a consequence of its OH group. Finally, it can pass through the hydrophilic proportion of the cell. After that, the OH group of eugenol can bind to proteins of the membrane of bacteria and can permeate the fundamental cell components [76,77]. Clove extract with various amounts (1 and 3 mg mL^{-1}) have been demonstrated to experience a great antimicrobial impact on *S. typhi* and *E. coli* [72]. Clove has strong antioxidant effects that can naturalize ROS and other free radicals in lipid chains. Therefore, they inhibit further oxidation of lipids [78]. Researchers have also observed that clove's extract could inhibit the malondialdehyde formation from horse blood plasma

oxidation [79]. Other researchers have reported the maximum antioxidant activity of clove against DPPH (2, 2-diphenyl-1-picryl hydracyl), than BHA (butylated hydroxyanisole), and BHT (butylated hydroxytoluene) radicals [80]. Similarly, the result of one research has shown the antioxidant activity of eugenol of clove extract against DPPH, ABTS and superoxide radicals [81]. Other studies have reported strong antioxidant activity of this herb against DPPH when compared to vitamin C [82]. The antiviral activity of this plant has been reported against different viruses such as herpes adenovirus, poliovirus, and coxsackievirus [83]. The high antioxidant activity of clove's extract and essential oil is related to the chemical content of this herb, like a phenolic compound.

PORTULACA

Portulaca is one of the traditional herbs from Asia. It has been reported to have potent antimicrobial and antioxidant activity. Several researchers have declared the biomedicine activities of portulaca over the past decades. The antioxidant effects of portulaca are the main factor of the biomedicine activity of this plant. Therefore, this plant can naturalize free radicals such as ROS in lipid chains. Hence, it can inhibit the further oxidation of lipids [40]. The antioxidant and antimicrobial property of portulaca is related to its components such as ascorbic acid, a-tocopherols, omega-3 fatty acids, apigenin, gallotannins, quercetin, and kaempferol. The antioxidant activity of portulaca is primarily related to omega-3 fatty acids [40,41]. Previous studies have shown the antimicrobial effects of this plant against different bacteria and fungi [84]. Furthermore, the pectic polysaccharide of this plant has been shown to have high antiviral properties against spatial viruses such as simplex virus type II [85]. Portulaca can be shown antibacterial activity against different bacteria (Gram-positive and Gram-negative) such as *Pseudomonas aeruginosa*, *Neisseria gonorrhea*, *E. coli (Escherichia coli)*, *Streptococcus faecalis*, *Bacillus* and *S. aureus (Staphylococcus aureus)* [86,87]. Researchers in the last decade have found that portulaca's extracts demonstrate inhibitory ability against different bacteria (Gram-negative and Gram-positive). Other studies have reported the antifungal activity of portulaca extracts against various fungi using an automatic single-cell bioassay system. The antifungal activity of the portulaca was also revealed against fungi such as *Aspergillus yeast Candida* and *Trichophyton*

TURMERIC

Turmeric (*Curcuma longa*) is one of the herbal medicines used traditionally. It belongs to the *Zingiberaceae* family. Due to the existence of curcumin (a polyphenolic compound), the extracts of turmeric have shown antimicrobial and antioxidant activity. Therefore, the phenolic compound of curcumin is responsible for its antioxidant activities [48]. The phytochemical structures in turmeric include vitamin C, cineole, tumerone, borneol, zingiberene, d-sabinene, and d-phellandrene. Many types of chemical compounds are found in turmeric including sesquiterpene Ketones, monoterpenes, and sesquiterpene alcohols (e.g., zingeberene). Fresh turmeric contains zingiberene, while the most significant curcuminoid presented in turmeric is curcumin. Previous literature has reported that turmeric has an antimicrobial (antibacterial and antifungal) effect [49,140,141,142]. Curcumin is known for its inhibitory action on microorganisms such as *E. coli*, *S. aureus*, *Salmonella typhimurium*, and *Pseudomonas aeruginosa* [141,143]. In numerous literature works, turmeric's extracts have been shown to have strong antioxidant properties. The main active compound of turmeric (curcumin) shows strong radical scavenger activity. It can scavenge RNS (reactive nitrogen species) and ROS such as superoxide radicals, alkoxy radicals, peroxyl radicals, hydrogen peroxide, singlet oxygen, peroxynitrite, hydroxyl radicals, and nitricoxide by three active sites through the electron transfer and hydrogen abstraction [144,145]. Curcumin also shows indirect antioxidant properties through a reduction process of numerous cytoprotective proteins including catalase, γ-glutamylcysteine ligase, glutathione S transferase, glutathione reductase, heme oxygenase 1, superoxide dismutase, and glutathione peroxidase [146,147]. Treatment with turmeric can reduce plasma malondialdehyde with increased glutathione reductase, glutathione peroxidase, catalase activity, and plasma albumin levels [148]. The aqueous and ethanol extracts of turmeric show significant antioxidant characteristics through the increase in antioxidant enzymes, scavenging different free radicals, and inhibiting lipid peroxidation [149]. Some in vivo studies on rats have demonstrated that turmeric inhibits hydrogen peroxide in cells by preventing lipid peroxidation [150,151]. The different extracts of turmeric, such as chloroform, *n*-butanol, ethyl acetate, and *n*-hexane, show strong antioxidant characteristics. Analyses have revealed a high correlation between the

scavenging ability and the phenolic contents of these extracts [152].

CONCLUSION

Herbal medicines also high antimicrobial potential at a lower price. Bioavailability is the primary essential measure for assessing the health benefits of herbal medicine for humans. In current years, the idea that natural remedies are more secure in comparison with prescription medications has acquired traction and contributed to a massive rise in phytopharmaceutical applications [377]. The bioavailability of these herbal medicinal products varies in blood, plasma, or tissue [378]. The bioavailability of these herbal medicinal products such as thyme [379], eucalyptus [380], turmeric [381], mint [378], garlic [382], ginger [377], cinnamon [377], and clove [377] was recorded in earlier research. These studies significantly lead to the precise scientific evaluation of the numerous remarks

REFERENCE

[1] Scheepmaker, J.W.; Busschers, M.; Sundh, I.; Eilenberg, J.; Butt, T.M. Sense and nonsense of the secondary metabolites data requirements in the EU for beneficial microbial control agents. Biol. Control 2019, 136, 104005. [Google Scholar] [CrossRef]

[2] Dastjerdi, R.; Montazer, M. A review on the application of inorganic nano-structured materials in the modification of textiles: Focus on anti-microbial properties. Colloids Surf. B 2010, 79, 5–18. [Google Scholar] [CrossRef]

[3] Yang, Z.C.; Wang, B.C.; Yang, X.S.; Wang, Q.; Ran, L. The synergistic activity of antibiotics combined with eight traditional Chinese medicines against two different strains of Staphylococcus aureus. Colloids Surf. B 2005, 41, 79–81. [Google Scholar] [CrossRef] [PubMed]

[4] Parham, S.; Wicaksono, D.H.; Bagherbaigi, S.; Lee, S.L.; Nur, H. Antimicrobial treatment of different metal oxide nanoparticles: A critical review. J. Chin. Chem. Soc. 2016, 63, 385–393. [Google Scholar] [CrossRef]

[5] Huh, A.J.; Kwon, Y.J. Nanoantibiotics: A new paradigm for treating infectious diseases using nanomaterials in the antibiotics resistant era. J. Control. Release 2011, 156, 128–145. [Google Scholar] [CrossRef]

[6] Shaikh, S.; Nazam, N.; Rizvi SM, D.; Ahmad, K.; Baig, M.H.; Lee, E.J.; Choi, I. Mechanistic insights into the antimicrobial actions of metallic nanoparticles and their implications for multidrug resistance. Int. J. Mol. Sci. 2019, 20, 2468. [Google Scholar] [CrossRef] [Green Version]

[7] Raut, P.K.; Kim, S.H.; Choi, D.Y.; Jeong, G.S.; Park, P.H. Growth of breast cancer cells by leptin is mediated via activation of the inflammasome: Critical roles of estrogen receptor signaling and reactive oxygen species production. Biochem. Pharmacol. 2019, 161, 73–88. [Google Scholar] [CrossRef]

[8] Nakamura, Y.; Arakawa, H. Discovery of Mieap-regulated mitochondrial quality control as a new function of tumor suppressor p53. Cancer Sci. 2017, 108, 809–817. [Google Scholar] [CrossRef] [PubMed] [Green Version]

[9] Kim, S.H.; Kim, K.Y.; Yu, S.N.; Park, S.G.; Yu, H.S.; Seo, Y.K.; Ahn, S.C. Monensin induces PC-3 prostate cancer cell apoptosis via ROS production and Ca^{2+} homeostasis disruption. Anticancer Res. 2016, 36, 5835–5843. [Google Scholar] [CrossRef] [PubMed] [Green Version]

[10] Panieri, E.; Santoro, M.M. ROS homeostasis and metabolism: A dangerous liason in cancer cells. Cell Death Dis. 2016, 7, 2253. [Google Scholar] [CrossRef] [PubMed]

[11] Parham, S.; Nemati, M.; Sadir, S.; Bagherbaigi, S.; Wicaksono, D.H.; Nur, H. In Situ Synthesis of Silver Nanoparticles for Ag-NP/Cotton Nanocomposite and Its Bactericidal Effect. J. Chin. Chem. Soc. 2017, 64, 1286–1293. [Google Scholar] [CrossRef]

[12] Parham, S.; Wicaksono, D.H.; Nur, H. A proposed mechanism of action of textile/Al_2O_3–TiO_2 bimetal oxide nanocomposite as an antimicrobial agent. J. Text. I. 2019, 110, 791–798. [Google Scholar]