Annals of Research in Antioxidants

http annresantioxidants.com

Herbal antioxidants and kidney

Elahe Aleebrahim-Dehkordy[1], Samaneh Khodadadi[2], Zahra Mousavipanah[3], Hamid Nasri[2*]

[1]The Young Researchers Club, Department of Medicinal Plants, Shahrekord Branch, Islamic Azad University, Shahrekord, Iran
[2]Nickan Research Institute, Isfahan, Iran
[3]Islamic Azad University, Falavarjan branch, Isfahan, Iran

Correspondence to:
Prof. Hamid Nasri, Email; hamidnasri@med.mui.ac.ir

Received: 12 December 2015
Accepted: 2 January 2016
ePublished: 17 January 2016

Keywords: Antioxidant, Kidney, Medicinal plants, Herbal antioxidants

Abstract

There is an increasing interest in natural antioxidants, such as polyphenols, present in medicinal and dietary plants, which might help preventing oxidative damages caused by free radicals. Free radicals are chemical species with a highly reactive single unpaired electron which has been hunted by pair with a new free electron, and as a result of these consequences other free radicals may produce. Herbal medicines have been focused as a new resource of antioxidants elements with limited obstacles. Natural antioxidants can protect the human body from free radicals and delay the growth of many chronic diseases such as retarding the lipid oxidative rancidity in foods. Herbal sourced food antioxidants such as carotenes, phenolic acids, vitamin C, vitamin E and phytoestrogens have been known as having the potential to lessen disease risk. Herbal drugs normally fight these complications with their antioxidant efficacies. A number of them have been detected to capable anti-oxidative ability which could help to diminish free radical formation and promote endogenous antioxidant enzyme activity.

Citation: Aleebrahim-Dehkordy E, Khodadadi S, Mousavipanah Z, Nasri H. Herbal antioxidants and kidney. Ann Res Antioxid. 2016;1(1):e08.

Introduction

Biological products of animals and herbal sources have been administered by human for thousands of years either in its pure forms or crude extracts to treat various diseases. Plants are used as bases of medicine in many ways in human beings in their life. Research interest has focused on various herbs that possess rich antioxidant properties. In different herbs, a wide-ranging of phytochemicals, such as the flavonoids, polyphenolics, lignans, terpenoids, sulfides, carotenoids, saponins, plant sterols, curcumins, and phthalides have been identified. Plants are rich in flavonoids, vitamin C, or the carotenoids so can enhance immune function. The flavonoid-rich herbs may also possess mild anti-inflammatory action. Their beneficial effect named as anti-inflammatory and as an immune-stimulant action because of deal with reactive oxygen species (ROS) (1). ROS and free radicals largely play a chief role in the pathogenesis of various diseases (1,2).

Materials and Methods

For this review, we used a variety of sources by searching through PubMed/Medline, Scopus, EMBASE, EBSCO and directory of open access journals (DOAJ). The search was conducted, using combination of the following key words and or their equivalents; antioxidant, kidney, medicinal plants and herbal antioxidants.

Core tip

Natural antioxidants can protect the human body from free radicals and delay the growth of many chronic diseases such as retarding the lipid oxidative rancidity in foods. Herbal sourced food antioxidants such as carotenes, phenolic acids, vitamin C, vitamin E, and phytoestrogens have been known as having the potential to lessen disease risk.

The effects of herbal antioxidants on kidney function

Experimental investigations have revealed an increase of ROS creation associate with resultant micro-inflammation and target organ damage (like, heart, kidney, and vessels) (2). Free radicals are chemical species with a highly reactive single unpaired electron which has been hunted by pair with a new free electron, and as a result of these consequences, other free radicals may produce. Thus, when a chain reaction of free radicals happens, resulting to damaging biological systems and various tissues (3). In fact, oxidative stress is caused by discrepancy in creation of ROS and the biological competency to detoxify the reactive intermediates or repair the ensuing

injury (4). Additionally an imbalance between radical generating and radical scavenging systems can increased production of ROS or reduced activity of antioxidant defenses or both and also may lead to oxidative stress and injury (3).

Antioxidant protection against reactive oxygen species molecules

Recent investigations have showed the generated ROS are detoxified by the existent antioxidants in the body and there is equilibrium between the generated ROS and the present antioxidants (3,4). The oxidants/free radicals are substances with very short half-life, high reactivity and injuring activity towards macromolecules like proteins, DNA and lipids. These species may be either ROS or importantly nitrogen derived (RNS) (5). The most important ROS include superoxide anion (O2), peroxyl radicals (ROO) and reactive hydroxyl radicals (OH) and hydrogen peroxide (H2O2).The nitrogen derived free radicals are nitrogen dioxide (NO2), nitric oxide (NO), peroxynitrite anion (ONOO) and dinitrogen trioxide (N2O3) (6). Based on the growing interest in biologic free radicals and the lack of effective treatments for curing a large number of chronic diseases, efficacy of antioxidants in protection against these diseases is strengthened .The major feature of an antioxidant is its capability to trap free radicals. Furthermore most of the antioxidant compounds in a standard diet are resultant from plant resources and belong to various classes of compounds with a wide variety of physical and chemical efficacies.

Rich sources of antioxidant

Herbal sourced food antioxidants such as carotenes, phenolic acids, phytate, vitamin C, vitamin E, and phytoestrogens have been known as having the potential to lessen disease risk (5,6). Medicinal herbs have been administered as sources of traditional medicine in virtually all tribal civilizations and currently, according to world health organization as many as 80% of the world's population depend on traditional medicine for their primary healthcare requirements (6). Numerous medicinal plants are considered as potential sources of antioxidants. In some cases, other active constituents are also found. *Punica granatum*, *Terminalia chebula*, *Acacia nilotica*, all of which have antioxidants property, found high content of phenolic like gallic acid. Plants are believed to be well compatible with the human body and also make fewer side effects than the pharmaceuticals in recent years (7). Recently, great attention has been centered on the antioxidant role of defense system in oxidative stress. Endogenous antioxidants in medicinal herbs can show an important function in anti-oxidative defense against oxidative injury, probably protecting the biological functions of various cells (7). In a normal cell there is an appropriate pro-oxidant and antioxidant balance. Nevertheless, this balance can be changed towards the pro-oxidant when creation of oxygen species is augmented or when levels of antioxidants are lessened. This state is called 'oxidative stress' and can result in serious cell injury if the stress is enormous or long-lasted. Herbal drugs normally fight these complications with their antioxidant efficacies (8,9). Lately an upsurge of interest has been existed in the therapeutic potentials of medicinal drugs as antioxidants in diminishing such free radicals induced tissue damage. In addition to well-known and traditionally used natural antioxidants from green tea, spices, fruits and vegetables, some natural antioxidant are already exploited commercially either as nutritional supplements or antioxidant additives (7,8). In fact there are lots of evidences on protective and curative efficacies of herbal drugs on various complications. Some of these efficacies consist of anti-diabetic, antimicrobial, immunomodulatory, anti-cancer, amnesia, anti-atherosclerosis, vascular protection, renal protection or even renopreventive properties (8). Recently, according to the beneficial properties of antioxidants, predominantly natural antioxidants, in the treatment and prevention of diseases, there has been a considerable interest in finding natural antioxidants from herbal sources. The investigations on herbal plants revealed that most of them have significant antioxidant activity (6-8). Like *Ficus benghalensis* Linn aqueous extract, that its root has been examined for its free radical scavenging activity, reducing capacity and hydrogen peroxide activity. These studies have shown that the antioxidant efficacies are mainly due to the presence of phenolic compounds (7,9). Epidemiological investigations have repeatedly shown an inverse correlation between the risk of chronic human diseases and the intake of polyphenolic rich diet. The phenolic groups in polyphenols are capable to accept an electron to form relatively stable phenoxyl radicals, hence, disrupting chain oxidation reactions in cellular components. It is well founded that polyphenol-rich foods and beverages may upward plasma antioxidant capacity (9). Natural antioxidants, particularly phenolics and flavonoids, are safe and also bioactive. Thus, substantial attention has been directed towards the identification of herbs with antioxidant capability in recent years that may be administered for human consumption (10). Vegetables and fruits are also stated to reduction the risk of degenerative diseases and could have a protective efficacy against various oxidative stress insults (8-10). The defending role of glutathione, as an antioxidant and detoxifying agent, has been established in some clinical investigations. It is a ubiquitous compound that synthesized swiftly in the kidney, liver and other tissues, containing the gastrointestinal tract (11). *Silybum marianum* (milk thistle) reduces paracetamol induced hepatotoxicity and nephrotoxicity in animals. Ferulic acid, an antioxidant of plant cell wall, was detected to prevent functional and pathological abnormalities in the kidney of diabetic rats reducing inflammation and oxidative stress (12). A number of herbal plants have been detected to capable anti-oxidative ability which could help to diminish free radical formation and promote endogenous antioxidant enzyme activity in the kidney. A sufficient body of in vitro and in vivo data exists to

assume that oxidant appears to be important mediators in glomerular disease and progressive renal failure. The evidence for the role of oxidants in progressive renal disease has been noted and consists of the demonstration of the augmented production of oxidants. There are some evidences that show oxidants induce similar morphologic and functional changes as seen in progressive kidney disease, and the beneficial effects of antioxidants was reported by numerous investigations (13). The kidney is a highly vulnerable organ to injury caused by ROS, possibly due to the richness of long-chain polyunsaturated fatty acids in the composition of kidney lipids (12). In certain pathological circumstances, amplified generation of ROS and/or depletion of antioxidant defense system directs to boosted ROS activity and oxidative stress (OS), ensuing to tissue injury. OS causes tissue injury by various mechanisms containing accelerating DNA damage, lipid peroxidation, and protein modification. These processes have been connected to the pathogenesis of some systemic diseases including renal tissue (11-13). The screening investigations for antioxidant efficacies of herbal and food plants have been conducted increasingly for the last few decades in hope of finding a useful medication for some renal disease consisting acute and chronic renal failure (4). Oxidative stress is associated with harmful effects on kidney function fallowed by diabetes. On the other hand, various investigations have discovered that there are some drugs like cisplatin that can induce kidney injury by free radical generation. Thus, natural and synthetic antioxidants and free radical scavengers are claimed to provide kidney protection in cisplatin kidney damage (14).

Medicinal efficiencies of herbal species

Ocimum basilicum has been identified for its effectiveness in controlling various renal disorders. This plant was reported to possess medicinal efficiencies like anti-inflammatory, antiplatelet, antiulcer, antiviral, anticancer anti-bacterial, antifungal, and also administered to treat various renal disease consisting particularly tubular and interstitial diseases (13,14). Similarly, the in vitro antioxidant investigations of hydroalcoholic extract of *Ocimum basilicum* exhibited its scavenging efficacies in a dose dependent manner. Hence it is possible that, *Ocimum basilicum,* possesses significant renoprotective capability with minimal toxicity and thus has a hopeful role in the treatment of acute kidney injury induced by various nephrotoxins, particularly cisplatin and gentamicin (15). Kidney insufficiency is accompanied by oxidative stress, which is supposed to be caused by heightened production of ROS and impaired antioxidant defense. Three components of *Salvia miltiorrhiza*, salvianolic acid A, B and rosmarinic acid were found to have antioxidant properties. *Ginseng saponin* protects renal tissues from oxidative stress. *Curcumin* protected against renal damage by suppressing free radicals and increasing renal glutathione content and glutathione peroxidase activity (endogenous antioxidants). Therapy with coenzyme Q10, a known antioxidant, improves kidney function in patients with chronic kidney disease and decreases the need for hemodialysis in individuals on chronic hemodialysis. Likewise, quercetin protects the kidney against injury inflicted by ROS (16). Quercetin has been detected to be a tremendous in vitro antioxidant. It is the most potent scavenger of ROS in the family of flavonoids, including O2− and RNS like NO and ONOO−. These anti-oxidative abilities of quercetin are contributed to the presence of two antioxidant pharmacophores within the molecule with the optimal formation for free radical scavenging, i.e. the catechol group in the B ring and the OH group at position 3 of the AC ring (17). Quercetin is prevalent in plant food products and is therefore a commonly consumed flavonoid. It is present in green tea, apples, peaches, onions, lettuce, cabbage, broccoli, beans, and buckwheat. A considerable number of current investigations have dealt with defining quercetin bioavailability and most of them have revealed that onion is an excellent source of quercetin (15,17). Studies have shown silibinin as a beneficial effects in renal protection from cisplatin and suitable in protecting kidney function and structure from other harmful components (16). Accordingly polyphenols are powerful antioxidant agent, with ability of scavenging of a wide range of free radical species and to inhibit their organization. Among them, we can realize proanthocyanidin have been detected to display a broad spectrum of biological and pharmacological activities against free radicals formation and also against oxidative stress (17). Proanthocyanidins, or condensed tannins, are polyphenolic compounds which are broadly detected in various herbs. These molecules have a role as antioxidants; thus, they have been applied in different research concerning diseases connected to oxidative stress and free radicals (17). Oligomers and polymers of proanthocyanidins can widely be detected in the plant kingdom, particularly in fruits and berries (acerola, apple, cranberry, blueberry, persimmon, and black raspberry), nuts (almond), seeds (grape seed, *Antidesma thwaitesianum* seed, cocoa beans, Oenothera seed), trees (maritime pine, *Croton palanostigma*, Croton celtidifolius), flowers (longan flower), tubers (onion), leafs (green tea, parsley), or legumes (pea, Jamapa bean) (18). The seeds of the grape (*Vitis vinifera*) are particularly rich source of proanthocyanidins, with 60% to 70% of grape proanthocyanidins being found in the seeds. Grape seed proanthocyanidins (GSPs) have been found to be potent antioxidants and free radical scavengers (19). Various studies have investigated the bioavailability of grape seed proanthocyanidins to multiple organs, consisting heart, spleen, liver, kidney and the brain (20). Finally Furanocoumarins were one of the main active constituents of *Ruta graveolens* and were also found to be potent antioxidants while total phenolic content detected have good correlation with nitric oxide reduction potential (20).

Conclusion

A number of medicinal herbs conventionally administered for many years and their affectivity have been approved. As a matter of fact, the presence of antioxidants like flavonoids

in diet can have a protective influence on various renal diseases and diabetic complications. Effective component such as polyphenols, powerful antioxidant agent with ability of scavenging of a wide range of free radical species, can create therapeutic properties in herbs and make them suitable as dietary supplement and remedies. Proanthocyanidins are one of the most important polyphenols that have made some herbs valuable drugs. Using of herbal medicines has been increased universally in recent years, and dietary supplements to treat various chronic diseases and to promote health. Consequently, natural products and drugs derived from medicinal herbs are strong candidates for anti-inflammatory and therapeutic properties.

Authors' contribution

Primary draft by EAD and HN. Researching the data by ZMP and SK. Editing the final manuscript by HN and SK.

Conflicts of interest

The authors declared no competing interests.

Ethical considerations

Ethical issues (including plagiarism, data fabrication, double publication) have been completely observed by the authors.

Funding/Support

None.

References

1. Wojcikowski K, Johnson DW, Gobe G. Medicinal herbal extracts – renal friend or foe? Part one:The toxicities of medicinal herbs. Nephrology. 2004;9:313-8.
2. Vashisth P, Jain V, Singh Chokotia L, Sironiya R, Matoli H, Jain M. An update on herb induced chronic kidney diseases. International Journal of Research and Development in Pharmacy and Life Sciences. 2013;2:428-31.
3. Preethi Peesa J. Nephroprotective potential of herbal medicines: a review. Asian J Pharm Tech. 2013;3:115-8.
4. Roshni PR, Jyothylekshmi V, Reghu R, Vijayan M. Renal disease with the use of herbal remedies. IJPCBS. 2014;4:367-71.
5. Mohana Lakshami S, Usha Kiran Reddy T, Sandhya Ran KS. A review on medicinal plants for nephroprotective activity. Asian J Pharm Clin Res. 2012;5:8-14.
6. Rezaeizadeh H, Alizadeh M, Naseri M, Shams Ardakani MR. The traditional iranian medicine point of view on health and disease. Iranian J Publ Health. 2009;38:169-72.
7. Namjooyan F, Azemi ME, Rahmanian VR. Investigation of antioxidant activity and total phenolic content of various fractions of aerial parts of Pimpinella *Barbata* (DC.) BOISS. JJNPP. 2010;5:1-5.
8. Sen S, Chakraborty R, De B. Challenges and opportunities in the advancement of herbal medicine: India's position and role in a global context. J Herb Med. 2011;1:67-75.
9. Shan B, Cai YZ, Sun M, Corke H. Antioxidant capacity of 26 spice extracts and characterization of their phenolic constituents. J Agric Food Chem. 2005;53:7749-59.
10. Chrpová D, Kouřimsk L, Harry Gordon M, Heřmanová V, Roubíčková I , Pánek J. Antioxidant Activity of Selected Phenols and Herbs Used in Diets for Medical Conditions. Czech J Food Sci. 2010;28:317-25.
11. Miser-Salihoglu E, Akaydin G, Caliskan-Can E, Yardim-Akaydin S. Evalution of antioxidant activity of various herbal folk medicines. J Nutr Food Sci. 2013;3:222-31.
12. Srivalli Kumari P, Maduri Latha T, Harika D, Nagaraju P. Herbal toxicities – an over view. IJPCBS. 2011;1:17-25.
13. Tuncok Y, Kozan O, Cavdar C, Guven H, Fowler J. Urginea maritime (squill) toxicity. Clin Toxicol. 1995;33:83-6.
14. Verma A, Gupta AK, Kumar A, Khan PK. Cytogenetic toxicity of Aloe vera (a medicinal plant). Drug Chem Toxiciol. 2012;35:32-25.
15. Gamaniel KS. Toxicity from medicinal plants and their products. Nigerian Journal of Natural Products and Medicines. 2000;4:4-8.
16. Youn M, Hoheisel JD, Efferth T. Toxicogenomics for the prediction of toxicity related to herbs from traditional Chinese medicine. Planta Medica. 2010;76:2019-25.
17. Bugrim A, Nikolskaya T, Nikolsky Y. Early prediction of drug metabolism and toxicity: systems biology approach and modeling. Drug Discov Today. 2004;9:127-35.
18. Gamaniel KS. Toxicity from medicinal plants and their products. Nigerian Journal of Natural Products and Medicines. 2000;4:4-8.
19. Kennedy S. the role of proteomics in toxicology: identification of biomarkers of toxicity by protein expression analysis. Biomarkers. 2002;7:269-290.
20. Dahl NV. Herbs and supplements in dialysis patients: panacea or poison? Adv Chronic Kidney Dis. 2005;12:312-25.