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Letter to the Editor

Medicinal Plants And Antioxidants: Why They Are Not Always Beneficial?

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Dear Editor-in-Chief

Oxidative stress is defined as an imbalance between stress and the available protective elements suggested playing a crucial role in induction of diseases. Medicinal plants mostly combat these complications with their antioxidant activities. Several preclinical and epidemiological studies have found an inverse association between the consumption of fruits, vegetables and/or grains which generally are high in antioxidants and induction of diseases in humans. Antioxidants are substances that remove, prevent or delay oxidative damage to a target molecule. Therefore, an antioxidant may act to control the level of free radicals to counteract oxidative damage (1). There is a lot of evidence on protective and curative effects of medicinal plants on various complications. Some of these effects include antimicrobial (2, 3), anti-cancer (4), anti-diabetic (5, 6), anti-atherosclerosis (7, 8), immune-modulatory (9), and even renoprotection or hepato-protective effects (10–14). Medicinal plants are rich sources of polyphenols with antioxidant activities and these beneficial effects have been attributed to their antioxidant mechanisms. There has also been a linear correlation between oxygen radical absorbance capacity values and total phenolic contents in several medicinal plants. In a study the equivalent antioxidant capacity values of several forms of garlic extracts were correlated well with their total phenolic, flavonoid and flavonol contents (15).

Although medicinal plants effects in prevention and treatment of disorders have been widely attributed to their antioxidants activities, however, there is increasing evidence pointing to their pro-oxidant hazardous effects, too. This property of medicinal plants is mostly contributed to their formulae preparation. Some of polyphenols have shown to be readily oxidized in preparation of beverages like green tea. The prescription formulae preparation in traditional medicine usually involves a long decoction process with water and medicinal plants for several hours. Polyphenols in the medicinal plants in this process or storage may be oxidized. This oxidation critically reduces the beneficial properties of herbal medicine products (16).

Pro-oxidant however, is a chemical agent that induces oxidative stress, either by generating reactive oxygen species (ROS) or by inhibiting antioxidant systems. The oxidative stress induced by this agent can damage cells and tissues. Polyphenols in medicinal plants can act as either antioxidants or pro-oxidants, depending on conditions. Concentration of the extract and whether oxygen or transition metals are present or not are of these conditions. Transition metals such as iron, copper and manganese are present in most cases of pro-oxidant activities of agents (1).

Adulteration and contamination of medicinal plants with transition metal ions such as copper

and iron can aggravate the pro-oxidant effects of medicinal plants by catalyzing oxidation reactions. Besides, polyphenols are usually present in medicinal plants in high concentration and are metabolized by phase I (cytochromes P450) and phase II (sulfotransferases, glucuronyl transferases and glutathione transferases) enzymes, and their metabolism can produce intermediate and final metabolites and reactive oxygen species (ROS) with pro-oxidants properties. There are other forms of plants extracts which may become pro-oxidant and induce oxidative stress by un-known mechanisms. These forms of medicinal plants extracts induced oxidative stress have also been demonstrated in preclinical or clinical trials, as well as various cell types (1). While cells exposed to medicinal extracts at short exposure times and low concentrations usually show increased cell viability, the powerful antioxidant extracts in high concentrations have been found to be cytotoxic by inducing severe oxidative stress (17).

It should be noted that medicinal plants extracts are rich sources of polyphenols and these compounds are unstable and might be subjected to polymerization. Therefore, it is important to check that the observed biological effects are not due to polymerization of phenolic compounds. This should be verified by measuring antioxidant capacity and stability of the polyphenols.

Other than oxidation, pro-oxidant activity and polymerization of the medicinal plants extracts, the toxicity related to the use of crude or products of medicinal products has also been reported. This kind of toxicity can be due to post-harvest processing and storage, adulteration, misuse of medicinal plants or contamination with toxic chemicals from cultivation (18).

In conclusion, although a lot of evidence supports that proper use of medicinal products may provide therapeutic benefits in the view that polyphenols in medicinal plants are antioxidants and effective in the treatment and prevention of diseases, however they may also act as pro-oxidants.

Care is needed to avoid oxidation, induction of pro-oxidant activity and polymerization of the medicinal plants extracts, as well as the toxicity related to the use of crude or products of medicinal products due to post-harvest processing and storage, adulteration, misuse of medicinal plants or contamination with toxic chemicals from cultivation 18-20).

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