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Natural Antioxidant by Scavenging Free Radicals Activities Using Nano Turmeric

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Abstract Humans are exposed to nuclear radiations every day, and these radiations are both natural and artificial. When the body tissues are exposed to nuclear radiation, free radicals are formed, which are responsible for cancer development. In this method, were added to deionized water that contained free radicals before and after exposure to gamma rays. The obtained results indicate that the turmeric have antioxidant potential through possessing free radical scavenging activity, as they can donate electron to free radicals and become neutralize.
Keywords: Scavenging of free radicals, Natural Antioxidant, Decontamination

INTRODUCTION

Ionizing radiation is divided into direct and indirect ionization to understand its biological effects. Electromagnetic radiation, x-rays and γ-rays, are indirectly ionizing because they do not produce chemical and biological damage [1]. Oxidative stress caused by ionizing radiation is an imbalance between free radicals and antioxidant systems to cause chronic diseases such as cancer, Alzheimer's and Parkinson's[2]. Reactive Oxygen Species (ROS) and free radicals, such as hydroxyl radical and hydrogen peroxide are produced in the human body during normal metabolic pathways and exposure to exogenous stress such as ionizing radiation and air pollutions can induce adverse effects on the normal physiological activity of cells. The body's system is equipped with antioxidant defense and enzymes which neutralize the ROS. Unfortunately, enhancement of ROS level or less ability of detoxification of the antioxidant defense system, can lead to increased oxidative stress and turn cell damage and death [3-5]. A number of synthetic and natural antioxidant compounds which are widely applied in products that directly come in contact with the human body. Thus, there is a growing need to develop environmentally friendly processes of preparation that do not use toxic chemicals [6]. Among the various organic natural material, turmeric received substantial attention for various reasons. Turmeric, is one of the very few promising natural products that has been extensively investigated by researchers from both the biological and chemical point of view. It is an effective antioxidant and antimicrobial agent which exhibits low toxicity and has diverse in vitro and in vivo applications [7]. The organic material are found to be effective in scavenging oxygen-based free radicals [8]. A free radical is defined as a molecular species capable of independent existence and contains one or more unpaired electrons [9]. Now Reactive oxygen species (ROS) are small, highly reactive, oxygen containing molecules that are naturally generated in small amounts during the body's metabolic reactions and damage complex cellular molecules such as fats, proteins, or DNA [10]. The preparation of natural material attracts an increasing interest due to their new and different characteristics as compared with those of macroscopic phase. This allows applications in various fields such as antimicrobials, medicine, biotechnology, optics, microelectronics, catalysis, information storage and energy conversion [11].

Turmeric have a wide range of application in various fields from biology, pharmaceuticals to medical diagnosis and therapeutics to biosensor development [12]. There are many researches who have been studying the scavenging of free radicals and antioxidant activity of natural materials [13-14].

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Turmeric is the most important material that may be utilized as free radical scavengers due to their inert properties and higher compatibility.
The aim of the present work is the use of turmeric for the scavenging of free radicals in the biological tissues and minimizing the radiation hazard occurring due to the formation of these free radicals which are responsible for decontamination of water and further adverse effects in the human body.

Turmeric Reactions with ROS

Turmeric has been found to be an excellent scavenger of most ROS, a property that bestows turmeric with antioxidant activity in normal cells. ROS consists of both free radical oxidants and molecular oxidants [13,14]. Free radical oxidants participate in hydrogen abstraction and also in electron transfer reactions. All three active sites of turmeric can undergo oxidation by electron transfer and hydrogen abstraction. Detailed investigations by different groups have confirmed that during free radical reactions, the most easily abstractable hydrogen from turmeric is from the phenol-OH group, resulting in formation of phenoxyl radicals, which are resonance stabilized across the keto-enol structure as shown in Fig1.

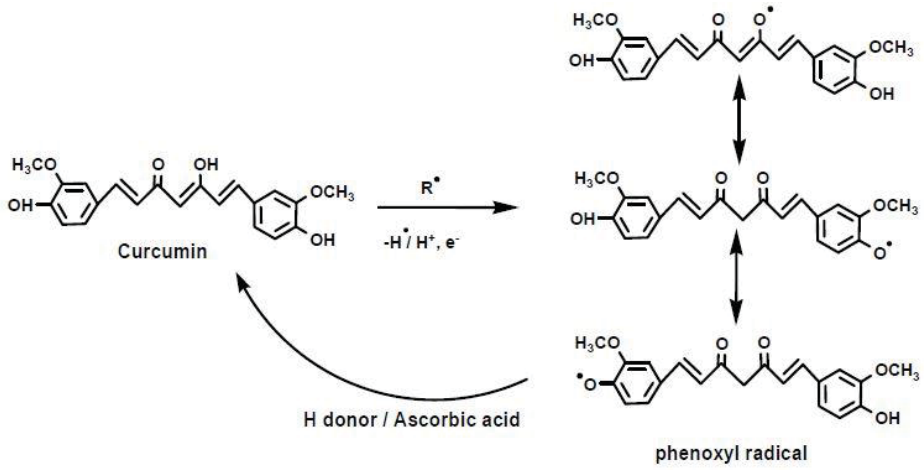

FIGURE 1. The proposed reaction for resulting in formation of phenoxyl radicals, which are resonance, stabilized across the keto-enol structure ions by curcumin

For example the reaction of peroxyl radicals with turmeric produces turmeric phenoxyl radicals, which are less reactive than the peroxyl radicals and thereby cause protection from ROS-induced oxidative stress [15]. The regeneration reaction of phenoxyl radicals back to turmeric by water soluble antioxidants like ascorbic acid, impart the molecule with a chain breaking antioxidant ability like vitamin E [16]. Reported in the literature are scavenging reactions of several other free radical ROS such as hydroxyl radicals, superoxide radicals and alkoxy radicals by turmeric.

EXPERIMENTAL WORK

Among all the known chemical and physical preparation methods, the plant extraction technique is one of the simplest methods for producing turmeric solution [9].Turmeric roots was washed in water, dried and grinded into coarse powder it is extract solution was added progressively to irradiant deionized water.
Deionized water was used as a sample for the study of scavenging of free radicals arising when water is exposed to different doses of ionizing radiation. The largest proportion of the human body (75%) is composed of water. Ionizing radiation has severe impacts on the water and leads to the formation of free radicals. Water samples were irradiated by ^{137}Cs gamma source with 5mCi activity, which emits gamma ray with 662keV energy. The irradiation process was performed using the radioactive isotope cesium-137 by placing the radioisotope directly over the water or the animal. The radiative dose was calculated by our

knowledge of the activity of the radioisotope. The exposure rate in Roentgen/hour was calculated using the fallowing equation:

– ——

where X/t is the exposure rate, Γ is gamma constant, A is the activity of Cs-137, and d is the distance between the source and the samples. Then the radiation dose rate D/t **gray** Gy. hour^{-1} unit was calculated using the following equation:

– –

where a is a constant used to convert the exposure to absorbed dose in air. Then the radiation dose was calculated using the following equation:

D= D/t ×T

where T is the exposure time [17].
The irradiation was performed in the Department of Physics, College of Science, University of Baghdad .Turmeric was performed in different concentration (0.50×10^{-4} 0.75×10^{-4}, 1.00×10^{-4}, 0.50×10^{-3} and 0.75×10^{-3}). The absorbance of the turmeric was identified by UV-visible spectrophotometer at 425 nm, as shown in Fig.2.

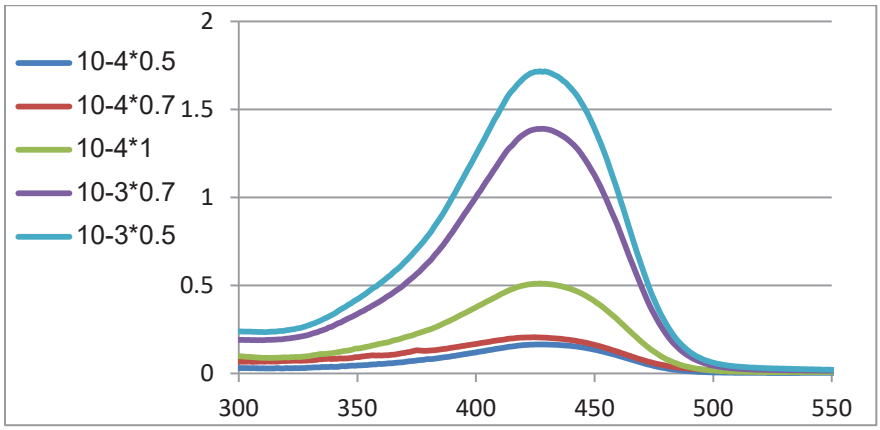

FIGURE 2. The absorbance of turmeric only at 422 nm

Percentage inhibition of 2, 2-diethyl-1-Bicryl hydrazyl (DPPH) was calculated according to the following equation [18]:

Inhib. (I %) = [(A ref -As)/A ref] x 100%

where Aref is the absorbance of irradiated water samples as a reference. As is the absorbance of samples with different concentration of silver nanoparticles.

RESULTS AND DISCUSSION

Antioxidant Properties of Solution

A freshly prepared DPPH solution exhibits a deep purple color with a maximum absorption around 514 nm. Various studies have been conducted to evaluate the antioxidant characteristics of different nanoparticles. However, this is the first time that nanoparticles with low concentrations are studied in

relation to the decontamination of radiation (scavengers of free radical) formed in gamma irradiated water samples using DPPH assay**.**

Turmeric as Decontamination Agents of Radiation in Vitro (Phantom)

The concentration of free radicals resulted by irradiation phantom with ^{137}Cs radionuclide was measured using DPPH material. The results of the in vitro decontamination (free radical scavenging) efficiency represented by the reduction of SPR of DPPH at 525nm and the inhibition% of free radical formation are shown in Fig.2.

In this experiment, turmeric with different concentrations were added to the deionized water samples, after irradiation with ^{137}Cs, for the decontamination of radiation (free radicals formation). Fig.3 shows DPPH absorbance at 514nm for all water samples with different concentrations of turmeric.

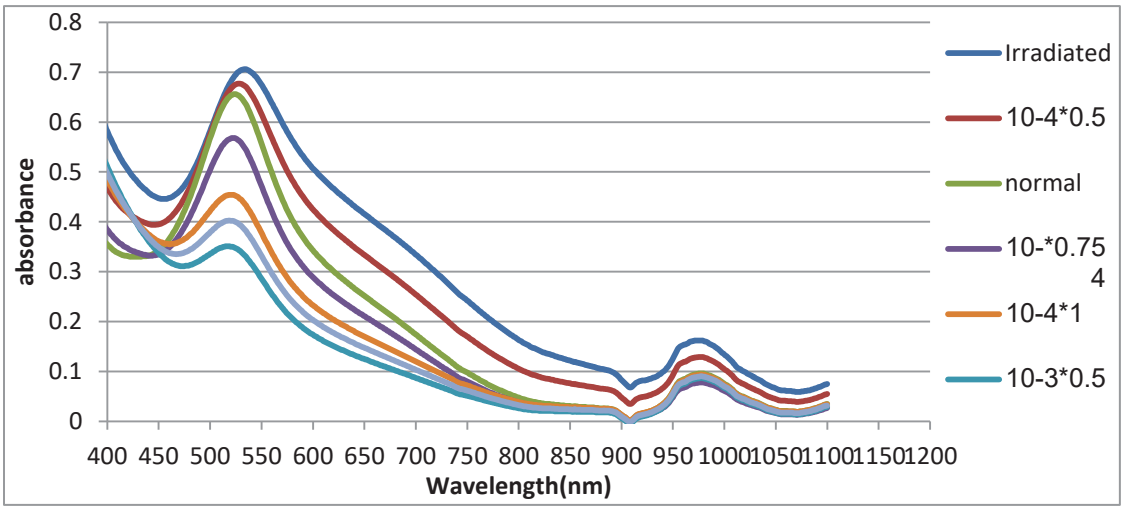

FIGURE 3. DPPH absorption for all water samples at 514 nm with different concentrations of turmeric.

Table 1 summarizes the values of DPPH absorption and free radicals scavenging (inhibition %) for different turmeric concentrations added after water irradiation.

TABLE 1. Values of DPPH absorption and inhibition for the samples with different concentration added

Water samples	absorption	Inhibition%
Normal water	0.656	
Irradiant water	0.706	
Irradiate water with different turmeric concentration		
0.50×10^{-4}	0.677	39.04
0.75×10^{-4}	0.568	54.6
1.00×10^{-4}	0.454	64.9
0.50×10^{-3}	0.351	70.33
0.75×10^{-3}	0.403	66.40

Fig.4 shows the absorption of DPPH for all samples with turmeric addition as function of concentration. The inhibition% for all samples with turmeric added after irradiation deionized water as a function of concentration was shown in Fig.5

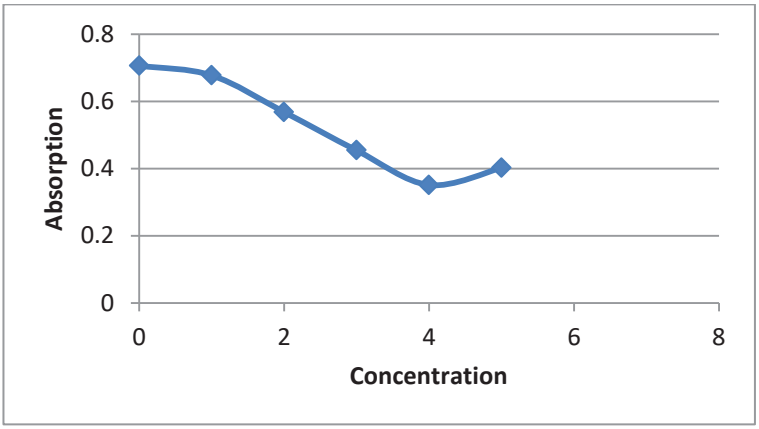

FIGURE 4. DPPH absorption for all samples with turmeric addition as function of concentrate

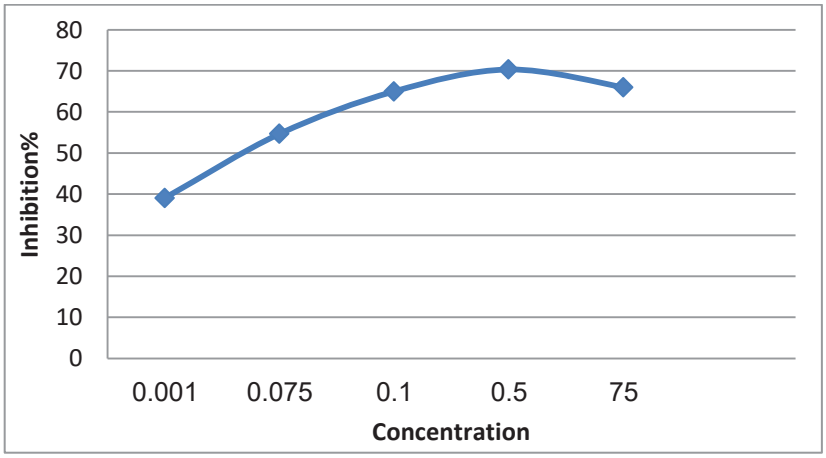

FIGURE 5. Inhibition% for all samples with turmeric added after irradiation deionized water as a function of concentration

The obtained results indicate that turmeric possess free radical scavenging activity, where they act as antioxidant agents that can donate electron to free radicals and become neutralized. After donating an electron, an antioxidant becomes a free radical by definition. Antioxidants in this state are not harmful because they have the ability to accommodate the change in electrons without becoming reactive. The unique properties of turmeric such as high reactivity cause their ability in decontamination in water samples induce by gamma radiation. The most common ROS include the superoxide anion, hydroxyl radical, singlet oxygen, and hydrogen peroxide, which have unpaired electrons and can react with the antioxidant to prevent the oxidative stress. The impact of turmeric as an antioxidant occurs only within a limited range of concentration; further increase in the concentration leads to the formation of additional pollution (free radicals) due to a dual feature through the material. As the function as oxidizer or antioxidant is dependent on turmeric concentration. Due to the larger surface area to mass ratio of smaller particles, more ROS could be formed than those in larger particles.

CONCLUSIONS

This study demonstrated that curcumin has powerful and excellent antioxidant activity. Curcumin can be used for minimizing or prevent formation of toxic oxidation products in body systems and has beneficial effects in life

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