

Omar S. Ashour
Asia H. Al-Mashhadani

Department of Physics,
College of Science,
University of Baghdad,
Baghdad, IRAQ



Inhibition of Free Radicals in Water Using Nano Olive Leaf

Olive leaf is known to contain various bioactive compounds, such as polyphenols (including oleuropein), flavonoids, and antioxidants, which contribute to its potential health benefits. When gamma rays interact with water molecules, they can cause the ionization of water molecules, leading to the formation of free radicals. A free radical is a highly reactive chemical species with an unpaired electron in its outer shell. In the context of the effect of gamma rays on water, these free radicals play a significant role in various chemical and biological processes. In this paper the nanoparticles of olive leaf extract were used to prevent the causing of free radicals formation in water due from radiation contamination. Expose water samples to gamma radiation at predetermined doses was done using a controlled radiation source of ^{137}Cs . Then the samples were analyzed to determine the extent of free radical formation. Techniques of UV-Vis spectroscopy can be used with 2,2-diphenyl -1-picrylhydrazyl (DPPH) material to quantify and characterize free radicals causing in water. This measurements of free radical concentrations was done in treated and untreated with nano olive samples. When the concentration of nano olive leaf increases the inhibition of free radicals are increases i.e. the quantity of free radicals are decreases, the maximum inhibition of free radicals was 83% at $1 \times 10^{-4} \text{g/l}$ from nano olive leaf materials. The conclusion from this paper the nano olive leaf can be used to protect the human from ionizing nuclear radiation.

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1. Introduction

Nuclear radiations from both industrial and natural sources are constantly being exposed to humans [1]. Free radicals are created when the body's tissues are exposed to ionizing nuclear radiation, and they play a role in the development of cancer [2]. The effects of radiation on the human body are quite complex [3]. Numerous pathogenic changes in human cells are among the several levels of biological consequences, ranging from different levels to living tissues dying [4]. Energy is deposited when radiation interacts with target atoms, resulting in ionization or excitation medium atoms [5]. Molecules are harmed both directly and indirectly as a result of the absorption of ionizing radiation energy [6]. There are two classes of radiation: ionizing and non-ionizing radiations [7]. Ionizing radiation has higher energy than non-ionizing radiation, which is sufficient to break chemical bonds and produce chemical changes. This impact has the potential to harm living tissues [8]. The direct action of radiation involve a transfer of the energy from the radiation directly to the target molecule (DNA), but the indirect action occur when radiation produces free radicals which react with the target molecule results in a biologic effect[9]. In order to comprehend how ionizing radiation affects biological processes, it is separated into direct and indirect types [10]. Since X-rays and Y-rays do not cause chemical or biological damage, they are indirectly ionizing radiations [11].

Radiation contains sufficient energy to excite molecules and atoms, forcing them to vibrate faster, as seen in a microwave oven, where the radiation forces water molecules to vibrate faster, causing heat to be produced called non- ionizing radiation [12]. Radiation that penetrates deeply is known as gamma radiation [13]. When an alpha or beta particle is expelled from the nucleus of an atom, it is typically released shortly after [14]. While it may pass through the human body, denser materials like concrete or lead nearly entirely absorb it [15].

Gamma radiation penetrates matter more deeply than either alpha or beta radiation because it is composed of photons that have neither mass nor electric charge [16,17]. The frequency of gamma radiation is larger than 3×10^{19} Hertz, and its wavelength is smaller than 1×10^{-11} m. The energy of gamma ray photons is generally more than 100 keV [18,19]. Gamma-ray have three ways interaction with matter: photoelectric ,Compton effect and pair production [20]. Indirect ionization is the main way that gamma rays ionize materials [21].

Chemical species like an atom, a molecule, or an ion that possess unpaired electrons are known as free radicals [22]. The main cause of radiation damage is aqueous free radicals, which are produced when radiation interacts with water [23]. In biological systems, free radicals can come from a variety of sources [24].

There are several methods to produce free radicals as well, but the mitochondria, which utilize 90% of

the O₂ in the human body, are their most common source [25]. Antioxidants are molecules that can donate an electron to a free radical. The free radical stabilizes as a result, becoming less reactive [26].

Nanoparticles (NPs) are tiny materials having size ranges from 1 to 100 nm, synthesized using two strategies: top-down and bottom-up [27-29]. Because of their greater surface area to volume ratio, nanoscale materials, also known as nanoparticles, have distinct and better features and are thought of as the foundation for nanotechnology to create materials with intriguing properties [30].

Nanotechnology is unique in that it represents not just one specific area, but a vast variety of disciplines such as physics, chemistry, biology, engineering, material science, medicine and pharmacology [31]. The science of nanotechnology, which deals with the creation, manufacturing, characterization, and manipulation of materials at the nanoscale, is now generating increasing attention [32,33] Due to their ability to connect atomic or molecular structures to bulk materials, nanoparticles are of tremendous scientific interest [34].

The materials at the nanoscale have interesting characteristics depending basically upon the following two features: surface area and quantum confinement effect [35]. There are four types of nanomaterials such as zero dimension, one dimension, two dimensions, and three dimensions [36,37]. Major improvements in cancer diagnosis, imaging, and therapy have been made as a result of the use of nanotechnology to medicine [38,39]. The DPPH technique is a quick, easy, precise, and affordable test for determining various substances' capacity to serve as hydrogen donors or free radical scavengers, as well as for assessing the antioxidant activity of foods and drinks [40].

DPPH free radical method is an antioxidant assay based on electron-transfer that produces a violet solution in ethanol [41]. This free radical, stable at room temperature, is reduced in the presence of an antioxidant molecule, giving rise to colorless ethanol solution [42]. The use of the DPPH assay provides an easy and rapid way to evaluate antioxidants by spectrophotometry, so it can be useful to assess various products at a time [43].

Olive leaf extract is a concentrated dose of the nutrients in olive tree leaves. It's a potent source of antioxidants that support immune system [44]. Mainly polyphenols in olive leaf extract are the antioxidants [45,46]. The structure and high antioxidant capacity of these phenolics would enable the usage of them in medicines, cosmetics, pharmaceutical and food [47,48].

The current research aims to use nano olive leaf extract to prevent, protect and minimizing the radiation hazard (free radical inhibition) occurring cause of radiation contamination in biological tissue and deionized water exposed to radiation.

2. Experimental Method

In this the study, nanoparticles olive leaves extract was used as a sample for Prevent Radioactive contamination occurs (protection) arising when deionized water is exposed to high doses of ionizing radiation (gamma ray). Water makes up the greatest percentage of the human body (75%). when exposure the deionized water to radiation ionizing leads so that to the radiation contamination (formation of free radicals).

Deionized Water samples were exposed to gamma radiation from a ¹³⁷Cs source with a 6mCi activity, which has a 662keV energy output. The radioactive isotope cesium-137 was used for the irradiation procedure, and it was either placed directly over or underneath the deionized water. To prevent the occurrence of radioactive contamination (formation of free radicals), nano olive leaves extract (OLENPs) are added to the water samples before the irradiation process.

Different concentrations (0.00002, 0.00004, 0.00006, 0.00008, 0.0001 g/L) were added from OLENPs to ethylene DPPH solution and water sample (exposed to radiation) in a same volume. After the mixture a good shake and letting it rest for a while in a dark area, the absorbance of all samples was measured at a wavelength of roughly 524 nm.

3. Results and Discussion

Nanoparticles olive leaves extract (OLENPs) was performed in different concentrations (0.2×10^{-4} , 0.4×10^{-4} , 0.6×10^{-4} , 0.8×10^{-4} and 1×10^{-3}). The absorbance of the (OLE) was identified by UV-visible spectrophotometer at 278nm was shown in Fig. (2).

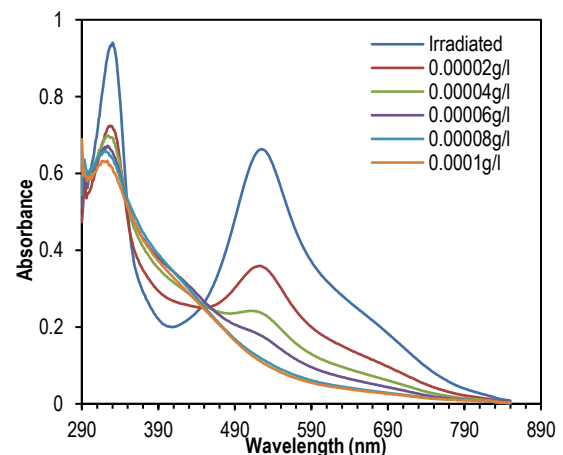


Fig. (2) DPPH absorption at 524 nm for various concentrations of OLENPs added prior irradiation

The results of the in vitro antioxidant activity of olive leaves extract nanoparticles are summarized in tables (1) included the DPPH absorption at 524nm and radical inhibition % which were calculated by equation (1).

$$I\% = [(A_a - A_b) / A_a] \times 100\% \quad (1)$$

where I% is the Inhibition%, A_a is the absorbance of irradiation deionized water with DPPH as a control, and A_b is the absorbance of samples with various concentration of olive leaves nanoparticles [42].

Table (1) Values of DPPH absorption and inhibition for samples with various amounts of olive leaf extract nanoparticles at 524nm

Water Samples	DPPH absorption	Inhibition %
Irradiated	0.663	
(OLE) Concentration g/l		
0.2×10^{-4}	0.359	46%
0.4×10^{-4}	0.237	64%
0.6×10^{-4}	0.178	73%
0.8×10^{-4}	0.119	82%
1×10^{-4}	0.110	83%

Table (1) includes the results of the experiment when adding the sequent concentrations of OLENPs to a constant volume of deionized water samples before the irradiation process. The samples were prepared presently at the time of measurements, which were containing the same ratio of DPPH solution to irradiated deionized water samples and different by the concentration of OLENPs. The absorbance of DPPH at 524nm for all samples was measured by UV- Vis spectrophotometer.

In the study scavenging them during irradiation to prevent free radicals formation and their hard effect. Free radical inhibition activity or antioxidant properties of OLENPs were estimated by reducing DPPH which leads to a reduction in absorbance at 524nm. Figure (1) summarizes the absorption of DPPH radical with the presence of olive leaves extract nanoparticles as antioxidant when added before irradiation.

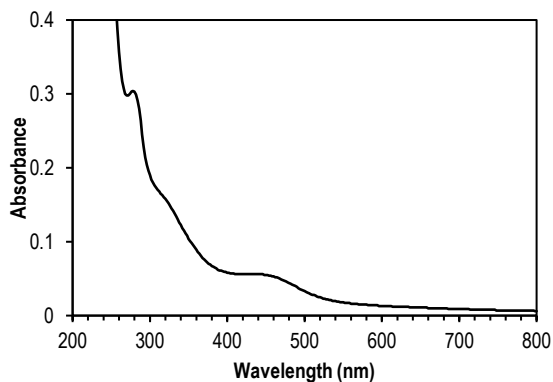


Fig. (1) The absorbance of only olive leaves extract nanoparticles at 278nm

From the results, DPPH radical absorption has a specific decrease with increasing OLENPs concentrations until 1×10^{-4} g/l concentration is reached where the absorbance starts to increase with the increase of OLE concentration as shown in Fig. (2). The maximum inhibition% of free radicals was found with 1×10^{-4} g/l CUNPs concentration as shown in Fig. (3).

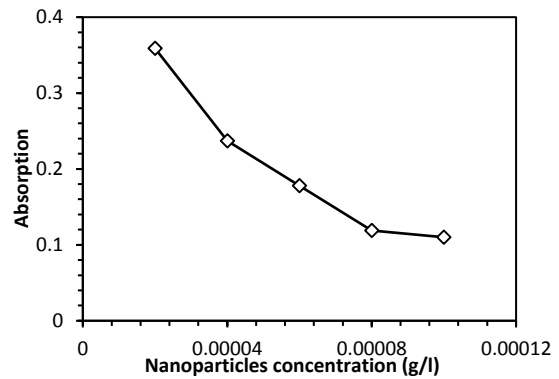


Fig. (3) Absorption as a function of Olive Leaves Extract Nanoparticles concentration.

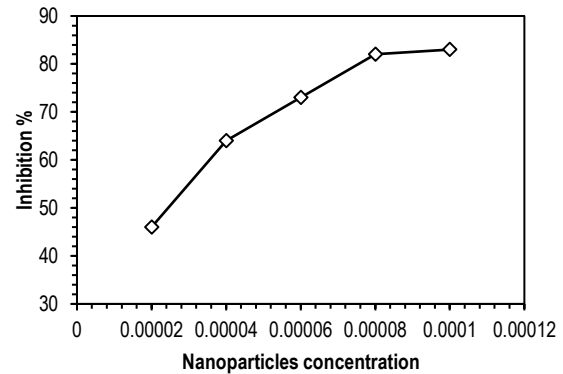


Fig. (4) Percentage inhibition of free radical as a function of concentration of olive leaves extract nanoparticles

4. Conclusions

The results of this paper confirmed that the olive leaves extract nanoparticles used in this work have a high ability to scavenge free radicals which are caused when human exposed to nuclear radiation.

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