Effect of β-Ray and TiO2-NPs Synthesis Using the sol-gel Technique on Lipids in Human Blood Plasma

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Titanium dioxide nanoparticles find application in numerous industrial products, with particular significance in soap and dyes for providing a white color, cooking utensils for their durability, and certain skin protection products in cosmetics, such as sunscreen. Consequently, the utilization of TiO2 in our daily lives is extensive. Therefore, the primary aim of the study is to examine the impact of this substance on the efficiency of cardiac function by analyzing its effect on body fat. Moreover, it is important to ascertain the effects of ionizing radiation on humans and whether the effectiveness of these nanoparticles remains constant or changes. The field of nanotechnology has witnessed widespread implementation across various scientific disciplines, offering viable solutions to challenges in science and medicine. The fundamental concept of nanotechnology revolves around the reduction of particle sizes, thereby enhancing cellular absorption capabilities and presenting novel physical characteristics that hold potential for biomedical research. The rapid progress of nanotechnology has fueled a growing interest in the utilization of nanoparticles (NPs) across diverse sectors, including photonics, catalysis, magnetics, biotechnology, cosmetics, pharmaceutics, and pharmaceuticals. NPs are materials of extremely small dimensions, typically ranging from 1 to 100 nm, and can be categorized based on their specific characteristics, shapes, or sizes.

Keywords: Thermal Enhancement, Heat Transfer Efficiency, Insert Designs, Laminar and Turbulent Flows, Industrial Heat Exchangers

1. Introduction

Titanium dioxide nanoparticles find application in numerous industrial products, with particular significance in soap and dyes for providing a white color, cooking utensils for their durability, and certain skin protection products in cosmetics, such as sunscreen. Consequently, the utilization of TiO2 in our daily lives is extensive. Therefore, the primary aim of the study is to examine the impact of this substance on the efficiency of cardiac function by analyzing its effect on body fat. Moreover, it is important to ascertain the effects of ionizing radiation on humans and whether the effectiveness of these nanoparticles remains constant or changes. The field of nanotechnology has witnessed widespread implementation across various scientific disciplines, offering viable solutions to challenges in science and medicine. The fundamental concept of nanotechnology revolves around the reduction of particle sizes, thereby enhancing cellular absorption capabilities and presenting novel physical characteristics that hold potential for biomedical research. The rapid progress of nanotechnology has fueled a growing interest in the utilization of nanoparticles (NPs) across diverse sectors, including photonics, catalysis, magnetics, biotechnology, cosmetics, pharmaceutics, and pharmaceuticals. NPs are materials of extremely small dimensions, typically ranging from 1 to 100 nm, and can be categorized based on their specific characteristics, shapes, or sizes. Unlike materials with indeterminate particle sizes, nanomaterials, composed of small particles possessing a significant surface area, yield materials that exhibit unexpected surface area, volume, quantum size, and macro tunneling effects. Different classifications of nanomaterials encompass fullerenes, metal NPs, ceramic NPs, and polymeric NPs. Nanoparticles possess unique physical and chemical properties owing to their large surface area and nanoscale size. Evidently, titanium dioxide (TiO2) nanoparticles (NPs) are extensively utilized in the fields of paints, plastics, papers, ink, cosmetics, and skincare products, especially when the particles have a size of approximately 100 nm. However, owing to their distinctive characteristics, such as their diminutive size, heightened reactivity, and expansive surface area per unit mass, nanoparticles (NPs) have the potential to swiftly infiltrate the human body, thereby presenting possible hazards to human health. Biochemical parameters are utilized to gather information regarding the functional status of vital organ systems, such as the liver, renal, hematopoietic, and immunological systems. In medical and biological applications, TiO2-NPs are widely used due to their distinctive properties, like decreased free radical levels and improved activity of antioxidant enzymes. These nanoparticles find application in the field of cosmetics and are even investigated for their antibacterial properties. The human body contains various types of lipids, including saturated fats, which can be found in red meat, full-fat dairy, and butter.

Saturated fats are solid at room temperature and have been found to increase levels of LDL cholesterol in the bloodstream.: Unsaturated fats include fats that are good for health, and are divided into two main categories:

Monounsaturated fats: These are found in olive oil, canola oil, and nuts such as almonds, pistachios, and cashews. These fats are heart healthy and promote overall health.

Polyunsaturated fats: These include omega-3 and omega-6 fatty acids. Omega-3 fatty acids are found in fatty fish such as salmon and sardines, as well as in flax and chia seeds. Omega-6 fatty acids are found in vegetable oils such as sunflower oil and corn oil. These essential fats are essential for a healthy heart and nervous system.

Trans fats: This type of fat is usually the result of industrial hybridization of liquid fats in vegetable oils, and is characterized by increasing levels of bad cholesterol and reducing levels of good cholesterol (HDL) in the blood. Trans fats are found in commercially manufactured products such as frying pans, fast food, and commercially made baked goods. Trans fat consumption should be avoided as much as possible because they are considered unhealthy and are associated with an increased risk of cardiovascular disease [10,11].

It is essential to properly balance these different types of fats in the daily diet. It is recommended to reduce the intake of saturated fats and trans fats, and increase the consumption of healthy unsaturated fats such as those found in olive oil, canola oil and nuts. The general approach should be to eat a healthy diet that includes a variety of food items and is balanced between proteins, carbohydrates and healthy fats. Low-density lipoprotein cholesterol test or LDL test, also known as a bad cholesterol test or LDL test, is one of the tests that are performed to determine the percentage of fats in the blood [12, 13].

2. Material and method

2.1 Syntheses of Titanium Dioxide Nanoparticles TiO_2-NPs

TiO2-NPs are available in various compositions such as Titania, Rutile, Anatase, or Brookite. Among these, rutile and anatase are the most commonly used compositions. Synthetic sol-gel method and chemical conventional approach were employed for the production of TiO2-NPs. The procedure began by mixing a specific quantity of TTIP (Titanium isopropoxide) and ethanol together in a ratio of TTIP:ethanol=1:5. This mixture was then swirled for a duration of 60 minutes. Following this, 3 ml of HNO3 was added to 150 ml of deionized water to serve as a hydrolysis catalyst. The resulting aqueous solution was cautiously injected drop by drop into the combined TTIP and ethanol solution for the hydrolysis process. The mixture was then agitated at a temperature of 60°C for approximately 2 hours until it yielded an opaque suspension with high viscosity. Subsequently, the mixture was heated at a temperature of 100°C for a duration of 24 hours to allow for the evaporation of solvents and the crystallization of TiO2 nanoparticles. Finally, the annealing process was conducted at a temperature of 600°C for 6 hours in an oven to achieve the anatase phase figure (1). This study employed a chemical method for the synthesis of TiO2-NPs, which is in accordance with the synthesis method described in the manuscript. [14]

Figure (1) TiO_2 –NPs from sol-gel to powder

Medical Procedure

In the current research, a particular subset that constituted one third of the different concentrations of TiO2 was utilized, namely (60, 40, and 20) μg/1 ml figouer of Normal Saline.

It is noteworthy to mention that instead of using distilled water in the TiO2-NPS solution, the utilization of normal saline solution is preferred. The objective is to apply this treatment to the solution containing blood, so as to prevent the RBC hemolysis, which may occur if distilled water is employed. It is important to observe that all blood models, even the control models that were not subjected to any substance and were not exposed to irradiation, had 1 ml of saline solution added to them.

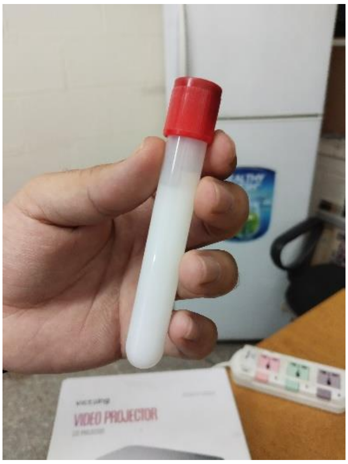


Figure (2) 40 µg of TiO2-NPs/1 ml of solution is utilized to dissolve it in the saline solution.

Venous blood samples, totaling 10 ml, were collected from a cohort of 40 healthy male donors aged between 20 and 48 years. The samples underwent separation using a centrifugal apparatus, with a speed of 4000Xs cycles for a duration of 15 minutes, employing an 800 ELECTRIC CENTERFUGE med in Chania. This process yielded blood plasma, which was subsequently divided into four distinct groups. Within the first group, the plasma samples were left without any additives, serving as the control sample. In the second group, the plasma samples were treated with TiO2-NPs, specifically 40 µl of TiO2-NPs to 1 ml of blood plasma. The preparation of TiO2-NPs involved dissolving 40 µm in 10 ml of normal saline, followed by thorough mixing and placement in a water bath for 10 minutes to ensure optimal particle distribution. The third group of plasma samples was exposed to Beta radiation β -ray, through exposure to strontium-90 as a source of beta particles for a period of 10 minutes, at a dose of approximately 8.94 Gy ≈ 9 Gy. It is important to note that while natural strontium is non-radioactive and non-toxic, its counterpart, strontium-90, is both radioactive and dangerous. During its half-life of 64 hours, it undergoes β-decay, producing electrons and the isotope Atrium 90 Y, with an energy of 0.546 MeV. Furthermore, during this process, the beta decay with an energy of 2.28 MeV is converted to stable zirconium 90 (90Zr). The fourth group of plasma samples consisted of a mixture, as outlined in step (b), where 1 ml of blood plasma was combined with 40 µl of TiO2-NPs, and subsequently irradiated by β –ray, similar to step (c). It should be noted that the blood collection process ensured the use of clean and sterile tools, and the workers captured relevant images related to the study. Additionally, the measured values of cholesterol, triglyceride, HDL, and LDL were obtained from the plasma samples in a private laboratory setting

3. Results and discussion

3.1 Characterization of TiO_2 NPs

3.1.1 X Ray Diffraction Analysis:

X-ray reaction XRD analysis helps find the crystal size plane, and phase of the TiO_2–NPs, [17]. This analysis helps to understand the properties of TiO_2 in terms of crystal structure, crystal size crystal distribution, crystal tension, wavelengths, and crystal patterns. The XRD analysis of the prepared sample of TiO_2 nanoparticles was done using a Bruker make diffractometer, Cu-Kα X-rays of wavelength (λ)=1.5406 Å and data was taken for the 2θ range of 10° to 70° with a step of 0.1972°. The results confirmed the nano-sized powder TiO_2. In X-ray refraction (XRD) analysis, peaks are defined as the reflection peaks or peaks on the pattern that is read from the X-rays that have been smashed through a crystalline sample. These peaks represent the subtle reflection peaks that appear on the pattern and represent the position of the refraction angles that express the crystal structures of the materials in the sample [17,18], as shown in Figure 1 and Table (1) show all pecks of XRD of TiO_2.

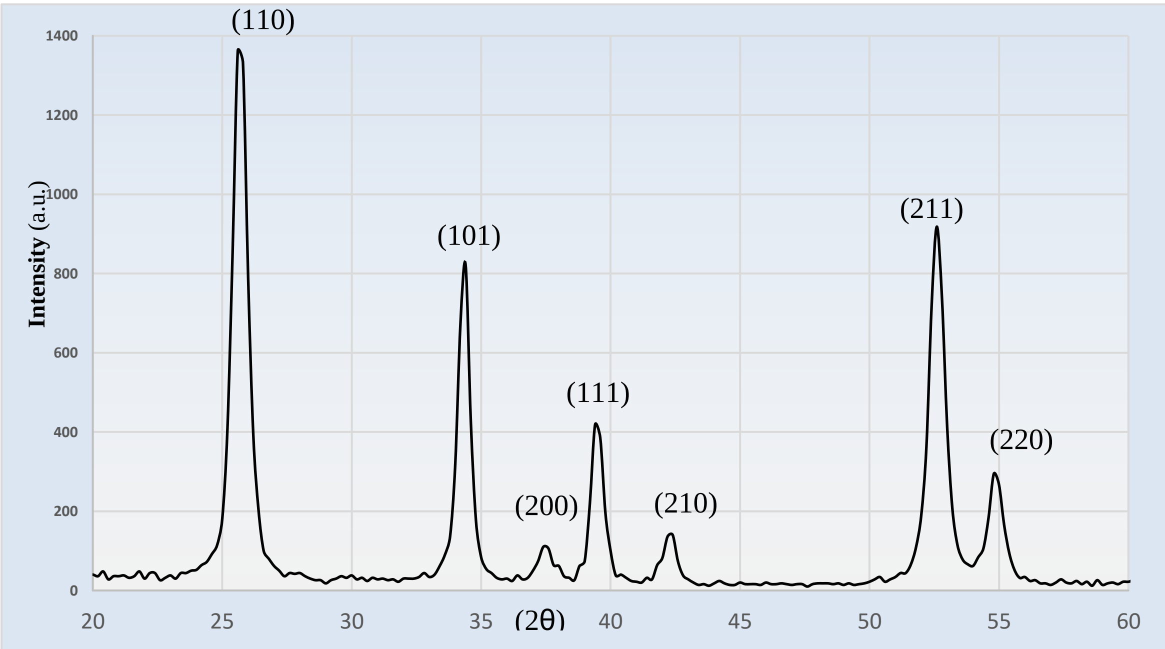


Fig. 1 shows XRD for TiO_2

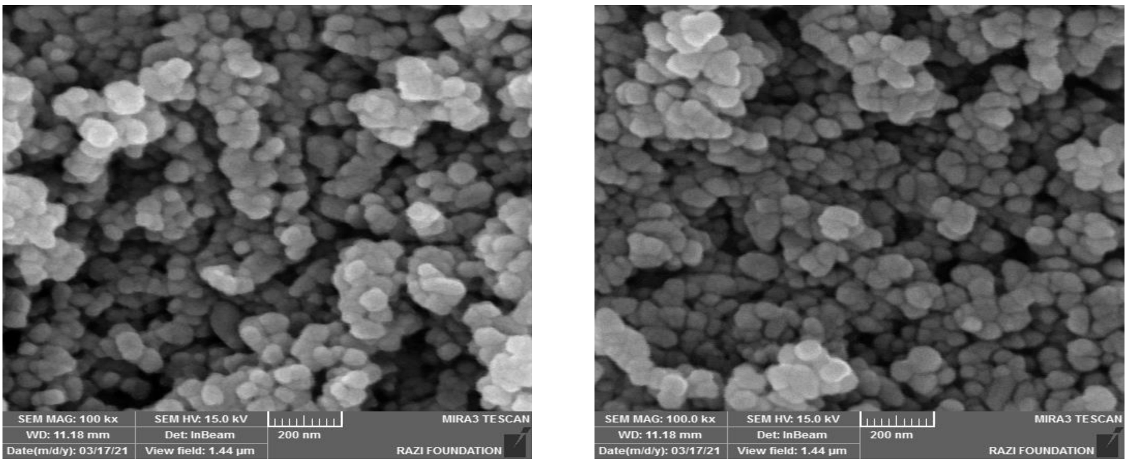
Table (1) below showed the peaks of XRD of TiO2-NPs

<2Θ>	hkl	I >	Θ	tan Θ	cos Θ	sin Θ
25.8	110	1362	12.8	0.237974995	0.9259	0.220341048
34.4	101	822	12.9	0.34658513	0.9239	0.320210002
37.2	200	64	26.3	2.342088268	0.6559	1.536175695

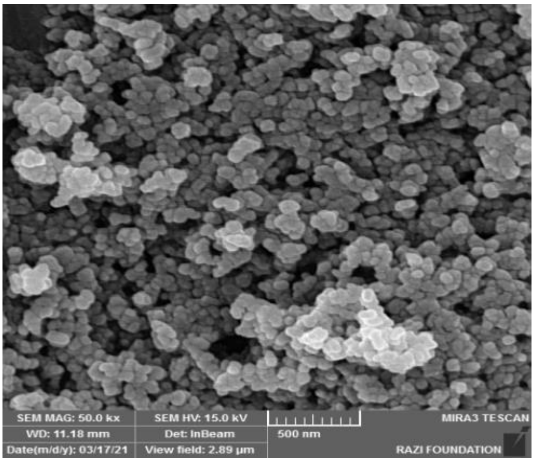
39.4	111	418	12.7	0.134430507	0.9279	0.124738067
42.4	210	136	17.2	12.67060168	0.8379	10.61669714
52.6	211	918	13	0.463021133	0.9219	0.426859182
55	220	268	26.4	3.192679086	0.6539	2.087692854

3.1.2 Results of SEM for TiO_2 -NPS

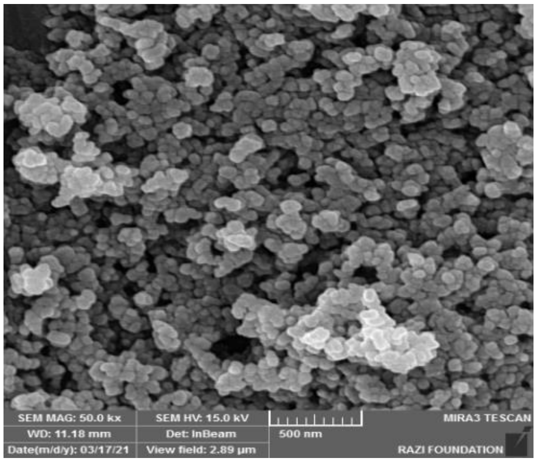
SEM results analysis of nanocomposites entails the assessment and explication of images and data produced through the utilization of scanning electron microscopy (SEM) for the examination of these composites. SEM is a technique employed for observing surfaces at a high resolution on a nanometer scale, capable of generating 3D images that reveal intricate details regarding the structure and composition of materials and nanocomposites. Presented here are fundamental procedures for interpreting SEM outcomes. Within this study, the scanning electron microscope was applied to determine the dimensions of TiO2-NPS. The outcomes of the SEM analysis indicated that the mean size of TiO2-NPs was 53.6 nm. Figure 2 illustrates the SEM image of TiO2-NPs, while Table 2 delineates the analyzed chemical ratios present within TiO2-NPs through SEM measurements.



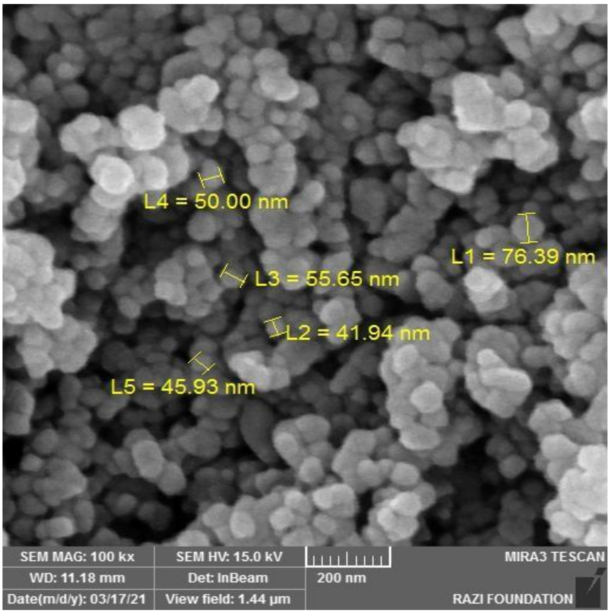
(a) (b)



(c)



(d)



(e)

Fig. 2. All a,b,c and d is the different size of titanium nanoparticles , figure e is average sizes of titanium nanoparticles by using SEM device.

Table (2) Analyzed ratios of chemicals contained within TiO2-NPs by measuring SEM

Elt	Line	Int	Error	K	Kr	W%	A%	ZAF
C	Ka	66.0	34.906	0.1770	0.081	16.04	25.12	0.5181
N	Ka	18.9	35.478	0.0710	0.033	8.65	11.62	0.3853

O	Ka	132.1	36.050	0.1736	0.085	43.06	50.61	0.1894
Ti	Ka	522.3	0.8537	0.5784	0.277	32.25	12.66	0.8426

3.1.3 UV-Absorption of TiO_2NPS:

The results of UV-absorption showed that the maximum peak of absorption for TiO_2 NP_S at λ_{max}=320nm, as shown in Figure (3).

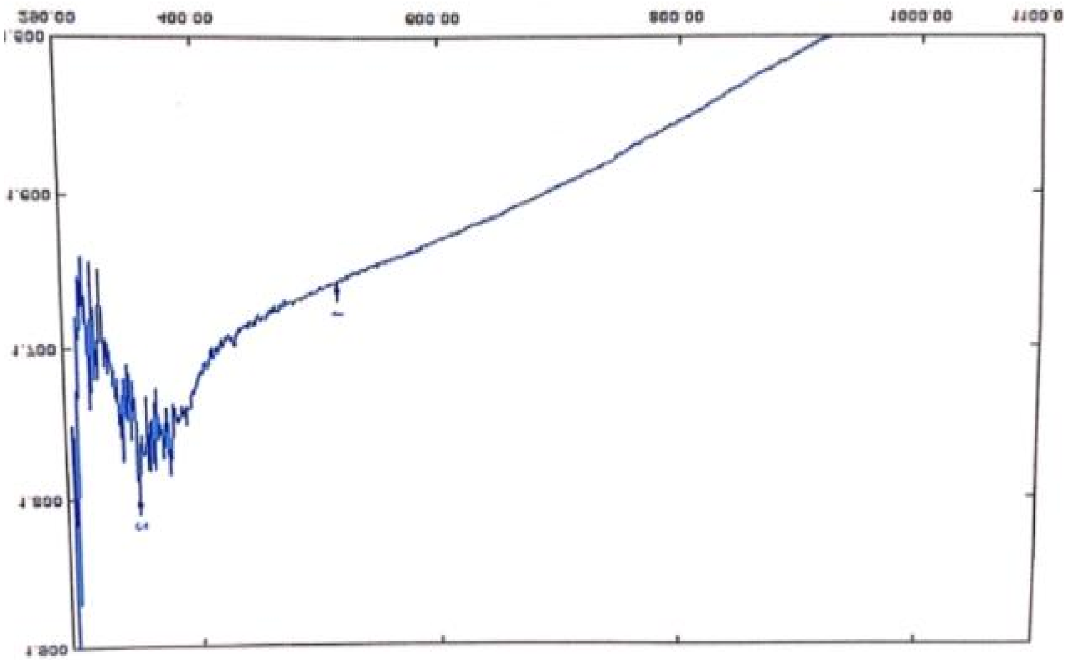


Fig. 3. UV-visible spectrum of titanium dioxidenanoparticles.

3.2. Fourier transformed infrared (FTIR)

Fourier transform infrared spectroscopy (FTIR) of TiO2 NPs, as shown in Figure 4, clarified the characteristics of the formation of a high-purity product. The FTIR spectra showed the presence of TiO bonds and the absence of peroxo and OH bonds at the end of the product. It also shows the peaks corresponding only to TiO2. The peak observed at 514 cm is due to TiO bond vibration. A broad intense band at ~3430 cm in the spectra can be assigned to the NH stretching frequency arising from the peptide bond lifetimes found in the biosynthetic proteins of A. flatus using TiO2. The maximum absorption peak appeared at 1779 cm −1, characterized by the asymmetric CO2 vibration of the anhydride group. Using the FTIR spectrum it was possible to observe the change in the carbonyl region around 1600-1800 cm −1 and the appearance of the characteristic bands at 1779 cm −1 and 1639 cm −1 assigned to amide I and amide II, despite the strong decrease in the relative intensity of the bands (characteristic of CO2 stretching vibrations homologous maleic anhydride groups). The new bands at 1779 and 1639 cm−1 characteristic of amides I and II prove the presence of amino acid residues from the fungal matrix of A [14,16].

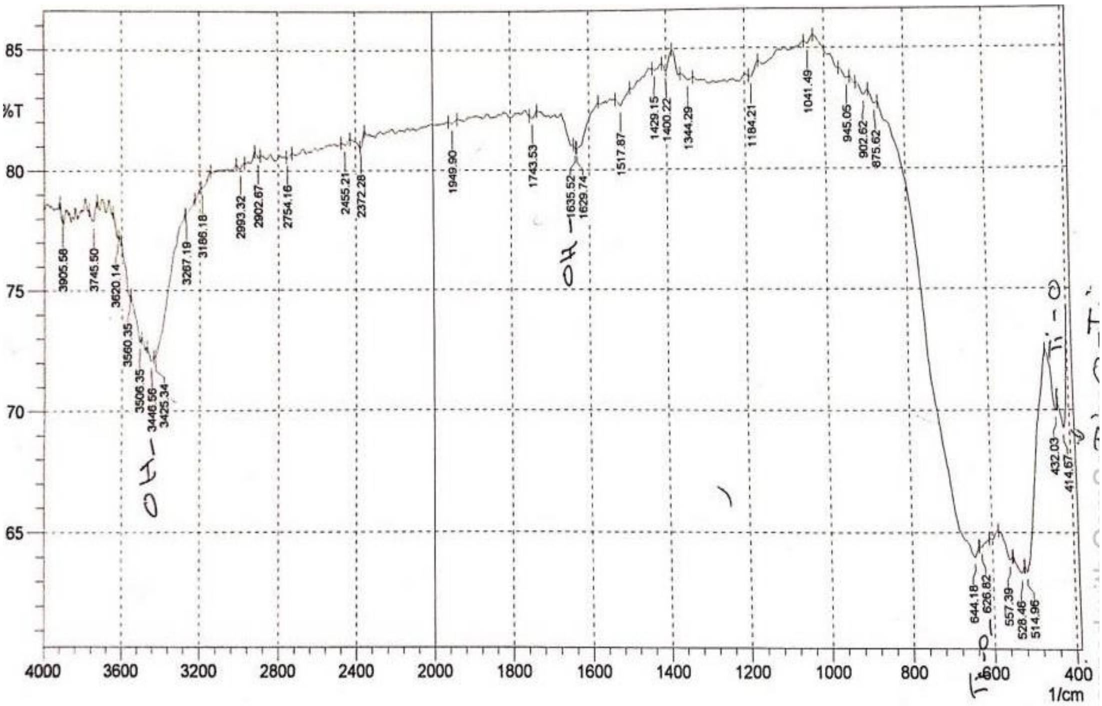


Fig. 4 FTIR spectrum of TiO_2- NPs

3.3 Effect of TiO_2 and β-ray on Triglycerides, Cholesterol, LDL and LHL

In this work, the drawn blood plasma sample was divided into four groups for each same sample, and treated with three different effects.

- The first group: are the control group (samples without any effect).
- The second: samples treated with TiO_2-NPs.
- The third group: samples exposed to 8.94 Gy of β- ray.
- The fourth group samples treated with TiO_2-NPs, then exposed to 8.94 Gy of β- ray.

Durin the present study, a segment of the various levels of TiO2 were utilized, specifically(60, 40, and 20) µg/1 ml of Normal Saline (this solvent was employed to prevent analysis in erythrocytes).

Post-experimentation analysis revealed that the 60 µg/ml and 20 µg/ml on centrations were considered ineffective due to multiple factors.

The adverse impact of 60 µg/ml, on red blood cells renders its utilization dangerous, resulting in a marked decline in red blood cell count to 49%, effectively reducing the initial count by half. Consequently, all data pertaining to this concentration were disregarded, deeming it harmful in the ongoing investigation.

Regarding the 20µg/ml concentration, it was observed that this specific level had an insignificant influence on most parameters. As illustrated in the table (3).

Table (3) effect of 20 and 60) 20 µg/1ml on (RBC*10^{12}/L, Triglycerides mg/dl, Cholesterol mg/Dl, LDL mg/dl, and HDL mg/dl)

		Control	TiO_2 (20)µg	TiO_2 (60) µg
RBC*10^{12}/L	Value dL	3.8± 0.306	2.854± 0.31	3.47±0.25
	SD	1.016	1.04	0.85801
	Reduction%		-3%	-49%
	P-value	« 0.02	« 0.08	« 0.005
Triglycerides mg/dL	Value Mg/dL	138.17±15.87	136 ± 48.015	91.9 ± 48.74
	SD	54.97	48.033	52.24
	Reduction%	-2%	-33%	
	P-value			
Cholesterol µg/dL	Value µg/dL	138.17±15.87	136 ± 48.015	91.9 ± 48.74
	SD	54.97	48.033	52.24
	Reduction%		-2%	56%
	P-value		« 0.006	« 0.005
LDL µg/dL	Value µg/dL	57.5±5.27	53.34±4.53	60.43±5.14
	SD	26.3357	22.69	25.7
	Reduction%		5%	25%
	P-value		« 0.004	« 0.008
HDL µg/dL	Value µg/dL	78.04 ± 8.846	77.32 ±7.588	14.44 ±1.75
	SD	44.23	37.94	8.76
	Reduction%		-1%	-81%
	P-value		« 0.03	« 0.005

In the case of 40µg/ml, all outcomes presented in Table (4) indicate that TiO2-NPs decreased all lipid components including Triglycerides, Cholesterol, LDL, and HDL, when compared to their levels in the control samples. Conversely, a noticeable increase in all lipid components was observed (P-value 0.005) in sample groups exposed to radiation at a dose of 8.94 Gy of β-ray. Within the fourth group, there was a minor adjustment in all parameters due to the combined impact of TiO2-NPs and β-ray, suggesting a mutual neutralization of their effects.

Table 4. The effect of TiO2-NPs and beta-ray on Triglycerides, Cholesterol, LDL, and HDL in blood samples

		Control	β-ray	TiO_2	β-ray+TiO_2
RBC*10^{12}/L	Value Mg/dL	3.8±0.306	2.854± 0.31	3.47±0.25	2.48 ± 0.25
	SD	1.04	0.85801	0.84	1.016
	Reduction %		-25%	-9%	-35%
	P-value	« 0.001	« 0.005	« 0.005	« 0.004
Triglycerides mg/dL	Value Mg/dL	57.956±4.71	48.6±4.568	72.17±4.359	53.347±4.539
	SD	23.55	21.795	19.539	19.418
	Reduction %	0%	-16%	25%	-6%
	P-value	« 0.005	« 0.005	« 0.005	« 0.005
Cholesterol mg/dL	Value Mg/dL	138.166±15.87	147.166±20.76	92.083±14.679	106.25±14.679
	SD	54.977	71.918	50.85	40.337
	Reduction %	0%	7%	-33%	-20%
	P-value	« 0.0001	« 0.0001	« 0.0001	« 0.0001
LDL mg/dL	Value Mg/dL	78.04±8.845	92.52±10.076	57.68±6.528	68.6±37.783
	SD	44.23	50.38	32.64	36.86
	Reduction %	0%	19%	-26%	-12%
	P-value	« 0.0001	« 0.0001	« 0.0001	« 0.0001
HDL mg/dL	Value Mg/dL	59.56±4.041	45.72±3.44	65.68±3.18	50.9±3.87
	SD	20.207	17.22	18.4	19.82
	Reduction %	0%	-23%	10%	-15%
	P-value	« 0.0001	« 0.0001	« 0.0001	« 0.0001

The results illustrated in a table exhibit significant increases in the levels of triglycerides and HDL attributed to the impact of TiO2-NPs. On the contrary, these levels decreased when exposed to 8.94 Gy of β-ray in comparison to the control samples. Conversely, samples exposed only to β-ray showed a notable reduction in these lipid levels, as shown in Figures (5A) and (5B). The findings for cholesterol and LDL, on the other hand, showed a distinct pattern, with substantial reductions observed following exposure to both β-ray and TiO2-NPs, as illustrated in Figures (5C) and (5D).different, as they decreased significantly with each β-ray and TiO_2- NPs, Figures (5C) and (5D).

The elevation in HDL (high-density lipoprotein) due to the influence of TiO2 nanoparticles may be ascribed to the decline in overall cholesterol concentrations. According to a particular investigation, the oral intake of TiO2 nanoparticles led to heightened levels of plasma glucose without any discernible variance in plasma insulin release. This augmentation in glucose levels could potentially result in a reduction in TC concentrations, subsequently fostering an upsurge in HDL levels. Furthermore, TiO2 nanoparticles have been identified as contributors to escalated reactive oxygen species (ROS) levels within the hepatic system, which have the capacity to trigger pathways linked to lipid metabolism and HDL production. Nevertheless, additional exploration is imperative to gain a comprehensive comprehension of the underlying mechanisms facilitating the rise in HDL levels induced by TiO2 nanoparticles This is consistent with previous research results [19,20,21,22].

Triglycerol and HDL: Studies investigating the effects of β-ray on triglyceride and HDL levels are limited. However, one study published in the journal Environmental Health Perspectives found that exposure to low doses of β -ray can lead to an increase in circulating triglycerides in mice, contrary to current research results. The study found that the increase in triglycerides was most pronounced at lower doses of radiation and persisted for several days after exposure.

Erica Werner et al. confirmed the same result, but in vivo, where they found that irradiation increases the activity of enzymes in the cholesterol pathway, that associated with increased cholesterol levels in irradiated cells and lung tissue [23]. The decrease in the triglyceride and HDL values with the effect of -ray is attributed to the fact that the irradiation dismantles the lipid chains, either by its direct influence on the large lipid chains causing fragmentation for these chains, ionization radiation can damage cholesterol molecules by increasing the oxidative stress in the surroundings that contain fats (cells or blood), which causes them to oxidize (cholesterol particles) and accumulate in the bloodstream, causing them to collect on the walls of blood vessels, causing atherosclerosis (a heart disease).

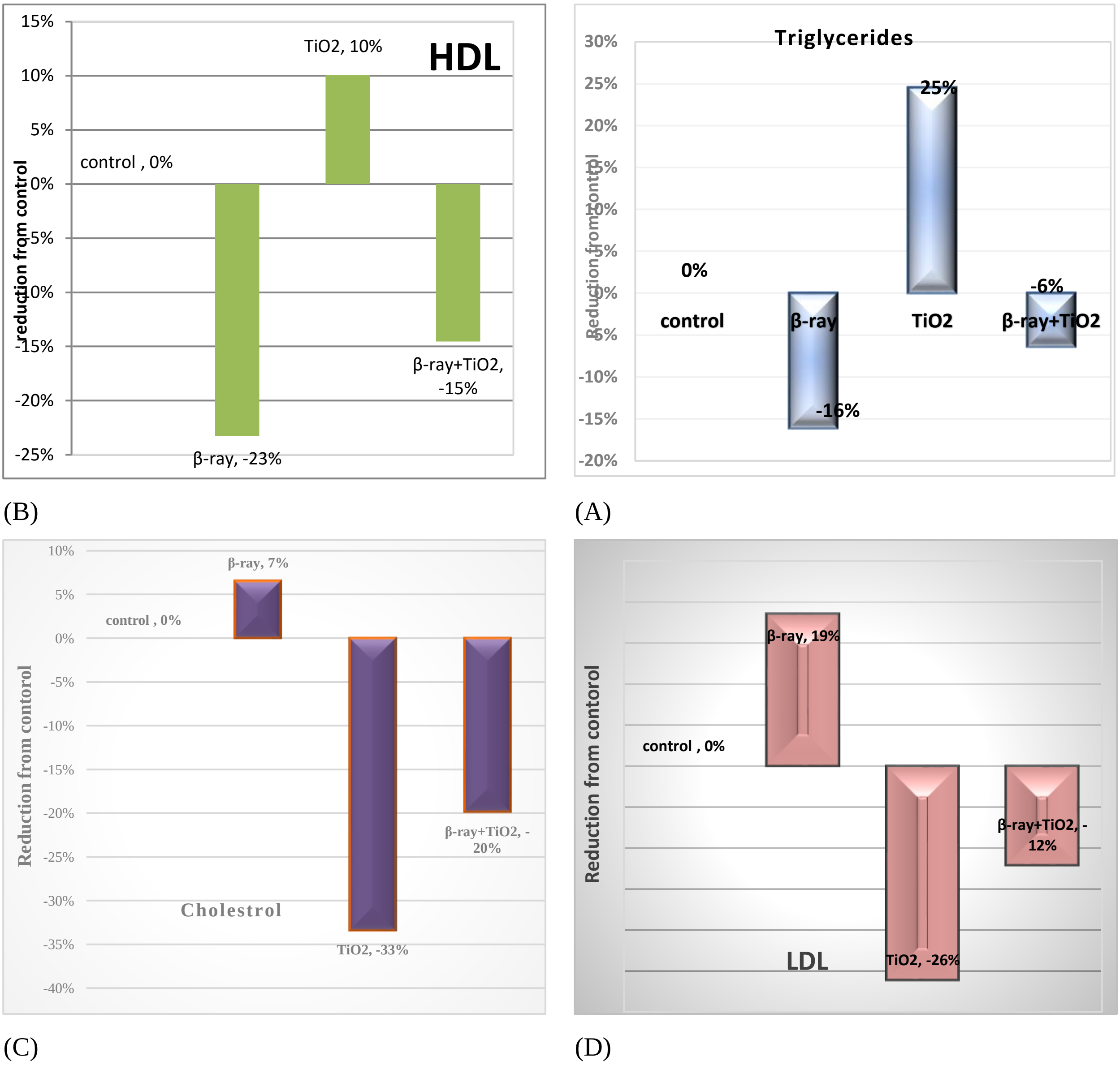


Fig. 5. Change human factors (A- Triglycerol, B-HDL,C-Cholesterol, D-LDL in blood samples with effect of β-ray and TiO_2- NPs.

Finally, for samples that were treated with TiO2-NPs and then irradiated, as is evident in Table 3, the concentrations of triglycerides and HDL are less than their values in irradiated (β-ray) samples, but they still exceeded their importance in the (control and treated with TiO_2-NPs) samples, for the same effects, Cholesterol and LDL concentrations decreased that -means that the influence of TiO_2-NPs on these compounds exceeded the impact of radiation.

In all cases, the clear conclusion is that ionizing radiation affects nanoparticle activity. For comparison, it was noted that all lipid concentrations in blood decreased in samples that were treated with TiO_2-NPs, much less than in samples that were treated with TiO_2-NPs and irradiated by β-ray, which confirms that the radiation has an apparent effect on the composition of the nanomaterials, which made them lose their influential properties. It will notice the effect of the nanoparticles, which seem to cross-liked low-density lipids this leads to assuming that it is one of the effects of the nanoparticles. It will affect the hydrogen bands, which are the basis for the composition of all lipids in the body.

The structure of the lipids showed in Figure (6) below which appear that almost structure are H and C-bands [24].

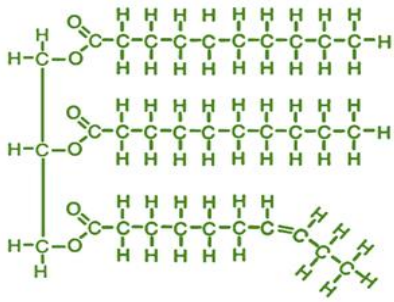


Fig. 6 The structure of the lipids

Nanoparticles may effect on lipids because Disruption of Hydrogen Bonds. Nanoparticles can disrupt existing hydrogen bonds in a material. When nanoparticles are introduced into a medium that contains molecules with established H-bonding interactions, they can physically interfere with the alignment of molecules involved in H-bonds. This disruption can alter the properties of the material, such as its viscosity, melting point, or chemical reactivity [25].

Aggregation and clustering [26,27]. Nanoparticles can aggregate or cluster together due to various forces, including hydrogen bonding. This can lead to the formation of nanoparticle aggregates with distinct properties, potentially influencing the overall H-bonding behavior in the system.

In the scanning electron microscopy (SEM) images, particles of sizes ranging from 41 to 75 nm were observed, displaying various shapes, with a predominant spherical morphology. The presence of these particles, particularly those exceeding 20 nm in size, is noted to diminish the internal impact of nanomaterials on cellular processes. Specifically, the enlarged dimensions of TiO_2 –NPs contribute to a reduced likelihood of cellular nucleus penetration, thereby resulting in limited effects on cell nuclei white blood cells (WBC), thus enhancing their direct influence on cellular components like protein molecules and lipids. The observed blood sample reveals the presence of irregularly shaped particles that are densely clustered, suggesting their potential classification as nanoparticles. These particles exhibit a rugged, porous surface morphology with cauliflower-like aggregations, which could potentially elicit various responses within adipocytes. Nanoparticles possess the capacity to interact with adipose tissue in diverse manners, potentially altering lipid storage mechanisms or inducing lipolysis.

The illustration depicts particles that are irregularly shaped and densely clustered, suggesting the possibility that they are nanoparticles. These particles exhibit a surface that is both rough and porous, characteristics which could potentially induce various responses in adipocytes within the organism. Nanoparticles have the capability to engage with adipose tissue through a variety of mechanisms, including modulation of lipid storage processes and promotion of lipolysis.

The nanoparticles synthesized in the present study are distinguished by a heightened surface energy and surface tensile energy, qualities that are deemed advantageous as an adsorbent and in enhancing the impact of particles on less dense fats. Nanoparticles have the capability to engage with blood fat through various mechanisms, such as altering fat storage processes or triggering lipolysis. The notable influence on cellular interactions can be ascribed to the elevated surface energy and surface tension exhibited by nanoparticles. An overview of implications encompasses the following: - Cellular Absorption. Nanoparticles with a high surface energy are inclined to display heightened attraction towards cell membranes, potentially leading to increased cellular absorption[28]. - Thermodynamics: Comprehending the thermodynamic aspects of nanoparticles hinges on the crucial role played by surface energy, which in turn can modulate their interactions with cells. It is important to acknowledge the existing ambiguity concerning micro-effects, particularly in the context of particle size[29]. -Surface-to-volume ratio: Within the realm of nanoscale particles, the ratio of surface area to volume holds significance alongside the influence of surface free energy. These factors can impact the effective coefficient of nanostructural components, rendering them size-specific. - Surface properties. The intricate interplay between nanoparticles and cells as well as lipid bilayers is dictated by their surface properties, encompassing energy and tension [30].

Several studies have provided empirical support indicating that the efficacy of TiO2-NPs can be improved by Beta radiation. The aforementioned phenomenon is a result of the interplay between beta rays and TiO2 nanoparticles, causing changes on the surface that may affect their chemical and physical attributes, subsequently influencing their catalytic activity. However, the present investigation yielded contrasting findings. The influence of nanotechnology on the outcomes was diminished in comparison to samples solely subjected to nanotechnology. Moreover, the introduction of beta rays induced changes in the composition and configuration of the nanostructures, consequently diminishing their impact on the experimental results.

4. Conclusions

Low-dose beta radiation (β-ray) is deemed advantageous for decreasing triglyceride levels, however, it is counterproductive in raising both cholesterol and LDL (bad lipids). However, TiO-NPs are acknowledged for their capacity to increase HDL levels while concurrently decreasing cholesterol and LDL. The breakdown of more compact molecules (such as triglycerides and HDL) by β-ray represents a notable advantage that could be leveraged. However, the presence of high cholesterol hinders its potential application as a therapeutic approach against triacylglycerol. The impact of β-radiation on TiO-NPs results in decreased interactions with blood samples, subsequently diminishing its influence on lipid profiles in the blood.

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Data Availability the author declare that all dada included in this work are available on demand.

Declarations

Conflict of interests The author declare no competing interests.

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