Study of Physiological and Biochemical Changes in Rabbit Blood: Resulting from Exposure to Wavelengths (565,810,1064) nm Used in Home Cosmetic Lasers

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Abstract*:* This study aimed to evaluate the physiological and biochemical effects of the home laser technology (Intense Pulsed Light - IPL), designed for hair removal in various body areas, using three wavelengths (565, 810, 1064) nm on the skin and surrounding areas. Twenty-four female domestic rabbits were used, randomly divided into four groups: Group 1 (control), Group 2 (exposed to the 565 nm wavelength), Group 3 (exposed to the 810 nm wavelength), and Group 4 (exposed to the 1064 nm wavelength). The measurements used in this study were for two time periods: 3 and 6 weeks. The study focused on assessing changes in vital and hematological indicators resulting from repeated exposure to radiation. Blood analysis results revealed changes in some blood components and characteristics. The results revealed significant physiological effects associated with the length of exposure and wavelength. Analyses also revealed statistically significant differences ($P \leq 0.05$) in the studied parameters. These changes included a decrease in the number of white and red blood cells, along with changes in other hematological indicators such as HGB, LYM%, and changes in biochemical indicators such as GOT (AST), LDH, ALP, and CRP. These results indicate that home laser radiation has potential physiological effects on blood components and vital functions. These effects depend primarily on the wavelength used and the duration of exposure, highlighting the need for further studies to further understand the mechanisms of these biological effects.

***Keywords*:** Home-use laser, Wavelength, Rabbit blood, LDH, WBC, Biochemical changes.

1. Introduction

In recent years, the progress in up-to-date electronic technologies such as applied physic, and medical technologies has evolved in electromagnetic radiation devices. Foremost among these is the technology of lasers. Home laser devices, particularly intense pulsed light (IPL), are now some of the most common for hair removal and various skin purposes [1]. The term ‘LASER’ refers to "Light Amplification by Stimulated Emission of Radiation" [2]. Owing to their unique physical and selective parameters (laser Intense Pulsed Light), laser technologies have found extensive application in therapeutic and aesthetic (rejuvenating) practice in biology, especially in oncology, for example, dermatology and hair removal. Laser beams are an electromagnetic wave and photons carrying electromagnetic energy, which can be absorbed by living cells or electrons in biomolecules. This absorption may result in several effects on the constituents of biological tissues. [3]. Although these

devices have proven highly effective in terms of biological effects their effects on fragile biological systems are still being studied. Laser therapy is a noninvasive treatment or a therapy in which energy is directed to tissues using different wavelengths between 400 nm and 1064 nm [4]. Selection of the laser wavelength used is crucial to what type of effect is exerted on the target tissue, because biological tissue has differing reactions to different wavelength of light [1-4]. Contemporary medical applications also indicate an obvious point of benefit for this property, due to the fact that high-intensity laser beams can be applied to affected cells and affect selective damage[5]. Its characteristic properties are: high power and it is monochromatic, coherent and highly concentrated [6].

The nature and scale of the biological changes, induced by such irradiation of laser-in the interaction with cells and tissues may include blood cells and their constituents, as well as organs and organ system the body, depend primarily power of rays of laser acting on the bio tissues, on their length or duration and extent of the exposure to laser beams. Blood and biological tissues are also affected since the optical properties and microstructure of these tissues can change dramatically when exposure a laser beam [7]. Investigation of the above-threshold changes of optical characteristics is a process of fundamental importance in study of the biological effects of exposure to laser, and can be used for indirect measurement of such changes in optical parameters of blood and tissues. Since blood is an indispensable biological tissue and has a vital function in the balance of human body physiological activity, a myriad of scientific studies and experiments have been conducted based on the blood [8,9].

Many studies have shown that laser radiation has a variety of influences on the biological structures of living systems. As the researches shows, red light has an exciting effect on red blood cell growth, proliferation and differentiation [8, 9], and it can regulate human body's cells microcirculation too. It is blood's job to transport gases like oxygen and carbon dioxide, hormones and nutrients between the body's tissues. It also helps keep body temperature stable and carries waste products from the body's cells and out of the body. Blood is made up of a number of fundamental components, these include red blood cells, white blood cells, and platelets together with other vital substances (proteins, salts, albumin, etc.) carried in a liquid called plasma. Hence, if the blood or tissues fail in any way, the interference with the perfection of the work of life becomes manifest immediately in organ and cell [10]. It has been demonstrated in several studies that exposure to laser rays at

specific wavelengths, can result in changes in some blood parameters, as the rise of white and red blood cells, the level of hemoglobin and platelets, as well as increase in important enzymes LDH, ALT, AST, CRP etc. These effects may differ depending on the laser used, intensity of, duration, and application [11].

The research centers around evaluating the alterations that accumulated in whole blood and certain key biological enzymes, which acts indicative of the organism's biological response to radiation. In this context, this study evaluates the effect of home laser radiation (IPL) on some physiological blood parameters using of the analysis of rabbits blood samples collected before and after treatment, complete blooded count (CBC) and biochemical tests were used, to detect these variations and compare them to those in the control group. These parameters are sensitive to the complex biological response of the body and are potential changes that could result from the absorption of light energy at the molecular level of blood cells, disruption of red or white blood cell or platelet counts, or of blood enzymes or proteins concentrations in the blood stream [12]. Variations in the optical and microstructural properties of these biomaterials were observed, with the resulting bio-effects depending on laser wavelength, intensity, exposure time, and tissue characteristics [10]. Other studies have also demonstrated a possible effect on the erythrogram and leukogram due to the exposure of experimental animals to various wavelengths of laser radiation [12]. In a study by Amal Yousef Al-Yasiri, no damage to the integrity of the cell membrane proteins in the suspended red blood cells due to direct exposure to semiconductor diode laser for as long as 20 minutes has been found to take place. utilized laser radiation of the wavelength equal to 650 nm and power of 50 milliwatts [13]. A study by Wang et al. (2016) demonstrated in hypercholesterolemic rabbits that, using a low intensity 650 nm laser, the positive effects on the lipid profile, blood flow and RBC deformability showed the beneficial role of laser therapy, which result in biological effects of the laser [14].

The present study is designed to assess the physiological and biochemical impacts of home application of hair removal lasers at varying wavelengths (565, 810, 1064) nm. Emphasis is placed on the degree of perturbation, elicited by the wavelengths, of several haematological parameters (the blood cell count, the fractions of the blood components, and the basic crystals involved in vitalymphe regelation), but also of some biochemical markers, which are indicative for the integrity of tissues and organs, or for their functionality. In addition, the objective is to assess in the short and medium term the biological safety linked to the

use of laser at home, considering the physiological and hematological modifications from the local and repetitive actions of light radiation.

1.1. Effects of Laser Radiation on Biological Systems:

Biological effects are due to functional or structural modification in a biological system, produced by the exposure to external stimulations in term of laser radiation. However, these effects do not translate into a biological damage unless under certain conditions, and it is not necessarily a health hazard, as the deleterious effects depend on the body's ability to remove the heat made from laser absorption through normal processes, i.e. blood circulation and sweating [15]. In the biological context, biological systems may be influenced by lasers through the influence exerted on charged particles in tissues. When these rays are incident on living tissues, a variety of biological effects are induced, which are determined mainly by the nature of the tissue and its biological composition, and also by the intensity and wavelength of the incident radiation [16]. Each laser type has specific biological properties and effects, and these provide multiple applications in different work areas like medicine, industrial, biological scientific, etc. Moreover, the inflammation is responsible of the carcinogenesis in other to be considered the type of used laser. This needs to know precisely the processes of absorption, transmittance, and scattering of laser beams while passing through living tissues at the certain wavelengths, the radiation intensity and an exposure time which are necessary for action, the size of an exposure and properties of the exposed cells-target. [17] Effects of laser radiation on biological organisms are usually categorized into two types: thermal and non-thermal effects. Heat-effects induce a rise in living tissue temperature. [15].

Repetitive home use of lasers (IPL) System may potentially cause biological effects according to wavelength, energy intensity, and time elapsed. These effects, are those caused by the thermal effect within the tissue when light energy is absorbed and converted to heat in the tissue (burns, alterations in proteins). [18] Non-thermal effects are, however, not observed to influence the emitted temperature. These may involve the activation or inhibition of certain biochemical pathways inside the cell (e.g., respiratory chains or gene activities that control growth of the cell). Some research have the thermal and non-thermal effect of laser irradiation is directly related to the energy and frequency used, respectively, and also the duration of time which the irradiated for. The proportion of water in the tissue (as well as other factors) influences the extent to which laser energy is absorbed in the tissue of an

organism. Water-rich tissues are better absorbers of radiation. [18,19].

Following laser exposure, the appearance and development of clinical symptoms were observed. laser exposure is influenced by numerous factors including the power of the laser beam, wavelength, exposure time and the area of exposed tissue. These may be the modification at the cellular level, a temporary physiological effect or even genetic change if the exposure to the factor is high and uncontrolled. The laser can also interact with the human body by polarization and electrical induction, while an almost imperceptible electric current could flow within the body tissue due to the absorption of photons, and because of this the distribution of charges in the cell could be displaced, especially being the water the highest component of tissues. Water participates in the cellular radiation response because it changes the polar orientational inhomogeneities in its parts. [15] Some studies show that (810 nm) phototherapy reduces oxidative stress in animal models of skin wound healing [20].

2. Materials and Methods

2.1 Sample Collection

A total of 24 local laboratory female rabbits were involved in this experiment. They were selected randomly at (6-8) months of age and in weight (1900-2400 g), which were weighed by a sensitive balance were confined in battery cages. They were scrubbed and disinfected and given fresh water bottles to drink out of, along with shelter, every day. The animals were kept in appropriate laboratory conditions at a temperature of 22-25°C, with a standard 12 h light/12 h dark cycle. Animals had free access to water and commercial feed, green vegetables (carrot, cucumber, and leafy vegetables) in the animal house of College of Education for Pure Sciences of Thi Qar University. Subsequent to capture they were allowed 14 days to acclimate in the laboratory. All the animals were inspected for their good health prior to commencement of the experiment. They were randomly allocated into 4 groups: the control, and 3 experimental groups receiving three nm wavelengths (565, 810, 1064) nm of nm of nm of Phototherapy (using home laser device, Philips Lumea, intense pulsed light (IPL) device, which is often used to remove body hair). The device is made by Philips, a Dutch company. The measurements taken for this study were for two intervals, three weeks apart, six weeks and apart. A blood sample was obtained by direct heart puncture or ear puncture from 6 rabbits in each group. The anesthetic was 1% sodium pentobarbital (60 mg/kg) in all samples. 3 ml were collected with a medical syringe and transferred to laboratory glass tubes with ETA as anticoagulant. The procedure was repeated

three weeks after, and compared to control blood samples untreated by irradiation.

2.2 The devices used

2.2.1. Complete Blood Count and Analysis Apparatus

A Mindray BC 3000 Plus, produced by the Chinese company Mindray, was used to measure these characteristics in a lab in the Dhi Qar Governorate, Iraq. At a rate of one sample per minute, this gadget can analyze 60 samples per hour and assess up to 19 parameters. Total white blood cell count (WBC), total red blood cell count (RBC), lymphocyte percentage (LYM%), total white blood cell type neutrophil percentage hemoglobin (HGB) level, the oxygen-transporting protein in red blood cells, and essential enzymes like LDH, GOT,ALP, and CRP were among the blood parameters that were measured. There were notable variations amongst the various labs.

2.2.2. Electrochemiluminescence Immunoassay - COBAS E311

The COBAS E311 is an advanced medical device used for immunological and biochemical analysis of blood and other body fluids. It is based on electrochemiluminescence immunoassay (ECLIA) technology, which uses a ruthenium compound to produce electric light upon interaction with the sample, providing high accuracy and excellent sensitivity in detecting antigens, hormones, and antibodies. The device is capable of performing a wide range of tests, including measuring hormone levels such as TSH and vitamin D, as well as proteins and enzymes such as troponin and LDH. It is a reliable device for diagnosing and monitoring many medical conditions, including thyroid disorders, liver diseases, protein disorders, and various immunological tests. The COBAS E311 is commonly used in medical laboratories and hospitals and is an essential tool for diagnosing and monitoring various medical conditions.

2.3. Statistical Analysis

The Social Science Statistical Package (SPSS) (version 20) was used, based on an independent-sample t-test. Two-way analysis of variance (ANOVA) was applied to examine the effects of both exposure intensity and exposure duration, as well as their interactions, on the results. The LSD test was used to determine significant differences between means in the ANOVA test. We subtract any two means from the table and compare the result with the LSD value. If the subtraction value is equal to or greater than the LSD value, the data are presented as mean ± standard deviation, to account for the variation between samples. All values are represented by the mean (median) and the significance level (Sig). The results

were considered statistically significant at a probability level of P≤0.05.

3. Results and Discussion

The results obtained in this study, shown in Tables (1-8), showed that exposure to home laser (IPL) using wavelengths (565, 810, 1064) affected the following blood parameters: (WBC, LYM%, RBC, HGB), in addition to changes in biochemical indicators such as GOT (AST), LDH, ALP, and CRP. The results showed varying changes.

The results showed clear significant differences in the effect of exposure, as the differences between some treatments exceeded the least significant difference (LSD) value of 713, especially between the control treatment and the other treatments, indicating that exposure had a clear significant effect on LDH enzyme activity. On the other hand, no statistically significant differences were recorded when comparing the third week with the sixth week, as the difference between the averages of the two times was almost non-existent and less than the LSD value of 504, indicating the absence of a significant effect of time. Regarding the interaction effect between exposure and time, significant differences emerged in some interactions, especially those that combined different exposure levels to wavelengths (810, 1064 nm). These differences exceeded the LSD value of 1008, confirming the existence of a significant effect of the interaction between exposure and time.

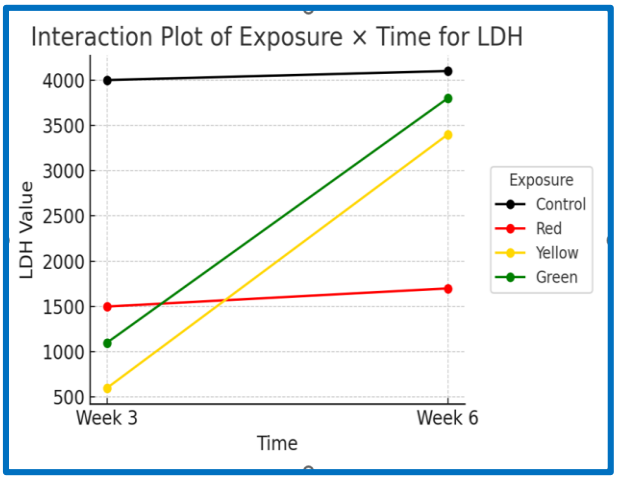

Fig. (1): Changes in LDH levels during the time periods (3 and 6 weeks) at different wavelengths: yellow (565 nm), red (810 nm), and green (1064 nm) and black(control)

Table 1: illustrates the results of changes in levels of LDH activity following exposure to laser at the following wavelengths: 565, 810, and 1064 nm over two time periods (3 and 6 weeks).

Exposure time / Exposure	After 3 weeks (M±SD)	After 6 weeks hot (M±SD)	concentration rate (M±SD)
Control	4441±7.78	4448±5.317	4444±7.334
wavelength 565nm	1659±2445	1887±9.309	1773±1652
wavelength 810 nm	560±6.74	3542±9.354	2051±1557
wavelength 1064 nm	1016±10.52	3919±13.382	2467±1516

Exposure rate	1919±1915	3449±978	2684±1691
LSD (P≤0.05)	**to be exposed= 713**	**For time = 504**	**To interfere = 1008**

Table 2: illustrates the results of changes in levels of (GOT) activity following exposure to laser at the following wavelengths: 565, 810, and 1064 nm over two time periods (3 and 6 weeks).

Exposure time / Exposure	After 3 weeks (M±SD)	After 6 weeks hot (M±SD)	concentration rate (M±SD)
Control	657.50±1.87	658.0±1.41	657.75±1.6
wavelength 565nm	80.03±0.71	164.0±1.41	122.02±43.8
wavelength 810 nm	45.03±0.71	278.0±1.41	161.52±121.6
wavelength 1064 nm	88.03±0.71	310.8±15.52	199.43±116.8
Exposure rate	259217.65±	352.71±188	234.7±285.17
LSD (P≤0.05)	**to be exposed =4.63**	**For time = 3.27**	**To interfere= 6.55**

The results showed a significant effect of exposure on GOT enzyme activity. The differences between some exposure levels exceeded the least significant difference (LSD) value of 4.63, indicating that exposure is a statistically significant factor in determining enzyme activity. Regarding the effect of time, the data revealed that the difference between the means of the third and sixth weeks was 135.06, which is higher than the approved LSD value for time of 3.27. This reflects the presence of significant differences between the two measurement periods and highlights the role of time as an influential factor in changing enzyme levels. Regarding the interaction effect between exposure and time, significant differences were observed between some interactions, with these differences exceeding the LSD value of 6.55, confirming that the interaction between exposure and time significantly contributes to influencing GOT enzyme activity. Therefore, it can be concluded that both exposure and time, as well as the interaction between them, play a statistically significant role in the physiological changes associated with the activity of this enzyme.

The results of the statistical analysis revealed significant differences in the effect of exposure on C-Reactive Protein (CRP) concentrations. The differences

recorded between some treatment levels exceeded the least significant difference (LSD) value of 0.026, which clearly indicates that exposure is a statistically significant factor affecting the level of this inflammatory protein.

As for the time factor, the data showed a clear significant effect, as the difference between the mean concentrations after the third week (0.47104) and after the sixth week (0.14992) was 0.32112, which significantly exceeds the time-specific LSD value of 0.018, indicating that the difference between the two time periods is not only significant.

Regarding the interaction between exposure and time, some interferences - particularly those associated with wavelengths of 565 nm and 1064 nm - showed differences that exceeded the LSD value of the interference of 0.037, indicating the presence of a significant interaction.

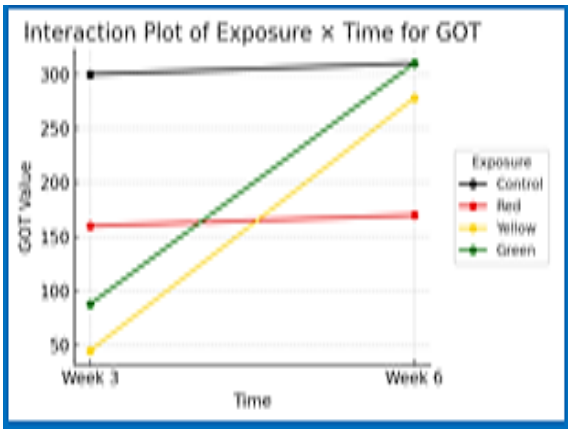

Fig. (2): Changes in GOT levels during the time periods (3 and 6 weeks) at different wavelengths: yellow (565 nm), red (810 nm), and green (1064 nm) and black (control).

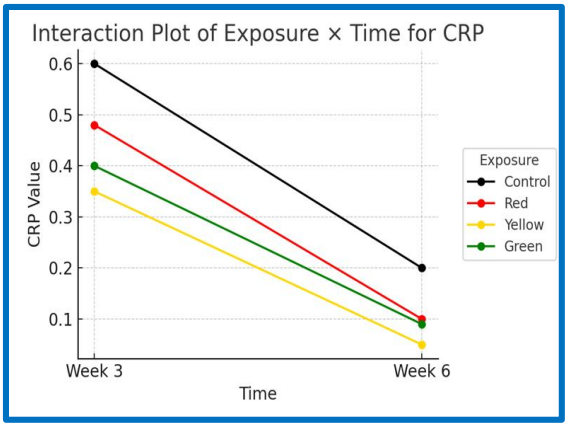

Fig. (3): Changes in CRP levels during the time periods (3 and 6 weeks) at different wavelengths: yellow (565 nm), red (810 nm), and green (1064 nm) and black (control)

Table 3: illustrates the results of changes in levels of (CRP) activity following exposure to laser at the following wavelengths: 565, 810, and 1064 nm over two time periods (3 and 6 weeks).

Exposure time / Exposure	After 3 weeks (M±SD)	After 6 weeks hot (M±SD)	concentration rate (M±SD)
Control	0.04±0.02	0.032±0.01	0.037±0.012
wavelength 565nm	0.61±0.03	0.011±0.005	0.314±0.316
wavelength 810 nm	0.60±0.027	0.55±0.04	0.578±0.043
wavelength 1064 nm	0.62±0.04	0.005±0.003	0.312±0.32

Exposure rate **LSD (P≤0.05)**	0.47±0.25 **to be exposed =0.026**	0.149±0.23 **For time =0.018**	0.29±00.3105 **To interfere=0.037**

Table 4: illustrates the results of changes in levels of (ALP) activity following exposure to laser at the following wavelengths: 565, 810, and 1064 nm over two time periods (3 and 6 weeks)**.**

Exposure time / **Exposure**	**After 3 weeks (M±SD)**	**After 6 weeks hot (M±SD)**	**concentration rate (M±SD)**
Control	86.67±1.08	87.03±0.71	86.85±0.89
wavelength 565nm	57.05±0.71	61.03±0.71	59.04±2.18
wavelength 810 nm	66.05±0.71	50.03±0.71	58.04±8.39
wavelength 1064 nm	52.03±0.71	44.03±.71	48.03±4.23
Exposure rate	65.45±13.54	60.53±16.83	15.31±62.99
LSD (P≤0.05)	**to be expose= 0.63**	**For time= 0.45**	**To interfere= 0.90**

The statistical results revealed significant differences between exposure and Alkaline Phosphatase (ALP) activity. The differences recorded between some treatment levels exceeded the least significant difference (LSD) value of 0.63, indicating that exposure had a statistically significant effect on altering the activity of this enzyme. Regarding the effect of time, the average ALP concentration after three weeks was 65.45, while it decreased to 60.53 after six weeks, a difference of 4.92. This difference is higher than the time-specific LSD value of 0.45, indicating significant differences between the two time periods, indicating the influence of time on enzyme activity. As for the interaction effect between exposure and time, the differences recorded in some interferences, particularly at wavelengths 565 nm and 810 nm, exceeded the LSD value of 0.90, confirming the existence of a significant interaction between these two factors in influencing ALP enzyme activity. Together, these results indicate that exposure and time, individually, as well as their interaction, are factors with a reliable significant effect on the biological changes associated with this enzyme.

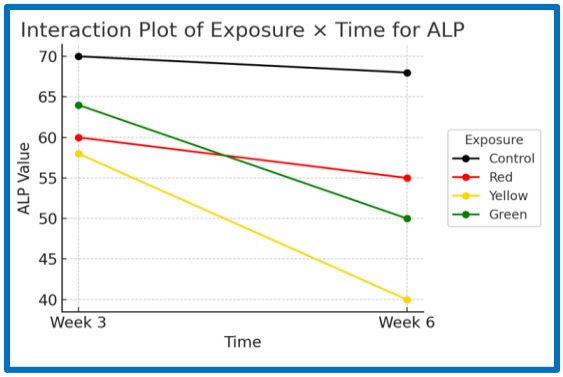

Fig. (4): Changes in ALP levels during the time periods (3 and 6 weeks) at different wavelengths: yellow (565 nm), red (810 nm), and green (1064 nm) and black (control).

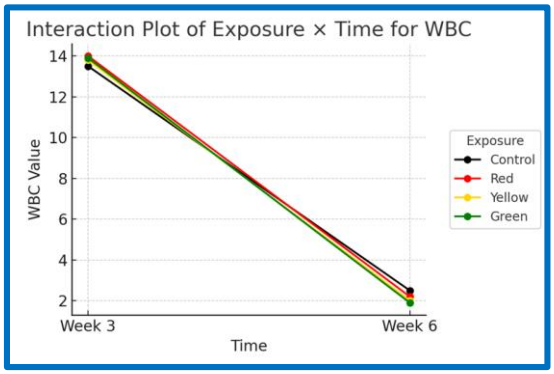

Fig. (5): Changes in WBC levels during the time periods (3 and 6 weeks) at different wavelengths: yellow (565 nm), red (810 nm), and green (1064 nm) and black (control).

The results showed significant differences in the effect of exposure on white blood cell (WBC) counts. The differences between some treatment levels, particularly between the green treatment and the control or red treatment group, exceeded the least significant difference (LSD) value of 0.240, indicating that exposure had a statistically significant effect on the changes in this blood indicator. Regarding the time factor, the difference between the average white blood cell counts after three weeks (13.7558) and after six weeks (2.3000) was 11.4558, a significant difference that exceeded the time LSD value of 0.170, indicating clear significant differences between the two periods and reflecting the clear influence of time in regulating WBC counts.

Regarding the interaction between exposure and time, some interactions, particularly at the 1064 nm wavelength, showed differences that exceeded the LSD value of 0.338, indicating a significant interaction between these two factors. Thus, it is clear that exposure and time, in addition to the interaction between them.

Table 5: illustrates the results of changes in levels of (WBC) activity following exposure to laser at the following wavelengths: 565, 810, and 1064 nm over two time periods (3 and 6 weeks).

Exposure time / Exposure	After 3 weeks (M±SD)	After 6 weeks hot (M±SD)	concentration rate (M±SD)
Control	2.367±0.21	2.250±0.18	2.308±0.202
wavelength 565nm	1.265±0.061	2.450±0.18	1.857±0.63

wavelength 810 nm	8.592±0.201	0.950±0.18	4.771±3.99
wavelength 1064 nm	42.80±0.66	3.550±0.18	23.175±20.502
Exposure rate	13.756±17.36	2.30±0.95	13.47±8.028
LSD (P≤0.05)	**to be expose= 0. 338**	**For time = 0.170**	**To interfere=0.240**

Table 6: illustrates the results of changes in levels of(LYM) activity following exposure to laser at the following wavelengths: 565, 810, and 1064 nm over two time periods (3 and 6 weeks) .

Exposure time / **Exposure**	**After 3 weeks (M±SD)**	**After 6 weeks hot (M±SD)**	**concentration rate (M±SD)**
Control	1.308±0.02	1.3450±0.07	1.33±0.05
wavelength 565nm	0.135±0.01	1.9617±0.12	1.05±0.95
wavelength 810 nm	1.328±0.015	0.6500±0.10	0.99±0.36
wavelength 1064 nm	0.570±0.01	2.4750±0.08	1.52±0.99
Exposure rate	0.835±0.51	1.6079±0.70	0.72±01.22
LSD (P≤0.05)	**to be expose= 0. 082**	**For time=0.040**	**To interfere= 0.059**

The results of the statistical analysis showed significant differences between some exposure levels in the lymphocyte ratio (LYM). The differences between specific parameters, such as the 1064 nm wavelength compared to the control or the 810 nm wavelength, exceeded the LSD value of 0.059, indicating a significant effect of exposure on the lymphocyte ratio (LYM). This indicates that exposure has a statistically significant effect on this immune indicator. Regarding the time factor, the average ratio after three weeks was 0.8354, while it increased to 1.6079 after six weeks, a difference of 0.7725. This significantly exceeds the time-specific LSD value of 0.040, reflecting clear significant differences between the two time periods. Regarding the interaction between exposure and time, some interactions, particularly those related to the wavelengths 565 nm and 810 nm, showed differences that exceeded the LSD value of 0.082, indicating a significant interaction between exposure and time on regulating lymphocyte ratios. Accordingly, it is clear that both exposure and time, in addition to the interaction between them, are statistically significant factors in determining this biomarker. The results

showed significant differences attributed to the exposure factor in hemoglobin (HGB) concentration. The differences recorded between some treatment levels, particularly between the 810 nm wavelength treatment and the rest of the treatments, exceeded the LSD value of 0.19, indicating that exposure has a significant impact on determining the levels of this blood indicator. Regarding the time factor, the data revealed a clear difference between the average concentration in the third week (7.967) and the sixth week (6.267), with a difference of 1.7, which is significantly higher than the estimated time LSD value of 0.134, indicating a significant time effect on the change in hemoglobin concentration. Regarding the interaction between exposure and time, significant differences were recorded that exceeded the LSD value for the interaction, which amounted to 0.270, particularly in the coefficients associated with the wavelengths "565 nm" and "810 nm," reflecting the presence of a statistically significant interactive effect between exposure and time on regulating HGB concentration. Therefore, these results combined indicate that exposure, time, and the interaction between them represent statistically significant factors influencing hemoglobin levels.

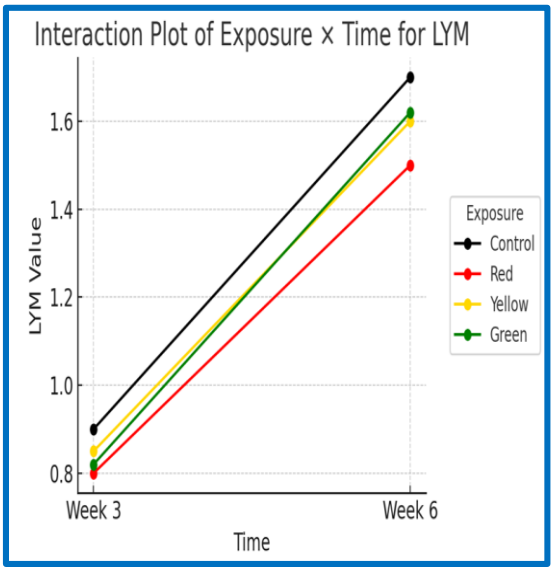

Fig. (6): Changes in LYM levels during the time periods (3 and 6 weeks) at different wavelengths: yellow (565 nm), red (810 nm), and green (1064 nm) and black (control). ermining this biomarker

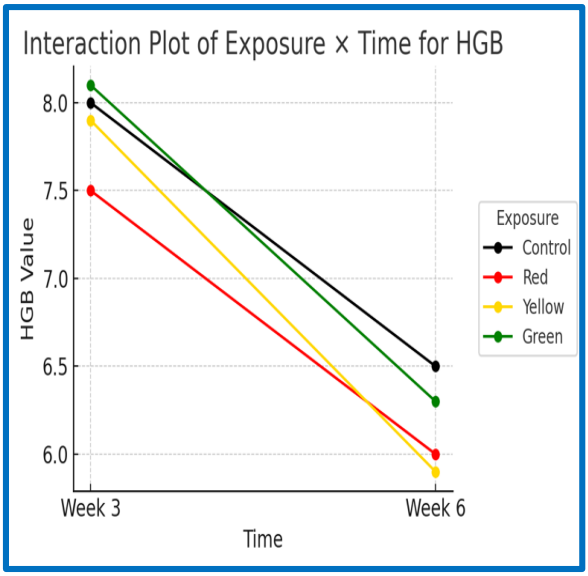

Fig. (7): Changes in HGP levels during the time periods (3 and 6 weeks) atdifferent wavelengths: yellow (565 nm), red (810 nm), and green (1064 nm. and black (control).

Table 7: illustrates the results of changes in levels of(HGB) activity following exposure to laser at the following wavelengths: 565, 810, and 1064 nm over two time periods (3 and 6 weeks).

Exposure time / Exposure	After 3 weeks (M±SD)	After 6 weeks hot (M±SD)	concentration rate (M±SD)
Control	4.81±.23	5.05±.18	4.93±.23
wavelength 565nm	6.58±.31	9.25±.18	7.92±1.41
wavelength 810 nm	12.05±.18	2.52±.24	7.28±4.98
wavelength 1064 nm	8.41±.25	8.25±.1871	8.33±.23
Exposure rate	±2.747.97	6.27±2.72	2.84±7.12
LSD (P≤0.05)	**to be expose = 0.270**	**For time 0.134=**	**To interfere 0.19 =**

Table 8: illustrates the results of changes in levels of(RBC) activity following exposure to laser at the following wavelengths: 565, 810, and 1064 nm over two time periods (3 and 6 weeks).

Exposure time / Exposure	After 3 weeks (M±SD)	After 6 weeks hot (M±SD)	concentration rate (M±SD)
Control	2.28±0.012	2.283±0.01	2.28±0.01
wavelength 565nm	3.296±0.02	5.03±0.01	4.16±0.90
wavelength 810 nm	5.54±0.012	1.46±0.01	3.50±2.12
wavelength 1064 nm	3.97±0.015	4.66±0.017	4.31±0.36
Exposure rate	3.77±1.21	3.36±1.55	3.56±1.39
LSD (P≤0.05)	**to be expose= 0.019**	**For time= 0.009**	**To interfere= 0.013**

The results showed clear significant differences between some exposure levels, with the recorded differences exceeding the LSD value of 0.013, particularly between the control group and the treatments associated with the 565 nm and 810 nm wavelengths, indicating a significant effect of exposure on red blood cell counts. A clear significant difference was also revealed between the two time periods, with the difference between the average. of the third week (3.77) and the sixth week (3.36) reaching 0.41, which is higher than the time LSD value of 0.009. Furthermore, significant differences were recorded in some interactions between exposure and time, exceeding the LSD value of 0.019, particularly for the treatments associated with the 565 nm and 810 nm wavelengths, indicating

a significant combined effect between the two factors on this blood indicator.

As shown in Tables 1-8, the results of home laser exposure showed significant physiological and biochemical effects compared to the control group, with clear changes after exposure periods of 3 and 6 weeks. These results indicate that the biological effects of lasers accumulate over time and depend on the duration of exposure. This suggests a direct relationship between the penetration depth of each wavelength in the extensions and the adverse effects. The data, therefore, exclude the wavelength, is one of the most important physical factors confirmed by the long-distance approach. For the 565 wavelengths, the collection showed highabsorption by melanin and hemoglobin, but not deep enough to be completely unchanged after three weeks. The percentage of white blood cells and red blood cells was characterized, while C-reactive protein (CRP) levels appeared, indicating a transient pathological inflammation. The white blood cells and red blood cells recorded an increase from the sixth week, and C-reactive protein decreased to lower values than the control group, indicating increased immunological diversity. It also confirms the increase in red blood cells and red blood cells, indicating the provision of essential blood functions. The 810 wavelength (near-infrared, with greater tissue penetration) had a wide-ranging effect on the biochemical and radiological effects of the 565 wavelengths. At three weeks, exposure produced the highest red blood cell count and HGB concentration, followed by Colorado at week six, indicating a physiological association with blood loss and efficient hematopoietic cell proliferation. Additionally, we were asked to move in a marine tetraplegia (PLT), where the highest association was observed, followed by a lower association indicating phototoxic/oxidative effects. Liver aminotransferase (GOT and GPT) and ALP levels were significant, particularly at six weeks, which may be related to impaired liver function and persistent hematologic inflammation. The 1064 wavelength demonstrated collagen, which penetrates the most (because melanin and hemoglobin absorb it less), and had immediate, rapid effects.

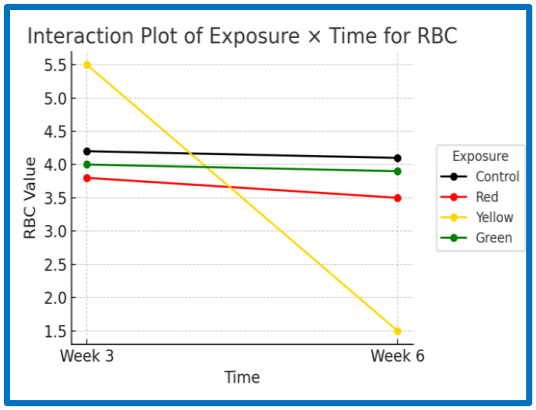

Fig. (8): Changes in RBC levels during the time periods (3 and 6 weeks) at different wavelengths: yellow (565 nm), red (810 nm), and green (1064 nm) and black (control).

Significant increases in leukocytes and C-reactive protein were also observed at three months, indicating severe tissue inflammation due to permeability of muscle tissue. These are gene sequences in red blood cells, namely myoglobin, which became fetal in alkaline phosphatase (ALP) and dehydrogenase (LDH), indicating any effect. With prolonged exposure for 6 weeks, C-reactive protein (CRP) and white blood cell (WBC) levels showed a marked improvement; lithium lysate (LYM) levels were clearly improved - from infection to immunological and physiological vaccination. These results indicate that each wavelength appears to work synergistically with respect to the duration of genetic modification. The effect of poor wavelengths is reflected in tissue depth and biochemical and biological markers, and time controls the reversal of these effects through physiological adaptation pathways. This onset may be attributed to the laser's interaction with tissue (i.e., the absorption of light energy in hemoglobin molecules and emerging enzymes, which are converted into a temporary component (thermal effect), as well as to the free choice that selects for oxidative residues, in addition to the expression of inflammation and metabolism.

Comparing the final results, it can be concluded that the 565 laser accelerates rapid changes in binding, while the 810 laser requires immunological integration for hematologic and transcriptional changes. The 1064 laser stimulates strong muscle, which quickly leads to immune adaptation, perhaps because the 1064 laser activates the organ's organelles. Comparing the results, the 565 laser generated rapid collective changes, compared to the different responses of the 810 laser as a primary component of immune activation, followed by a gradual change in electrical energy. The 1064 laser application was associated with severe inflammation and quickly transformed

into adaptation due to its profound effect properties at specific doses. Thanks to the above, the current findings confirm the impact of biological lasers. We have seen that 565 amplification leads to temporary effects, while the deeper 810 and 1064 amplifications have maximum effects within the body, including changes in blood components, related enzyme activity, and potential immunogenicity. These effects affect the range of wavelengths, access requirements, and frequency: these are linked to the wavelength's access property.

Therefore, it is advisable to use these devices within the home with caution, as more comprehensive research is needed on the safety limits and interaction mechanisms between these lasers and vital body elements. These findings are compared with previous research indicating that 810 amplification proteins cause damage and oxidative stress in red blood cells, especially in malnutrition.

4. Conclusion

The study demonstrated that exposure to home laser (IPL) at wavelengths of 565, 810, and 1064 nm resulted in significant physiological and biochemical effects on the vital blood components of rabbits. The 565 nm wavelength produced rapid and temporary effects, whereas the deeper wavelengths, 810 and 1064 nm, caused more pronounced changes, including alterations in blood cells, enzyme activity, and immune response. The intensity of these effects depended on both the wavelength and the duration of exposure, highlighting the importance of using home laser devices with caution and the need for further studies to understand the biological mechanisms of laser interaction with the body and its impact on vital functions.

Conflict of Interest Statement

The authors declare that there is no conflict of interest regarding the publication of this paper.

Authors' contributions

Zainab K. Ibrahim: Conducted the practical experiment, collecting samples, and supervising their conditioning in the laboratory. She also contributed to preparing some of the tools needed to perform tissue cutting and participated in the cutting process itself. Additionally, she contributed to preparing the main design of the experiment and repeated it

multiple times to ensure accurate and reliable results. She also played a role in reviewing the literature related to some of the main research topics.

Ahmed R. Mathloum: General supervision of the experiment and the measurement process generator as well as writing the main topics and collecting sources.

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