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Effects of Laser Radiation on Erythrocytes Sedimentation Rate

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ABSTRACT

The effect of the Carbon dioxide (CO_2) laser radiation on the Erythrocyte Sedimentation Rate (ESR) in the blood sample is studied in this research in vitro. Carbon dioxide (CO_2) laser was used for irradiation the blood samples. the study irradiation time was (5,10,15,20)s ; so the dose of irradiation were (1,8 ,13)watt . The sample of the blood obtained from twenty volunteers and each sample was divided into two samples for control and irradiation. The ESR was measured after laser irradiation and compared with un irradiation control. The results showed that there were significant differences in the values of sedimentation rates for (1,8 ,13)watt for control and irradiation. the results show that erythrocyte sedimentation rate decreases with increasing laser radiation with constant exposure time (5,10,15,20)sec and erythrocyte sedimentation rate decreases with increasing time exposure with constant laser radiation .

Introduction

The erythrocyte sedimentation rate (ESR) is defined as simple common and inexpensive laboratory test. It is normally used to assess the acute phase of the inflammatory response and to assissment diagnose conditions associated with acute and acute inflammation, including infections, cancers, and autoimmune diseases. ESR is nonspecific because the rise in its level does not tell exactly where is the inflammation site in the body or what is causing it, and also because it can be affected by other conditions besides inflammation. For this reason, ESR is typically used in conjunction with other tests **[1]**. The principle of the ESR is based on the actuality when well-mixed venous blood is placed in a vertical tube, the red blood cells (RBCs) will settle out of the plasma and fall towards the bad of the tube and the pale yellow liquid (plasma) rises to the top. After 60 minutes, measurements are taken of the distance the red cells traveled to settle at the bad of the tube. The length of the fall top of the column the red blood cells in a given interval of time is the erythrocyte sedimentation rate (ESR). Normally red cells don't settle far toward the bad of the tube, they fall slowly, leaving little clear plasma. Many diseases make additional or abnormal proteins (such as fibrinogen or immunoglobulins, which are increased in inflammation) that cause the red cells to move close together, stack up, and form a column rouleaux). In the group, red cells are heavier and fall faster. The faster they fall , the further they settle, and the higher the ESR. **[2]** Red cells carry a negative surface charge that impedes red cell aggregation.in the presence of asymmetric high molecular weight proteins especially those with appositive charge the tendency for red cells to repel each other is reduced and red cell aggregation is promoted. **[3,4,5].**

Aggregate cells sediment more quickly in the presence of inflammation, there is a cytokine mediated increase in proteins in the plasma as a part of acute phase response and consequently an increase in the ESR **[3,5]**.

Three stage of (ESR):-

First: Stage of the aggregation: the initial stage in which the piling up of red blood cells (RBCs) takes place. The phenomenon is known as Rouleaux formation. It occurs in the first 10-15 minutes.

Second: Stage of the sedimentation: It is stage of actual falling of red blood cells (RBCs) in which sedimentation occurs at a constant rate. This occurs in 30-40 minutes out of 1 hour, depending upon the length of the tube used.

Last: Stage of packing: This is a final stage and is also known as the stationary phase. In this, there is a slower rate of falling during which packing of

sedimented red blood cells RBCs in column occurs due to overcrowding. It occurs in the final 10 minutes in 1 hour fig(1)**[6]**.

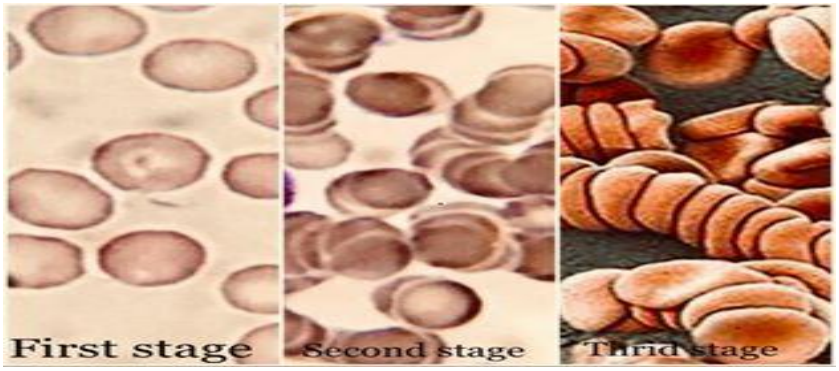

Fig. 1: Three stages of sedimentation rate.

Normal ESR Values:-

Gender	ESR
Males(under50)	0-15
Males (over50)	0-20
Females(under50)	0-20
Females(over50)	0-30
Children(under10)	0-13
New born	0-2

[11].

The ESR is affected by two main factors; biological factors and nonbiological factors. Biological factors include the plasma factor, the erythrocyte factor, the viscosity factor, the age factor and the race factor, and none biological factors include technical factors, physical factors such as the effect of laser radiation, and some of the mechanical factors **[7].**

There are several methods for the determination of ESR westergren methods, wintrob methods, landu methods **[8]**

There are many kinds of lasers (solid, liquid, and gas)are available .they all operator on the principle from they get their name. The carbon dioxide laser (CO2 laser) was one of the earliest gas lasers to be developed. It was invented by Kumar Patel of Bell Labs in 1964, and is still one of the most useful. Carbon dioxide lasers are the highest-power continuous wave lasers that are currently available. They are also quite efficient: the ratio of output power to pump power can be as large as 20%. The Carbon dioxide laser produces a beam of infrared light with the principal wavelength bands centering on 9.4 and 10.6 micrometers (μm) **[9]**. Laser radiation with different power and exposure time have been consumed in blood therapy for a variety of medical application due to its capability to modify blood rheology and enhancement of microcirculation. Actually the laser radiation therapy does not induce thermal changes for that reason; it will not cause living cell damage **[10]** .

Method of work :

- 5ml of fresh venous blood was collected from the ante cubital vein of each volunteers (after sterilizing the cubital fosa by apiece of cotton with alcohol). And put the blood in the EDTA tube . This part included or present study.
- take 2ml of blood put it in the tube ESR ,filled the westergren pipe exactly to (0) mark and put them in the rack .
- the sedimented erythrocyte was recorded every 20min for 2hour ,at the room temperature (22-28)C° cells measured in mm/hr we taked it as a control .
- take 1 ml of the same blood sample in the another tube fixed by holding in directly in fornt of the laser beam so the beam pass directly through the opening end of the tube and thus let the whole blood to exposed to the light(1, ,8,13)watt for limited time (by using stop watch).
- the value of ESR for this blood sample fixed by using westergren method. The erythrocyte sedimentation was recorded every 20 min for 80 min.
- the above process was repeated for different exposure time(5,10,15,20)s for each laser light and comparaed with the reading of ESR before and after the exposure .

Results and Discussion

The table (1) show's the ESR values is directly proportional to the laser radiation (power) at the constant red blood cells concentration of powers (1,8,13) watt .

Table 1: The effect of laser on ESR with values whole blood

Time(min.)	power(watt)	time exposure (sec.) control	5	10	15	20
20	1	1	0.62	0.52	0.37	0.25
	8	1	0.79	0.68	0.44	0.33
	13	1	0.83	0.75	0.62	0.51
40	1	1	0.69	0.6	0.54	0.31
	8	1	0.83	0.75	0.69	0.56
	13	1	0.86	0.81	0.73	0.67
60	1	1	0.74	0.66	0.59	0.47
	8	1	0.88	0.81	0.74	0.61
	13	1	0.93	0.85	0.79	0.72
80	1	1	0.81	0.72	0.66	0.56
	8	1	0.92	0.84	0.8	0.74
	13	1	0.98	0.92	0.87	0.82
P*, comparison with 5s.				<0.05	<0.05	<0.05
P**, comparison with 10s.					<0.05	<0.05
P***, comparison with 15s.						<0.05

In the figure (2) shows that the effect of laser (1,8,13) watt at time exposure (5,10,15,20) sec ,the exposure time of blood sample to laser is in sec because the laser radiation is very strong, we took it more than 60sec the blood sample was septicemia. we can see that the ESR values is directly proportional to the laser radiation and exposure time at constant time sedimentation 80 mine.

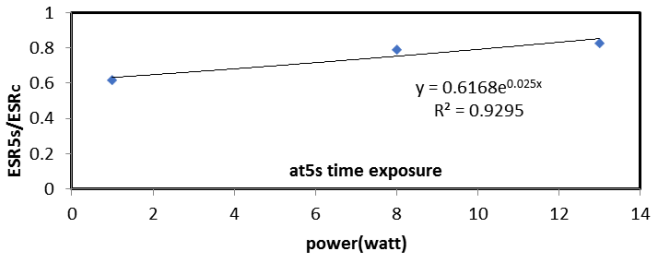

Fig. 2: (a) the relation between ESR and power with time exposure 5s with constant sedimentation time 20min.

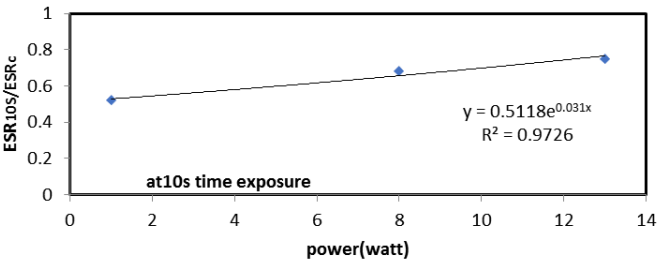

Fig. 2: (b) the relation between ESR and power with time exposure 10s with contant sedimentation time 20min.

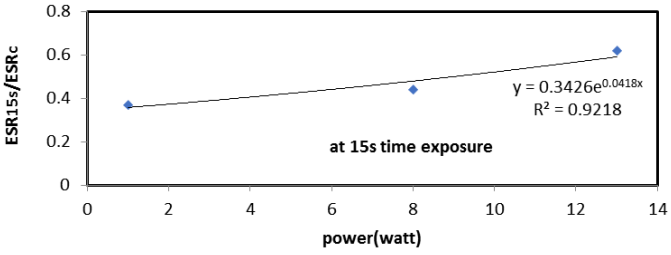

Fig. 2: (c) the relation between ESR and power with time exposure at 15s with constant sedimentation time 20min.

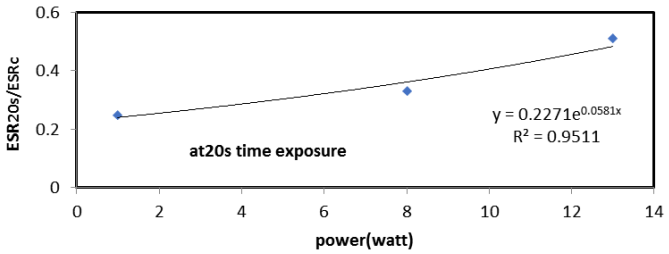

Fig. 2: (d) the relation between ESR and power with time exposure at (d)20s with constant sedimentation time 20min.

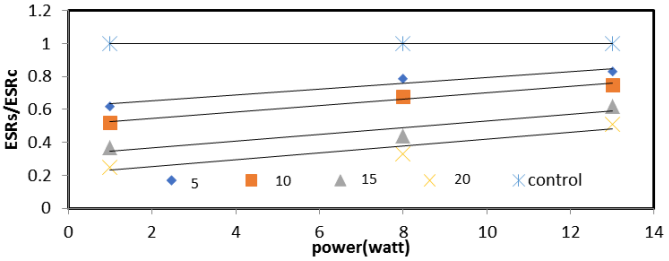

Fig. 3: compare the relation ship between ESRs/ESRc with different exposure time at constant sedimentation 20min.

from the figures (4,5,) we can see the time sedimentation rate proportional to the laser radiation if we increase the time exposure the blood sample to the laser and power of laser light and the time to the sedimentation increase .

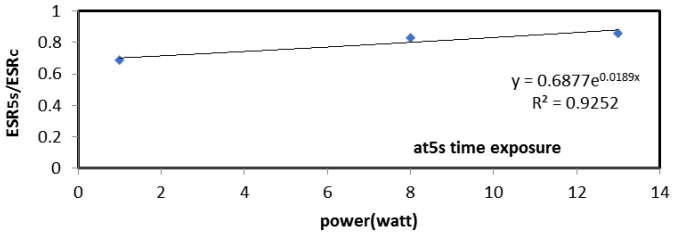

Fig. 4: (a) the relation ship between ESRs/ESRc and power at constant exposure time (a)5s constant sedimentation time 40min .

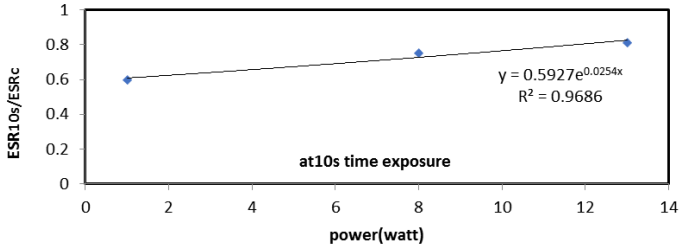

Fig. 4: (b) the relation ship between ESR10s/ESRc and power at constant exposure time (b)10s with constant sedimentation time 40min .

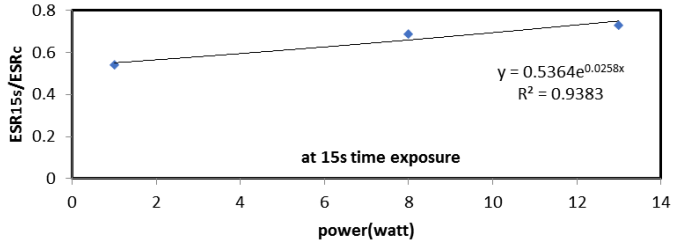

Fig. 4: (c) the relation ship between ESR15s/ESRc and power at constant exposure time (c)15s with constant sedimentation time 40min .

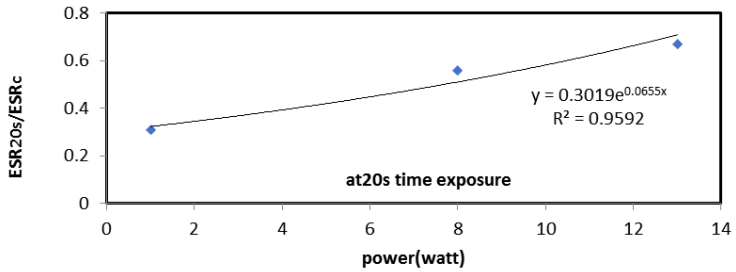

Fig. 4: (d) the relation between ESR20s/ESRc and power constant exposure time (d)20s with sedimentation time 40min.

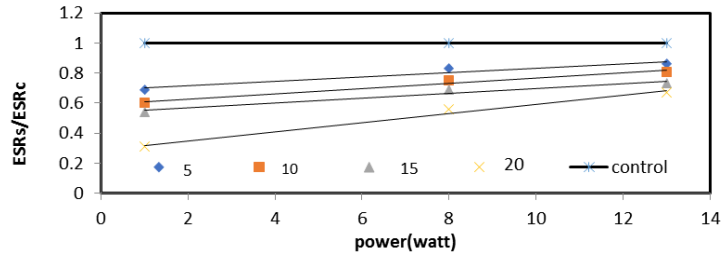

Fig. 5: compare the relation ship between ESRs/ESRc with different exposure time at constant sedimentation time 40s .

The ESR values is decrease with increasing the laser radiation (power) [12].thus,the change in the time exposure effecting to the ESR, increasing in the time exposure the blood sample to the laser radiation leads to decrease in ESR with increasing laser radiation.

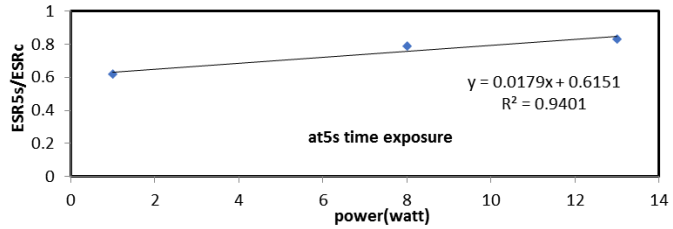

Fig. 6: (a) the relation ship between ESR5s/ESRc and power at constant exposur time (a)5s with contant sedimentation time 60s .

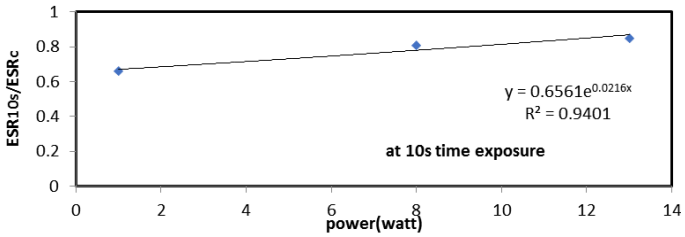

Fig. 6: (b) the relation ship between ESR10s/ESRc and powerat contant exposure time at ((b)10s with constant sedimentation time 60min .

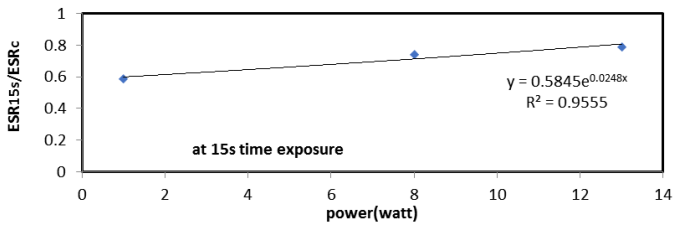

Fig. 6: (c) the relation ship between ESR15s/ESRc and power costant exposure time at (c)20s with constant sedimentation time 60min .

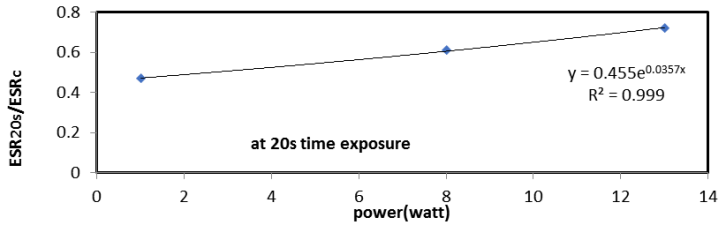

Fig. 6: (d) the relation ship between ESR20s/ESRc and power constant exposure time at (d)20s with constant sedimentation time 60min .

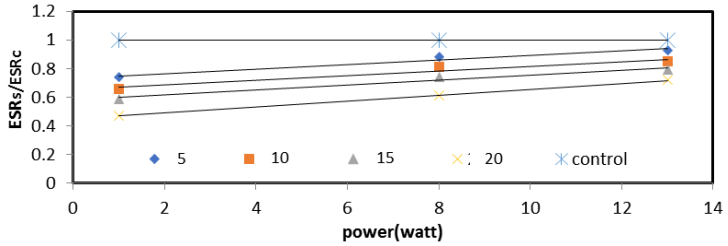

Fig. 7: compare the relation ship between ESRs/ESRc with different exposure time at constant sedimentation time 60.

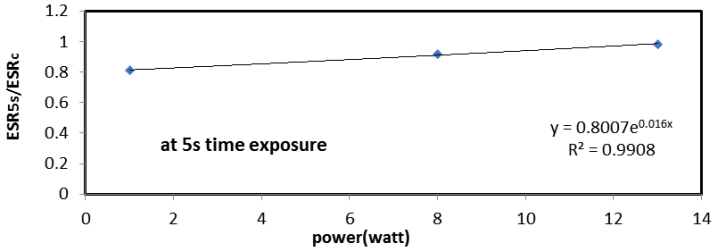

Figure8.(a) the relation ship between ESR5s/ESRc and power at costant exposure time (a)5s with sedimentation time 80min.

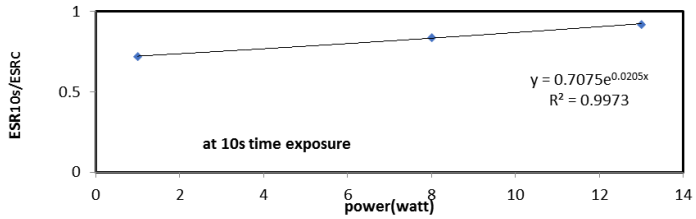

Fig. 8: (b) the relation ship between ESR10s/ESRc and power at constant exposure time [(b)10s] sedimentation time (80min).

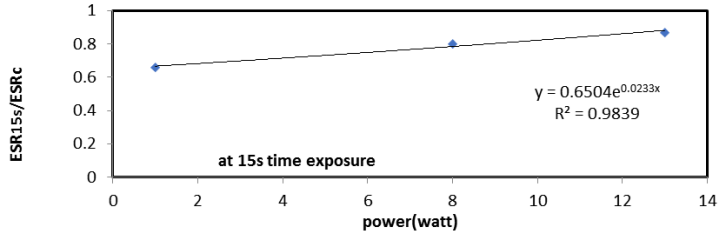

Fig. 8: (c) the relation ship between ESR15s/ESRc and power at constant exposure time (c)15s with constant sedimentation time 80min.

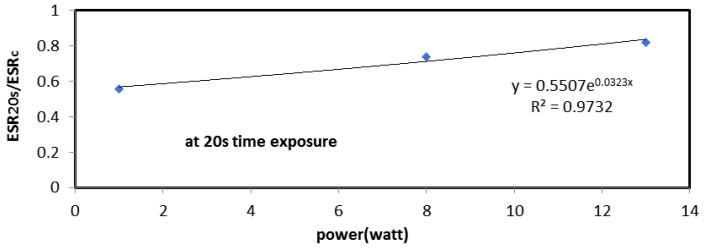

Fig. 8: (d)the relation ship between ESR20s/ESRc and power at constant exposure time (d)20s with constant sedimentation time 80min .

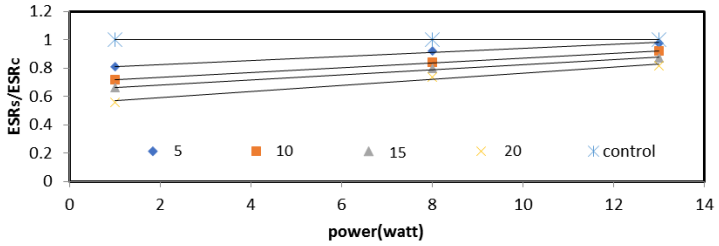

Fig. 9: compare the relation ship between ESRs/ESRc with different exposure time at constant sedimentation time 80min.

The red blood cells become important factor of determine the erythrocyte sedimentation rate, before the blood sample exposure for the laser carbon dioxide we notice in the figure (10) that the red blood cells are normal and ESR are normal value.

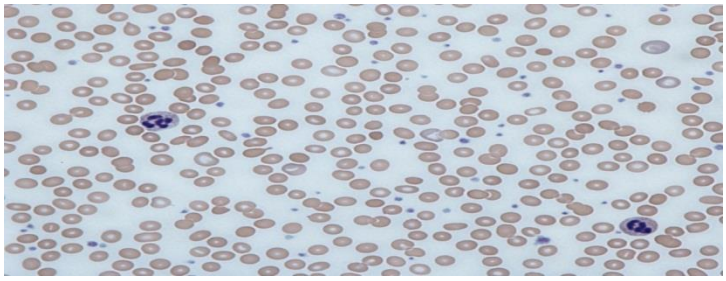

Fig.10: The red blood cells before exposure to laser radiation.

but in the figures (11,12) after exposure for the laser radiation. the membrane of red blood cells is affected by the laser radiation which is main reason to decrease in sedimentation rate of red blood cells which leads to some of the content of red blood cell deposit outside. This leads to increase plasma viscosity and reduce the size of red blood cells.

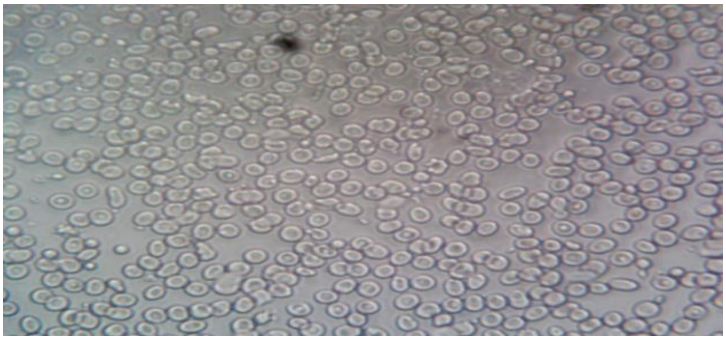

Fig.11: The red blood cell after exposure to the (5watt) laser radiation.

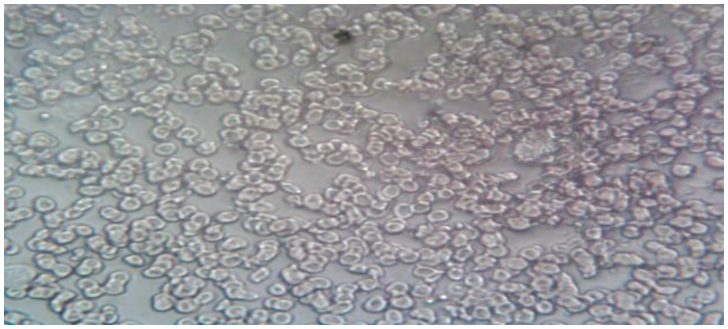

Fig. 12: The red blood cell after exposure to the (13watt) laser radiation.

Some deviations in the form of red blood cells after exposure to the laser radiation in a few doses may indicate injury to some specific diseases related to the blood. The concave shape indicates diseases associated with a genetic defect or area contagious or a result of chemical imbalance. swelling of the cells indicates malaria, while sickle shape cells take up with sickle cell anemia

Conclusions

The value of sedimentation rate of red blood cells decreased with increased laser radiation at different time exposure.

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