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# Hypolipidemic and antioxidant effect of liposomal Rosuvastatin *in vivo*

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**Abstract**

Liposomes are special kinds of lipid vesicles with phospholipid complexes and amphiphilicity. They can help the body use and absorb drugs that don't dissolve well in water. The objective of the current study is to increase the bioavailability and solubility of rosuvastatin calcium (ROSCa) in aqueous media.Liposomal rosuvastatin was synthesized after decalcification (dicalcium) to complete phospholipid binding. Optical microscopy(Safranin, methyl blue and methyl red ) Scanning Electron Microscopy ,zeta potential during month, Along with their electrophoretic mobility, viscosity and charge mobility were used to characterize the formation of liposomes, *in vivo* effect of the liposome on the level of lipid profile, Hydroxy methyl glutaral-Co reductase and peroxisome proliferator-activated receptor gamma compared to the rosuvastatin calcium and to know the ability of the prepared liposome to raise antioxidants or fight free radicals resulting from feeding a high-cholesterol diet.The study's findings show that the prepared liposome by SEM results showed that the vesicle size was 37.99-75.77 nm and Small single fat vesicles surrounded by an aqueous layer, and has a zeta potential was -50.54 the drug was found to be stable ,The charge of the liposome, electrophoretic mobility, and viscosity were -0.0007, 3.95 µm/cm.sec.V., and 0.714x10-3±0.007 poise, respectively. ,*in vivo* results liposome reduced the concentration of T.Ch, T.G and LDL and improved the level of HDL and HMG-CoA compared to rosuvastatin calcium as for its ability to resist harmful oxidation, its effect on malondialdehyde and peroxy nitrate decreased compared to Rosuvastatin calcium It also It also improved the levels of total antioxidants and R-SH .From all the results, we can conclude that the liposomal drug showed hypocholesterolemic and oxidative stress efficiency, which may be due to the improvement of the bioavailability of the drug in the liposomal formula.

## Introduction:

Rosuvastatin calcium (ROSCa) is one of the most powerful statin drugs available and is effective even for patients with a high risk of cardiovascular disease [1]. Like all statins, ROSCa works by inhibiting the enzyme hydroxy methyl glutaral-CoA reductase (HMG-CoA reductase). There have been side effects of rosuvastatin despite a higher efficacy rate than other statins [2]. The drug undergoes extensive primary metabolism after oral administration , the oral bioavailability of rosuvastatin is approximately 20% [3]. Rosuvastatin calcium is a water-insoluble drug with poor that lipophilic statins have less selectivity for liver cells than hydrophilic statins [4].

Liposome delivery system has drawn attention as one of the good approaches to increase the solubility of especially water-insoluble substances and thus increase absorption in the

gastrointestinal tract due to its ability to encapsulate hydrophobic molecules and its biocompatibility [5]. The vesicles contain phospholipid bilayers that allow them to dissolve water-insoluble drugs [6]. In addition, the structural and compositional similarity of liposomes to biofilms has also encouraged their use in the oral delivery of poorly delivering drugs [7] . Liposomes appear most promising when taking hydrophobic drugs orally, protecting the drug from decomposition in the digestive system without benefiting from it and enhancing permeability through the intestinal epithelial cell membrane, thus increasing oral bioavailability [5] . Combinations are less toxic than drugs alone and have better pharmacokinetic parameters. Although it seems to be the first choice of drug delivery systems for various diseases[8] .

**Aim of Study:** Increasing the solubility of the calcium drug rosuvastatin, as it is an insoluble substance in aqueous media, and increasing its bioavailability by encapsulating it inside liposomes.

**Material and Methods**

Liposome Preparation: the preparation was done by dissolving (0.66:1:1) mmol/L lecithin, ROSCa, and β-sitosterol, respectively. The drug was dissolved in 50 ml of deionized water, and acidified with 1 M HCl to precipitate calcium ions move to separating funnel and add 50 ml of chloroform and stir manually for 30 min., then leave it to settle for 24 hours. The organic layer was isolated and mixed with lecithin and β-sitosterol dissolved in 50 ml of dichloromethane and reflex at 45 C° for 3 hours, then poured into a Petri dish to dried in drying oven at 45 C° until it is formed thin layer yellow colour.

The characterization of liposomal ROSCa was conducted through various methods, including direct examination using an optical microscope (followed by staining with safranin, methyl blue, and methyl red), scanning electron microscopy (SEM), determination of its viscosity using a viscometer, and photon correlation spectroscopy (PCS) using a Malvern Zeta sizer (Malvern Nano ZS90, Malvern Instruments Ltd., Worcestershire, UK). The Malvern Zeta sizer was made available through the Department of Science and Technology's laboratories. The liposome's electrophoretic mobility was investigated and its charge was computed.

- **The liposomal ROSCa hypolipidemic effect (*in vivo*):** In order to conduct the study, fifty adult male rats weighing 200–300 g were divided into five groups of ten. After that, the rats were maintained in their cages. The animals were housed in plastic cages with mesh coverings. Sawdust was used to cover the cage floors, and three to four times a week, the floor was changed to ensure the cages were clean [9] .
- **Induce hyperlipidemia by cholesterol**, the rats were kept in a standard environment with a temperature range of 20 to 28°C and a 12-hour light-dark cycle. The rats were fed either laboratory chow containing 5g cholesterol and 2.5 g sodium chloride for every 1 Kg (high-cholesterol diet) or standard pellet diet for all groups, with the exception of the control group, which was fed standard pellet diet. The rats were kept for three weeks to induce hyperlipidemia [10], and after that, they were given the following doses orally, as indicated in the table below.

  Following the induction of hyperlipidemia, the animal groups were given the following doses orally for 35 days, as indicated in the table 1:

**Table 1:** Induction of hyperlipidemia

| Groups | Model |
|---|---|
| **Control group-C** | - |
| **First group-G1** | - |
| **Second group-G2** | 1mg/Kg* of ROSCa |
| **Third group-G3** | 2.44mg/Kg** of liposomal ROSCa dissolved in phosphate buffer |

* The concentration of ROSCa was used according to the [11] .

** The concentration of liposomal ROSCa was used according to the drug content [12]

- **Blood sample collection:** Animals were fasted for 12 hours before cardiac puncture to obtain 4-6 ml of blood. Blood serum was then obtained by centrifuging the blood at 411 xg for 15 minutes. It was separated into four parts in ependorf tube and stored at -20 °C until the following biochemical were performed:
- Hypolipidemic effect of Liposomal Rosuvastatin :- enzymatic colorimetric kits from the Linear company used to measure the concentrations of the serum lipid profile, which comprises triglycerides (TG), total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C), and LDL-C. An enzyme-linked immunosorbent assay (ELISA) kit from Cloud-Clone Corp. was used to evaluate the level of peroxisome proliferator-activated receptor gamma (PPARg) and the activity of HMG-CoA reductase
- levels of oxidative stress parameters: The concentration of the peroxynitrite radical (ONOO-) was estimated using the modified method Al-Zamely *et al* [13], and the level of malondialdehyde (MDA) was measured according to El-Missiry *et al* [14] .
- Antioxidant effect of the Liposomal Rosuvastatin : Total antioxidant capacity(TAC), where copper +2 combines with the antioxidants present in serum to produce the copper +1 ion, which in turn reacts with 2,9-dimethyl-1,10-phenanthroline (Neocuproine), according to the Apak *et al* [15], The activity of the enzyme glutathione peroxidase(GPX) was also measured according to Cunningham-Rundes [16] , Total thiol group (R-SH) are estimated according to Ellman [17-18] and superoxide dismutase activity (SOD) Estimated indirectly through the appearance of a decrease in the optical absorption of formazine formed from the $O_2$.-reduction of nitrobutitrazolium dye (NBT) generated by irradiation with fluorescent rays [19]. A decrease in concentration from the control (reagent without enzyme) indicates an increase in the activity of the SOD enzyme.

- **The statistical analysis** was performed using GraphPad Prism Version 8.4.0 (671). For clinical biological research employing the study Variance test (ANOVA), significant differences were evaluated using Duncan's multiple ranges test with a significance criterion ($p \leq 0.05$) [20].

**Results and discussion:**

The following methods were used to characterize liposomes:

Optical microscopy examination: Safranin, methyl blue and methyl red respectively are used in optical microscopy, which is one of the main methods for the early identification of liposome formation. Figure 2-4 show these dyes in their different formats.

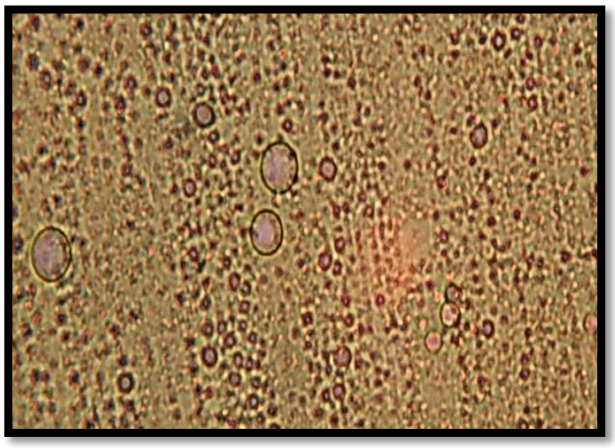

**Fig.1:** without staining at 40X magnification

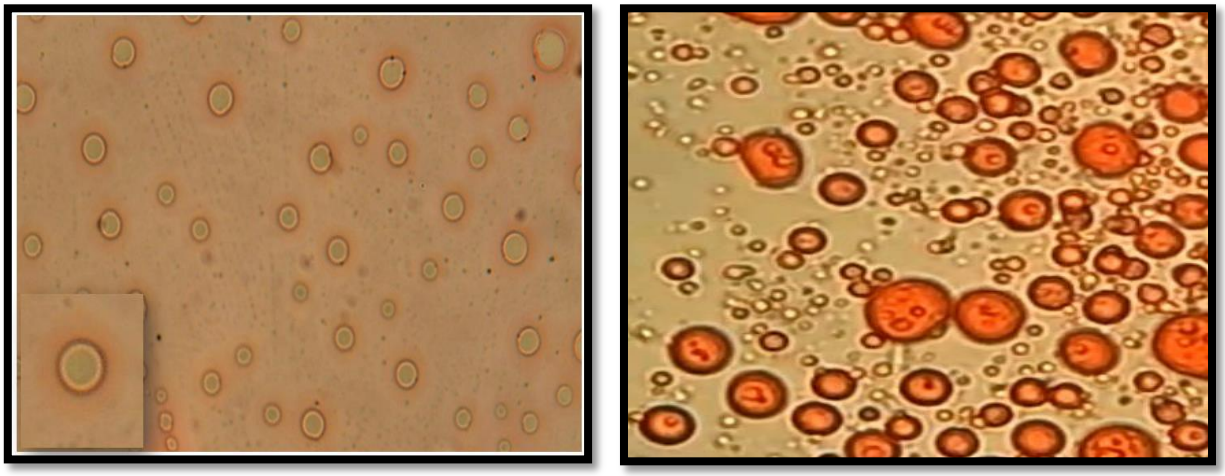

**Fig. 2:** liposomal ROSCa after staining with safranin at 40X magnification

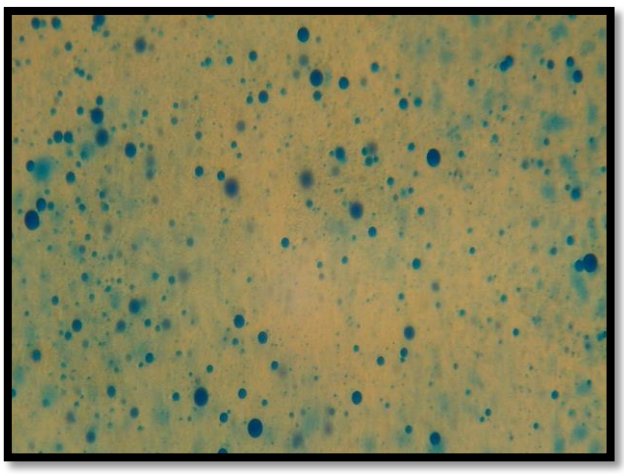

**Fig. 3:** liposomal ROSCa after staining with methyl red at 40X magnification

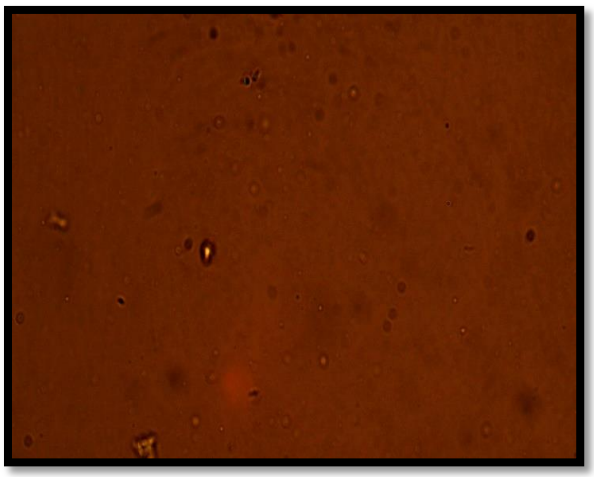

**Fig. 4:** liposomal ROSCa after staining with methyl blue at 40X magnification

The figures above show the liposome, which is dyed with safranin where the outer lecithin layer is a different color from the center, which took on a different color when the drug interacted with safranin as explained by Krishna and Sankar [21] in the method for spectrophotometrically determining the drug rosuvastatin, where it forms a colored compound with safranin that absorbs at 530 nm. Figure (2-4) shows the staining of the vesicles with methyl blue dye, but its features are not clear in terms of the boundaries of the phospholipids or the staining of the drug inside the vesicle,

despite the presence of a source documenting the method of spectroscopically identifying the drug using methyl blue [22], although methyl blue is a basic dye that combines with phospholipids (lecithin). Using equal sample volumes and concentrations, as well as equal magnification power for all optical microscopic images, it can be concluded that the shape of the vesicle is smaller than when stained with safranin, leading to the conclusion that the staining included only the center of the drug-containing vesicle without depicting the vesicle borders, leading to the conclusion that coloring using safranin dye was better than using methyl blue in giving more details.

-Scanning Electron Microscope (SEM): The range of particle size obtained from SEM for liposomal ROSCa is (37.99–75.77 nm) . In addition, It is classified as a nanoliposome because its size is less than 100 nanometres . as in fig.(5)

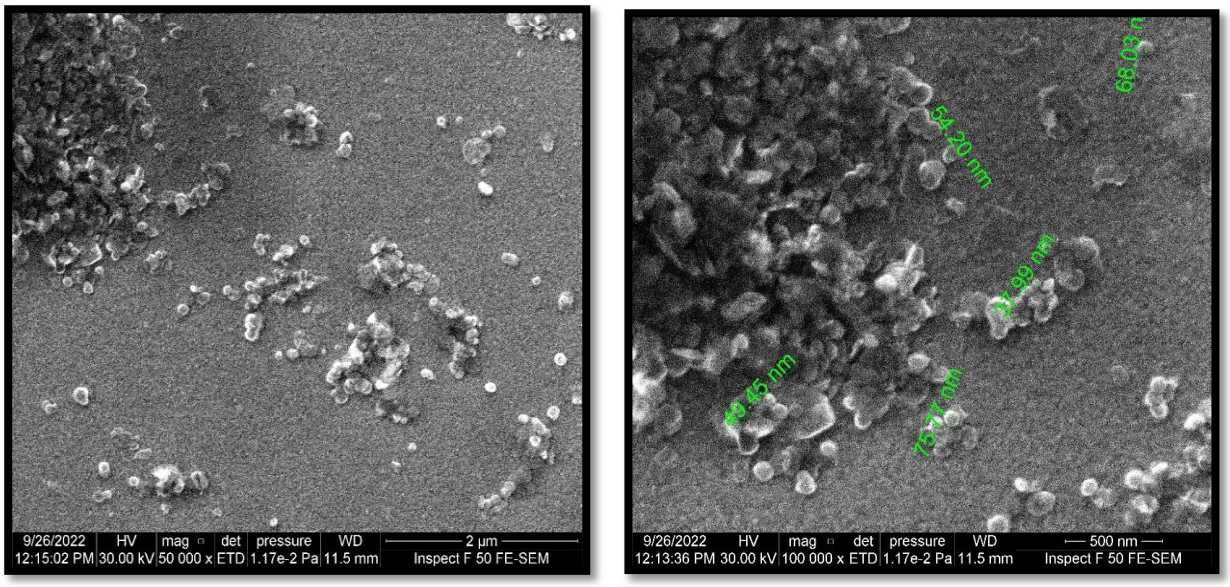


**Fig 5: SEM micrographs of the liposomal ROSCa**

These results are consistent with Ahsan *et al* [23] who prepared a solid, self-emulsifying nanoliposome of 100 nm in size from the calcium drug rosuvastatin , The proposed type of LR liposomes are small monomeric lipid vesicles that consist of a single phospholipid bilayer surrounding the aqueous layer and their size ranges between 20-100 nm [24].

-The viscosity of the prepared liposomes: The viscosity of the prepared liposome was measured at a concentration of 100 mg/dl using a viscometer, it was found that the liposome has a high viscosity of $0.714*10^{-3}\pm0.007$ poise. The viscosity of the liposome was relatively low, and the reason for this may be due to the nanosized size of the liposome, which was revealed by imaging with a SEM . Measuring viscosity is considered one of the important physical values of liposomes, as it provides valuable information about its physical properties as well as the extent of its stability [25].

-Zeta Potential: The stability of liposomes, which encompasses the processes of production, storage, and transportation, controls the therapeutic efficacy of medicinal molecules. Evaluation of physical parameters that guarantee the integrity of the liposome during storage is one of the stability studies [26-27]. The stability of the manufactured liposomes was assessed in this work by tracking the liposome's zeta potential for one month. Photon correlation spectroscopy (PCS) was used to evaluate the liposomes' zeta potential (Table 2).

**Table 2:** The value of zeta potential during four weeks

| Week | Zeta Potential Mv |
|---|---|
| 1 | **50.54** |
| 2 | **48.41** |
| 3 | **42.29** |
| 4 | **44.73** |

The reason for the high zeta potential values of the prepared liposome may be due to the fact that Sterols, especially β-sitosterol, improve the rigidity of the liposome membrane and reduce its deformation. It also gives good stability to the size of the vesicle during storage, according to the results of Song *et al.* [28]. The high zeta potential of liposomes is due to the presence of β-sitosterol in their structure, which works to enhance the stability of the vesicles compared to cholesterol [29].The zeta potential of the liposomes is measured to identify the stability of the prepared molecule, as liposome particles with a high zeta potential value, whether negative or positive, tend to repel each other, and this repulsion prevents aggregation or fusion [30]. Particles with a zeta potential of more than +30 millivolts or more than -30 millivolts are considered stable [31-32].

Zeta potential was measured for four weeks in this investigation. Random motions and particle charge determine particle stability. Because of Brownian motion, particles with repulsive solid interactions rarely pack together when they approach. The situation reverses if the molecules do not have enough net charge to repel each other [30]. Excellent stability with respect to the zeta potential is when the degree of repulsion is higher than 61 mV. Moderate force is between 31 and 40 mV, and instability is when it is between 10 and 30 mV. The ROSCa liposome synthesized for this study was very stable because the zeta potential range, which ranges from −30 to +30 mV shows emulsion instability. As the value approaches zero, the level of instability increases [31]. Measuring the zeta potential also provides information about the distribution mechanism of charged lipids, which is of great importance in understanding the mechanism of interaction of liposomes with biofilms and other charged molecules within the cells of the body [33].

-Charge of the liposome: The stability and shelf life of liposomes are increased by vesicle surface charges, which also aid in improving storage conditions (temperature and humidity) [34]. The charge of the liposome was -0.0007µm\cm.sec.V. Negative or positively charged liposomes are more stable compared to neutrally charged liposomes [35]. The phospholipids included in the liposome structure (positive and negatively charged phospholipids) of liposomes are the main content that affects the total surface charge of the liposome [36].

-Electrophoretic of liposome:- is a term used to describe a liposome's surface charge and to describe how quickly a charged liposome moves in an electric field. It reached 3.95 µm/cm.sec.V. The study conducted by Tomnikova *et al* revealed that the electrophoretic value of liposomes is significantly influenced by their size and shape. Specifically, larger and more deformed liposomes experience a greater pull in the electric field, resulting in a decrease in electrical mobility when compared to smaller or spherical liposomes. Additionally, the surface charges of liposomes can be protected by ionic strength [37] .

-The hypolipdemic effect of liposomal ROSCa (*in vivo*):- The current study evaluated the hypolipidemic effects of liposomal ROSCa; Table 3 summarises the study's findings.

**Table 3:** The level of lipid profile (as mean ± standard deviation) in sera of rats groups under investigation

| Groups | TC (mg/dl) | TG (mg/dl) | LDL-C (mg/dl) | HDL-C (mg/dl) | HMG-CoA (ng/ml) | PPARg (ng/ml) |
|---|---|---|---|---|---|---|
| **C** | ±13.194 86.335 b | 44.529 ± 8.270 b | 27.76± 6.42 b | 58.131±19.5 78 a | 16.760±2.85 6 a | 3.165 ±1.127 c |
| **$G_1$** | ±9.791 98.897 a | 57.872 ± 8.172 a | 31.08 ±7.30 a | 56.940 ± 8.268 a | 3.479±0.443 d | 14.396±1.44 7 a |
| **$G_2$** | 68.893 ±8.672 c | 49.058 ± 8.186 b | 14.57± 4.49 c | 41.470± 8.474 d | 14.467±1.02 6 b | 3.731± 0.345 c |
| **$G_3$** | 65.139 ±6.720 d | 32.827 ± 8.900 c | 8.97 ± 3.47 d | 43.053 ± 7.008 c | 10.053±2.20 4 c | 6.947 ± 1.253 b |

* Different letters indicate statistically significant differences, while similar letters do not have statistically significant differences.

The study showed that the concentration of TC increased significantly in the sera of rats in G1 that were fed a cholesterol-rich diet, and decreased significantly after treatment in $G_2$ , $G_3$ compared to Group C. The concentrations of TG , LDL-C and PPARg and increased significantly in G1 and decreased significantly to normal level after treatment, and the same results were obtained in HMG-CoA reductase activity and HDL-C concentrations decreased significantly in $G_1$ and then increased significantly after treatment in $G_2$ and G3 compared to C as showed in table 3.

The reason behind this is the presence of β-sitosterol, which is similar in structure to cholesterol, so it is likely to compete with it and work to absorb it in the intestine, thus leading to a decrease in its level in the serum [38].The liposomal drug also showed its effectiveness in significantly reducing the level of triglycerides in the G2 compared to the G1, which explains the importance of the liposomal drug and its specificity in reducing T.G. compared to the calcium drug rosuvastatin. The lipid structures protect the drugs from hard conditions and Slowing the rate of enzymatic degradation of liposomes in the gastrointestinal tract, thus improving drug availability and stability [39].

The results of the present study are consistent with the finding Kumar *et al* [40] that the TC level was significantly decreased in the sera of hyperlipidemia rats (induced with Triton The efficiency of liposomal rosuvastatin in reducing blood cholesterol may be due to the fact that Coating the drug with lipids may protect the drug from some factors that may affect it in the digestive system, such as the acidic pH of the stomach and digestive enzymes, especially esterase enzymes, on the other hand. Some types of diets may also reduce the bioavailability of the drug [41]. Therefore, drug encapsulation can contribute to increasing its bioavailability. A liposomal drug may also work better because it can target specific cells or tissues. This makes the drug less harmful and more effective, and prevents the liver from producing cholesterol by blocking the hepatic enzyme HMG-CoA reductase [42-43]. It was found that the liposomal drug was better at reducing cholesterol and triglyceride levels. This may be due to the nano-size of the liposome, which allows it to remain in the blood circulation for a longer period while reducing the absorption of the Reticuloendothelial system - RES, as it interacts less with plasma proteins and the tissues are targeted through the effect Permeability and retention effect (EPR) [43]. The most important focus

of the pharmacokinetics of liposomes is their distribution in all body tissues and fluids and their metabolism. Metabolism mainly includes the process of chemical degradation and release of the liposomal content, which is achieved through its absorption and removal after performing its work by the reticuloendothelial system [45].

The $G_2$ witnessed a significant decrease in the concentration of LDL compared to the $G_1$ group fed a high-cholesterol diet and treated with the Rosuvastatin calcium. This is due to the fact that liposomal drugs, when given orally, It can pass into the lymphatic pathway and bypass metabolism. During intestinal lymphatic drug transport, long-chain polyunsaturated fats are accumulated in the intestinal cells within the chylomicrons. They enter the lymphatic pathway by being expelled by microbes. Therefore, the shared property of liposomes with fats enhances the lymphatic transport of lipophilic drugs. There are several ways to enhance the transport of drugs within the lymph: taking the drug during the postprandial state, using liposomes nanoparticles and liposomal prodrugs. In particular, liposomes, the most common lipid nanoparticles used in drug delivery, have advantages over other methods of intestinal lymphatic drug delivery because they can deliver many lipophilic drugs very efficiently to intestinal cells and phospholipids catalyze their formation and excretion cells. [45]. A decrease in the level of effectiveness of the cholesterol-synthesizing enzyme HMG-CoA Reductase is observed in a group of animals fed a high-cholesterol diet. The reason for the inhibition of this enzyme may be due that is inhibited by an increase in the availability of the product of the enzymatic reaction. Its significant decrease was also observed in the $G_2$ .

Targeting PPARs therapeutically is an effective way to control metabolic syndrome and its associated risk factors. They are transcription factors, and their receptors, also known as PPARs, are members of the superfamily of ligand-activated nuclear receptors. The PPARs that have been found and described so far are known as PPAR-α, PPAR-β/δ, and PPAR-γ. Exogenous and endogenous ligands for peroxisome proliferator-activated receptors (PPARs) are abundant. The main roles of PPAR-α and PPAR-γ are to regulate glucose homeostasis, lipid metabolism, and insulin sensitivity. Type 2 diabetes and hyperlipidemia are treated with antagonists that selectively bind to these receptors (T2DM). The control of fatty acid oxidation, anti-inflammation, glucose homeostasis, and lipid metabolism is significantly impacted by PPAR-/. Thus, agonists have been employed in the treatment of metabolic syndrome and cardiovascular illnesses [46-47].PPARs and statins are examples of nuclear transcription factors that may interact, according to a number of studies. This interaction must be carefully taken into account when evaluating the possibility of statins to treat cardiovascular problems. One could argue that statins have two main purposes: (i) they inhibit HMG-CoA reductase, which is a well-known way to lower cholesterol levels; (ii) they activate PPAR, a recently discovered mechanism that may account for most of the statins' cardiovascular protective effects, including their anti-inflammatory, antioxidant, and anti-fibrotic effects [48–50].
-Measuring oxidative stress levels in experimental animals: The level of oxidative stress was measured by monitoring the level of P.N & MDA as showed in table 4.

**Table 4:** Levels of Oxidative stress parameters in experimental animals

| Groups | MDA (mol/L) | P.N (mol/L) |
|---|---|---|
| C | 0.734±0.124 c | 25.682±6.918 b |
| G1 | 1.777±0.672 a | 38.308±9.990 a |
| G2 | 1.142±0.193 b | 26.205±6.778 b |
| G3 | 0.855 ± 0.176 c | 17.727±4.778 c |

* Different letters indicate statistically significant differences, while similar letters do not have statistically significant differences.

The results show a significant increase in oxidative stress indicators such as Peroxy nitrite and Malondialdehyde for $G_1$ fed a high-cholesterol diet compared to C as a control sample;

The drug rosuvastatin calcium did not succeed in reducing the levels of (P.N) and (MAD) and returning them to normal values, but the drug liposomes proved effective in significantly reducing their concentrations. The success of the liposome compound in ridding the body of harmful indicators of oxidative stress may be due to the liposome containing the antioxidant compound β-sitosterol, as the results of Ali and Al-Samarrai [51] explained the ability of the β-sitosterol compound to be an antioxidant compound, as it exceeds the ability of standard vitamin C in three ways: Scavenging hydrogen peroxide, reducing ammonium molybdate and its reductive capacity. Or the ability of the lipid-Coated compound to attack target cells without opposition from the immune system to which any drug is exposed.

-Measuring antioxidant levels in rats: Enzymatic antioxidants and glutathione were measured to evaluate the level of the animals' body's defense against damage from oxidative stress. as showed in table 5

**Table 5:** Level of antioxidant parameters in experimental animals

| **Groups** | **TAC (mmol/L)** | **GPx (U/L)** | **R-SH (µmol/L)** | **SOD (U/L)** |
|---|---|---|---|---|
| **C** | 1.036 ± 0.126 a | 1.559±0.490 b | 219.590±45.315 a | 9.698±0.526 b |
| **G1** | 1.010±0.137 a | 1.748±0.563 b | 191.943±3.918 b | 9.694±0.398 b |
| **G2** | 0.989±0.103 b | 1.888±0.685 a | 178.092±47.919 b | 10.211±0.420 a |
| **G3** | 1.013±0.109 a | 1.064 ±0.613 c | 209.074±41.957 a | 9.905±0.637 b |

*

Different letters indicate statistically significant differences, while similar letters do not have statistically significant differences.

The antioxidant results in the table above indicate a significant decrease in the percentage of the thiol group in $G_2$, while the liposomal drug in $G_1$ remained within normal limits. Therefore, it is recommended to use liposomal instead of rosuvastatin calcium in order to maintain the level of thiol groups in the blood within normal limits in patients, as it is one of the main components of glutathione. The increase in glutathione in animals treated with β-sitosterol liposomes may be due to liposomes that are sensitive to redox potentials, with benefit. A significant difference in redox

potential It exists between the intracellular reducing space and the oxidizing extracellular space. When disulfide bonds in lipids or other components are reduced by glutathione to thiol groups, redox-sensitive liposomes release their intracellular content. As a result, the structural integrity of the liposomes is compromised, which would normally be maintained by disulfide bonds in glutathione compounds [52]. Those who suffer from high lipid profile levels. This may be due to the fact that the fat ball contains the antioxidant compound β-sitosterol. The value of the drug can actually be enhanced by encapsulating it in lipids, which can show highly stable circulation in the blood and effective absorption by the liver, enhancing the activities of cellular antioxidant enzymes within the liver, resulting in a more effective antioxidant effect .

The increase in the level of R-SH in $G_3$ was consistent with the findings of Bjørnstad *et al* [53], who explained that when encapsulating one of the statins combined with cancer treatment, the percentage of reactive oxygen radicals is reduced as a result of the increase in antioxidants and their fight against them. Considering R-SH is included in the synthesis of glutathione is one of the antioxidants that fight reactive oxygen radicals [54] .

**Conclusions**

From the present study, we can conclude that the efficiency of the proportional liposomal ROSCa in the study was to reduce the blood cholesterol level by inhibiting the enzyme HMG-CoA reductase and improving the lipid profile and PPARg In serum compared with rosuvastatin calcium. it also worked to raise the level of HDL and HMG-CoA reductase It reduced the parameters of oxidative stress and improved the level of endogenous antioxidants. This is due to the improvement in the bioavailability of the drug in the liposomal formula.

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# التأثير الخافض لدهون الدم والمضاد للأكسدة للايبوسوم الروزوفاستاتين داخل جسم الكائن الحي

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**الخلاصة:**

اللايبوسومات هي أنواع خاصة من الحويصلات الدهنية تحتوي على مجاميع من الدهون الفوسفاتية. يمكنها مساعدة الجسم على استخدام وامتصاص الأدوية التي لا تذوب جيدًا في الماء. الهدف من الدراسة الحالية هو زيادة التوافر الحيوي وقابلية ذوبان رسيوفاستاتين الكالسيوم في الوسط المائي. تم تصنيع لايبوسوم الروسوفاستاتين بعد إزالة الكالسيوم لإكمال ارتباط الدهون الفوسفاتية. تم التأكد من شكل الحويصلات بواسطة المجهر الضوئي باستخدام الصبغات(السفرانين، المثيل الأزرق و الميثيل الأحمر) والتصوير بالمجهر الالكتروني الماسح. ثم مراقبة ثبات الدواء المتكون بواسطة إمكانات جهد زيتا خلال شهر، بالإضافة إلى حركتها الكهربية ولزوجتها، كما تم دراسة تأثيرها داخل جسم الكائن الحي وتحديد تأثير اللايبوسوم على مستوى الدهون و وفعالية انزيم الهيدروكسي مثيل كلوترايل -كو اي و المستقبل المنشط المكاثر للبروكيسوم مقارنة مع عقار الروزفستاتين كالسيوم ومعرفة قدرة اللايبوسوم المحضر على رفع مضادات الأكسدة و محاربة الجذور الحرة بفعل التغذية بنظام غذائي عالي الكولسترول. أوضحت نتائج المجهر الالكتروني الماسح أن حجم الحويصلة كان 75.77-37.99 نانومتر وشكل الحويصلة عبارة عن حويصلات دهنية أحادية صغيرة تتكون من طبقة ثنائية من الدهون الفوسفاتية واحدة منها تحيط بالطبقة المائية، وكانت قيم جهد زيتا – 50.54 مما يثبت استقرارية اللايبوسوم المحضر، وكانت شحنة اللايبوسومات -0.0007 مايكرومتر/سم.ثا.فولت والتنقل الكهربي 3.95 مايكرومتر/سم.ثا.فولت واللزوجة 0.714*10$^{-3}$±0.007 بواز هذا من جانب اما من جانب اخر فكانت النتائج داخل جسم الكائن الحي فقد أدى اللايبوسوم إلى خفض تركيز الكوليسترول الكلي والكليسريدات الثلاثية والبروتين الدهني واطئ الكثافة وتحسين مستوى البروتين الدهني عالي الكثافة وفعالية انزيم الهيدروكسي مثيل كلوترايل -كو مقارنة بالروزوفاستاتين كالسيوم أما قدرته على مقاومة الأكسدة الضارة فقد خفض استعمال اللايبوسوم من مستوى المالون ثنائي الالديهايد وجذر البيروكسي نتريت مقارنة بالروزوفاستاتين كالسيوم كما حسن من مستويات مضادات الأكسدة الكلية و مجموعة الثايول المسؤولة عن تكوين احد مضادات الاكسدة المهمة وهو الكلوتاثايون . من جميع النتائج، يمكننا أن نستنتج أن اللايبوسوم أظهر كفاءة في خفض دهون الدم والإجهاد التأكسدي، والذي قد يكون بسبب تحسن التوافر الحيوي للدواء داخل اللايبوسومات .