The Biochemical Assessments of Cellular Oxidant - Antioxidant Status and Lipid Profile for Some of COVID-19 Vaccines (Pfizer, AstraZeneca and Sinopharm) in Vaccinated People of Wasit Province in Iraq

Tahrir Ghali Resan Al-Salmi¹, Jafar Abass Issa Al-Maamori²
¹²University of Wasit, College of Science- Department of Biology
Email: tahrirghali105@gmail.com
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Abstract

Background: Coronaviruses (SARS-CoV-2) cause COVID-19 pandemic in March, 2020, after Chinese scientists published the genome of the virus vaccine manufacturer produced several COVID-19 vaccines that aimed to induce a humoral and cellular immune response to prevent the fatality and harm caused by COVID-19. Existing study aimed to evaluate the biochemical efficiency of some of COVID-19 vaccines (Pfizer, AstraZeneca and Sinopharm) in vaccinated people of Wasit Province in Iraq by lipid profile estimation, Human SOD1 (Superoxide Dismutase 1, Soluble) and Human Malondialdehyde (MDA).

Methods: The current study sample included (55) individuals whom vaccinated with two shots of one of the three vaccines (Pfizer, AstraZeneca and Sinopharm) whom did not suffer from chronic health problems, and a control group of (35) unvaccinated individuals of both genders. Their age ranges from 18-45 years, they were divided into two age ranges (18-31 and 32-45 years) and their vaccination history was confirmed according to a special form. The blood samples were collected from fasting vaccinated individuals 2-4 weeks post the second dose of COVID-19 vaccine for the purpose of conducting lipid profile, SOD and MDA.

RESULTS: The data of serous endogenous oxidative-antioxidants balance showed a variation in the concentrations of malondialdehyde (MDA), its significant increase (P≤0.05) was observed in those vaccinated with the Pfizer vaccine for the first age range (31-18 years) and its insignificant decrease (P>0.05) in the two Sinopharm and AstraZeneca vaccines in both age ranges and both genders comparing to the control group. Besides, the findings of estimating the serum level of enzyme Superoxide dismutase (SOD) was not significantly different (P>0.05) between the vaccinated people of this study for all three vaccines and the control group for both age ranges and both genders. Additionally, the serum lipid profile levels (TG, LDL, HDL and VLDL) of the vaccinated individuals were not significantly changed (P>0.05) compared to the control group (unvaccinated individuals) except for the cleared variation in cholesterol level among the first age range for both genders compared to the control group.

Conclusion: the findings of the present study showed that all the three targeted vaccines in the study (Pfizer, AstraZeneca and Sinopharm) have shown a high efficacy and safely on body oxidation balance and heart in terms of the biochemical assessment (MDA, SOD and lipid profile) of the healthy vaccinated participants.

Keywords: COVID-19 vaccine, vaccine efficiency, biochemical assessment after COVID-19 vaccination, Oxidation balance after COVID-19 vaccine.

INTRODUCTION

Corona virus or Severe Acute Respiratory Syndrome Corona Virus (SARS-CoV-2), is the cause of the new world pandemic that appeared into the world 2019 named Coronavirus Disease 2019 (COVID-19) (Li et al., 2020). As soon as Chinese scientists published the genome of the virus (Wang et al., 2020) vaccine manufacturers started with bold and unprecedented steps to produce safe vaccines in a limited period of time, (Calina et al., 2020). Clinical laboratory routine tests that including infection related indices, blood glucose, coagulation function, hematologic parameters, serum lipids, electrolytes, cardiac function related enzymes, liver, and renal function related biomarkers, were achieved to reveal safety features of the vaccine (Liu et al., 2021). Lipid peroxidation process is generated from free radicals in an organism. Malondialdehyde (MDA) is one of the ending products of poly-unsaturated fatty acids-peroxidation in the cells. Elevation in free radicals causes over-production of MDA.
High concentration of MDA in plasma is observed during viral infection (Olaniyan et al., 2020). Superoxide dismutase (SOD) under the circumstances of oxidative stress, acts as a cellular endogenous defense system to degrade superoxide (O−2) into hydrogen peroxide and oxygen. And so, SOD is possibly useful as a therapeutic agent to treat inflammatory disorders (Yasui and Baba, 2006). SOD is the chief detoxification enzyme and most powerful anti-oxidant within the cells. It is, in fact, a very important endogenous anti-oxidant enzyme which acts as a component of first line defense system against reactive oxygen species (ROS) (Fridovich, 1995). The lipid panel is usually obtained in blood serum after fasting for at least 8 hours (Rifai and Warnick, 2006). Lipid profiles should be measured as a part of global risk assessment, and the frequency of checkup is determined by age, sex, and risk factors for cardiovascular disease. In patients on lipid lowering therapy, a lipid panel should be performed after the initiation or dose change in therapy; it should also be performed periodically in patients on stable therapy to assess treatment efficacy and medication adherence (Rick, 2021). Oxidation balance (SOD and MDA) as well as lipid profile estimated in this study to detect possible vaccine side effects, since the vaccination record was not devoid of severe and dangerous side effects, despite their rarity, several studies have indicated that serious cases that accompanied receiving the Pfizer vaccine including cases of hypersensitivity and myocarditis, pericarditis (Gargano et al., 2021 and Hajjo et al., 2021), nephrotic syndrome caused by minimal change disease four days after getting the first dose of Pfizer vaccine (Abdulgayoom et al., 2021) and finally autoimmune hepatitis case report (Avci and Abasiyanik, 2021). Vaccinated with AstraZeneca can result in the unusual development of immune thrombotic thrombocytopenia (Greinacher et al., 2021) and there were a case of minimal change disease with severe acute kidney injury (AKI) following the first injection of the vaccine from Oxford-AstraZeneca against COVID-19 (Leclerc et al., 2021), reports revealed as well worsening of hyperglycemia in response to vaccination after receiving second doses of AstraZeneca and COVAXIN in patient with diabetes type one (Ganakumar et al., 2022), while Sinopharm vaccine was safe, and getting vaccinated made individuals feel safer (Mutlag and Elaibi, 2021).

MATERIAL AND METHODS

Study group

Total study participants were 90 volunteers with age range (18-45) year, 55 were vaccinated and 35 were unvaccinated (control group) for both genders. The vaccinated participants divided into three groups according to vaccine type (Pfizer, AstraZeneca and Sinopharm). The blood samples of all participants for this study were collected from fasting vaccinated people against COVID-19, 2-4 week after second dose of COVID-19 vaccine at vaccine centers, schools, offices and vaccinated participants residents in Wasit governorate, Iraq, through the period from December 1, 2021 to March, 15, 2022. They were divided as well into two groups according to their age ranges; the first age range (18-31) years and the second age range (32-45) years, Healthy people were chosen to be our study field; people with comorbidities, smokers, and autoimmune diseases patients were excluded from our study. Any participant of the study with chronic disease such as (hypertension, diabetes mellitus, heart disease, liver cirrhosis, and other diseases) was excluded from this study. Pregnant or breastfeeding women were also excluded. Complete history of the participants was taken including (age, gender, residence, job, and date of second dose of vaccine, date of previous possible infection with COVID-19, type of vaccine, date of second dose and date of obtaining samples for both samples groups. Assay

Samples Collecting

Five milliliters of venous blood was drawn from vaccinated and control subjects, after getting verbal agreement, by using disposable syringe of 5 ml any time at fasting control group and at least two weeks to five weeks after gaining second dose of COVID-19 vaccine in fasting vaccinated groups, the blood samples were put in disposable gel tubes, then it was left at room-temperature for about (30) minutes for the formation of clot and then centrifuged for (10) minutes at (3000) run per minute the serum was distributed in to eppendorf tubes and frozen at (-20 °C) for laboratory biochemical assay.

Methodology

Human SOD1 (Superoxide Dismutase 1, Soluble) and Human Malondialdehyde (MDA) assay was achieved by competitive ELISA, ELISA Kit from Elabscience, USA and the lipid profile was achieved by COBAS c111.
Statistical Analysis

The results of present study were achieved using a statistical software package (SPSS 25) and analysed by ANOVA (one-way analysis). Microsoft Excel 2013. The data was stated as mean ± standard error of the mean (M ± S.E.M.) and Least significant difference (LSD) was considered to be less significant difference for study parameters at significant level (P≤0.05)

RESULTS

Serum MDA (ng/ml) data showed statistically a non-significant reduced (P>0.05) of serum MDA after vaccination with both AstraZeneca and Sinopharm vaccines compared with Pfizer vaccine and control of first age range (18-31 year). While the second age range (32-45 year) the serum MDA level showed non-significant differences (P>0.05) between all study groups (figure 1). Additionally, the serum MDA level of Pfizer vaccinated compare to control group individuals increased significantly (P≤0.05) of first age (18-31 year) in both genders compared to control (table 1). On the other hand Serum Superoxide Dismutase (SOD) post COVID-19 vaccination, the serum SOD (pg/ml) assay in vaccinated volunteers showed non-significant differences (P>0.05) among vaccines group Pfizer, AstraZeneca, Sinopharm and control, which represented in figure (2). Besides, the gender data in table (2) indicated that serum SOD levels increased significantly (P≤0.05) in females of late age range (32-45 year) compared to first age range (18-31 year) of Pfizer vaccinated individuals, while the data of other two vaccines (AstraZeneca and Sinopharm) showed non-significant differences (P>0.05) in SOD levels in both genders for both age ranges.

![Figure 1](image_url)

Figure (1): Serum Malondialdehyde (MDA) (ng/ml) level according to age range of study groups. NS* = non-significant differences (P>0.05)

Table (1): The mean value of MDA (ng/ml) of control and vaccinated individuals according to age range for both genders.

<table>
<thead>
<tr>
<th>Serum MDA (ng/ml)</th>
<th>(18-31)</th>
<th>(32-45)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Males</td>
<td>Females</td>
</tr>
<tr>
<td>Control</td>
<td>220.4 ± 70.9 Aa</td>
<td>1376.5 ± 584.6 Ab</td>
</tr>
</tbody>
</table>
Table (2): The mean value of SOD (pg/ml) of control and vaccinated individuals according to age range for both genders.

<table>
<thead>
<tr>
<th>Vaccine type</th>
<th>Age range (year)</th>
<th>(18-31)</th>
<th>(32-45)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
</tr>
<tr>
<td>Pfizer</td>
<td>2261.4 ± 2.4</td>
<td>2252.7 ± 2.5</td>
<td>2253.5 ± 2.7</td>
</tr>
<tr>
<td></td>
<td>Aa</td>
<td>Ab</td>
<td>Aab</td>
</tr>
<tr>
<td>AstraZeneca</td>
<td>2258.3 ± 3.3</td>
<td>2258.5 ± 1.7</td>
<td>2253.05 ± 3.18</td>
</tr>
<tr>
<td></td>
<td>Aa</td>
<td>Aa</td>
<td>Aab</td>
</tr>
<tr>
<td>Sinopharm</td>
<td>2260.7 ± 2.7</td>
<td>2257.8 ± 6.3</td>
<td>2261.01 ± 6.1</td>
</tr>
<tr>
<td></td>
<td>Aa</td>
<td>Aa</td>
<td>Aa</td>
</tr>
</tbody>
</table>

LSD=14.6

Figure (2): Serum Superoxide Dismutase (SOD) (pg/ml) level according to age range of study groups.

NS* = non-significant differences (P>0.05)

Data= Mean ±S. E. M.
Different capital letters denote to significant differences between groups (P≤0.05).
Different small letters denote to significant differences within groups (P≤0.05).
Similar capital and small letters denote to non-significant differences (P>0.05).
LSD = Least significant difference.
Data = Mean ± S. E. M. 
Different capital letters denote to significant differences between groups (P≤0.05). 
Different small letters denote to significant differences within groups (P≤0.05). 
Similar capital and small letters denote to non-significant differences (P>0.05). 
LSD = Least significant difference.

Lipid profile of vaccinated participant of current study, very low density lipoprotein (VLDL), triglyceride and high density lipoprotein (HDL) clearly indicated non-significant differences compared to control (unvaccinated) group (P>0.05) showed in figures (3,4,5 respectively).

Figure (3): Serum Very low-density lipoprotein (VLDL) (mg/ml) level according to age range of study groups.

NS* = non-significant differences (P>0.05).

Figure (4): Serum Triglycerides (TGs) (mg/ml) level according to age range of study groups.

NS* = non-significant differences (P>0.05).
Figure (5): Serum high density lipoprotein (HDL) (mg/ml) level according to age range of study groups

NS* = non-significant differences (P>0.05).

While the serum cholesterol (mg/ml) for study groups, which are shown in figure (6), showed that the serum cholesterol levels was not significantly change (P>0.05) for all study groups (vaccinated and control individuals) for both age ranges (18-31 and 32-45 years) between Pfizer, AstraZeneca, Sinopharm volunteers and control group. Besides, the data exhibited a non-significant (P>0.05) change in serum cholesterol levels in Pfizer, AstraZeneca and control groups between genders for both age ranges (18-31 and 32-45 years). Whereas the serum cholesterol mean was significantly decreased (P≤0.05) in females vaccinated with Sinopharm in first age range (18-31 year) compared to other study groups for both genders of second age group (32-45 year) (table 3). Generally LDL levels in vaccinated sera were not significantly changed (figure 7) when comparing according to age groups, on the other hand, comparing according to gender showed as illustrated in table (4) significant increase in LDL levels of Pfizer and Sinopharm males (P≤ 0.05) compared to AstraZeneca and control groups males within first age (18-31 year). Whereas in the second age range AstraZeneca females exhibited significant decreased (P≤ 0.05) in LDL level compared to control, Pfizer and Sinopharm.

Figure (6): Serum Cholesterol (mg/ml) level according to age range of study groups.

NS* = non-significant differences (P>0.05).
Figure (7): Serum Low-density lipoprotein (LDL) (mg/ml) level according to age range of study groups.

NS* = non-significant differences (P>0.05)

Table (3): The mean value of Cholesterol (mg/ml) of control and vaccinated individuals according to age range for both genders.

<table>
<thead>
<tr>
<th>Vaccine Type</th>
<th>Age Range (year)</th>
<th>(18-31)</th>
<th>(32-45)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Males</td>
<td>Females</td>
<td>Males</td>
</tr>
<tr>
<td>Control</td>
<td>60.0 ± 8.1</td>
<td>91.0 ± 4.8</td>
<td>97.2 ± 6.7</td>
</tr>
<tr>
<td></td>
<td>Aa</td>
<td>Ab</td>
<td>Ab</td>
</tr>
<tr>
<td>Pfizer</td>
<td>93.9 ± 9.8</td>
<td>109.3 ± 11.5</td>
<td>83.4 ± 7.7</td>
</tr>
<tr>
<td></td>
<td>Ba</td>
<td>Aa</td>
<td>Aa</td>
</tr>
<tr>
<td>AstraZeneca</td>
<td>69.0 ± 0.0</td>
<td>95.7 ± 4.0</td>
<td>89.6 ± 11.3</td>
</tr>
<tr>
<td></td>
<td>ABa</td>
<td>Aa</td>
<td>Aa</td>
</tr>
<tr>
<td>Sinopharm</td>
<td>108.0 ± 10.8</td>
<td>96.0 ± 64.0</td>
<td>101.0 ± 8.0</td>
</tr>
<tr>
<td></td>
<td>Ba</td>
<td>Aa</td>
<td>Aa</td>
</tr>
</tbody>
</table>

LSD=18.9

Data = Mean ± S. E. M.
Different capital letters denote to significant differences between groups (P≤0.05).
Different small letters denote to significant differences within groups (P<0.05).
Similar capital and small letters denote to non-significant differences (P>0.05).
LSD = Least significant difference.

Table (4): The mean value of LDL (mg/ml) of control and vaccinated individuals according to age range for both genders.

<table>
<thead>
<tr>
<th>Vaccine Type</th>
<th>Age range (year)</th>
<th>(18-31)</th>
<th>(32-45)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Males</td>
<td>Females</td>
<td>Males</td>
</tr>
<tr>
<td>Control</td>
<td>124.7 ± 10.3</td>
<td>148.8 ± 5.3</td>
<td>161.7 ± 9.8</td>
</tr>
<tr>
<td></td>
<td>Aa</td>
<td>Aab</td>
<td>Ab</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th></th>
<th>Pfizer</th>
<th>AstraZeneca</th>
<th>Sinopharm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>144.2 ± 7.6</td>
<td>146.1 ± 16.9</td>
<td>158.0 ± 11.2</td>
</tr>
<tr>
<td></td>
<td>ABa</td>
<td>Aa</td>
<td>Ba</td>
</tr>
<tr>
<td></td>
<td>146.1 ± 16.9</td>
<td>153.2 ± 4.38</td>
<td>52.0 ± 2</td>
</tr>
<tr>
<td></td>
<td>Aa</td>
<td>Aa</td>
<td>Bb</td>
</tr>
<tr>
<td></td>
<td>154.5 ± 13.1</td>
<td>161.33 ± 31.2</td>
<td>156.5 ± 16.5</td>
</tr>
<tr>
<td></td>
<td>Aa</td>
<td>Aa</td>
<td>Aa</td>
</tr>
<tr>
<td></td>
<td>188 ± 21.0</td>
<td>115.3 ± 0.0</td>
<td>186.5 ± 22.5</td>
</tr>
<tr>
<td></td>
<td>Aa</td>
<td>Aa</td>
<td>Aa</td>
</tr>
<tr>
<td>LSD</td>
<td>31.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Data: Mean ± S. E. M.
Different capital letters denote to significant differences between groups (P≤0.05).
Different small letters denote to significant differences within groups (P≤0.05).
Similar capital and small letters denote to non-significant differences (P>0.05).
LSD = Least significant difference.

**DISCUSSION**

The elevation of MDA in some of AstraZeneca females of first age range of present study could be probably due to unchecked preexisting health problems such as undiagnosed diabetes, and the relationship between diabetes and MDA (oxidative stress) has been established (Ding et al., 2019 and Kasco et al., 2014). As well as elevation of MDA in some individuals also could be caused by heart diseases, Liu et al., (2020) indicated elevation of MDA in his study individuals caused by heart problems. These results of serum MDA agreed with the study of Dergham, (2022) achieved in the Iraqi University, the researcher reported while the MDA concentration showed a significant differences in some of study groups the researcher thought there were possible health problems of some study participants. The SOD Superoxide dismutase (SOD) made a very important antioxidant defense in the body against oxidative stress. The enzyme acts as an important therapeutic agent against reactive oxygen species-mediated diseases (Younus, 2018), thus elevation in SOD in Pfizer females is a good sign of the vaccine efficiency in protection against COVID-19. The results of current study agreed with the aforementioned study of Dergham, (2022) who indicated that SOD concentration did not show any significant difference between the different study groups (Referring to Pfizer, Sinopharm, and AstraZeneca and control group) (Dergham, 2022).

It is commonly known that cardio vascular diseases (CVD) is related with hypertension and elevated blood levels of total cholesterol (TC), triglycerides (TG) and low density lipoprotein (LDL). While, a low level of high density lipoprotein (HDL) is a risk factor for fatality from CVD (Mora et al., 2013). Generally from the lipid profile results of present study it appeared that there were non-significant differences in serum (TGs, Cholesterol, HDL, LDL and VLDL) among study volunteers. Whereas, another study, that disagree with this results, achieved on vaccinated people with preexisting clinical conditions in Beijing they found raised serous cholesterol levels at day seven and day twenty eight, after the first dose with inactivated with SARS-CoV-2 vaccine. (Liu et al., 2021).

Lipid profile were strictly normal 10 days after the vaccination in a young Caucasian women aged of 41 years old at the beginning of symptoms of ‘Blue toes’ after vaccination with the Pfizer mRNA COVID-19 vaccine, with a normal Doppler-ultrasonography of the lower limb arteries arguing against a cholesterol-embolization syndrome confirmed no argument for a systemic vasculitis (Davido et al., 2021).

There were reports of two cases of central-retinal vein occlusion after COVID-19 vaccination, with normal outcomes of lipid profiles, CRP and renal function assay, of 50-year-old diabetic male and a 43 years old women with unremarkable systemic history (Sonawane et al., 2022).

**CONCLUSIONS**

The serum lipid profile levels (TG, LDL, HDL and VLDL) and the oxidation balance (SOD and MDA) of the vaccinated people were not significantly changed for all of the three vaccine types groups (Pfizer, AstraZeneca and Sinopharm) compared to
control (unvaccinated) group. Which declared the safety of the mentioned vaccines on body oxidation balance and metabolism as well as heart health in healthy vaccinated individuals.

REFERENCES


