

PROTECTIVE ROLE OF AQUEOUS MORINGA OLIFERA LEAVES EXTRACT AGAINST ADVERSE EFFECT OF CISPLATIN ON HEMATOIMMUNOBIOCHEMICAL PARAMETERS IN RABBITS

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ABSTRACT

The present study was carried out to evaluate the effects of cisplatin on immunobiochemical parameters in rabbits and modulating by moringa leaves extract. A total of 20, healthy rabbits, 3-3.5 kg bwt were divided into 4 groups. Gp (1) control, Gp (2) received 5 mg/kg bwt IP cisplatin one dose every week for 4 weeks, Gp (3) received orally 200 mg of moringa olifera leaves extract/kg bwt daily for 4 weeks and Gp (4) received cisplatin and moringa leaves extract by same dose and periods. At 1st, and 10th days post administration 3 blood samples were taken from the ear vein for determination of some biochemical parameters. Cisplatin induced a significant decrease in WBCs, lymphocyte, phagocytic activity, killing %, total protein, albumin, total globulin, γ -globulin, HDL, GSH, SOD and CAT besides an insignificant decrease in basophil, α and β globulin coupled with a significant increase in AST, ALT ALP, urea, creatinine, cholesterol, triglycerides, LDL, VLDL, MDA and insignificant increase in neutrophil, monocyte and eosinophil at 1st-day post-administration. Moringa leaves extract induced a significant increase in WBCs, neutrophil, monocyte, phagocytic activity, killing %, total protein, albumin, total globulin, γ -globulin, HDL GSH SOD, CAT and a significant decrease in cholesterol, triglycerides, LDL, VLDL, MDA beside non significant decrease in lymphocyte beside insignificant increase in basophil, eosinophil, α , β globulin AST, ALT, ALP, creatinine, urea at 1st-day post-administration. Moringa leaves extract ameliorated the adverse effect of cisplatin by improving hematobiochemical and immuno-logical parameters and it returned to normal levels. It could be concluded that cisplatin induced adverse effects on biochemical parameters in rabbits. Using moringa leaves extract modulated the adverse effects of cisplatin. So, it is better to use antioxidants as moringa leaves extract with cisplatin

Keywords: Cisplatin, rabbits, moringa extract, immunobiochemical

INTRODUCTION

Cisplatin is platinum compound inhibit RNA, DNA and protein synthesis

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(Zandvoort *et al.*, 2001). Its initially discovered to prevent the growth of *E. coli* (Kaushal *et al.*, 2001). It induced hypoxia and accumulation of reactive oxygen free radicals in tissues (Baek *et al.*, 2003). It has no selective effect on cancer cells as it can intermingle with the DNA of cancer and normal cells (Siddik 2003). It induces nephrotoxicity (Wang and Lippard 2005). It

is effective against cancer but induces cell damage and immune deficiency (Karmakar *et al.*, 2018). It has a cytotoxic effect on immune cells (Brown *et al.*, 2019).

Medicinal plants possess many immunopharmacological activities that have immense in the pharmaceutical industry for the discovery of drugs (Hasan and Qari, 2010). Moringa is a medicinal plant that belongs to the family Moringaceae in tropical and subtropical regions (Sinha 2012). Moringa olifera is contain many nutrients such as minerals, vitamins, and essential phytochemicals (Abou-zaid and Nadir 2014). Moringa leaves have antioxidant, anti-inflammatory and antitumor (Shaht *et al.*, 2017). Moringa contains macro and micronutrients and many bioactive compounds (Zahidul *et al.*, 2021)

The objective of the present work was studying the effect of cisplatin on immunochemical parameters in rabbits and modulating these effects by moringa leaves extract

MATERIALS AND METHODS

1-Drug:-

1- Cisplatin clear light-yellow, sterile aqueous solution, available in vials containing 100 mg/cisplatin was purchased from Sigma chemical Compy (Si Louis USA)

2- Preparation of Aqueous Extract: Leaves of moringa oleifera were collected; air dried and pounded using mortar and pestle then extracted (Njar *et al.*, 1993).

Rabbits and Experimental design:

A total of 20, 4-month-old healthy rabbits, 3-3.5 kg bwt were housed in metallic cages under hygienic conditions. Rabbits were divided into 4 groups (5/each). Gp (1) received distilled water (control), Gp (2) received cisplatin (5mg/kg bwt IP) (Amr and Alaa el din 2006) one dose every week for 4 weeks, Gp (3) received 200 mg of moringa leaves extract/kg bwt by mouth

tube (Iwuji *et al.*, 2016) daily for 4 weeks and Gp (4) received cisplatin with moringa leaves extract by same doses, route and periods. At the 1st & 10th days post-administration, 3 blood samples were taken from the ear vein. 1st sample was taken in a tube containing heparin to measure phagocytic activity and killing % (Wilkinson, 1976 and Lucy and Larry, 1982). The 2nd sample was taken in a tube containing EDTA for estimation of total and differential leukocytic count (Feldman *et al.*, 2000). 3rd sample was taken and centrifuged to obtain clear serum and estimate AST and ALT (Reitman & Frankel (1957) ALP (John 1982) total protein (Doumas et al 1981) albumin (Bauer 1982) protein fraction were performed using cellulose acetate electrophoresis (Henry *et al.*, 1974). Cholesterol (Allian *et al.*, 1974), triglycerides (Wahlefeld, 1974), high-density lipoproteins (Lopes *et al.*, 1977), low-density lipoprotein (LDL) and very low-density lipoprotein (VLDL) (Burtis and Ashwood, 1999) were measured. Urea (Faweet and Scott, 1960) and Creatinine (Henry, 1974), Superoxide Dismutase (SOD) (Nishikimi *et al.*, 1972), catalase (CAT) (Sinha 1972) Malondialdehyde (MDA) (Nielsen *et al.*, 1997) were also determined.

Statistical analysis: obtained data were analyzed by using the computerized SPSS program version 25 (Tambane and Dunlop 2000).

RESULTS

Rabbits received cisplatin one dose every week for 4 weeks showed a significant decrease in phagocyte count, killing %, WBCs count, lymphocyte count, total protein, albumin, globulin, γ -globulin, HDL, GSH, SOD & CAT, and insignificant decrease in basophil count, α & β globulin beside significant increase in AST, ALT, ALP, urea, creatinine, cholesterol, LDL, VLDL and triglycerides insignificant increase in in the count of neutrophil, monocyte, eosinophil and MDA at 1st day

post-administration (Table 1,2,3 & 4). Rabbits that received moringa leaves extract daily for 4 weeks showed a significant increase in the count of WBCs, neutrophil, monocytes, phagocytic (activity and index), killing %, T protein, albumin, T globulin γ -globulin & HDL beside significant decrease in cholesterol, triglycerides, LDL, VLDL, GSH, SOD and CAT coupled with an insignificant decrease in lymphocyte count

and insignificant increase in basophil, eosinophil, α , β globulin, AST, ALT, ALP, creatinine, urea and MDA at 1st day post administration (Table,1,2,3 & 4). Moringa leaves extracts ameliorated the adverse effect of cisplatin by improving immunobiochemical parameters, antioxidant enzymes and returned to nearly normal levels at 10th day post-administration.

Table 1: Effect of cisplatin and moringa extract on total and differential leukocytic count, Phagocytosis, Phagocytic index and killing % at 1st& 10th days post supplementation in rabbits (n=5)

Parameters	1 st day				10 th days			
	Gp(1)	Gp(2)	Gp(3)	Gp(4)	Gp(1)	Gp(2)	Gp(3)	Gp(4)
T. leukocytes' count	10.40± 0.58b	8.56± 0.51c	12.02± 0.37a	10.15± 0.89ab	10.39± 0.26a	10.27± 0.62a	11.08± 0.53a	10.44± 0.37a
leukocytes' Differential count	Lymphocyte	4.02± 0.60a	2.02± 0.36b	3.98± 0.79ab	3.59± 0.69ab	4.00± 0.56a	3.89± 0.65a	3.99± 0.93a
	Neutrophils	3.05± 0.45b	3.19± 0.27a	4.10± 0.25b	3.22± 0.32a	3.14± 0.75a	3.16± 0.76a	3.55± 0.78a
	Eosinophile	0.82± 0.18a	0.89± 0.12a	0.92± 0.17a	0.87± 0.18a	0.80± 0.18a	0.85± 0.16a	0.87± 0.19a
	Basophile	0.89± 0.17a	0.75± 0.19a	0.93± 0.21a	0.77± 0.17a	0.90± 0.20a	0.78± 0.16a	0.91± 0.18a
	Monocyte	1.62± 0.44b	1.71± 0.23b	2.09± 0.34a	1.67± 0.43b	1.55± 0.37a	1.69± 0.17a	1.76± 0.28a
Phagocytic %	58.89± 1.03b	49.48± 0.89c	64.19± 0.91a	54.19± 1.07ab	58.51± 0.89a	56.09± 0.82a	60.37± 0.77a	57.04± 1.11a
Phagocytic index	5.79± 0.37b	3.19± 0.62c	8.60± 0.72a	4.98± 0.50ab	5.45± 0.62a	4.90± 0.80a	5.96± 0.48a	4.99± 0.62a
Killing %	38.69± 0.64b	30.89± 0.85c	44.93± 0.79a	36.87± 0.93ab	38.58± 0.95a	36.54± 0.93a	40.55± 0.78a	37.94± 0.84a

Means with different superscripts of the same row indicate significant differences at $P < 0.05$

The results show significant differences must be demonstrated by symbols a, b, a, b and ab and c

Gp (1) control

Gp (2) cisplatin

Gp (3) moringa leaves extract

Gp(4) cisplatin + moringa leaves extract

Table 2: Effect of cisplatin and moringa extract on liver function at 1st and 10th days post supplementation for 4 weeks in rabbits (n=5)

Parameters	1 st day				10 th days				
	Gp(1)	Gp(2)	Gp(3)	Gp(4)	Gp(1)	Gp(2)	Gp(3)	Gp(4)	
liver enzymes	AST	37.32± 1.32ab	48.68± 1.56a	37.96± 1.72ab	40.38± 1.58b	38.45± 1.71b	44.37± 1.78a	39.56± 1.86b	39.25± 1.48b
	ALT	58.28± 1.61b	69.76 ±1.45 a	59.48± 1.33 b	62.04± 1.21ab	60.92± 1.40b	67.8± 1.27 a	61.34± 1.56b	60.87± 1.56b
	ALP	114.06± 1.74b	125.2± 1.89a	115.18± .53b	116.3± 1.39b	113.2± 1.54b	118.3± 1.32a	114.08± 1.44ab	115.6± 1.83ab
Tprotein (gm/dl)	6.47± 0.22b	4.22± 0.87c	7.18± 0.77a	5.81± 0.34ab	6.61± 0.40a	5.97± 0.52a	7.10± 0.92a	6.22± 0.94a	
Albumin (gm/dl)	3.76± 0.39b	2.26± 0.32c	3.98± 0.42a	3.35± 0.96ab	3.82± 0.82a	3.43± 0.54a	3.98± 0.56a	3.70± 0.54a	
Protein picture Globulin (gm/dl)	α	0.84 ± 0.12b	0.75 ± 0.13b	0.91± 0.10a	0.80 ± 0.10b	0.90± 0.15a	0.80± 0.11a	0.95± 0.13a	0.89± 0.18a
	β	0.63 ± 0.10a	0.51 ± 0.11a	0.69± 0.12a	0.59 ± 0.11a	0.74± 0.16a	0.65± 0.13a	0.75± 0.14a	0.66± 0.12a
	γ	1.18 ± 0.13b	0.70 ± 0.34c	1.90± 0.20a	1.13 ± 0.12b	1.25± 0.15a	1.09± 0.14a	1.42± 0.11a	1.19± 0.11a
	total	2.20± 0.76b	1.96± 0.29c	3.20± 0.61a	2.46± 0.11b	2.89± 0.53b	2.54± 0.73b	3.12± 0.38a	2.52± 0.64b
	A/G Ratio	1.48± 0.17a	1.22± 0.38a	1.38± 0.21a	1.36± 0.19a	1.32± 0.21a	1.35± 0.20a	1.28± 0.21a	1.50± 0.21a

Means with different superscripts of the same row indicate significant difference at P < 0.05
The results show significant difference must be demonstrated by symbol a, b and ab

Table 3: Effect of cisplatin and moringa extract either alone or together on urea, creatinine lipid profile at 1st and 10th day post supplementation for in rabbits (n=5).

Parameter	1 st day				10 th day				
	Gp(1)	Gp(2)	Gp(3)	Gp(4)	Gp(1)	Gp(2)	Gp(3)	Gp(4)	
Kidney function	Urea (mg/dl)	6.78± 0.59b	11.28± 0.84a	6.68± 0.48b	7.34± 0.57b	6.75± 0.68b	9.55± 0.97a	6.60± 0.58b	7.12± 0.69b
	Creatinine (mg/dl)	0.98± 0.21b	2.06± 0.23a	0.95± 0.18b	1.03± 0.17ab	0.99± 0.18b	1.88± 0.19a	0.96± 0.22b	1.01± 0.20ab
Lipid profile	Cholesterol (mg/dl)	90.52± 1.87b	99.09± 1.54a	84.03± 1.31c	92.12± 1.41ab	90.89± 1.48b	95.45± 1.39a	87.46± 1.33c	93.56± 1.52ab
	Triglyceride (mg/dl)	87.93± 1.32b	96.39± 1.26a	80.14± 1.59c	89.43± 1.27ab	88.65± 1.27b	93.76± 1.67a	84.28± 1.87c	89.26± 1.82ab
	HDL (mg/dl)	43.49± .41b	35.34± 1.28c	56.21± 1.37a	41.34± 1.67ab	43.83± 1.78a	38.09± 1.47b	42.89± 1.54a	41.28± 134a
	LDL (mg/dl)	25.48± 1.21b	33.71± 1.34a	20.18± 1.41c	29.47± 1.79ab	25.82± 1.76b	30.59± 1.55a	23.21± 1.33c	28.32± 1.65ab
	VLDL (mg/dl)	18.23± 1.48b	29.45± 1.28a	13.43± 1.70c	20.47± 1.83ab	18.7± 1.69b	25.54± 1.44a	15.09± 1.59c	20.34± 1.76ab

Means with different superscripts of the same row indicate significant differences at P < 0.05
The results show significant differences must be demonstrated by symbol a, b and ab

Table 4: Effect of cisplatin, moringa olivera leaves extract either alone or together on in MDA and antioxidant enzyme at the 1st and 10th day post supplementation for in rabbits (n=5).

Parameter	1 st day				10 th day			
	Gp(1)	Gp(2)	Gp(3)	Gp(4)	Gp(1)	Gp(2)	Gp(3)	Gp(4)
MDA (nmol/ml)	18.03± 0.82c	28.74± 1.21a	17.60± 1.22ab	24.31± 1.76b	18.32± 0.54ab	23.09± 1.67a	17.79± 1.32ab	21.15± 1.34b
CAT	21.38± 1.28b	14.17± 1.47c	28.44± 1.81a	17.67± 1.89ab	21.12± 1.54b	17.23± 1.52c	25.33± 1.79a	19.16± 1.47ab
SOD (µ/ml)	12.42± 1.44b	7.12± 0.54c	17.59± 0.48a	10.78± 0.75ab	12.71± 1.48b	9.33± 0.48c	15.20± 0.52a	11.43± 0.82ab
GSH (µ/ml)	8.48± 1.38b	4.59± 1.46c	14.03± 1.29a	6.21± 1.65ab	8.21± 1.48b	5.48± 1.64c	13.32± 1.54a	7.43± 1.38ab

Means with different superscripts of the same row indicate significant differences at $P < 0.05$. The results show significant differences must be demonstrated by symbols a, b and ab

DISCUSSION

Our results revealed that cisplatin induced a significant decrease in WBCs, lymphocyte, phagocytic (% & index) killing % and an insignificant decrease in basophil besides insignificant increase in neutrophil, monocyte and eosinophil in rabbits. This result is supported by the findings of Awadallah *et al.* (2001) who stated that cisplatin induced leukopenia, lymphocytopenia, and neutrophilia in rabbits. Change in total and differential WBCs due to cisplatin led to producing reactive oxygen species and induced apoptosis of circulating blood and bone marrow cells (Pieretti *et al.*, 2002). Cisplatin induced a decrease in WBCs, lymphocytes, phagocytosis %, killing % and increase in neutrophil may be due to damage in bone marrow by cisplatin (Abd El Azeem *et al.*, 2019)

Rabbits received the watery extract of moringa leaves for four weeks evoked a significant increase WBCs, neutrophils, phagocytic %, phagocytic index, killing % and monocytes, coupled with an insignificant decrease in lymphocytes besides insignificant increase in basophil and eosinophil, these may be due to moringa leaves rich in macro and micronutrients as minerals, vitamins and antioxidants. Moringa leaves induced a significant increase in phagocyt % (Du *et al.*, 2007). Our results agreed with

Hisham *et al.* (2012) found that moringa leaves induce a significant increase in WBCs in rabbits. Similar results were reported by Otitoju *et al.* (2014) in rabbits and Hossam *et al.* (2016) in broilers. Moringa leaves extract induced an increase in phagocytic (% & index) and killing %, WBCs neutrophil, eosinophil and a decrease in lymphocyte (Anslem *et al.*, 2017).

Cisplatin induced a significant decrease in total protein, albumin, total globulin, γ -globulin and an insignificant decrease in α and β globulin in rabbits. Reduction in serum total globulin and γ -globulin may be due to the cytotoxic effect of cisplatin on immune-competent cells such as B lymphocytes and plasma cells (Jílek *et al.*, 1989). Cisplatin induced a decrease in albumin, globulin and γ globulin in mice (Saikat *et al.*, 2013), similar to the findings of Martins *et al.* (2017) in rats that received cisplatin. This result is supported by the findings of Abd El Azeem *et al.* (2019) where cisplatin induced a significant decrease in total protein, albumin, total globulin and γ -globulin

Our results revealed a significant increase in total protein, albumin, globulin, and γ -globulin besides an insignificant increase in α and β globulin in rabbits received moringa leaves extract. The increased protein profile in our study could be attributed to the large amount of protein that moringa leaves contain

in addition to the abundant essential amino acids (Moyo *et al.*, 2011). Rabbits fed moringa leaves meal extract showed a significant increase in total protein, albumin and globulin (Walaa *et al.*, 2016). Moringa oleifera leaves extract has antioxidants which led to an increase in protein pictures (Igbinaduwa and Ebhotemhem, 2016). The same results were also reported by Shaat *et al.* (2017) who stated that moringa leaves has a role in hepatoprotective and increased serum total protein, albumin and globulin.

In the current work, rabbits that received cisplatin showed a significant increase in AST, ALT, ALT, urea and creatinine. It might cause liver cell damage and nephrotoxicity. The same results were agreed with Mora *et al.* (2003) in rats. Cisplatin is accumulated in the liver and kidney causing hepatorenal toxicity that led to elevated liver enzyme activities and kidney functions (Saikat *et al.*, 2013). These results were also supported by Amnah and Alsuhaibani (2018) stated that cisplatin induced an increase in AST, ALT, ALP, urea and creatinine in rats.

Rabbits that received moringa leave extract showed insignificant changes in AST, ALT, ALP, urea and creatinine. These minor changes in liver enzymes may be due to the antioxidant and immunological properties of moringa leaves (Isitua and Ibeh, 2013). These leaves have a hepatorenal protective effects inducing insignificant changes in liver enzymes, urea and creatinine levels (Igbinaduwa and Ebhotemhem 2016). Similar results were recorded by Norah and Suha (2018) and Shaimaa *et al.* (2021) who stated that moringa leaves has a hepatorenal effect and induce insignificant changes in serum AST, ALT, ALP, urea and creatinine.

Our results revealed that cisplatin induced a significant increase in serum cholesterol, LDL, VLDL triglycerides and a decrease in HDL. Our results agreed with Maheshwari *et al.* (2013) who reported that cisplatin induced a significant increase in serum cholesterol, LDL and VLDL. Comparable results were

reported by Martins *et al.* (2017) who stated that rats received cisplatin showed a significant increase in cholesterol. Also, cisplatin induced an increase in triglyceride, and cholesterol (Al-Shimaa, 2017)

Moringa olifera leaves extract induced a significant decrease in serum cholesterol triglycerides, LDL, VLDL and an increase in HDL in rabbits as compared to the control group. These may be due to moringa leaves have antioxidants and being rich in essential phenol compounds. Our results agreed with Tabassum *et al.* (2013) who stated that moringa leaves in the diet induced a reduction in serum cholesterol, LDL, VLDL, and triglyceride and an increase in high-density lipoprotein. Moringa leaves extract lowered the lipid profile levels may be due to the presence of phenolic compounds, polyphenolic, and flavonoids. These bio-active compounds reduce the uptake of dietary cholesterol from the intestine (Maheshwari *et al.*, 2014). Similar findings were also reported by Salem *et al.* (2020) who stated that moringa leaves have hypolipidemic properties that led significant decrease in levels of serum cholesterol, LDL lipoprotein and triglyceride.

Rabbits that received cisplatin showed a significant elevation in MDA, a significant decrease in GSH SOD and CAT (table 6). Zhifei *et al.* (2015) also stated that cisplatin induced the production of reactive oxygen species and an increase in MDA besides a decrease in GSH, SOD and CAT. Our results were supported by studies of Kiran *et al.* (2016) who stated that cisplatin induced an increase in MDA. Similarly, Martins *et al.* (2017) stated that rats received cisplatin increased oxidative stress associated with an elevation in MDA and decrease activity of CAT, GSH and SOD. Similarly, Yadav *et al.* (2019) showed that cisplatin induced a significant increase in MDA and a decrease in GSH, SOD and CAT of rats.

Rabbits that received Moringa leaves extract revealed a decrease in MDA and an increase in CAT, GSH and SOD (table 6). Moringa

oleifera leaves decreased MDA and increased SOD and CAT (Osman *et al.*, 2012). Our results agreed with El-Badawi, *et al.* (2014) who stated that moringa leaves enhance CAT, GSH and SOD and decrease MDA in rabbits. Moringa leaves extract induced a significant increase in CAT, GSH, SOD and a reduction in MDA (Osawe and Farombi 2013). Similarly, Salem *et al.* (2020) reported that rabbits fed Moringa leaves showed a decrease in MDA and an increase in CAT, GSH and SOD levels.

Results of our study showed Moringa leaves extracts ameliorate cisplatin toxicity by improving the leukocytic picture, phagocytic %, index, killing%, AST, ALT, ALP, creatinine, urea and insignificant reduction in total protein, albumin, globulin, cholesterol, triglyceride, MDA, CAT, GSH and SOD at 1st-day post administration and returned to nearly normal levels at 10th-day post administration. These results agreed with Martins, *et al.* (2017) stated that rats received cisplatin and Moringa oleifera leaf extract together improved AST, ALT, ALP, total protein, globulin, cholesterol, triglyceride, MDA, CAT, GSH and SOD. Ameliorative effect of Moringa leaves against cisplatin toxicity due to the free radical scavenging properties of Moringa leaves (Stohs and Hartman, 2015). Antioxidants are effective in ameliorating cisplatin toxicity (Al-Shimaa, 2017). Improve in total and differential leukocytic count biochemical parameters in rabbits received cisplatin due to the antioxidant effect of moringa leaves (Salem *et al.*, 2020).

It could be concluded that cisplatin induced adverse effects on immunobiochemical parameters in rabbits. Moringa oleifera leaves extract modulates these adverse effects of cisplatin. So, it is preferred to use antioxidants as moringa leaves with cisplatin.

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الدور الوقائي لمستخلص أوراق المورينجا في تقليل التأثير الضار للسيسبلاتين على القياسات المناعية والبيوكيميائية في الأرانب

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أجرى هذا البحث بهدف دراسة الدور الوقائي لمستخلص أوراق المورينجا في تعديل تأثير السيسبلاتين الضار على القياسات الدموية والمناعية والبيوكيميائية في الأرانب. تم استخدام عدد ٢٠ أرنب نيوزيلاندى عمر ٤ شهور وزنهم من ٣-٣,٥ كجم, قسموا إلى ٤ مجموعات متساوية (٥ أرنب بكل منها) الأولى تم تجريعها بالماء المقطر (ضابطة). المجموعه الثانية حقنت بالسيسبلاتين بجرعة (٥مجم/كجم من وزن الجسم داخل التجويف البروتينى) كجرعة واحدة أسبوعيا لمدة ٤ أسابيع. المجموعه الثالثة تم تجريعها باستخدام مستخلص أوراق المورينجا بجرعة (٢٠٠مجم/كجم من وزن الجسم) يوميا لمدة ٤ أسابيع أما المجموعه الرابعة تم اعطائها السيسبلاتين و مستخلص أوراق المورينجا بنفس الجرعة والطريقة والمدة السابقة. عند اليوم الأول والعاشر بعد نهاية الاعطاء تم أخذ ٣ عينات دم من كل أرنب بكل مجموعة. لاجراء بعض القياسات المناعية و البيوكيميائية.

أظهرت النتائج أن السيسبلاتين أدى إلى وجود نقص معنوى فى العدد الكلى لكرات الدم البيضاء, الخلايا الليمفاوية, نسبة ومعدل التهام الخلايا ونسبة القتل, البروتين الكلى, الزلال, الجلوبيولين وجاما جلوبيولين, الدهون عالية الكثافة, CAT, GSH and SOD بينما زيادة معنوية فى انزيمات الكبد (الأسبرتيت أمينوترانس فيراز والألانين أمينوترانس فيراز والفوسفاتيز القاعدى), الكرياتينين, اليوريا, الكوليستيرول الكلى, الدهون الثلاثية, الدهون منخفضة الكثافة جدا, MDA. وزيادة غير معنوية فى الخلايا المتعادلة والخلايا الملتهمة الكبيرة والخلايا الحامضية عند اليوم الأول من نهاية أعطاء السيسبلاتين عند اليوم ١٠ كانت تلك التأثيرات غير معنوية.

مستخلص أوراق المورينجا أحدث زيادة معنوية فى العدد الكلى لكرات الدم البيضاء, الخلايا المتعادلة, الخلايا الملتهمة الكبيرة, نسبة ومعدل التهام الخلايا ونسبة القتل, البروتين الكلى, الزلال, الجلوبيولين الكلى وجاما جلوبيولين, MDA, GSH and SOD. بينما نقص معنوى فى الكوليستيرول الكلى, الدهون الثلاثية, الدهون منخفضة الكثافة, الدهون منخفضة الكثافة جدا, بجانب نقص غير معنوي بالخلايا الليمفاوية وزيادة غير معنوية فى الخلايا القاعدية والحامضية, الفا وبيتا جلوبيولين, انزيمات الكبد (الأسبرتيت أمينوترانس فيراز, الألانين أمينوترانس فيراز والفوسفاتيز القاعدى) الكرياتينين, اليوريا والدهون عالية الكثافة.

استخدام مستخلص أوراق المورينجا مع السيسبلاتين أدى الى تعديل التأثيرات العكسية للسيسبلاتين وحسنت صورة الدم البيضاء, نسبة ومعدل التهام الخلايا ونسبة القتل, صورة البروتين وصوره الدهون وانزيمات الكبد, الكرياتينين, اليوريا وعودة هذه القياسات تقريبا لوضعها الطبيعى عند اليوم العاشر بعد نهاية الأعطاء.

نستخلص من هذه الدراسة أن السيسبلاتين يحدث أثار عكسية على القياسات المناعية والبيوكيميائية فى الأرانب ولكن استخدام مستخلص أوراق المورينجا يعدل هذه الأثار العكسية للسيسبلاتين. لذلك من الأفضل استخدام مستخلص أوراق المورينجا كمضاد للأكسدة مع السيسبلاتين.