

# Reduction in Transaminase Enzymes Action after Application of Leaves Extract of IR Bagendit Paddy on Liver Cell of Lead Exposed Rat

*by Budi Santosa*

---

**Submission date:** 13-Apr-2022 05:43AM (UTC-0400)

**Submission ID:** 1809600433

**File name:** 24.\_Reduction\_in\_Transaminase\_Enzyme\_Action...\_MJMHS.pdf (116.26K)

**Word count:** 3803

**Character count:** 19060

## ORIGINAL ARTICLE

# Reduction in Transaminase Enzymes Action after Application of Leaves Extract of IR Bagendit Paddy on Liver Cell of Lead Exposed Rat

Herlisa Angraini<sup>1</sup>, Budi Santosa<sup>1</sup>, Erick Erianto Arif<sup>1</sup>, Sandeep Poddar<sup>2</sup>

<sup>1</sup> Universitas Muhammadiyah Semarang, Jl. Kedungmundu No.18, Kedungmundu, Kec. Tembalang, Kota Semarang, Jawa Tengah 50273, Indonesia

<sup>2</sup> Lincoln University College, Wisma Lincoln, No, 12-18, Jalan SS 6/12, 47301 Petaling Jaya, Selangor, Malaysia

## ABSTRACT

**Introduction:** When entering the body, plumbum metabolized in the liver may turn to free radicals causing hepatocyte necrosis and increasing Serum Glutamic Oxaloacetic Transaminase (SGOT) and Serum Glutamic Pyruvic Transaminase (SGPT). Rice leaf water extract containing metallothionein protein functions to bind plumbum. This study aims to determine the effect of water extract of IR Bagendite rice leaf on the SGOT and SGPT levels in plumbum-induced Wistar rats. **Methods:** This study used a negative control group and a positive control which was given plumbum acetate 60 mg/kg/BW per day. A group of rats with a preventive extract of IR Bagendite rice leaf water 0.2; 0.4, 0.8 ml per day and each treatment were induced with plumbum 60 mg/kg/body weight per day. The study was conducted for 60 days. The enzymatic colourimetric method was used to measure the SGOT and SGPT and analyzed using the One Way ANOVA and Bonferroni 5% test. **Results:** The results showed the mean SGOT of negative control was lower than those of the positive. Treatment 1 (99.7) and 2 (111.7) were lower than the positive control (100.2), while treatment 3 (118.7) was higher than the positive control. There was a significant difference between positive control and treatment 1 ( $p=0.00$ ) and 2 ( $p=0.01$ ). **Conclusion:** Infusion of rice leaf water of Blora location can prevent liver function disorders at doses of 0.2 ; 0.4 at SGOT and 0.2 at SGPT.

**Keywords:** IR Bagendit, SGOT SGPT, Plumbum

## Corresponding Author:

Dr. Budi Santosa, MSi, Med

Email: budisantosa@unimus.ac.id

Tel: +6281805867211

## INTRODUCTION

Lead is a heavy metal with the symbol Pb (from the Latin plumbum). Pb is toxic to cells, organs, and body tissues (1,2,3). Exposure to plumbum is still commonly found in residential areas as a result of its use in various industries such as battery, nail paint, cosmetics and others (4). Plumbum enters the body through inhalation, skin, and digestion (5). Plumbum that enters the body will be metabolized in the liver and if exposed continuously will be toxic and excreted together with bile and blood. A series of metabolic processes in the liver can cause damage to the liver due to the loss of function and structure of liver cells (6). Liver function can be indicated by changes in the levels of Serum Glutamic Oxaloacetic Transaminase (SGOT) and Serum Glutamic Pyruvic Transaminase (SGPT) (7).

SGOT and SGPT are transaminase enzymes produced

by liver cells and are used to measure liver function disorders. Many factors can cause damage to liver cells, including exposure to heavy metals such as Pb. Continuous exposure to Pb will accumulate in the liver and can become free radicals (8). Free radicals are molecules that contain electrons and are unpaired so that they induce a chain reaction of unsaturated fats in the cell membrane layer that will cause hepatocyte cell necrosis (9). The number of hepatocyte cell necrosis causes impaired liver function which can be observed due to an increase in SGOT and SGPT.

So far, the chelating agents are used to treat Pb toxicity. Some chelating agents include dimercaprol (BAL), 2,3-dimercaptosuccinic acid (DMSA), and d-penicillamine (DPCN) (10,11,12). Due to the complexity of parenteral administration, toxic effects, and a susceptibility to exacerbate the neurotoxicity of particular metals, therapeutic usage of EDTA (ethylenediamine tetraacetate) and BAL (2,3-dimercaptopropanol) is now restricted (13). A chelating agent is needed to reduce or prevent heavy metal exposure (14,15). One of the chelating materials is metallothionein (16,17) protein. This protein is rich

in sulfhydryl groups which can bind covalently to heavy metals (18). Metallothionein is a small cytosolic (25-82 aa, 2.5-8.0 KDa), cysteine-rich protein, which plays a role in chelating heavy metals with high affinity located in the thiol group of cysteine (Cys) (18-23 Cys contained in the conserved gene region). The presence of metallothionein can be detected using the ELISA method (19).

The results of previous studies showed that various plants such as rice, corn, beans, soybeans contain a lot of metallothionein protein and the most abundant is in the leaves of IR Bagendite type of rice (20). Isolation, Identification Similarity and Qualitative Expression of Metallothionein Gene in various rice leaf varieties, namely IR Bagendite, Inpari, IR 34, IR 35, Umbu, Umbuk, and Sticky Rice showed that the quantification and purity of DNA and RNA were mostly found in IR Bagendite rice leaves. The results of *in silico* analysis of metallothionein gene sequences in rice leaves based on the NCBI database show that the metallothionein gene is located on chromosome 3 of Rice plant (*Oryza sativa*) which functions for stress-inducible protein in drought conditions, soil and water conditions containing metals, so the presence of metallothionein can be used as a biomarker of heavy metal exposure (21).

IR Bagendite rice is widely planted in various areas of Central Java, Indonesia including Boja, Blora, Batang, and Weleri. In the preliminary study, it was found that the highest metallothionein content was IR Bagendite at Blora location amounting to 380,636 ng/L, Weleri 252,189 ng/L, Batang 121,746 ng/L, and Boja 28.836 ng/L. In this study, an infusion of rice leaf water from IR Bagendite in Blora location was tested as a preventive measure to prevent Pb-induced liver function disorders in *Rattus norvegicus*. IR Bagendite rice leaves in the Blora location were chosen because they have the highest metallothionein protein content.

## MATERIALS AND METHODS

### 5 Research Design

This research was experimental with a randomized post-test only control group design. The Integrated Research and Testing Laboratory (LPPT) at the University of Muhammadiyah Semarang kept and intervened with experimental animals. The length of time for raising the animals from the selection period to the treatment period took place within 8 weeks.

The number of samples was calculated by using the formula:  $BS = (t - 1) (r - 8) \geq 15$ . The number of rats used was 6 for each group (1 negative control group, 1 positive control group, and 3 treatment groups) so the total number of samples used in this study was 30 *Rattus norvegicus*. All rats were selected which were male and 15 weeks old.

### Infusion Making Process

Rice leaves of various varieties are cleaned and washed with running water before being chopped into small pieces. As much as 100 g was put into pan A and added 1 litre of distilled water, then closed. Pan B (as a water bath) is added with enough water so that the upper pan (A) is partially submerged. It is heated for 15 minutes, starting with pan A reaching a temperature of 90°C while stirring occasionally. The infusion is spread while hot through the flannel. The supernatant is an infusion. The obtained infusion was examined for metallothionein protein using the ELISA method.

Intervention in experimental animals and data analysis  
Water extract of rice leaves at Blora location was given to treatment groups 1(P1), 2(P2), and 3(P3) with graded doses of 0.2, 0.4, 0.8 ml/day via a probe, while the negative and positive controls were not given IR Bagendite rice leaf extract. The positive control group and all treatment groups were given Pb exposure at a level of 60 mg/kg of body weight(BW)/day for 8 weeks.

On the last day of week 8, blood was drawn from the control and treatment groups through the retro-orbital plexus to check the levels of SGOT and SGPT using the Enzymatic colourimetric method at an accredited Unimus chemistry laboratory. Liver function tests using SGOT and SGPT parameters were distinguished from the negative control group, positive control group, and treatment group 1, 2, and 3 using the one way ANOVA test and Bonferroni test.

### Ethical Clearance

The study obtained ethical clearance from the ethics committee of FKM UNIMUS Semarang with No. 503/KEPK-FKM/UNIMUS/2021. The head of the Integrated Research and Testing Laboratory (LPPT), University of Muhammadiyah Semarang, is notified of the ethical clearance results and the research was accepted.

## RESULTS

### Description of experimental animal characteristics

Measurement of body weight (BW) was carried out at the beginning and end of the treatment with the results of the average weight listed in table 1. The average initial body weight was highest in the 1st treatment group and the lowest in the 3rd treatment group. The control group had the greatest final mean

Table 1: Average Body Weight

Group	Average Weight		
	Before (gram)	After (gram)	difference
C	183.6	208.5	24.9
T1	191.7	202.1	10.4
T2	162.4	189.3	26.9
T3	154.8	179.4	24.6

Note: C= Control, T=Treatment

weight, while the third treatment group had the lowest. The highest weight gain occurred in the 2nd treatment group.

**Liver function**

**SGOT level**

SGOT levels in the negative control group were the lowest on average when compared to other groups. SGOT levels increased in the positive control group and experienced a downward trend in treatment groups 1 and 2, while treatment group 3 experienced an increase above the positive control group. The average per group in detail can be seen in the Table II.

**Table II: Average SGOT Levels in Control and Treatment Groups**

Group	Level of SGOT (U/L)	
	Average	
C -	81.6 ±2.64	P=0.00*
C +	100.2± 4.96	
T1	99.7 ±2.95	
T2	98.7 ±2.86	
T3	118.7 ± 1.31	

\*ANOVA

Based on the normality test using Shapiro-Wilk, the p-value of 0.47 was obtained, which means that the data was normally distributed, so the ANOVA test was carried out to determine the differences between groups. The results of the ANOVA test obtained p-value of 0.00, which means that there were significant differences in SGOT levels between groups. To determine the differences between groups, the Bonferroni test was carried out. Table II shows the summary of the Bonferroni test results. The result of the Bonferroni test showed that the levels of SGOT in the negative control group were significantly different from those in the positive control group (p=0.00). The positive control group was significantly different from all groups with p-value of less than 0.05 (p-value < 0.05).

**SGPT Level**

SGPT levels in the negative control group were lower than in the positive control group. The positive control group was higher than treatment groups 1 and 2 but lower than treatment group 3. The highest SGPT levels occurred in treatment group 3. The average of SGPT

**Table III: Bonferroni Test Results for Each Control and Treatment Group**

Group	Mean Difference	Sig	95% Confidence Interval		
			Lower Bound	Upper Bound	
C -	C +	18.5	0.00	4.48	32.58
	T1	0.5	1.00	-13.51	14.58
	T2	1.4	1.00	-14.11	17.01
	T3	-18.5	0.02	-34.11	-2.98
C +	C -	-18.5	0.00	-32.58	-4.48
	T1	-18.0	0.00	-31.39	-4.60
	T2	-17.1	0.01	-32.06	-2.10
	T3	-37.1	0.00	-52.06	-22.10

23

levels for each group can be seen in the Table IV. The results of the normality test using Shapiro-Wilk obtained a p-value of 0.97 which means that the data is normally distributed, so the ANOVA test was carried out to determine the differences between groups.

**Table IV: Average of SGPT levels in Each Control and Treatment Group**

Group	Amount of SGPT (U/L)	
	Average (%)	
C -	55.6 ±1.35	p=0.01*
C +	58.2 ±2.55	
T1	50.0 ± 2.03	
T2	56.5 ± 0.86	
T3	59.75± 1.31	

\*ANOVA

The results of the ANOVA test obtained a p-value of 0.01, which means that there are significant differences between groups. To determine the differences between groups, the Bonferroni test was carried out. Table V shows a recapitulation of the results of the Bonferroni test. Based on the results of the Bonferroni test, only 1 group was significant, namely the positive control group against the treatment group 1 with a p-value of 0.03.

**Table V: Bonferroni Test Results for Each Control and Treatment Group**

Group	Mean Difference	Sig	95% Confidence Interval		
			Lower Bound	Upper Bound	
C -	C +	-2.5	1.00	-10.40	5.33
	T1	5.6	0.27	-1.83	13.17
	T2	-0.8	1.00	-9.22	7.55
	T3	-4.0	1.00	-12.47	4.30
C +	C -	2.5	1.00	-5.33	10.40
	T1	8.2	0.03	0.32	16.07
	T2	1.7	1.00	-7.02	10.42
	T3	-1.5	1.00	-10.27	7.17

**DISCUSSION**

The average bodyweight of the rats complied with the inclusion criteria and was quite homogeneous. All rats in the control group and the treatment groups until the end of the treatment experienced an increase in body weight, and the highest increase was found in the 2nd treatment (T2) with a delta value of 26.5. In the control and treatment groups, the weight gain was quite varied, the influencing factors were the average initial body weight and the amount of Pb exposure. Giving Pb can affect the metabolism of nutrients so that there is an impact on weight loss.

The results of the study on SGOT levels showed that the treatment groups 1 and 2 treated with IR bagendite leaf infusion 0.2 and 0.4 ml/day, SGOT level decreased significantly when compared to the positive control. This proves that the administration of IR Bagendite leaf infusion can prevent liver function disorders in Pb-induced rats. Treatment 3 also significantly different but the levels were higher than the positive control group, the dose may be too high so that it is feared to be a toxic dose.

PT levels in treatment groups 1 and 2 were decreased when compared to the positive control group, but only treatment group 1 experienced a significant decrease ( $p=0.03$ ) when compared to the positive control group. Treatment group 2 has the highest mean although it is not significant when compared to the control group, it is necessary to take into account toxic doses. Based on the results of this study, the administration of IR Bagenditerice leaf water infusion in the Blora location was able to significantly prevent liver function disorders, especially at doses of 0.2 to 0.4 ml/day for SGOT and 0.2ml/day for SGPT, with Pb exposure 60 mg/kg bw per day and the metallothionein content in the infusion was 380,636 ng/L.

SGOT and SGPT are transaminase enzymes produced by liver cells and are used to measure liver function disorders(22). The liver is an organ that is very susceptible to the influence of chemicals and is the main target organ for the toxic effects of chemicals (toxicants) including Pb (5). In general, the effect of plumbum on the hepatobiliary system is to catalyze the peroxidation of unsaturated fatty acids, reduce nitrogen oxides and increase hydroxyl radicals. Pb exposure can also increase Kupffer cells and hepatocytes significantly characterized by low levels of lipopolysaccharide and increased proteolytic activity (23).

Plumbum (Pb) is a heavy metal and can cause cell injury so that it can cause degeneration and necrosis of liver cells. The presence of cytoplasmic swelling, which can be induced by cell damage, might be interpreted as a feature of cell degeneration. Cell necrosis can occur directly or can lead to cell degeneration (reversible injury). The microscopic picture of necrosis is pyknosis, karyorexis, and karyolysis. The location of necrosis is observed in three regions, namely focal, zonal, and submassive necrosis (24,8,25)

Plumbum can cause histopathological and biochemical changes in the liver of rat and cause disturbances in the balance of oxidants and antioxidants that cause an increase in oxidative stress, an increase in the percentage of abnormal livers, inducing lipid peroxidation which can damage tissues and cell membranes (26) resulting in changes in cell structure and function further impacting on the increase in SGOT and SGPT (27).

IR Bagenditerice leaf water infusion has been investigated and proven to contain metallothionein protein rich in sulfhydryl groups which can bind covalently to heavy metals including Pb. Metallothionein protein perhaps binds with Pb and eventually enters the detoxification process to reduce or prevent Pb induction/exposure inside the body.

## CONCLUSION

Giving IR Bagenditerice leaf water infusion of Blora

location can prevent liver function disorders in Pbexposed *Rattus norvegicus*. Doses of 0.2 and 0.4 ml of rice leaf water infusion were significantly able to prevent the increase in SGOT while the dose of 0.2 ml of rice leaf water infusion was able to significantly prevent the increase of SGPT. However, increasing the dose of paddy leaves extract did not significantly reduce the activity of the transaminase enzymes.

## ACKNOWLEDGMENT

This work was supported by internal funding from Unimus Nomor:001/UNIMUS.L/PT.INT/2121.

## REFERENCES

1. Assi MA, Hezmee MN, Abd Wahid Haron MY, Sabri MA. The detrimental effects of lead on human and animal health. *Veterinary world*. 2016 June;9(6):660.
2. Gillis BS, Arbieva Z, Gavin IM. Analysis of lead toxicity in human cells. *BMC genomics*. 2012 Dec;13(1):1-2.
3. Jaishankar M, Tseten T, Anbalagan N, Mathew BB, Beeregowda KN. Toxicity, mechanism and health effects of some heavy metals. *Interdisciplinary toxicology*. 2014 June;7(2):60.
4. Bah HA, Bandeira MJ, Gomes-Junior EA, Anjos AL, Rodrigues YJ, Dos Santos NR, Martinez VO, Rocha RB, Costa RG, Adorno EV, Menezes-Filho JA. Environmental exposure to lead and haematological parameters in Afro-Brazilian children living near artisanal glazed pottery workshops. *Journal of Environmental Science and Health, Part A*. 2020 July 2;55(8):964-74.
5. Ab Latif Wani AA, Usmani JA. Lead toxicity: a review. *Interdisciplinary toxicology*. 2015 June;8(2):55.
6. Sall ML, Diaw AK, Gningue-Sall D, Efremova Aaron S, Aaron JJ. Toxic heavy metals: impact on the environment and human health, and treatment with conducting organic polymers, a review. *Environmental Science and Pollution Research*. 2020 Aug;27:29927-42.
7. Ewid M, Sherif H, Allihimy AS, Alharbi SA, Aldrewesh DA, Alkuraydis SA, Abazid R. AST/ALT ratio predicts the functional severity of chronic heart failure with reduced left ventricular ejection fraction. *BMC research notes*. 2020 Dec;13(1):1-6.
8. Tsutsui H, Kinugawa S, Matsushima S. Oxidative stress and heart failure. *American Journal of Physiology-Heart and Circulatory Physiology*. 2011 Dec;301(6):H2181-90.
9. Zhu H, Sun A. Programmed necrosis in heart disease: molecular mechanisms and clinical implications. *Journal of molecular and cellular cardiology*. 2018 Mar 1;116:125-34.
10. Mouret S, Wartelle J, Emorine S, Bertoni M, Nguon N, Cléry-Barraud C, Dorandeu F, Boudry I. Topical

- efficacy of dimercapto-chelating agents against lewisite-induced skin lesions in SKH-1 hairless mice. *Toxicology and applied pharmacology*. 2013 Oct 15;272(2):291-8.
11. Björklund G, Mutter J, Aaseth J. Metal chelators and neurotoxicity: lead, mercury, and arsenic. *Archives of toxicology*. 2017 Dec;91(12):3787-97.
  12. Björklund G, Crisponi G, Nurchi VM, Cappai R, Buha Djordjevic A, Aaseth J. A review on coordination properties of thiol-containing chelating agents towards mercury, cadmium, and lead. *Molecules*. 2019 Jan;24(18):3247.
  13. Aaseth J, Skaug MA, Cao Y, Andersen O. Chelation in metal intoxication—principles and paradigms. *Journal of Trace Elements in medicine and Biology*. 2015 Jul 1;31:260-6.
  14. Björklund G, Oliinyk P, Lysiuk R, Rahaman MS, Antonyak H, Lozynska I, Lenchuk L, Peana M. Arsenic intoxication: general aspects and chelating agents. *Archives of toxicology*. 2020 Jun;94(6):1879-97.
  15. Amadi CN, Offor SJ, Frazzoli C, Orisakwe OE. Natural antidotes and management of metal toxicity. *Environmental Science and Pollution Research*. 2019 Jun;26(18):18032-52.
  16. Sears ME. Chelation: harnessing and enhancing heavy metal detoxification—a review. *The Scientific World Journal*. 2013 Jan 1;2013.
  17. Yu XZ, Lin YJ, Zhang Q. Metallothioneins enhance chromium detoxification through scavenging ROS and stimulating metal chelation in *Oryza sativa*. *Chemosphere*. 2019 Apr 1;220:300-13.
  18. Ruttkay-Nedecky B, Nejdil L, Gumulec J, Zitka O, Masarik M, Eckschlager T, Stiborova M, Adam V, Kizek R. The role of metallothionein in oxidative stress. *International journal of molecular sciences*. 2013 Mar;14(3):6044-66.
  19. Jia Q, Dahms HU, Wang L. Detection of Metallothionein Proteins by Enzyme-Linked Immunosorbent Assay (ELISA). *Current Pharmaceutical Biotechnology*. 2020 Jun 1;21(7):544-54.
  20. Santosa B, Sunoko HR. Analysis, Identification, And Formulation Of Metallothionein Extracts On Numerous Varieties Of Paddy 95 Leaves. *Inprosidng Seminar Nasional & Internasional 2017 Oct 18 (Vol. 1, No. 1)*.
  21. Santosa B, Kartika AI, Nuroini F, Ernanto AR, Ayuningtyas A, Salleh MN, Zulaikhah ST. Isolation, Identification Similarity And Qualitative Expression Of Metallothionein Gene in IR-Bagendit Rice (*Oryza sativa*). *Pharmacognosy Journal*. 2020;12(4).
  22. Lala V, Goyal A, Bansal P, Minter DA. Liver function tests. *StatPearls [Internet]*. 2020 Jul 4.
  23. Melanie K, Djamani R, Zulfahmi I, Nurlian R, Sardi A, Paujiah E, Muliari M, Akmal Y, Humairani R. Toxic effect of lead (Pb) on hatching rate and larvae abnormalities of Nile Tilapia (*Oreochromis niloticus*). *InIOP Conference Series: Earth and Environmental Science 2021 Feb 1 (Vol. 674, No. 1, p. 012096)*. IOP Publishing.
  24. Tackling G, Borhade MB. Hypertensive heart disease. *StatPearls [Internet]*. 2021 Feb 7.
  25. de Mattos GF, Costa C, Savio F, Alonso M, Nicolson GL. Lead poisoning: Acute exposure of the heart to lead ions promotes changes in cardiac function and Cav1. 2 ion channels. *Biophysical reviews*. 2017 Oct;9(5):807-25.
  26. Kisaoglu A, Borekci B, Yapca OE, Bilen H, Suleyman H. Tissue damage and oxidant/antioxidant balance. *The Eurasian journal of medicine*. 2013 Feb;45(1):47.
  27. Lopes AC, Peixe TS, Mesas AE, Paoliello MM. Lead exposure and oxidative stress: a systematic review. *Reviews of Environmental Contamination and Toxicology Volume 236*. 2016:193-238.

# Reduction in Transaminase Enzymes Action after Application of Leaves Extract of IR Bagendit Paddy on Liver Cell of Lead Exposed Rat

## ORIGINALITY REPORT

11%

SIMILARITY INDEX

8%

INTERNET SOURCES

6%

PUBLICATIONS

3%

STUDENT PAPERS

## PRIMARY SOURCES

1	Submitted to Universitas Negeri Jakarta Student Paper	1%
2	forskning.ruc.dk Internet Source	1%
3	doaj.org Internet Source	1%
4	123dok.com Internet Source	1%
5	Submitted to Universitas Airlangga Student Paper	<1%
6	José Luis Calunga, Zullyt B. Zamora, Aluet Borrego, Sarahí del Río et al. "Ozone Therapy on Rats Submitted to Subtotal Nephrectomy: Role of Antioxidant System", Mediators of Inflammation, 2005 Publication	<1%
7	indianpediatrics.net Internet Source	<1%

8	1library.co Internet Source	<1 %
9	www.auctoresonline.org Internet Source	<1 %
10	etheses.whiterose.ac.uk Internet Source	<1 %
11	ir.lib.uwo.ca Internet Source	<1 %
12	worldwidescience.org Internet Source	<1 %
13	www.i-scholar.in Internet Source	<1 %
14	Mohy E. Abdel Fattah, Hanan M. Sobhy, Areeg Reda, Heba M. A. Abdelrazek. "Hepatoprotective effect of Moringa oleifera leaves aquatic extract against lead acetate-induced liver injury in male Wistar rats", Environmental Science and Pollution Research, 2020 Publication	<1 %
15	Neera Tewari-Singh, Dinesh G Goswami, Rama Kant, David A Ammar et al. "Histopathological and Molecular Changes in the rabbit cornea from Arsenical Vesicant Lewisite Exposure", Toxicological Sciences, 2017	<1 %

16

[journal.untar.ac.id](http://journal.untar.ac.id)

Internet Source

<1 %

---

17

[www.abacademies.org](http://www.abacademies.org)

Internet Source

<1 %

---

18

Ashfaq Ahmad, Munavvar A. Sattar, Hassaan A. Rathore, Mohammed H. Abdulla et al. "Up Regulation of cystathione  $\gamma$  lyase and Hydrogen Sulphide in the Myocardium Inhibits the Progression of Isoproterenol-Caffeine Induced Left Ventricular Hypertrophy in Wistar Kyoto Rats", PLOS ONE, 2016

Publication

<1 %

---

19

Liu, J.G.. "Effect of selenium-enriched malt on hepatocarcinogenesis, paraneoplastic syndrome and the hormones regulating blood glucose in rats treated by diethylnitrosamine", Life Sciences, 20060411

Publication

<1 %

---

20

Qirun Wu, Xiaowei Chen, Peng Wang, Qiong Wu, Xun Qi, Xiangjun Han, Lufeng Chen, Xianwei Meng, Ke Xu. "Delivery of Arsenic Trioxide by Multifunction Nanoparticles To Improve the Treatment of Hepatocellular Carcinoma", ACS Applied Materials & Interfaces, 2020

Publication

<1 %

---

21	Submitted to The International School of Penang (Uplands) Student Paper	<1 %
22	<a href="http://cjdr.quintessenz.de">cjdr.quintessenz.de</a> Internet Source	<1 %
23	<a href="http://jgpt.co.in">jgpt.co.in</a> Internet Source	<1 %
24	<a href="http://journal.unesa.ac.id">journal.unesa.ac.id</a> Internet Source	<1 %
25	<a href="http://jurnal.unai.edu">jurnal.unai.edu</a> Internet Source	<1 %
26	<a href="http://wikizero.com">wikizero.com</a> Internet Source	<1 %
27	Donatella Chillè, Giuseppe Cassone, Fausta Giacobello, Ottavia Giuffrè et al. "Removal of As(III) from Biological Fluids: Mono- versus Dithiolic Ligands", Chemical Research in Toxicology, 2020 Publication	<1 %
28	Pachara Vijitkul, Mesayamas Kongsema, Thularath Toommakorn, Vasakorn Bullangpoti. "Investigation of genotoxicity, mutagenicity, and cytotoxicity in erythrocytes of Nile tilapia () after fluoxetine exposure", Toxicology Reports Internet Source	<1 %

29

Hayatun Fuad, Nur Hidayati, Sri Darmawati, Hendra Munandar et al. "Prospects of fibrinolytic proteases of bacteria from sea cucumber fermentation products as antithrombotic agent", BIO Web of Conferences, 2020

Publication

<1 %

---

Exclude quotes      On

Exclude matches      Off

Exclude bibliography      On