

## Effect of Penicillin on Hematological and Plasma Biochemical Parameters in Female Wistar Rats

K.O. Oyedeji\* and R.O. Momoh

Department of Physiology, College of Medicine and Health Sciences,  
Afe Babalola University, Ado-Ekiti, Nigeria.

\*Corresponding Author E-mail: sinaoyedeji@yahoo.com

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An antibiotic is a type of antimicrobial substance active against bacteria. It is the most important type of antibacterial agent for fighting bacterial infections, and antibiotic medications are widely used in the treatment and prevention of such infections. This study was designed to investigate effect of penicillin on blood parameters in female rats. Ten female Wistar rats (130 – 150 g) were grouped into control and penicillin (17.14 mg/kg) – treated groups for blood assay. The penicillin was administered orally for 50 days. Haematological assay was carried out using haemocytometer, while biochemical assay was carried out using spectrophotometry. Mean  $\pm$  SEM and student's t-test at  $p < 0.05$  were determined. Penicillin (17.14 mg/kg) significantly decreased haemoglobin and lymphocyte values, but induced significant increase in eosinophil value relative to their controls. It also significantly decreased total protein and ALP values relative to their controls. Conclusively, it can be suggested that penicillin had harmful effects on blood parameters in female Wistar rats via induction of significant reductions in hemoglobin, lymphocyte and total protein values. However, it also had advantageous effects on blood parameters in female Wistar rats via induction of significant increase in eosinophil value as well as significant decrease in ALP activity.

**Keywords:** Eosinophil; Haemoglobin; Penicillin; Rats; Total protein.

Penicillins belong to the class of  $\beta$ -lactam antibiotics which were originally gotten from moulds called *Penicillium* especially *P. chrysogenum* and *P. rubens*. Deep tank fermentation<sup>1</sup> and purification<sup>2</sup> from *P. chrysogenum* are the methods used to produce the majority of penicillins which are still in clinical use. Numerous penicillins of natural sources have been discovered, however only two pure penicillins are used clinically which are penicillin G and penicillin V. Penicillins were reported to be among the early drugs to be efficacious against infections caused by bacteria.

Till today they are vastly used to treat various infections caused by bacteria, however, resistance has been developed against them by many bacteria because of wide usage.

Ten percent of the users have reported allergies due to usage of penicillins, but investigation did not totally agree with this figure; however ninety percent of users can still tolerate the drug. Further, people with allergies claims can still tolerate another member of the  $\beta$ -lactam family called cephalosporins due to antibody cross reactivity which is three percent<sup>3</sup>.

History has revealed that Alexander Fleming was the discoverer of this drug in 1928 in the form of *P. rubens*<sup>4</sup> crude extract and penicillin F which is the purified form which was produced in 1940 by a group of Oxford University researchers headed by H. Florey and E. B. Chain; for their contributions to research on penicillins, these three people were awarded the Noble Price in Physiology/Medicine in 1945.

The effect of penicillin on: rats' metabolome<sup>5</sup>, anxiolytic activity in rats<sup>6</sup> epileptic seizures in rats<sup>7</sup> as well as on reproductive effect in female rats<sup>8</sup> have been reported.

But, as a result of limited information obtained concerning the activities of penicillin on blood parameters in female rats, hence, this research intends to bridge this gap.

## MATERIALS AND METHODS

### Experimental Animals

Ten female rodents of weight range 130 – 150 g raised in the Animal Holding of ABUAD were used in the current study. These rodents were accommodated in a conducive laboratory atmosphere with unlimited supply of feed and water; the acclimatization period was for two weeks. All animal experiments were carried out in accordance with ABUAD Ethical Committee (16/MHS02/026) on care and use of laboratory animals.

### Drug

Penicillin injection (Yanzhou Xier Kangtai Pharmaceutical Ltd., China) was purchased from Danax Pharmacy, Ibadan, Nigeria. Among these, penicillin injection (600 mg) was diluted in 10 ml of distilled water to produce a concentration of 60 mg/ml. The dosage of the penicillin considered in this research was as recommended by the manufacturing industry.

### Experimental Design

Ten matured female rats (five per group) used for this study received the following oral and intraperitoneal (i.p.) doses of distilled water (control) and penicillin respectively for 50 days as follows:

Group A rodents (control group) were given 0.5 ml/100 g of distilled water.

Group B rodents were given 17.14 mg/kg of penicillin.

### Blood sample collection

On day 51, blood samples were collected from the rodents and prepared as previously described<sup>9</sup>.

### Haematological Parameters Determination

The red blood cells (RBC) count, white blood cells (WBC) count, hemoglobin (Hb) concentration, packed cell volume (PCV), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) were determined as previously reported<sup>9</sup>.

**Table 1.** Effect of treating rats for 50 days with penicillin on hematological parameters

Parameters	Control	Penicillin (17.14 mg/kg)
PCV (%)	51.50 ± 0.66	49.00 ± 0.92
Hb (g/dL)	16.75 ± 0.34	15.72 ± 0.41*
RBC (×10 <sup>6</sup> /μL)	8.66 ± 0.04	8.08 ± 0.23
TWBC (×10 <sup>3</sup> /μL)	10.76 ± 0.36	4.39 ± 0.66
Platelets (×10 <sup>5</sup> /μL)	1.34 ± 0.08	1.22 ± 0.06
Lymphocytes (%)	74.25 ± 0.85	71.75 ± 0.75*
Neutrophils (%)	23.50 ± 0.89	25.00 ± 0.41
Monocytes (%)	1.75 ± 0.31	2.00 ± 0.54
Eosinophils (%)	0.50 ± 0.14	2.75 ± 0.62*
MCV (fL)	59.46 ± 0.15	60.66 ± 0.14
MCHC (g/dL)	32.53 ± 0.24	32.09 ± 0.11
MCH (pg)	19.34 ± 0.14	19.40 ± 0.12

(n=5, \*p<0.05)

**Table 2.** Effect of treating rats for 50 days with penicillin on plasma biochemical parameters

Parameters	Control	Penicillin (17.14 mg/kg)
Total Protein (g %)	8.70 ± 0.07	8.38 ± 0.11*
Albumin (gm %)	3.40 ± 0.08	3.25 ± 0.06
Globulin (gm %)	5.30 ± 0.04	5.13 ± 0.09
AST (μ/L)	45.00 ± 0.92	45.25 ± 0.75
ALT (μ/L)	33.25 ± 0.63	34.25 ± 0.85
ALP (IU/L)	113.00 ± 1.93	109.75 ± 2.13*
BUN (mg/dL)	17.53 ± 0.17	17.30 ± 0.14
Creatinine (μmol/L)	0.78 ± 0.02	0.75 ± 0.03

(n=5, \*p&lt;0.05)

**Biochemical Parameters Determination**

The total protein concentration, albumin concentration, globulin concentration, activities of plasma alanine transaminase (ALT), aspartate transaminase (AST) and alkaline phosphatase (ALP), levels of creatinine and urea (BUN) were determined as previously reported <sup>10</sup>.

**Statistical analysis**

Mean +/- SEM and student's t-test at p<0.05 were determined.

**RESULTS**

From table 1, treatment of rodents with penicillin (17.14 mg/kg) caused significant (p<0.05) reductions in Hb and lymphocyte values, but induced significant increase in eosinophil value relative to their controls. However, the table also revealed that treatment of rodents with penicillin (17.14 mg/kg) caused non-significant (p>0.05) changes in the other parameters as shown in the table.

From table 2, it was revealed that treatment of rodents with penicillin (17.14 mg/kg) caused significant (p<0.05) reductions in total protein and ALP values when compared to their controls. However, the table also revealed that treatment of rodents with penicillin (17.14 mg/kg) produced non-significant (p>0.05) changes in the other parameters as shown in the table.

**DISCUSSION**

Analysis of blood parameters is believed to be relevant in risk evaluation and response to

therapy as changes in the hematological system have high predictive value <sup>11</sup>.

The results of this study have revealed that penicillin induced significant reduction in hemoglobin value. This could indicate that the drug caused decrease in oxygen binding capacity of blood with ultimate reduction in the quantity of oxygen transported to the tissues. Similar account was given by <sup>12</sup> in penicillin G-induced epileptic seizures in rats. This result was corroborated by the assertions of <sup>13,14</sup>.

Penicillin produced significant decrease in lymphocyte count which could signify the body acquired immune suppression. Similar result was given by <sup>15</sup> in rodents treated with *Ocimum gratissimum*.

The drug caused significant increase in eosinophil value which suggests a potentiation in the body's anti-allergic and anti-parasitic infectious responses. Similar account was given by <sup>16</sup> in rodents treated with extract of *Arctotis actotooides*.

Penicillin caused no significant change in the platelet value which suggests that it had no effect on the haemostatic function of the body. Opposite result was given by <sup>17</sup> in rodents treated with ciprofloxacin

Also, penicillin caused insignificant change in TWBC value which suggests that it had no effect on resistance of the body to foreign pathogens. Opposite result was given by <sup>18</sup> in rodents treated with linezolid. This result was supported by the assertions of <sup>19</sup>.

The drug caused non-significant change in the neutrophil value which suggests that it had no effect on the body response to pathogenic bacteria,

viruses and other harmful agents. Similar result was given by <sup>20</sup> in rodents treated with tetracycline.

Further, the drug induced non-significant change in the monocyte value which suggests that it lacked phagocytic function <sup>21</sup>. Opposite result was given by <sup>22</sup> in hens fed with *Saccharomyces cerevisiae*.

The drug produced non-significant changes in MCV and MCH values which suggests the absence of effect on macrocytic anaemia induction. Similar account was given by <sup>23</sup> in rats treated with extract of *Jatropha gossypifolia*.

The drug produced insignificant change in the MCHC value which suggests absence of effect on hereditary spherocytosis induction. Similar account was given by <sup>23</sup> in rats treated with extract of *Jatropha gossypifolia*.

The plasma biochemical study results have revealed that penicillin caused significant reduction in total protein level which suggests that the drug inhibited blood buffering capacity and also decreased the colloidal osmotic pressure. Contrary result was given by <sup>24</sup> in rodents treated with extract of *Euphorbia heterophylla*. This result was validated by the assertion of <sup>19</sup>.

In addition, penicillin caused significant decrease in ALP activity which suggests the inhibition of cholestasis. Contrary result was given by <sup>25</sup> in rats treated with *Telfaria occidentalis*. This result was corroborated by the assertion of <sup>26</sup>.

Penicillin induced non-significant change in the level of albumin which suggests that it had no effect on the levels of essential plasma components like amino acids, metals, bilirubin e.t.c. Contrary result was given by <sup>27</sup> in rats treated with extract of *Enicostemma axillare*.

The drug caused non-significant change in globulin level which suggests the lack of effect on both the natural and acquired immunity of the body. Similar account was given by <sup>28</sup> in rats treated with extracts of *Portulaca oleracea*.

It also caused insignificant change in AST activity which could mean the lack of effect on induction of tissue necrosis. Opposite result was given by <sup>29</sup> in poultry treated with amoxicillin.

Penicillin produced non-significant change in ALT activity which suggests that it had no effect on the induction of liver damage. Contrary result was given by <sup>30</sup> in rodents treated with extract of *Moringa oleifera*.

Penicillin caused non-significant change in BUN level which suggests the absence of nephrotoxicism. Opposite result was given by <sup>31</sup> in rats treated with extract of *Passiflora edulis*. This result was corroborated by the assertion of <sup>32</sup>.

Penicillin produced non-significant change in creatinine level which suggests the absence of renal dysfunction. Opposite result was given by <sup>33</sup> *Mucuna pruriens* extract treated rats.

## CONCLUSION

Conclusively, it can be suggested that penicillin had harmful effects on blood parameters in female Wistar rats via induction of significant reductions in hemoglobin, lymphocyte and total protein values. However, it also had advantageous effects on blood parameters in female Wistar rats via induction of significant increase in eosinophil value as well as significant decrease in ALP activity.

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### Conflict of Interest

There is absence of conflicting interests in this study.

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