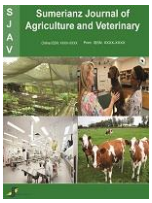
*Sumerianz Journal of Agriculture and Veterinary, 2023, Vol. 6, No. 2, pp. 12-18*
*ISSN(e): 2617-3077, ISSN(p): 2617-3131*
*Website: https://www.sumerianz.com*
*DOI: https://doi.org/10.47752/sjav.62.11.18*

Original Article Open Access

# Therapeutic Effects of *Zea Mays* Husk Extracts on the Behavioural and Haematological Alterations of *Pseudomonas Aeruginosa s*Infected *Clarias Gariepinus*

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**Article History**

**Received: 10 April, 2023**

**Revised: 15 September, 2023**

**Accepted: 8 October, 2023**

**Published: 16 October, 2023**

**How to Cite**

Abu, O. M. G. Ukwe, I. O. K. Audu, S. 2023. Therapeutic Effects of Zea Mays Husk Extracts on the Behavioural and Haematological Alterations of Pseudomonas Aeruginosa sInfected Clarias Gariepinus. *Sumerianz Journal of Agriculture and Veterinary*, Vol. 6, No. 2, pp. 12-18.

## Abstract

The present study examined the behavioural and haematological alterations in *Clarias gariepinus* infected with *Pseudomonas aeruginosa* and exposed to *Zea mays* husk aqueous extract. One twenty (120) fish were infected via intra-peritoneal injection with 1.0ml of $1.5\times10^5$ cfu/ml of *P. aeruginosa*. After the infection the infected fish were distributed into four (4) different groups in triplicate. The four groups were treated with *Zea mays* husk aqueous extract via immersion in four different concentrations (treatments): 0ml/l (untreated), 10ml/l, 20ml/l, 30ml/l for a period of 9 days and water exchange was done every two days (48 hours). After infection behavioural changes such as poor swimming, air gasping, restlessness, serious wounds, discolouration of fins, loss of reflex, and loss of appetite were observed manually in the experimental fish at day 3, 6 and 9. Blood was extracted after day 3, 6 and 9 of treatment and taken to the laboratory for haematological analysis and results were compared to the control to ascertain the therapeutic effect of *Zea mays* husk aqueous extracts. Haematological parameters such as Pack Cell Volume (PCV), Hemoglobin (HB), Red Blood Cell (RBC), White Blood Cell (WBC), Platelets (PLT), Mean Corpuscular Hemoglobin (MCH), Mean Corpuscular Hemoglobin Concentration (MCHC) and Mean Corpuscular Volume (MCV) were determined in the experimental fish after day 3, 6 and 9 of treatment. Behavioural changes were more noticeable in the untreated (control) when compared to fish exposed to the various concentration of the aqueous extracts of *Zea mays* husk. The values of PCV, Hb and RBC decrease after infection, but there were restoration at various level of treatment. WBC and Platelets increases after infection but normalized as the period of treatment goes on MCV, MCH and MCHC decreases after infection and improve in the various treatment as the period of treatment increases. The present study has shown that *Zea mays* husk aqueous extracts have the capacity of normalizing alterations in the haematological parameters of *P. aeruginosa* infected *Clarias gariepinus.*

**Keywords:** Behavioural observations; Heamatological parameters; *Zea mays; P. aeruginosa.*

# 1. Introduction

Aquaculture is the rearing of aquatic organisms in a controlled and conducive environment [1], it involves the cultivation of aquatic resources (freshwater and saltwater populations); such as fish, mollusks, crustaceans and aquatic plants, while the controlled environments like ponds, cages, raceways, and pens [2]. Most of these aquatic organisms are been consumed by man to meet the demand for high quality animal protein, with species such as tilapia, carp, mudfish and catfish as the major cultured fishery operation in Nigeria. Aquaculture is growing rapidly throughout the world and it has the prospective for the provision of valuable protein for human consumption. In Nigeria as in most African countries, aquaculture plays a major role in the creation of employment and income generation [3].

Globally, aquaculture is growing in a very fast rate and more people are relying on fisheries and aquaculture for food and as a source of income in the world [2]. Ike and Chuks-Okonta [4] observed that many of the fish farmers in Nigeria focuses on catfish production which has a market value of about three times that of tilapia. Catfish is the fastest-growing fish under captivity and can thrive in a wide range of conditions because it is hardy and tolerates dense stockings [5]. Fish farming and culture can be carried out on a small or medium-scale [6]

The aquaculture industry has been overwhelmed with its share of diseases and problems caused by viruses, bacteria, fungi, parasites and other emerging pathogens,causing economic losses, lack of employment and health challenges [1, 7, 8].

*Pseudomonas aeruginosa* is a gram-negative, rod shaped asporogenous and mono-flagellated bacterium of the *pseudomodaceae* family. *Pseudomonas aeruginosa* is a primary cause of infections in fish and human [9]. *P.aeruginosa* attacks on a host displays weakness in the host immune defense resulting to an infection in the urinary track, respiratory system, dermis, soft tissue, bone and joints, gastro intestine and blood. Bacteria are important pathogens of cultured fish and causes serious economic losses. Consequently, bacterial pathogens gives major threat to fish production worldwide [10]. Bacteria cause superficial disorders such as skin or gill infections, and leads to systemic infections in fish [10-12].

The use of synthetic drugs to treat infections in fish is threatening to consumers and the environment [13], and the use of herbs and herbal products have proven to be a productive alternative to the use of synthetic drugs [12-14].

*Zea mays* (maize) husk with the silk has been utilized as a medicinal plant product and livestock feed [15]. The maize husk extract has significant antimalarial activity against *plasmodium berghei*, [16]. *Zea mays* husk has some phytochemicals and mineral elements that are beneficial to health [17]. A lot of research had been carried out using plants to reduce the presence of disease/pathogens in aquaculture but none has been done using corn (*Zea mays*) husk extracts. This research is geared towards the use of *Zea mays* (corn) husk extract as a therapeutant on the haematological activities and behavioural response of *C. gariepinus* expose to *Pseudomonea aeregunosa.*

# 2. Materials and Methods

## 2.1. Location

The experiment was conducted in the fish farm of the Department of Fisheries and Aquatic Environment, Rivers State University, Port Harcourt, Nigeria.

## 2.2.Experimental Fish

One hundred and twenty (120) healthy *C. gariepinus* of mean weight 110-120kg was purchased from Rivers State university aquaculture center and were observed for a period of two weeks for disease presence and fed 5% body weight of commercial feed twice daily during the period.

## 2.3. Source of Pathogen

*P.aeruginosa* was ordered from the Department of Microbiology in the Rivers State University, Nkpolu Oroworukwo, Port Harcourt, Rivers State, Nigeria.

## 2.4. Preparation of Experimental Herb

The corn husk aqueous extract was prepared using the method of Ukwe and Jamabo [18]. They were husk was washed with clean water and rinsed. It was boiled in clean boiling water for 30minuts at 100g/l, filtered and the filtrate was used after cooling.

## 2.5. Experimental Design

A complete randomized method (CRD) was used. There were four treatments in triplicates.

## 2.6. Experimental Procedure

One hundred and twenty (120) *C.gariepinus* were infected via intra-peritoneal injection with 1.5 x $10^5$ cfu/ml of *P.aeruginosa* using 2ml injection syringe and 21-guage hypodermic needle at day 1 and 2, and were observed for disease presence. After diseases presence (48 hour post infection period) the infected *C. gariepinus* were distributed into four (4) groups of ten (10) in triplicates, and were treated via immersion with corn husk aqueous extract at 0ml, 10ml, 20ml and 30ml for nine days. Exchange of water/extract was done every forty eight (48) hours.

## 2.7. Blood Extracts

Three fish from each group were blindfolded**;** covering the head with a clean towel to attain calmness and blood was extracted via kidney puncture through the genital opening using 5ml injection syringe.

## 2.8. Haematological Analysis

This was done using haematological analyzer; model MY-BOOZB, Manufactured by Maya medical equipment limited company limited in Guangdong, China. The packed cell volume (PCV), White Blood Cells (WBC), Heamoglobin (Hb), Red Blood Cells (RBC), and Platelets (PL) were determined. The blood indices; mean corpuscular volume (MCV); mean corpuscular heamoglobin (MCH) and mean corpuscular heomaglobin concentration (MCHC) were determined using the methods of Adeniran *et al*., 2017.

## 2.9. Behavioral Responses

The infected *C. gariepinus* were observed daily, for: erratic swimming, loss of reflex, air gasping, serious wounds, skin peeling and discoloration of fin during the experimental period.

## 2.10. Physio-Chemical Parameter

Temperature, Dissolve oxygen, pH were determined using thermometer, D.O. meter and pH meter respectively.

## 2.11. Data Analysis

The data was analysed using SPSS statistics software 17.0 for windows, a one-way analysis of variance was used to determine if there was difference in the variables among treatments. Turkeys multiple comparison test was used to compare the means of the treatment [19].

# 3. Results

## 3.1. Physiochemcial Parameters/ Behavioural Responses of *C. Gariepinus* Infected with *P. Aeruginosa* and Exposed to *Zea Mays* Husk Aqueous Extracts for 9 days.

The physio-chemical parameters of the experimented water was conducive for aquaculture practice: Do (5.1±09); Temperature (28±13$^{o}$C) and pH (6.9±10).

The behavioural responses of *C. gariepinus* infected with *P.aeruginosa* and exposed to *Zea mays* husk aqueous extracts for 9 days are presented in Table 4.1.The result shows that after infection (AI), the behavioural responses such as loss of reflex and loss of appetite were highly present. Behavioural responses such as air gasping, eractic swimming, discoloration of fins, and skin peeling were highly present, with zero mortality in all the treatments. After 3 days of exposing the fish to different concentrations of corn husk aqueous extracts, serious wound, skin peeling and loss of appetite were highly present at 0.00ml and discoloration of fins was present at 0.00ml and 10.00ml, while mortality was observed at 0.00ml. At day 6 of the experimental period serious wound and skin peeling were present at 0.00ml and 10.00ml of the aqueous extracts. But at the end of 9 days exposure to the corn husk extract, all the fish in the various groups were seen to be normal.

**Table-4.1.** Behavioral response of *Clarias gariepinus* before and after infected with *P. aerugionosa* and exposed to different concentrations of *Zea mays.* husk aqueous extract for nine (9) days

| | BI | AI | After three (3) days | | | | After six (6) days | | | | After nine (9) days | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 0ml | 10ml | 20ml | 30ml | 0ml | 10ml | 20ml | 30ml | 0ml | 10ml | 20ml | 30ml |
| **Behavior/ Concentrations** | | | | | | | | | | | | | | |
| Air gasping | - | + | - | - | - | - | - | - | - | - | - | - | - | - |
| Eratic swimming | - | + | - | - | - | - | - | - | - | - | - | - | - | - |
| Discoloration | - | + | ++ | ++ | - | - | - | - | - | - | - | - | - | - |
| Serious wounds | - | + | ++ | + | + | + | + | + | - | - | - | - | - | - |
| Loss of reflex | - | ++ | - | - | - | - | - | - | - | - | - | - | - | - |
| Skin peeling | - | + | ++ | + | - | - | + | + | - | - | - | - | - | - |
| Loss of appetite | - | ++ | ++ | - | - | - | - | - | - | - | - | - | - | - |
| Mortality | - | + | ++ | - | - | - | - | - | - | - | - | - | - | - |

**Key:** ++ = highly present; += present; - = absent, AI = after infection, BI = before infection

## 3.2. The Haematological Parameters of C. Gariepinus Infected with P. Aeruginosa and Expose to different Concentrations of Zea Mays Husks Aqueous Extract

The haematological parameters of C. gariepinus before infection (BI) and after infection (AI) with P. aeruginosa are presented in Table 4.2. The results shows that packed cell volume (PVC)%, Haemaglobin concentration (HB) and Red blood cell count (RBC) were significantly higher before infection than in the (after infection in the fish). However, the white blood cell (WBC) and platelets values were higher in after infection compared to their values after infection.

## 3.3. Haemtological Parameters of C. Gariepinus Infected with P. Aeruginous and Exposed to different Concentration of P. Americana Aqueous Leaf Extracts for Three Days

After three (3) days of administration of the aqueous Zea mays husk extract (Table 4.3), the pack cell volume (PVC)% were similar in fish exposed to 0.00ml/l, 10.00ml/l, 20.00ml/l and 30.00ml/l concentration of the aqueous corn husk extract. The values of haemoglobin (HB)g/dl were similar in fish exposed to 10.00ml/l, 20.00ml/l and 30.00ml concentration of the aqueous corn husk extracts, but was significantly lower in 0.00ml (8.73+0.66) concentration of aqueous extracts .The number of red blood cell (RBC) were similar in fish exposed to 10.00, 20.00 and 30.00ml but significantly lower in 0.00ml.The WBC was significantly higher in fish exposed to the aqueous extracts in 0.00ml(9.97+1.70), and lower values were recorded in 10.00ml/l, 20.00ml/l and 30.00ml concentration. The platelets were significantly increased in the fish exposed to 0.00ml and 20.00ml, while lower values were observed in fish exposed to 10.00 and 30.00ml of aqueous extracts concentration.

**Table-4.2.** Haematological Parameters of Experimental Fish Before and After infection with P. aeruginosa

| Period | PCV (%) | HB (g/dl) | RBC (Cells x $10^{12}$) | WBC (Cells x $10^{9}$) | Platelets (Cells x $10^{12}$) | MCV (fl) | MCH (pg) | MCHC (g/dl) |
|---|---|---|---|---|---|---|---|---|
| Before infection (BI) | 42.67±4.72 $^{b}$ | 12.97±1.13 $^{b}$ | 5.80±0.62$^{b}$ | 5.77±3.23 $^{a}$ | 189.66±23.69 $^{a}$ | 73.80±7.90 $^{b}$ | 22.36±1.10 $^{b}$ | 30.60±4.34 $^{b}$ |
| After Infection (AI) | 28.00±3.61 $^{a}$ | 8.23±0.57 $^{a}$ | 4.76±1.00 $^{a}$ | 11.90±1.60$^{b}$ | 220.00±24.87 $^{b}$ | 60.40±5.31 $^{a}$ | 17.73±3.84 $^{a}$ | 29.63±3.84 $^{b}$ |

Means within the same column with different superscripts are significantly different (P<0.05)
**Key:** PCV – Packed Cell Volume, HB – Haemoglobin, RBC – Red Blood Cell, WBC – White Blood Cell, MCV – Mean Corpuscular Haemoglobin, MCH – Mean Corpuscular Haemoglobin, MCHC – Mean Corpuscular Haemoglobin Concentrations,

**Table-4.3.** Haematological Parameters of Infected Fish after 3 days treatment with aqueous corn husk extracts (Zea mays)

| Treatments (ML/L) | PCV (%) | HB (g/dl) | RBC (Cells x $10^{12}$) | WBC (Cells x $10^{9}$) | Platelets (Cells x $10^{12}$) | MCV (fl) | MCH (pg) | MCHC (g/dl) |
|---|---|---|---|---|---|---|---|---|
| 0.00 | 31.00±8.88 $^{a}$ | 8.73±0.66 $^{a}$ | 4.67±0.91$^{a}$ | 9.97±1.70 $^{b}$ | 206.66±12.74 $^{b}$ | 65.67±5.97 $^{a}$ | 19.07±3.10 $^{a}$ | 29.40±6.66 $^{a}$ |
| 10.00 | 39.00±1.00 $^{b}$ | 11.33±2.92 $^{b}$ | 5.57±1.20 $^{b}$ | 8.53±0.91 $^{a}$ | 183.00±25.09 $^{a}$ | 72.53±17.57 $^{b}$ | 20.17±1.06 $^{b}$ | 29.03±7.39 $^{a}$ |
| 20.00 | 37.67±6.00$^{2b}$ | 12.43±2.06 $^{b}$ | 5.36±1.51 $^{b}$ | 8.27±0.40 $^{a}$ | 205.33±48.04 $^{b}$ | 71.97±12.53 $^{b}$ | 23.67±3.55 $^{b}$ | 32.97±0.75 $^{b}$ |
| 30.00 | 33.33±10.11 $^{a}$ | 10.70±1.87 $^{b}$ | 5.43±1.30 $^{b}$ | 8.93±1.98 $^{a}$ | 185.00±52.73 $^{a}$ | 61.03±7.19 $^{a}$ | 20.17±4.47 $^{b}$ | 33.90±11.11 $^{b}$ |

Means within the same column with different superscripts are significantly different (P<0.05)
**Key:** PCV – Packed Cell Volume, HB – Haemoglobin, RBC – Red Blood Cell, WBC – White Blood Cell, MCV – Mean Corpuscular Haemoglobin, MCH – Mean Corpuscular Haemoglobin, MCHC – Mean Corpuscular Haemoglobin Concentrations

The mean corpuscular volume (MCV) were significantly higher in fish exposed to 0.00 and 30ml, but lower in fish exposed to 10.00 and 20.00ml.The mean corpuscular haemoglobin (MCH) were similar in the fish exposed to 10.00, 20.00 and 30.00ml, but lower in 0.00ml of concentration of aqueous extracts. The mean corpuscular haemoglobin concentration (MCHC) values were significantly (P<0.05) higher in fish exposed to 20.00 and 30.00ml, and lower values were recorded in 0.00 (29.40+6.66) and 10.00ml (29.03+7.39).

## 3.4. Haemtological Parameters of C. Gariepinus Infected with P. Aeruginous and Exposed to different Concentration of P. Americana Aqueous Leaf Extracts for Six Days

The result for six (6) days exposure of the experimental fish to the various treatment is presented in table 4.4. The values of PCV were within the same range with no significant difference (P>0.05) in all the concentrations. The values of haemoglobin (HB) were similar in fish exposed to 10.00ml/l, 20.00ml/l and 30.00ml concentrations of the aqueous extracts, while significantly lower values were observed in the fish exposed to the control (0.00ml).The number of red blood cell (RBC) were similar in fish exposed to 10.00ml/l, 20.00ml/l, and 30.00ml,while lower value was observed in the fish exposed to the control (0.00ml). The white blood cell (WBC) were significantly higher in fish exposed to 0.00ml (12.30+2.46) and 10.00ml (11.13+60). but lower in fish exposed to 20.00ml and 30.00ml.The platelets values were within the same range with no significant difference across various treatments. The values of MCV were within the same range with no significant difference in all the treatments. The MCH values were similar in fish exposed to 0.00ml/l, 20.00ml/l and 30.00ml, but higher in fish exposed to 10.00ml concentration of the aqueous extracts. The values of MCHC was significantly lower in fish exposed to 0.00ml (29.26+6.98), but higher values of MCHC were recorded in 10.00, 20.00 and 30.00ml.

**Table-4.4.** Haematological Parameters of Infected Fish after 6 days treatment with aqueous corn husk extracts (Zea mays)

| Treatments (ML/L) | PCV (%) | HB (g/dl) | RBC (Cells x $10^{12}$) | WBC (Cells x $10^{9}$) | Platelets (Cells x $10^{12}$) | MCV (fl) | MCH (pg) | MCHC (g/dl) |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| 0.00 | 32.00±6.08 $^{a}$ | 9.10±0.72 $^{a}$ | 4.26±0.20 $^{a}$ | 12.30±2.46 $^{b}$ | 193.66±20.42 $^{a}$ | 75.36±17.12 $^{a}$ | 20.27±6.98 $^{a}$ | 29.26±6.98 $^{a}$ |
| 10.00 | 38.00±11.26 $^{a}$ | 11.77±3.23 $^{b}$ | 5.23±1.72 $^{b}$ | 11.13±1.60 $^{b}$ | 184.33±14.36 $^{a}$ | 74.53±22.06 $^{a}$ | 31.30±3.46 $^{b}$ | 31.30±3.65 $^{b}$ |
| 20.00 | 37.00±7.54$^{a}$ | 11.17±2.89 $^{b}$ | 5.27±1.59 $^{b}$ | 8.70±2.99 $^{a}$ | 176.33±34.70 $^{a}$ | 72.23±15.78 $^{a}$ | 21.33±0.86 $^{a}$ | 30.23±5.05 $^{b}$ |
| 30.00 | 33.33±7.09 $^{b}$ | 10.40±3.98 $^{b}$ | 5.36±1.99 $^{b}$ | 8.97±0.97 $^{a}$ | 196.66±18.50 $^{a}$ | 70.20±20.53 $^{a}$ | 20.70±4.58 $^{a}$ | 30.80±7.08 $^{b}$ |

Means within the same column with different superscripts are significantly different (P<0.05)
**Key:** PCV – Packed Cell Volume, HB – Haemoglobin, RBC – Red Blood Cell, WBC – White Blood Cell, MCV – Mean Corpuscular Haemoglobin, MCH – Mean Corpuscular Haemoglobin, MCHC – Mean Corpuscular Haemoglobin Concentrations,

### 3.5. Haemtological Parameters of C. Gariepinus Infected with P. Aeruginous and Exposed to different Concentration of P. Americana Aqueous Leaf Extracts for Nine Days

After nine (9) days of exposing infected C. gariepinus to the aqueous corn husk extracts (Table 4.5). The PCV values were higher in fish exposed to 10.00ml,however lower values were recorded in 0.00,20.00and 30.00ml concentrations of the aqueous extracts. The haemoglobin (HB) were within the same range with no significant difference in all the treatments. The red blood cell (RBC) were significantly higher in 10.00, 20.00 and 30.00ml, but ,lower values were recorded in the control (4.90+1.25). The values of platelets were higher in the 0.00ml and 10.00ml, but lower values were recorded in the 20.00ml and 30.00ml treatment groups. The MCV values were significantly higher in 0.00, 20.00 and 30.00ml.The values of MCH and MCHC were within the same range with no significant difference across the treatments.

**Table-4.5.** Haematological Parameters of Infected Fish after 9 days treatment with aqueous corn husk extracts (Zea mays)

| Treatments (ML/L) | PCV (%) | HB (g/dl) | RBC (Cells x $10^{12}$) | WBC (Cells x $10^{9}$) | Platelets (Cells x $10^{12}$) | MCV (fl) | MCH (pg) | MCHC (g/dl) |
|---|---|---|---|---|---|---|---|---|
| 0.00 | 32.67±7.76 $^{a}$ | 10.37±2.81 $^{a}$ | 4.90±1.25 $^{a}$ | 10.57±4.17 $^{b}$ | 211.67±2.88 $^{b}$ | 66.86±5.31 $^{a}$ | 21.03±1.10 $^{a}$ | 31.53±1.54 $^{a}$ |
| 10.00 | 40.33±7.09 $^{b}$ | 11.90±2.19 $^{a}$ | 5.23±1.44 $^{a}$ | 5.87±3.21 $^{a}$ | 201.67±10.26 $^{b}$ | 78.53±10.87 $^{a}$ | 26.73±4.43 $^{a}$ | 30.43±10.46 $^{a}$ |
| 20.00 | 38.67±7.37$^{a}$ | 12.00±0.82 $^{a}$ | 5.76±0.50 $^{a}$ | 9.33±4.46 $^{b}$ | 184.00±50.32 $^{a}$ | 66.76±8.46 $^{a}$ | 20.97±3.21 $^{a}$ | 31.83±6.78 $^{a}$ |
| 30.00 | 39.00±4.00 $^{b}$ | 12.60±0.46 $^{a}$ | 5.60±0.69 $^{a}$ | 10.26±6.21 $^{b}$ | 194.67±42.19 $^{a}$ | 69.83±4.24 $^{a}$ | 22.00±1.81 $^{a}$ | 32.43±2.13 $^{a}$ |

Means within the same column with different superscripts are significantly different (P<0.05)

**Key:** PCV – Packed Cell Volume, HB – Haemoglobin, RBC – Red Blood Cell, WBC – White Blood Cell, MCV – Mean Corpuscular Haemoglobin, MCH – Mean Corpuscular Haemoglobin, MCHC – Mean Corpuscular Haemoglobin Concentrations,

## 4. Discussion

### 4.1. Behavioural Observation of C.gariepinus (catfish)

Fish exposed to P. aeruginosa displayed behavioural abnormalities in response to the pathogen after infection. The infected fish showed abnormal behaviors such as poor swimming, air gapsing, restlessness, serious wounds and discoloration of the skin/fins. The abnormal behaviors were noticed in 0.00ml, 10.00ml but more noticeable in 0.00ml which is the control. Ukwe and Oladapo-Akinfolarin [20] and Christybapitu, *et al.* [21] reported similar observations when fish were infected with different pathogens and exposed to different aqueous extracts to prevent ulceration. The absence of this abnormalities in the experimental fish exposed to the corn husks extracts can be attributed to the presence of phytochemicals, such as carotenoid, flavonoid, phytosteriod, phenolic acid, anthocyanins, polysaccharide and glycosides. Ukwe and Gabriel [13] and these phytochemicals have been observed to be present in corn husk extracts [15].

5.2 Therapeutic Effect of the Zea mays husk on the Haematological Parameters of C. gariepinus infected with P. aeruginosa

The health status of a fish can be ascertained by evaluating the haematological parameters of the fish [22]. Determination of various haematological parameters of fish gives details of the fish health and it's physiological responses to any environmental stress, contaminants, diseases presence etc [18, 23]. In this study the values of the Pack Cell Volume (PCV), Hemoglobin (Hb), Mean Corpuscular Hemoglobin (MCH), Mean Cell Hemoglobin and Red Blood Cell (RBC) reduced significantly after the infection compared to the values before infection. Similar observation were recorded by Ukwe and Etire [24] when C. gariepinus was infected with P. aeruginosa and exposed to Carica papaya root extracts and Adeyemi, *et al.* [22] who reported same when C. gariepinus was experimentally challenged with E.coli and Vibrio fischeri. The reduction of these parameters can be attributed to the presence of the P. aeruginosa that negatively affected the production of the RBC, PVC, Hb, hence the MCV, MCH [24],which could lead to poor oxygen circulation as observed in the gasping of air by the fish in this work.

However, after day 3 and Day 6 of the treatment, the RBC, PVC, Hb, MCH, MCV were significantly lower in the untreated group compared to the treated groups, though were higher before treatment. Similar results were obtained in the work of Nnabuchi, *et al.* [25] and Ukwe and Vopnu [12].The non- significant increase in the untreated group compared to the values before treatment could be as a result of reduced virulence of the pathogen due to the water changing system in the experiment or the fish immune system was fighting back. The haematological parameters improved in the treated groups except in the 30ml/l extracts that had significantly lower values. This could be as a result of the bactericidal effects of the phytochemicals [24, 26].The lower Values of these Parameters after day 3 and day 6 in the 30ml/l extracts could be that the corn husk extract at this concentration was abit toxic to the fish.

After 9 days of treatment , values of PCV, Hb, RBC, MCH and MCV were significantly higher in the treated group compared to the untreated groups, although they improved in the untreated group compared to the values before treatment. The increase in the PCV, Hb, RBC, MCH and MCV indicates that the fish had improved immune system and oxygen circulation in the blood [27] which could be as a result of the phytochemicals such as flavonoid, carotenoid, phenolic, steroidal and anthraquinones present in the corn husk extracts [15] which is antibacterial and have enhanced the bactericidal activities of the experimental fish against the P.aeruginosa. [18, 24].

There were significant increase in the values of the WBC and Platelets in the experimental fish after infection with P. aeruginosa. Similar observation was reported by Ukwe and Vopnu [12] when C. gariepinus was infected with P. aeruginosa and exposed to C.papaya root extracts and, Suoza, *et al.* [28].when silver catfish was infected with A.hydrophila. The WBC is an important component of the fish immune system, and it's undue increase depicts diseases presence or stress response [18, 29, 30]. The increase in the Platelets have been reported as a defense mechanism for fish [1, 31]. After 3 days of exposure to the various corn husk extracts the value of the WBC was

higher (P<05) in the untreated group but were lower and similar in the rest. The reduced WBC in the infected fish treated with zea mays husk extracts could be as a result of the phytochemicals present in the zea mays husk extracts that are bactericidal to the pathogen (P.aeruginosa). Duru [15] [24, 32] Similar result was observed at the end of 6 days of treatment with the zea mays husk extracts but at the end of 9 days treatment the values for the Platelets were significantly higher in the untreated fish and fish exposed to 10ml/l of the corn husk extracts compared to the values in the rest treatments. Increase in fish Platelets after infection have been reported in several works [1, 31]. According to Alsaid, *et al.* [33] and Bozzo, *et al.* [31] the increase in WBC of fish can be attributed to defense mechanism. The WBC was significantly higher in untreated fish (0.0ml), 20ml and 30ml extracts compared to the values before the infection at the end of 9 days treatment. The increase WBC in the untreated fish (0.0ml) could be as a result of the presence of the pathogen [24, 25, 34], while the increase of WBC in the 20ml and 30ml extracts could be as a result of the presence of the pathogen or the concentration of the extracts at the given period (9 days) was too high, imposing stress /toxicity on the fish [35].The stabilization of the WBC and the Platelets in the fish exposed to zea mays husk extracts could be as a result of the right application of the concentration and period of treatment ,as it was either bactericidal to the pathogen [12] or there were enhanced antibody production which promote recovery [27].

## 5. Conclusion

The Present study revealed that the presence of P. aeruginosa is a threat to the aquacultural industry .Occasional monitoring of the hematological parameters of fish in our farms is not only need but necessary to evaluate the health status of fish to prevent uncontrol mortality .Corn husk are considered as wastes or unwanted part of the plant, to the best of our knowledge this is the first work were corn husk extracts have been used as an antibacterial in fish culture especially as a therapeutant to the hematological parameters of C. gariepinus infected with bacterial pathogen such as P. aeruginosa .

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