# The Phytochemical Screening, Antibacterial and Antipyretic Properties of Extracts of *Chrysophyllum Albidum* Leaves.

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## ABSTRACT

*Chrysophyllum albidum* is a tropical plant commonly found in different parts of Sub-Saharan Africa used in folklore for the treatment of yellow fever, toothache, malaria, diarrhea, vaginal and dermatological infections. This study investigated the phytochemical constituents and antibacterial and antipyretic activities of the methanol, ethyl acetate, and aqueous extracts of *C. albidum* leaves. The aqueous crude extract was obtained using cold water maceration, while the methanol and ethyl acetate extracts were obtained using Soxhlet's extraction method. The presence of phytochemicals was investigated using qualitative methods, and the antibacterial activity was determined against *Staphylococcus aureus, Pseudomonas aeruginosa, Klebsiella pnuemoniae, Proteus mirabilis, Escherichia coli, Streptococcus pnuemoniae., Enterococcus faecalis, Salmonella typhi,* and *Bacillus subtilis* using the agar well-diffusion method and the minimum inhibitory concentration (MIC) by the broth dilution method at various concentrations. The in-vivo antipyretic activity was determined by the baker's yeast-induced pyrexia method. The phytochemical analysis of the methanol crude extract of *C. albidum* leaves revealed the presence of alkaloids, flavonoids, tannins, saponins, and cardiac glycosides. The ethyl acetate crude extract revealed the presence of alkaloids, flavonoids, tannins, and saponins, while the aqueous crude extract revealed the presence of alkaloids, flavonoids, tannins, saponins, and cardiac glycosides. The methanol extract at concentrations of 25 mg/mL, and 100 mg/mL showed antibacterial activity against 3 out of the 9 bacterial isolates*: S. typhi, E. coli,* and *S. pnuemoniae* with the highest activity against S. typhi inhibition zone diameter (IZD) of 10 mm, 8 mm, and 8 mm at concentrations of 100 mg/mL, 25 mg/mL and 3.125 mg/mL, respectively. The ethyl acetate extract also showed apparent antibacterial activity against 4 out of the 9 bacterial isolates: *P. aeruginosa, P. mirabilis, E. coli,* and *S. typhi. P. aeruginosa* were the most sensitive organisms to the ethyl acetate extract of *C. albidum* having IZDs of 10mm, 9mm, and 8mm at concentrations of 100 mg/mL, 25 mg/mL, and 3.125 mg/mL, respectively. Proteus mirabilis was the most sensitive organism to the aqueous leaf extract of *C. albidum* at the different concentrations of 100 mg/ml, 25 mg/mL, and 3.125 mg/mL having an IZD of 18 mm, 18 mm, and 15 mm, respectively. *E. coli* and *S. typhi* isolates were inhibited by all the leaf extracts of *C. albidum* (methanol, ethyl acetate, and aqueous), while S. *aureus, Klebsiella sp.,* and *B. subtilis* were resistant to all the extracts of *C. albidum* at the same concentrations. The results of the effects of the methanol, ethyl acetate, and

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aqueous leaf extracts of *C. albidum* on baker's yeast-induced pyrexia in rats showed that aqueous leaf extracts showed a more pronounced and significant ($P < 0.05$) dose- and time- dependent effect in lowering the hyperthermia than the methanol and ethyl acetate extracts and were found to have a similar effect as the standard drug paracetamol 2 hours post-administration. The results of the study justify the ethnomedicinal use of *C. albidum* leaves for the treatment of fever and bacterial infections, and further research on these plant parts is encouraged.

**Keywords**: *Chrysophyllum albidum*, phytochemical, antibacterial activity, antipyretic activity, multidrug resistance microorganisms

## INTRODUCTION

The use of natural products, including minerals and medicinal plants, for medicinal purposes by man in an attempt to treat an array of maladies emanates even before history. It is the first form of traditional medicine known and reported, and the practice is still popular [1].

Drug chemotherapy remains one of the major curative options worldwide [2]. Antibiotics are one of the most important weapons in fighting bacterial infections and have greatly benefited the health-related quality of human life, since their introduction. However, over the past few decades, these health benefits have become under threat as many commonly used antibiotics have become less effective against certain illnesses, not only because many of them produce toxic reactions; but also due to the emergence of drug- resistant bacteria. It is essential to investigate the latest drugs with less resistance [3].

In general, bacteria have the genetic ability to transmit and acquire resistance to synthetic drugs, which are utilized as therapeutic agents. The resistance among various microbial species (infectious agents) to different antimicrobial drugs has emerged as a cause of public health threats all over the world at a terrifying rate. Due to the pacing advent of new resistance mechanisms and the decrease in efficiency of treating common infectious diseases, it fails in microbial response to standard treatment, leading to prolonged illness, higher expenditures for health care, and an immense risk of death [4]. As a result, society is facing one of the most serious public health dilemmas over the emergence of infectious bacteria displaying resistance to many antibiotics, as stated by Kapil [5].

Currently, attention is being given to the use of herbal medicinal products and therapy for the treatment of most ailments, whether physiological disorders or of bacterial, viral, or parasitic origin. Screening of plant extracts for anthelmintic, antiviral, or antiparasitic properties is one of the basic steps in identifying target drugs after extraction [2]. Due to the potential health benefits of plants of medicinal value, medicinal plant extracts have been developed and proposed for use in food as natural antimicrobials [6].

The medicinal value attributed to plants is a function of the bioactive phytochemical constituents that produce definite physiological action in the human body [7].

Pyrexia, also known as fever and febrile response, is an increase in body temperature (when the body temperature goes up above the normal range of 36.5–37.5°C (97.7–99.5°F) due to an increase in the body temperature set point) [8].

*Chrysophyllum albidum*, commonly known as the white star apple, belongs to the family of Sapotaceae. In Nigeria, it is known by various local names, such as Agbalumo in Yoruba, Udara in Igbo, and Agwaluma in Hausa ([9], [10], [11]). The plant is a crop of commercial value in Nigeria [12]. *C. albidum* is used for various medicinal purposes in ethnomedicine. The bark is employed for the treatment of yellow fever, toothache, and malaria in folklore medicine [11]. Its leaves are used as emollients and for the treatment of malaria, stomach aches, and diarrhea. Also, its leaves and cotyledons from its seed are used as ointments in the treatment of

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vaginal and dermatological infections in Western Nigeria [12].

There is a paucity of data on the antimicrobial screening of *C. albidum* leaves, fruits, and seeds against multidrug-resistant organisms, including Extended Spectrum Beta-Lactamase (ESBL) producers and Methicillin-Resistant Staphylococcus aureus (MRSA).

This study screened the phytochemical content and evaluated the antibacterial and antipyretic activity of aqueous, methanol, and ethyl acetate extracts of *C. albidum*.

## MATERIALS AND METHODS

*Collection and Identification of Plant Material.*

The fresh leaves of *C. albidum* was collected from its natural habitat at Umuekwe village, Enugu-Agu, Ozalla in Nkanu West Local Government Area of Enugu State, Nigeria, between July and August. The plant materials were identified by the Chief Laboratory Technologist at the herbarium unit of the Pharmacognosy Laboratory, Faculty of Pharmaceutical Sciences, Enugu State University of Science and Technology, ESUT, Enugu State.

### Test Organisms

Clinical isolates of *Salmonella typhi, Klebsiella pnuemoniae, Pseudomonas aeruginosa, Escherichia coli, Staphylococcus aureus, Enterococcus faecalis, Proteus mirabilis, Streptococcus pneumoniae, and Bacillus subtilis* obtained from Adonai Research Laboratory of Medical Microbiology and Biomedical Services at Nsukka, Enugu State, were used for the study.

### Experimental Animals

White albino rats (150 – 200 g) were used for the study. The animals were obtained from the animal house of the Department of Pharmacology, Faculty of Pharmaceutical Sciences, Enugu State University of Science and Technology, ESUT, Enugu State. They were allowed access to food and water ad libitum. All the animal experiments were conducted in compliance with the National Institute of Health's (NIH) guidelines for the care and use of laboratory animals.

### METHODS

### Preparation of Aqueous Leaf Extract with Distilled Water

About 200g of the powdered leaves of *C. albidum* was dissolved in 1000ml of distilled water and allowed to soak for 48 hours, after which the mixture was filtered using Whatman filter paper and evaporated to dryness using a water bath at 40°C. The extracts were stored at 4°C until use.

### Preparation of Methanol and Ethyl Acetate Leaf Extract (Soxhlet Extraction)

About 150 ml of methanol was poured into a round bottom flask. 30 g of the powdered leaf sample was weighed, placed in the thimble, and inserted in the center of the Soxhlet extractor. The extractor was then heated to and held constant at 65°C. As the solvent began boiling; the vapor rose through the vertical tube of the extractor into the condenser at the top of the extractor. The liquid condensate was then dripped into the filter paper thimble in the center, which contained the solid sample from which the leaf was extracted. The extract seeped through the pores of the thimble and filled the siphon tube, where it flowed back down into the round bottom flask. This was allowed to continue for 5 hours. It was then removed from the tube, concentrated using a rotary evaporator, and weighed again to determine the amount of extract obtained as well as the

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percentage yield. This procedure was repeated until the entire powdered sample was exhausted. The crude extracts were stored at 4°C until use.

**Phytochemical Screening of Plant Extract**

The quantitative chemical analysis of the crude powdered plant sample was carried out for the presence of alkaloids, tannins, saponins, steroids, cardiac glycosides, flavonoids, and terpenoids using the method adopted in similar surveys [13] and standard established protocols [14], [15].

**Preliminary Antimicrobial Assay**

The antibacterial activities of the test samples (methanol, ethyl acetate, and aqueous extract) realized from the leaves of C. albidum and the standard agent (Gentamycin) were determined using the agar diffusion method [16]. All the extracts were reconstituted accordingly into the following concentrations; 100, 50, 25, 12.5, and 6.25 mg/mL, using dimethyl sulphoxide (DMSO). The susceptibility testing was investigated by the agar well diffusion method. A 0.1ml of 1:10,000 broth culture dilutions (equivalent to $10^6$cfu/ml) of a fresh overnight culture of the test organisms, *Staphylococcus aureus, Enterococcus faecalis, Pseudomonas aeruginosa, Proteus mirabilis, Streptococcus pnuemoniae, Klebsiella pnuemoniae, Escherichia coli, Salmonella typhi, and Bacillus subtilis,* were grown in Mueller Hinton agar and were used to seed the molten nutrient agar and sanctioned to set. The mixture was aseptically poured into sterile Petri dishes and allowed to set.

Using a sterile corkborer of 6mm diameter, equidistant wells were made in the agar. Drops of the re- suspended (2 ml per well) extracts with concentrations of 100 mg/mL, 25 mg/mL, and 3.125 mg/mL were introduced into the wells till they were filled. Gentamycin 50mg/mL was used as the control experiment for bacteria. The plates were allowed to stand on the bench for an hour, to allow pre-diffusion of the extracts before incubation at 37 ºC for 24 hours for the bacterial isolates. The zones of inhibition were measured to the nearest millimeter (mm) using a standard transparent meter rule. All experiments were performed in duplicate [17].

**Minimum Inhibitory Concentration (MIC)**

The concentrations were determined as earlier described by Vollekovà et al. [18], with some modifications by Usman et al. [19]. The MIC was determined for the micro-organisms that showed reasonable sensitivity to the test extracts. In this test, the microorganisms were prepared using the broth dilution technique.

**Antipyretic Study**

**Experimental Design**

Body weights of the animals were recorded, and they were randomly divided into 4 major groups, with group A-D having two (2) subgroups; each consisting of 5 animals, as follows:

Group A1: animals were administered 5ml/kg of DMSO4.

Group A2: animals were treated with yeast via subcutaneous injection (20mg/kg) and 5ml/kg of DMSO4

Group A3: animals were administered with yeast (20mg/kg) and the standard drug paracetamol (100mg/kg b.w.),

Group B1: animals were administered with yeast (20mg/kg) and the standard drug paracetamol (100mg/kg b.w.), animals were administered with yeast (20mg/kg), and with methanol leaf extract of *C. albidum*(100mg/kg b.w.), orally.

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Group B2: animals were administered with yeast (20mg/kg) and with methanol leaf extract of *C. albidum* (250mg/kg b.w.), orally.

Group B3: animals were administered with yeast (20mg/kg) and with methanol leaf extract of *C. albidum* (500mg/kg b.w.), orally.

Group C1: animals were administered with yeast (20mg/kg)and with ethyl acetate leaf extract of *C. albidum* (100mg/kg b.w.), orally.

Group C2: animals were administered with yeast (20mg/kg) and with ethyl acetate leaf extract of *C. albidum* (250mg/kg b.w.), orally.

Group C3: animals were administered with yeast (20mg/kg) and with ethyl acetate leaf extract of *C. albidum* (500mg/kg b.w.), orally.

Group D1: animals were administered with yeast (20mg/kg) and with an aqueous leaf extract of *C. albidum* (100mg/kg b.w.), orally.

Group D2: animals were administered with yeast (20mg/kg) and with an aqueous leaf extract of *C. albidum* (250mg/kg b.w.), orally.

Group D3: animals were administered with yeast (20mg/kg) and with an aqueous leaf extract of *C. albidum* (500mg/kg b.w.), orally.

The animals were administered baker's yeast subcutaneously, and the rectal temperatures of the rats were measured 18 h later by inserting a thermometer into the rectum of the animals. After 1 h, 100mg/kg of *C. albidum* methanol, ethyl acetate and aqueous extract, paracetamol (all dissolved in DMSO4), and an equivalent volume of DMSO4 were administered to the respective groups. The rectal temperatures of the animals were subsequently measured at 30, 60, 90, and 120 min post methanol, ethyl acetate aqueous extract, standard drug, and DMSO4 administration. This same procedure was repeated for 250 mg/kg and 500 mg/kg of *C. albidum* methanol, ethyl acetate, and aqueous extract, respectively.

The mean of post-baker's yeast rectal temperatures was compared with the pre-drug treatment temperature [20].

### Statistical Analysis

Statistical analysis of the results was done by two-way analysis of variance (ANOVA) using GraphPad software followed by Dunne's comparison test for significance. The significance was set at $P < 0.05$. Graphical illustration was carried out using Microsoft Excel, in 2013.

## RESULTS

The results of the preliminary phytochemical screening of *Chrysophyllum albidum* leaves (Table 1) revealed that the methanol extract contains alkaloids, flavonoids, tannins, saponins, and cardiac glycosides. However, steroids and terpenoids were absent. The ethyl acetate extract contains alkaloids, flavonoids, tannins, saponins, and cardiac glycosides, while cardiac glycosides, steroids, and terpenoids were absent. The aqueous extract contains trace alkaloids, flavonoids in high quantities, tannins, and saponins; while steroids and terpenoids were absent.

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**TABLE 1: PRELIMINARY PHYTOCHEMICAL SCREENING of *C. ALBIDUM* LEAVE**

| Constituents | Aqueous Extract | Methanol Extract | Ethyl Acetate Extract |
|---|---|---|---|
| **Alkaloids** | ++ | ++ | ++ |
| **Flavonoids** | +++ | ++ | ++ |
| **Tannins** | + | + | + |
| **Saponins** | + | + | + |
| **Steroids** | – | – | – |
| **Cardiac glycosides** | + | + | – |
| **Terpenoids** | – | – | – |

**KEY:** + Present; – Absent.

The methanol extract of *C. albidum* showed antibacterial activity against 3 out of 9 test organisms having an IZD in the range of 8 to 10 mm for *S. typhi*, 11 to 13 mm for *E. coli* and 8mm for *S.pneumoniae*. (Figure 1). The MIC value for *S. typhi, S.pnuemoniae* and *E. coli* were 3.125 mg/mL, 25 mg/mL respectively (Table 2).

The result for the antibacterial activity of ethyl acetate leaf extract is shown in Figure 2. The IZD ranges from 8 to 10 mm for *P. aeruginosa*, 10 to 15mm for *E. coli*, 8 to 18 mm for *S. typhi* and an IZD of 8mm for *Proteus mirabilis*. Table 2 shows the MIC result.

The aqueous leaf extract of *C. albidum* exhibited antibacterial activity against 5 out of 9 test organisms, having IZD in the range of 10 to 18 mm for *Enterococcus faecalis*, 18mm to 15mm for *Proteus mirabilis*, 10 to 15 mm for *E. coli*, 8 to 15 mm for *S. typhi* and an IZD of 12 mm for *P. aeruginosa* (Figure 3). The MIC value for *E. faecalis, S. typhi, E. coli* and *P. mirabilis* was 3.125 mg/mL while that of *P. aeruginosa* was25 mg/mL, (Table 2).

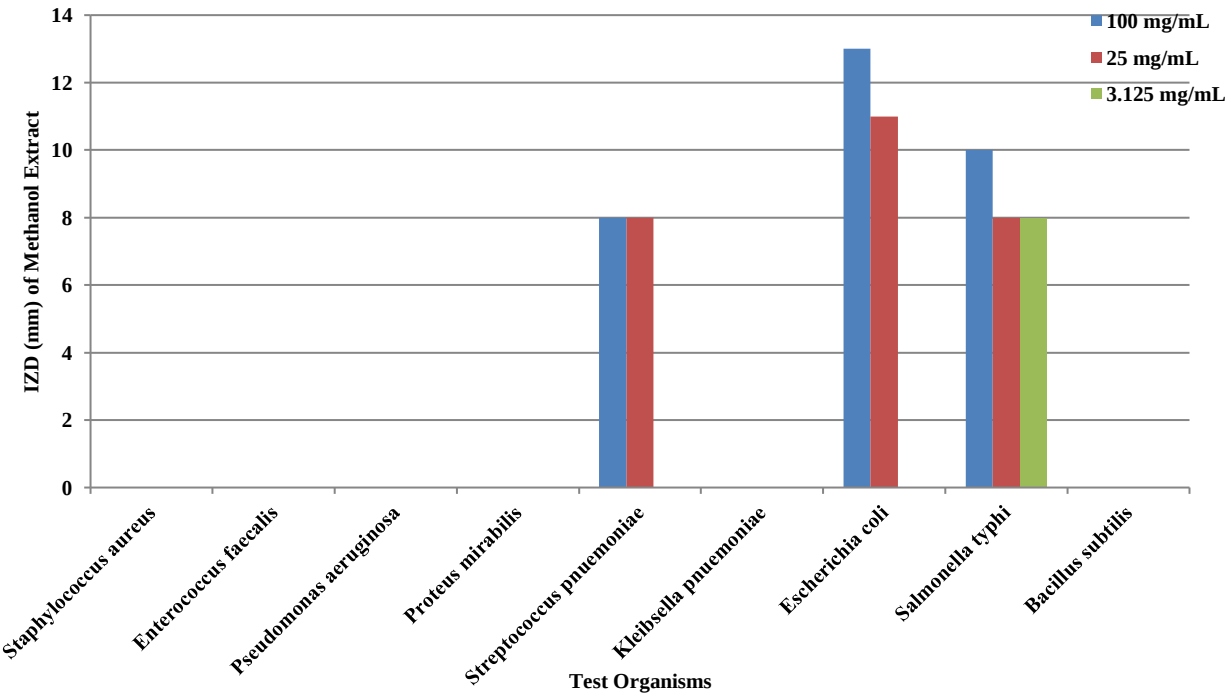


**Figure 1: Diameter of Zone of Inhibition (mm) of Methanol Extract**

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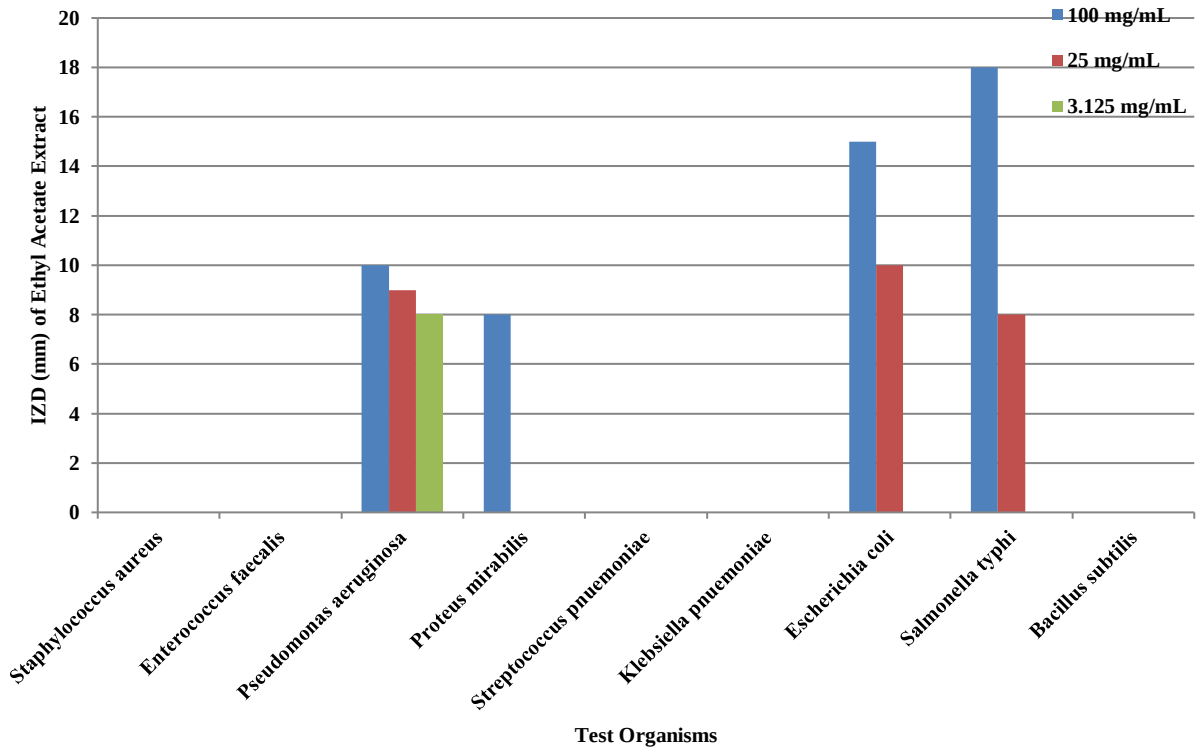


**Figure 2: Diameter of Zone of Inhibition (mm) of Ethyl Acetate Extract**

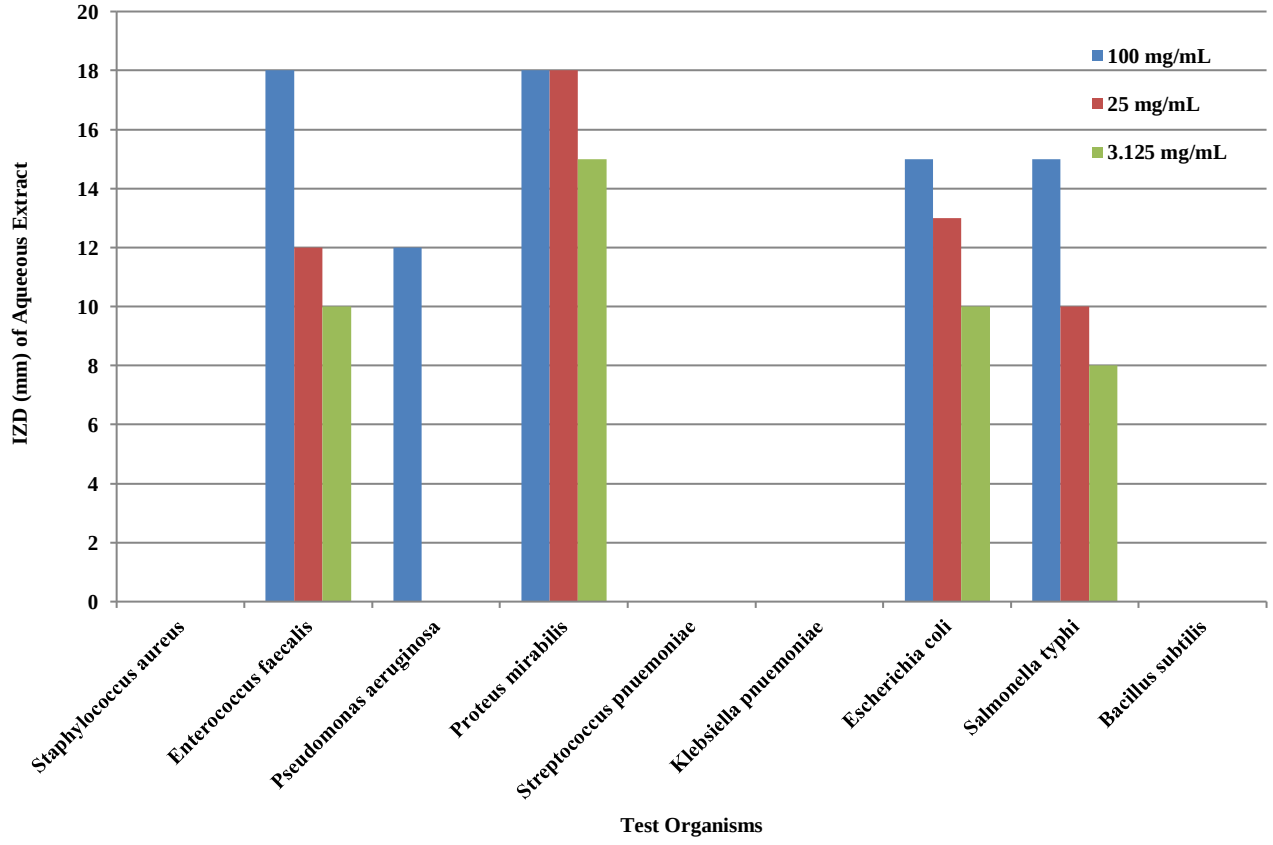


**Figure 3: Diameter of Zone of Inhibition (mm) of Aqueous Extract**

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**TABLE 2: MINIMUM INHIBITORY CONCENTRATIONS (MICS) of the PLANT EXTRACTS**

| Plant extracts | Minimum inhibitory concentration (MIC) mg/mL | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | ***S. a*** | ***E. f*** | ***P. a*** | ***S. t*** | ***K. p*** | ***B. s*** | ***E. c*** | ***P. m*** | ***S. p*** |
| **Aqueous** | - | 3.125 | 25 | 3.125 | - | - | 3.125 | 3.125 | - |
| **Methanol** | - | - | - | 3.125 | - | - | 25 | - | 25 |
| **Ethyl Acetate** | - | - | 3.125 | 25 | - | - | 25 | 50 | - |

***S. a = Staphylococcus aureus, B. s = Bacillus subtilis, S. t = Salmonella typhi, P. a = Pseudomonas aeruginosa, K. p = Klebsiella pnuemoniae, E. f= Enterococcus faecalis P. m = Proteus mirabilis, E. c = Escherichia coli, S.p = Streptococcus species.***

The results of the effects of the methanol, ethyl acetate, and aqueous leaf extracts of *C. albidum* on baker's yeast-induced pyrexia in rats is shown in Tables 3, 4, and 5.

The mean basal body temperature of the animals in the various groups ranged from 36.96$^{o}$C to 37.82$^{o}$ C(Tables 3, 4, and 5). The group treated with 100mg/kg of methanol extract had no significant reduction in temperature ($P$> 0.05) compared to the negative control throughout the duration of the study (Table 3).

The group treated with 100 mg/kg b.w. of the EE extract showed no significant reduction in temperature ($P$ > 0.05) throughout the duration of the study (Table 4). There was a significant temperature reduction ($P$< 0.05) in animals treated with 250 mg/kg b.w. of the extract (37.96 ± 0.18$^{o}$C, 37.48 ± 0.24$^{o}$C) compared to the control.

The treatment group was administered 250 mg/kg b.w. of A.E. showed mild antipyretic activity ($P$< 0.05) 1 hour post administration (38.46 ± 0.22$^{o}$C), while the antipyretic activity was more pronounced (P < 0.05) after 1 hour 30 minutes (38.04 ± 0.16$^{o}$C) and 2 hours (37.82 ± 0.10$^{o}$C) post administration (Table 5). The 500 mg/kg b.w. of aqueous extract (A.E) a highly significant and more potent antipyretic activity ($P$< 0.05) from 30 minutes (38.30 ± 0.10$^{o}$C) till after 2 hours post administration (36.76 ± 0.05$^{o}$C).

**TABLE 3: E FFECT of the CONTROL, STANDARD DRUG and METHANOL EXTRACT (ME) of *C. ALBIDUM* ON BODY**

**TEMPERATURE in YEAST-INDUCED PYREXIA.**

| Group | Treatment | Dose (mg/kg) | Initial Rectal Temp. in $^{o}$C before Yeast Injection | Rectal Temperature in $^{o}$C after 18hrs of Yeast Injection (Mean± SEM) | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | 0hr | 0.5hr | 1hr | 1.5hrs | 2hrs |
| **A2** | Yeast | 20 ml/kg | 37.38±0.14 | 39.78±0.10 | 39.46±0.12 | 39.20±0.13 | 38.92±0.12 | 38.70±0.10 |
| **A3** | SP | 100 | 37.42±0.15 | 39.18±0.21 | 37.72±0.09*** | 37.12±0.09*** | 36.76±0.09*** | 36.60±0.04*** |
| **B1** | ME | 100 | 37.12±0.06 | 39.38±0.15 | 39.08±0.13 | 38.80±0.12 | 38.50±0.09 | 38.20±0.08 |
| **B2** | ME | 250 | 37.50±0.12 | 39.20±0.17 | 38.48±0.20* | 37.86±0.13*** | 37.38±0.14*** | 37.16±0.12*** |
| **B3** | ME | 500 | 37.44±0.19 | 39.66±0.20 | 38.68±0.07* | 38.08±0.04*** | 37.14±0.04*** | 37.00±0.03*** |

**Values are expressed as Mean ± SEM. n = 5 in each group, "*" indicates P < 0.05 compared to control.**

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**TABLE 4: EFFECT OF THE CONTROL, STANDARD DRUG AND ETHYL ACETATE EXTRACT OF *C ALBIDUM* ON BODY TEMPERATURE IN YEAST-INDUCED PYREXIA.**

| Group | Treatment | Dose (mg/kg) | Initial Rectal Temp. in $^{o}$C before Yeast Injection | Rectal Temperature in $^{o}$C after 18hrs of Yeast Injection (Mean± SEM) | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | 0hr | 0.5hr | 1hr | 1.5hrs | 2hrs |
| **A2** | Yeast | 20 ml/kg | 37.38±0.14 | 39.78±0.10 | 39.46±0.12 | 39.20±0.13 | 38.92±0.12 | 38.70±0.10 |
| **A3** | SP | 100 | 37.42±0.15 | 39.18±0.21 | 37.72±0.09*** | 37.12±0.09*** | 36.76±0.09*** | 36.60±0.04*** |
| **C1** | EA | 100 | 37.18±0.19 | 39.18±0.37 | 38.90±0.34 | 38.66±0.33 | 38.42±0.27 | 38.10±0.25 |
| **C2** | EA | 250 | 37.34±0.15 | 39.52±0.43 | 39.08±0.37 | 38.58±0.40 | 37.96±0.18** | 37.48±0.24*** |
| **C3** | EA | 500 | 37.20±0.12 | 39.32±0.14 | 38.76±0.20* | 38.18±0.18*** | 37.82±0.16*** | 37.52±0.20*** |

**Values are expressed as Mean ± SEM. n = 5 in each group, "*" indicates P < 0.05 compared to control**

**TABLE 5: EFFECT OF THE CONTROL, STANDARD DRUG AND AQUEOUS EXTRACT (A.E) OF *C. ALBIDUM* ON BODY TEMPERATURE IN YEAST-INDUCED PYREXIA**

| Group | Treatment | Dose (mg/kg) | Initial Rectal Temp. in $^{o}$ C before Yeast Injection | Rectal Temperature in $^{o}$C after 18hrs of Yeast Injection (Mean± SEM) | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | 0hr | 0.5hr | 1hr | 1.5hrs | 2hrs |
| **A2** | Yeast | 20 ml/kg | 37.38±0.14 | 39.78±0.10 | 39.46±0.12 | 39.20±0.13 | 38.92±0.12 | 38.70±0.10 |
| **A3** | S.P | 100 | 37.42±0.15 | 39.18±0.21 | 37.72±0.09*** | 37.12±0.09*** | 36.76±0.09*** | 36.60±0.04*** |
| **D1** | AE | 100 | 37.56±0.10 | 39.32±0.17 | 39.02±0.15 | 38.78±0.17 | 38.48±0.15 | 38.24±0.12 |
| **D2** | AE | 250 | 37.82±0.07 | 39.48±0.19 | 38.80±0.26 | 38.46±0.22* | 38.04±0.16** | 37.82±0.10** |
| **D3** | AE | 500 | 36.96±0.05 | 39.20±0.14 | 38.30±0.10*** | 37.80±0.09*** | 37.20±0.05*** | 36.76±0.05*** |

**Values are expressed as Mean ± SEM. n = 5 in each group, "*" indicates P < 0.05 compared to controls**

## DISCUSSION

The medicinal attributes of plants lie in some chemical and biochemical substances that have definite physiological compounds. The phytochemicals may act as precursors for bioactive compounds utilized as therapeutic drugs. Plants with phytochemicals such as flavonoids and alkaloids have been reported to have the potential to exhibit antibacterial and antipyretic activity [21].

In this study, the aqueous and methanol extracts of *C. albidum* leaves revealed an abundance of flavonoids and alkaloids and moderate quantities of tannins, cardiac glycosides, and saponins. This is in agreement with the previous report by [21].

In the same vein, saponins have been reported to possess antimicrobial activity, and this characteristic has been studied using animals ([22],[23]). The presence of most general phytochemicals might be responsible for the antibacterial and antipyretic effects.

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*Chrysophyllum albidum* leaf extract exhibited antibacterial activity against the tested organisms *Staphylococcus aureus, Enterococcus faecalis, Pseudomonas aeruginosa, Proteus mirabilis, Streptococcus pnuemoniae., Klebsiella pnuemoniae., Escherichia coli, Salmonella typhi* and *Bacillus subtilis,* contrary to the study by [24], which had no activity on bacteria isolates.

Methanol leaf extract showed good antibacterial activity against *Streptococcus sp., E. coli* and *Salmonella typhi* this is in accordance with an earlier report by [25], who reported the broad spectrum antibacterial activity of *C. albidum* on these organisms.

The ethyl acetate extract of *C. albidum* leaves had better activity against the test organisms compared to the methanol extract; notably, they exhibited good antibacterial activity against organisms like *Pseudomonas aeruginosa*, *Salmonella typhi* and *Escherichia coli*. This may explain the ethnomedicinal use of *C. albidum* leaves for the treatment of vaginal infections, GIT infections, and dermatological infections.

Furthermore, *Staphylococcus aureus, Kleibsella sp.* and *Bacillus subtilis* were resistant to all the extracts of *C. albidum* at concentrations of 3.125, 25, and 100 mg/mL respectively.

The strong antimicrobial activities demonstrated by the crude extracts of this plant may therefore justify some of the ethno-pharmacological claims about this plant in the treatment of diseases like dysentery, wounds, sepsis, and cough.

Since antipyretic activity is commonly mentioned as a characteristic of drugs or compounds that have inhibitory activity on prostaglandin biosynthesis, the yeast induced hyperpyrexia in a rat model was employed to investigate the antipyretic activity of the extract [26]. Yeast induced pyrexia is called pathogenic fever, which is due to the production of prostaglandins (PGE2), which set the thermoregulatory center at a higher temperature [27].

The results showed that the groups treated with 100mg/kg of methanol, ethyl acetate and aqueous leaf extracts of *C. albidum* did not show any significant reduction in rectal temperatures ($P > 0.05$) of the animals throughout the period of this study (2 hrs) as compared to both positive and negative controls. The groups treated with 250 mg/kg of methanol, ethyl acetate, and aqueous leaf extracts showed a significant reduction in rectal temperatures ($P < 0.05$), with the 250 mg/kg methanol extract having the highest significant reduction of rectal temperature out of the 3 extracts. The temperature reduction exhibited by 250 mg/kg of methanol extract started 30 mins (0.5 hr) post-treatment, while that of 250 mg/kg ethyl acetate extract and 250 mg/kg aqueous commenced at 90 mins (1.5 hrs) and 60 mins (1 hr), respectively (Table 3). The 500 mg/kg of the aqueous leaf extracts showed a more pronounced effect in lowering the hyperthermia than the methanol and ethyl acetate extracts, but were found to have a similar effect as the standard drug paracetamol 2 hours post-administration (Table 5).

At 250 mg/kg, and 500 mg/kg, the methanol, ethyl acetate, and aqueous extract of *C. albidum* and paracetamol reduced the rectal temperatures of the treated animals in a time-dependent manner. This may also indicate that at these concentrations, the leaf extracts may show a sustained reduction in rectal temperature if there is a follow up dose after the initial administration.

These results showed that *C. albidum* leaf has mild antipyretic activity. The mild antipyretic activity observed may be attributed to the presence of flavonoids, which have been earlier reported to exhibit an antipyretic effect in a study by Onyegbule *et.al.* [28]. The extracts are likely to reduce pyrexia by reducing the brain concentration of prostaglandin E2, especially in the hypothalamus, through their action on COX-3 or by enhancing the production of the body's own antipyretic substances like vasopressin and arginine [29].

The findings of this study revealed the presence of phytochemicals, which are medicinally active constituents, in the *C. albidum* leaf extracts studied. The leaf extract of *C. albidum* demonstrated varying

degrees of antibacterial activity on the tested bacteria isolates and antipyretic activity on rats. This study also provides evidence for *Chrysophyllum albidum* which could partly contribute to its ethnomedical use and scientifically validate the previous studies done on this plant.

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