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Antimicrobial activities of camphor on Nigerian currency notes

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Abstract

The use of purses and pouches were recommended to prevent protracted body contact with currency notes in order to abate microbial contamination of the notes, however many currency users do not comply with the use of purses, and many pouches where these notes are kept are usually dirty. It is therefore imperative to look for a way of disinfecting the notes and the environment in which it is kept. Camphor has been discovered as an effective insecticide and has been used by people to safeguard fabrics without adverse health effect. It is instructive to investigate the possibility of using the substance as antimicrobial agent for currency notes. One hundred and twenty- eight (128) samples of currency notes containing different denominations were collected at random from different sources in Ado- Ekiti metropolis. Sixty-four (64) samples were treated with camphor for six hours; the other sixty-four samples were left untreated. Isolation of microorganisms was carried out using pour plate method, microbial loads and antimicrobial activity of camphor on the samples was determined. Isolates from the samples included *Staphylococcus aureus, Pseudomonas aeruginosa, Escherichia coli, Enterobacter aerogenes, Aspergillus flavus, Mucor, Rhizopus nigrican* and *Scopulariopsis*, but *E. aerogenes, Rhizopus nigrican* and *Scopolariopsis* were not isolated on the ₦500 and ₦1000 notes of the treated samples. The microbial loads of untreated currency notes ranged from 1.70 ×102 – 2.4× 102 cfu/ml while that of treated samples ranged from 1.00 × 102 – 1.2 × 102 cfu/ml. The reduction in the number of microorganisms and the microbial loads of the treated samples is evidence that camphor could be used as an antimicrobial agent on currency notes.

Keywords: Antimicrobial; Camphor; Currency Notes; Vehicles

1. Introduction

Many people who live personal hygienic life are still infected by contagious diseases, and the currency notes are suspected to be a source of infection. The naira notes have been produced by the Central bank of Nigeria (CBN) in various denominations. There are eight different denominations which include ₦5, ₦10, ₦20, ₦50, ₦100, ₦200, ₦500 and ₦1000 notes [1]. In most day-to-day cash transactions, money in the form of these notes pass through the hands of many people in the form of payment for goods, services or alms [2]. In the process of transaction, a currency which is contaminated with pathogens can be passed from user to user.

The source of contamination of the currency notes can be traced to dust, soil, water and micro flora of the body of handlers. As well, some money handling habits such as keeping naira notes in brassiere and dirty pockets, the counting of money with saliva and squeezing of currency notes which loosens its fiber to create habitat for microbes [3] are other sources of contamination. The poor toilet habit of some handlers is another source of contamination. For instance, microorganisms that have been observed to be contaminants of the naira notes are mainly of faecal origin [4]. Individuals handling the notes shed some of their body flora on the notes; leading to the spread of the pathogens among the handlers [5]. This mode of pathogen transfer has been implicated in serious health hazards. Microorganisms such

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as *Rhizopus*, *Aspergillus flavus*, *Mucor*, *Staphylococcus aureus* and have been isolated from naira notes [6], this suggests that the currency notes could serve as fomites for some infectious agents.

Efforts have been made on how to prevent the spread of microorganisms on currency notes. For example, the use of purses and pouches were recommended to prevent protracted body contact with currency notes in order to abate microbial contamination of the notes. However, the pouches cannot eliminate the microorganisms on an already contaminated currency. Also, many pouches where these notes are kept, usually becomes dirty over time and this can serve as fomites [7]. Another effort at ridding the currency of contaminant was the use of bleach to chlorinate the notes [8]. However, the bleaches usually come in a liquid form, which can wet the paper currency and render it vulnerable to mutilation. More so, it is not easy to carry the bleach about in transit, especially in a purse. Since it is required to constantly disinfect the currency in the pouch, a dry antimicrobial agent is proposed. The proposed antimicrobial agent is camphor.

Camphor is a white waxy transparent solid with a strong aromatic odour [9]. It is very easy to get, less poisonous, cheap and portable. It is readily absorbed through the skin and produce a feeling of cooling similar to that of menthol and acts as slight local anaesthetic and antimicrobial agents [10]. Though, some researchers have used camphor to inhibit the growth of microorganisms such as *Staphylococcus aureus*, *Candida albicans* and *Aspergillus niger* [11], but it has not been used as an antimicrobial agent on currency notes. As a result of the efficiency of camphor to inhibit the growth of microorganisms, it is suggestive that it could be used as an antimicrobial agent for currency notes.

2. Material and methods

2.1. Samples collection

Sixteen samples of each denomination were collected randomly from different sources in Ado- Ekiti, Ekiti – state in to separate sample bottles making a total of one hundred and twenty- eight (128) samples. The different denominations which included ₦5, ₦10, ₦20, ₦50, ₦100, ₦200, ₦500 and ₦1000 were brought to the laboratory for microbiological analysis.

2.2. Isolation of Microorganisms from the currency notes

Eight samples from each denomination were collected in different sterile sample bottles and camphor was introduced to it for six (6) hours, the other samples were left untreated, the camphor was removed carefully by means of sterile forceps and 10mL of distill water was added to each denomination of the treated and the untreated samples, they were allowed to stand for two (2) hours. The isolation of microorganisms from the two groups was done by using pour plate method as described by Sam [12], both the nutrient agar and the potato dextrose agar plates were incubated and observed for the presence of growth and the colonies on nutrient agar plates were counted and expressed as colony forming unit per meal.

2.3. Identification of Microorganisms

The bacterial isolates were identified based on cultural, morphological and biochemical characteristics such as catalase test, coagulase test, oxidase test and MRVP test as described by Fawole and Oso [13]. While the fungal isolates were identified on the basis of their morphological characteristics using lactophenol cotton blue stain.

3. Results and discussion

A total of one hundred and thirty- five (135) bacteria belonging to four genera and one hundred and twenty- three (123) fungi belonging to four genera were isolated from the untreated currency notes samples; these include *Staphylococcus aureus, Escherichia coli*, *Enterobacter aerogenes, Pseudomonas aeruginosa*, *Aspergillus flavus*, *Mucor*, *Rhizopus* and *Scopulariopsis* (Figure 1 and 2). The presence of these microorganisms on the untreated currency notes implies contamination which may lead to diseases conditions such as Staphylococcal food poisoning, aspergillosis and enteric fever which can be transmitted from one person to another. The sources of contamination of the currency notes could be as a result of poor money handling practices like spraying during ceremonies where such notes may be trampled upon when they fall on the ground, wetting of fingers with saliva to lubricate the hand in counting money, keeping of currency notes under the brassier or under the rugs or carpet. In addition, daily transactions have made the currency notes to pass through many hands and pathogens become imposed on them. This result is in line with the result of Gaynes [14] and Ofoedu [5] where the authors isolated haemolytic *staphylococci, Enterobacter species, pseudomonas*, *Bacillus Species, Alkaligenes species, diphtheriods and Escherichia coli* from currency notes.

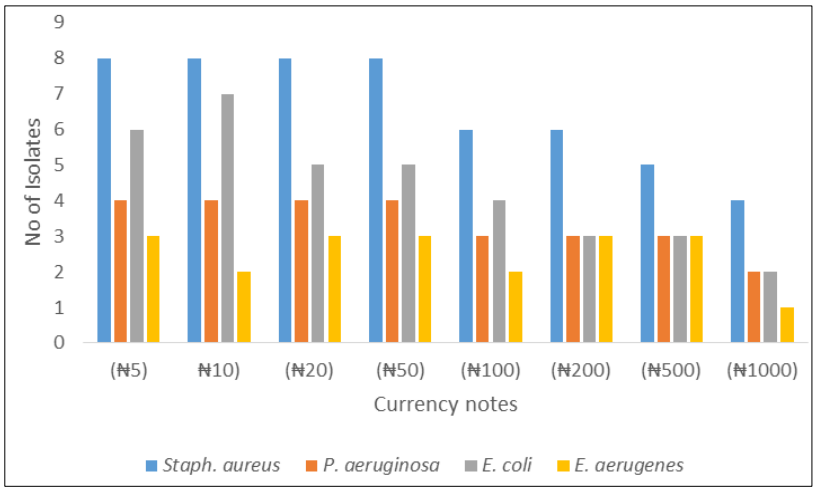

Figure 1 Bacterial isolates from the untreated currency notes

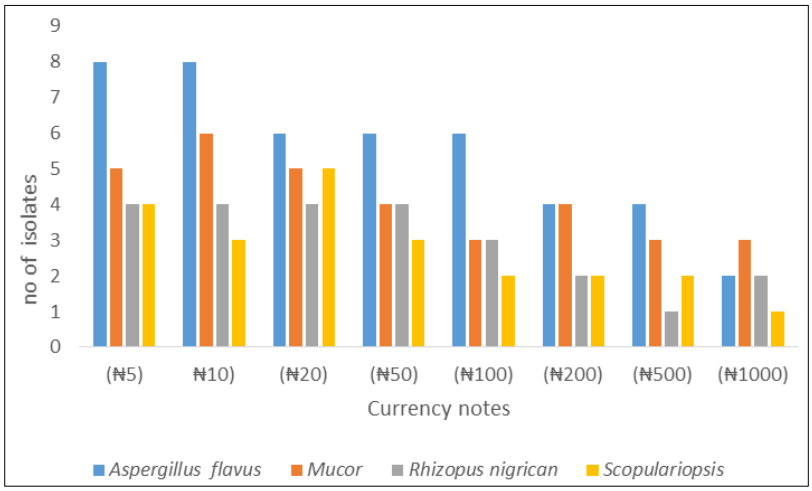

Figure 2 Fungi isolated from the untreated currency notes

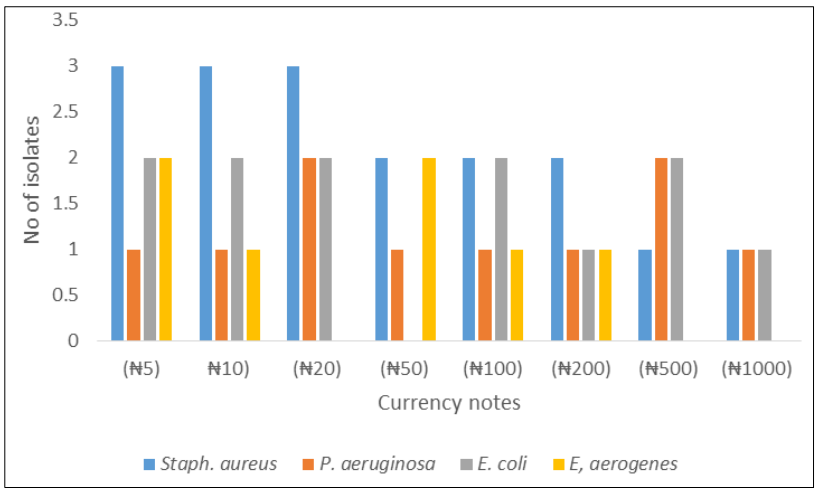

Figure 3 Bacteria isolated from the treated samples

Results from Figure 3 and 4 showed that forty-nine (49) bacterial isolates and fifty-one (51) fungal isolates were obtained from the treated currency notes samples. The reduction in the number of bacterial and fungal isolates in the treated samples may be due to the treatment of the currency notes with camphor which act as an antimicrobial agent before isolating the microorganisms from the notes. This work corroborates the result of Chunxia *et al*. [16] who used camphor oil as antimicrobial agent to inhibit the growth of *Staphylococcus aureus*, *Candida albicans* and *Aspergillus niger* on cotton fabrics.

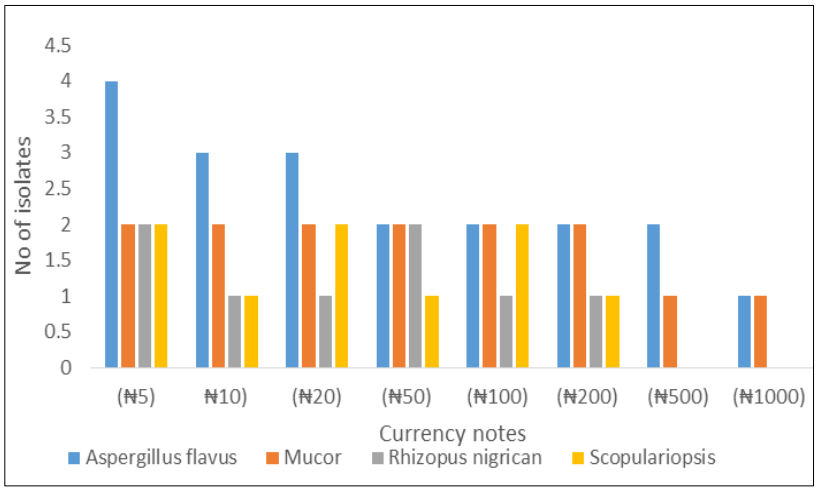

Figure 4 Fungi isolated from the treated currency notes

Results showed that the microbial loads of the untreated samples ranged from 1.70 ×10^2 – 2.4× 10^2 cfu/ml while that of the treated samples ranged from 1.00 × 10^2 – 1.2 × 10^2cfu/ml (Figure 5 and 6). The reduction in the microbial loads of the treated samples may be due to the effect of camphor on the currency notes. Camphor has been observed to have a number of biological properties such as insecticidal, antimicrobial, antiviral, anticoccidial and anti-nociceptive activities [9]. The work is in line with Zafar, *et al*. [11] where the authors used camphor as an antimicrobial agent on arrays of microorganisms.

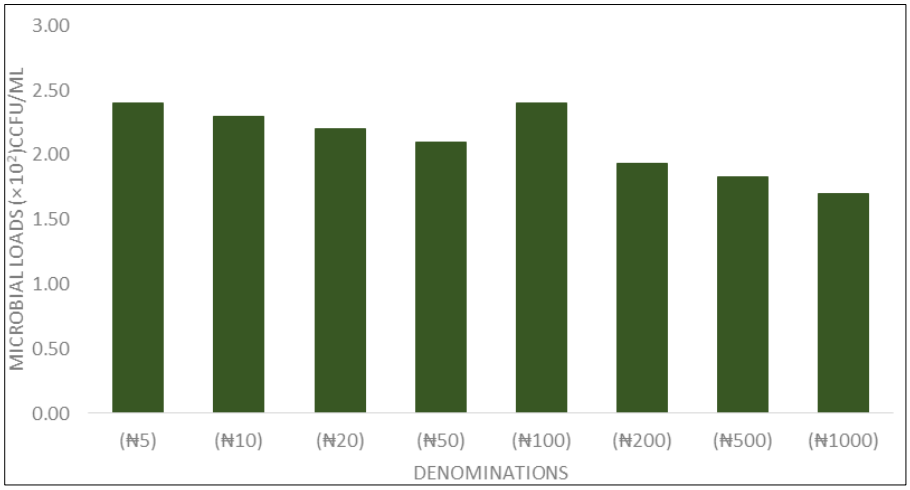

Figure 5 Microbial Loads of the Untreated Currency notes

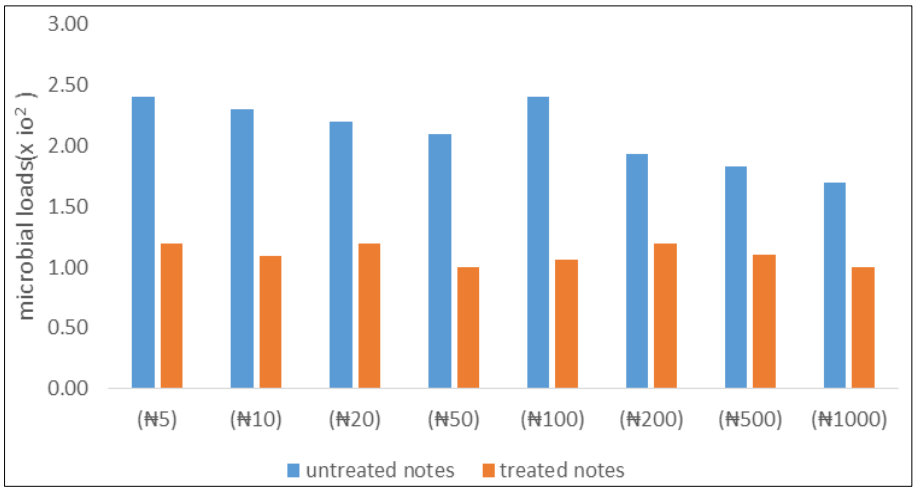

Figure 6 Microbial Load of untreated as compared to Treated Samples

4. Conclusion

A total of 135 bacterial and 123 fungal isolates belonging to four genera respectively were isolated from the untreated currency notes samples while Forty-nine (49) bacterial isolates and Fifty-one (51) fungal isolates were obtained from the treated currency notes samples. The microbial loads of the untreated current notes ranged from $1.70 \times 10^2 - 2.4 \times 10^2$ cfu/ml while that of treated samples ranged from $1.00 \times 10^2 - 1.2 \times 10^2$ cfu/ml. The reduction in the number of microorganisms and the microbial loads of the treated samples when compared with the treated samples is evidence that camphor could be used as an antimicrobial agent on currency notes.

Compliance with ethical standards

Disclosure of conflict of interest

Authors have declared that no conflict of interests exists.

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