

Isolation and Identification of causative agents from some Iraqi Banknote currency

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Abstract

One hundred and twenty eight currency notes samples 250, 500, and 1000 Iraqi Dinars (ID) values were collected from students, markets, banks, and hospitals in Erbil city , Iraq. The results showed that all collected samples were contaminated with one or more bacteria and fungi species representing 100% contamination and none from the new (control) notes. Seventeen bacterial species and twelve fungal species were isolated, which include *Staphylococcus aureus* (83.3%), *Streptococcus pyogenes* (83.3%), *Pseudomonas species* (83.3%), *Aspergillus niger* (83.3%), *Klebsiella species* (75%), *Staphylococcus epidermidis* (66.6%), and *Escherichia coli* (66.6%) being the most prevalent. The lower values of currency notes (250 ID and 500 ID) were highly contaminated .

Key words: paper currency, bacteria, fungi, microbial contamination.

Introduction

Iraqi paper currency is widely used and handled by all manners of people . Money is very important to human life as it facilitates our economics and trade needs [1]. The possibility that currency notes might act as environmental vehicles or fomites for the transmission of potential microorganism was suggested in the 1970s [2]. Many people do not care how dirty their fingers are when handling money [3]. The contaminated currency notes go in circulation and contaminate the hands of others transmitting pathogenic organisms in the process [3,4] . Contamination may occur during production, during storage after production, and during use [5]. So, the infected currency is identified as potential public health hazard as pathogen spread by circulating banknotes [6].

Studies on currency in different countries indicated bacterial and fungal contamination .In south Africa 96% of the used banknotes in were contaminated by different bacteria and one fungal species (*Staphylococcus epidermidis* (13%), *Klebsiella* species (11%) ,*Staphylococcus aureus* (11%), and *Candida albicans* (13%)[7]. A study by Umeh *et al.*, [8], revealed that 89.8% of Nigerian currency notes in circulation has microbial contamination, while Tago *et al.*, [9] found that 100% of currency notes in circulation by bacterial contamination and they isolated *Coagulase negative Staphylococci* (23.4%), *Staphylococci aureus* (8.4%), *Escherichia coli* (5.6%), *Bacillus species* (23.4%), *Klebsiella species* (5.6%), *Enterobacterspecies* (2.8%), *Enterococci species* (10.3%), and *Proteus species* (8.4%) among others. The microorganisms implicated included members of the family *Enterobacteriaceae*, *Mycobacterium tuberculosis*, *Vibrio cholerae*, *Bacillus species*, *Staphylococcus sp.*, *Micrococcus sp.* and *Corynebacterium sp.* Most likely contaminants of paper money are environmental organisms such as Gram-positive flora (especially *Bacillus sp.*) and those arising from human normal skin flora such as *Staphylococcus aureus* [10]. In Sudan Saadabi *et al.*, [1]isolated many fungal genera such as *Trichophyton sp*, *Microsporium sp*, *Epidermophyton sp*, *Taenia sp*, *Aspergillus sp* and *Saccharomyces sp* ,while the genera of bacteria that isolated were *Escherichia coli*, *Citrobacter sp*, *Klebsiella. sp*, *Proteus sp*, *Bacillus sp*, *Corynebacterium sp* and *staphylococcus sp*.

Materials and Methods

Collection of paper currency

In the present study 128 samples of Iraqi paper currency in Erbil city were collected based on the level of usage and thus circulation. Banknotes were obtained from students, markets, banks, and hospitals were obtained. The values of banknotes were: 32 of the 250 ID, 32 of the 500ID, and 32 of the 1000 ID (in addition to new control), which were collected randomly. Each paper currency was collected directly into a sterile plastic bag and transferred to the microbiology laboratory to apply all microbiological examinations for the different values of collected paper currency .

Isolation and identification of bacteria

Each paper currency was soaked separately in bottles containing 10 ml of sterile buffered peptone water and the bottle vigorously shaken for 2 minutes. The currency was removed and the resulting peptone water solution and incubated for 24hours at of 37°C. The incubated test sample was then cultured by sterilized swab onto Nutrient Agar, Blood agar, MacConkey, Eosin Methyl Blue, xylose lysine deoxycholate agar, salmonella–shigella agar, and Cysteine Lactose Electrolyte Deficient (CLED). The plates were incubated aerobically overnight in an incubator at 37°C. Pure cultures were obtained by sub-culturing distinct colonies. Control samples underwent the same processes. Pure isolated colonies were identified using their morphology, Gram reaction as well as biochemical techniques such as the IMViC, Catalase,

Coagulase, Oxidase, Urease, test and Triple sugar iron tests (sugar fermentation and gas production) as described by Bjerring and Oberg [11] and Baron [12].

Identification of fungi

The growth of fungi on Sabaroud dextrose agar was examined critically after one week, using prepared microscope slides. The prepared specimens were mounted on Lacto phenol cotton blue and identification of the fungal species was performed with aid of binocular compound microscope (40X) adopting the techniques used by Bruge *et al.* [13].

Results and Discussions

A total of one hundred and twenty eight Iraqi dinar notes were analyzed for bacterial and fungal contamination. Seventeen different bacteria species and twelve fungal species were obtained from currency notes from studied places representing 100% contamination. Isolated bacteria from the paper notes with its percentage of contamination were *Staphylococcus aureus* 83.3%, *Streptococcus pyogenes* 83.3%, *Pseudomonas species* 83.3%, *Klebsiella species* 75%, *Staphylococcus epidermidis* 66.6%, *Escherichia coli* 66.6%, *Staphylococcus saprophyticus* 58.3%, *Streptococcus pneumoniae* 58.3%, *Streptococcus fecalis* 58.3%, *Enterobacter specie* 58.3%, *species* 58.3%, *Proteus species* 50%, *Citrobacter species* 41%, *Corynebacterium species* 25%, *Yersinia species* 25%, *Salmonella species* 25%, *Acinetobacter species* 16.6% as shown in table 1, while the isolated genera of fungi were *Aspergillus niger* 83.3%, *Stachybotrys species* 50%, *Penicillium species* 50%, *Staccharymycetes species* 50%, *Epidermophton species* 50%, *Actinomycetes species* 33.3%, *Emericella species* 25%, *Rhizopus species* 25%, *Botrytis species* 25%, *Memoneilla species* 16.6%, *Aspergillus flavus* 16.6%, and *Mycellia sterilin* 16.6% as its shown in (table 2), also the results showed that most of the paper currency had more than one microbial contamination. On the other hand, the results showed that high values of currency such as 1000 ID were less contaminated with bacteria and fungi with percentage 26.48%, 24.86% respectively than low values 500 ID and 250 ID with percentage 53.44%, 47.75% and 83.83%, 54.16% respectively, Although there was no differences between studied places and these results were similar with those reported by Kuria *et al.*, [14]; Felgo and Nkansah [15]. In present study the 100% contamination of the currency confirms other research finding about bacterial and fungal contamination of currencies in circulation as well as other researchers have detected contamination level of 89.9% [8], 94% [16], 96% [7], 100% [9] and this indicated that currency which is handled by large numbers of the people in Erbil city which involves a large population under a variety of personal and environmental conditions and low values are more wide spread and exchangeable between people in population [7]. More handling, more frequent exchange of currency lead to more contamination and can be asource of infection. In the present study, the bacterial and fungal isolates that were isolated were associated with oral, nasal, skin and fecal contamination. This is an indication that money contamination is associated to unhygienic practice of people and this includes indiscriminate sneezing, coughing and defecation with indecent handling of currency notes [17&16]. To minimize the hazards that may arise from the use of dirty and contaminated notes, it is suggested that individuals should improve upon their personal health consciousness by washing hands after handling of currency notes [18 &19]. Children and immunocompromised person must be prevented from handing currency notes and adults should avoid using salvia during counting of paper currency notes and the people should be educated. [20].

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Table (1) Isolation & Identification of some pathogenic bacteria from some Iraqi currency notes in different places.

Isolated bacteria	Students			Bank			Markets			Hospital		
	1000	500	250	1000	500	250	1000	500	250	1000	500	250
Control	-	-	-	-	-	-	-	-	-	-	-	-
<i>S.aureus</i>	-	+++	+++	-	+	++	+	+	+	+	+	++
<i>S.epidermis</i>	-	+	+	-	+	+	-	-	+	+	+	+
<i>S.saprophyticus</i>	-	+	++	+	-	++	-	++	++	-	-	+
<i>Streptococcus pyogenes</i>	-	++	++	-	+	++	+	+	+	+	+	++
<i>S.faecalis</i>	-	++	+	-	-	+	+	+	+	-	-	+
<i>S.pneumoniae</i>	-	++	++	-	++	+++	-	-	-	++	++	++
<i>Corynbacterium species</i>	-	-	+	-	-	+	-	-	-	-	-	+
<i>Acinetobacter species</i>	-	-	+	-	-	++	-	-	-	-	-	-
<i>Enterobacter species</i>	-	+	++	-	-	++	-	-	+	+	+	+
<i>Citrobacter species</i>	-	+	++	-	+	+	-	-	-	-	+	-
<i>E.coli</i>	-	-	++	+	+++	+++	-	-	+	++	++	+++
<i>Yersinia species</i>	-	-	-	-	+	+	-	-	+	-	-	-
<i>Klebsiella species</i>	++	++	++	-	-	+	+	-	++	+	+	++
<i>Proteus species</i>	+	+	++	+	-	+	-	-	-	-	-	+
<i>Bacillus species</i>	-	-	+	-	+	++	-	++	++	-	++	+
<i>Salmonella species</i>	-	-	-	-	-	-	-	+	+	-	-	+
<i>Pseudomonas aerogenosa</i>	-	++	+++	+	+	+	+	-	+	+++	+++	+++

-: non occurrence +: low occurrence ++: medium occurrence +++: high occurrence

Table (2) Isolation & identification of some fungi isolated from some Iraqi currency notes.

Isolated fungi	Students			Bank			Markets			Hospital		
	1000	500	250	1000	500	250	1000	500	250	1000	500	250
Control	-	-	-	-	-	-	-	-	-	-	-	-
<i>Mycelia sterilia</i>	-	-	-	-	+	+	-	-	-	-	-	-
<i>Stachybotrys species</i>	-	-	-	+	+	+	-	-	-	++	++	++
<i>Penicillium species</i>	-	+	++	-	+	+	-	+	++	-	-	-
<i>Memoneilla species</i>	-	-	-	+	+	-	-	-	-	-	-	-
<i>Aspergillus niger</i>	-	+	+	++	++	+++	-	+	+	++	+++	+++
<i>Aspergillus flavus</i>	+	+	+				+	+	++	-	+	+
<i>Actinomycetes species</i>	-	++	++	+	-	+	-	-	-	-	-	-
<i>Emericella species</i>	-	-	-	-	-	-	+	+	++	-	-	-
<i>Rhizopus species</i>	-	-	-	+	+	+	-	-	-	-	-	-
<i>Botrytis species</i>	-	-	-	-	-	-	+	+	++	-	-	-
<i>Saccharomyces species</i>	-	-	++	+	++	++	-	-	+	-	-	++
<i>Epidermophyton species</i>	-	-	+	-	+	++	-	-	+	-	++	+++

-: non occurrence +: low occurrence ++: medium occurrence +++: high occurrence

عزل وتشخيص البكتريا والفطريات من بعض العملات النقدية الورقية

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الخلاصة

جمعت مئة وثمانين وعشرون عينة من العملات الورقية 250 ، و 500، و 1000 دينار عراقي من الطلاب، والأسواق ، والبنوك ، والمستشفيات في مدينة اربيل. اظهرت النتائج بان جميع العملات الورقية كانت ملوثة بواحدة او اكثر من الانواع البكتيرية والفطرية متمثلة 100% تلوث في حين لم تظهر اي تلوث في العملات الجديدة (السيطرة) . عزلت سبعة عشرة نوعاً بكتيرياً واثنان عشر نوعاً من الفطريات والانواع الاكثر توافراً هي (Staphylococcus aureus 83.3%) ، (Aspergillus niger 83.3%) ، (Pseudomonas species 83.3%) ، (pyogenes 83.3%) ، (Staphylococcus epidermidis 66.6%) ، (75%) و (66.6%) (Escherichia coli) وقد كانت القيم الادنى من العملات الورقية (250 و 500 دينار عراقي) الاكثر تلوثاً.

الكلمات المفتاحية : عملات ورقية، بكتريا، فطريات، تلوث ميكروبي.