

Investigation of bacterial contamination in Iraqi paper currency

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Abstract

The objective of this study was to examine the extent of bacterial contamination of the most used denominations of the Iraqi currency.

A total of (160) isolates (112) were gram positive bacteria and (48) were gram negative bacteria has been isolated from different denominations (250, 1000, 5000, 10000 and 25000 ID) in circulation in AL-Najaf city which collected from different local markets. The results had shown the most predominant bacteria was *Bacillus* sp. with 41.2% and the small denominations were more contaminated, there where statistically significant association between the source of collection and bacterial type. The antibiotic susceptibility was doing with 7 types of antibiotics disc (Gentamicin, Azithromycin, Trimethoprim, Cephalothin, Cefotaxime, Lincomycin and Clarithromycin). The most bacteria were resistant to lincomycin antibiotic.

الخلاصة

أجريت هذه الدراسة لفحص مدى التلوث البكتيري للعملات الورقية العراقية الأكثر تداولاً في الاسواق المحلية في محافظة النجف شملت الفئات التالية (250 و 1000 و 5000 و 10000 و 25000) دينار عراقي وقد تم عزل (162) عزلة بكتيرية , (112) منها بكتيريا موجبة لصبغة غرام (48) منها سالبة لصبغة غرام .

وقد أظهرت نتائج الدراسة ان بكتيريا *Bacillus* sp. احتلت موقع الريادة وبنسبة 41.2% وقد كان هناك فرق إحصائي معنوي بين نوع البكتيريا ومصدر جمع العينة. كما اجري اختبار الحساسية لبعض العزلات لسبعة أنواع من المضادات الحيوية تضمنت (الجنتاميسين, ازيثرومايسين, ترايميثوبريم, سيفالوثين, سيفوتاكسيم, لنكوميسين, و كلاريثرومايسين) ووجد ان معظم العزلات قيد الاختبار كانت مقاومة لمضاد اللنكوميسين.

Introduction

Papers money are susceptible to bacterial contamination during continuous handling from person to person especially if handled with unclean hands or storing them at contaminated bags at moist, sweat and dark conditions, which are most favorable for the growth of coliforms as well as other pathogens⁽¹⁾. Pathogens associated with throat infections ,pneumonia, tonsillitis, peptic ulcers, urino-genital tract infections ,gastroenteritis and lung abscess had been reported⁽²⁾.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*⁽³⁾. Other microorganisms was isolated such as fungi that may pose a public health risk⁽⁴⁾. Paper money might be foliate playing an important role in the spreading of drug resistant strains in the community⁽⁵⁾.

However, in most of the studies, the antibiotic sensitivity pattern is lacking .This information is necessary as to the appropriate antibiotics to be employed in situation of infection or disease resulting from contaminated paper money.

To determination the role of paper currency in the transmission of potentially harmful bacteria this study was done.

Materials and method

The eighty of Iraqi paper currency in five denominations (250,1000,5000,10000 and 25000) were collected from various sites including fast food, butchery, grocery, super market, restaurant, and officers currencies. Both sides of denominations were swabbed using serial swab moisted with normal saline solution and cultured on blood agar , MacConkey agar and manitole salt agar ⁽⁶⁾.Pure colonies of isolated bacteria were identified and characterized by conventional method ⁽⁷⁾.Some isolates were selected to antibiotics sensitivity test according to Kirby - Bauer method by using only 7 types of antibiotics disc ⁽⁸⁾ including Gentamicin, Azithromycin, Trimethoprim, Cephalothin, Cefotaxime, Lincomycin and Clarithromycin .X² analysis was done.

Results and Discussion

Paper currency has recently been identified as an other mode of spread by which community-acquired infection may be transmitted, since paper currency is frequently trassferred from one person to an other ⁽⁹⁾.

In this study that bacterial contamination was shown as follow: *Bacillus* sp. 41.2%, *Staphylococcus aureus* 15.6%, coagulase negative staphylococci 13.1%, *Klebsiella* sp.11.2%, *E.coli* 11.2%, *Enterobacter* sp. 3.7% and *Proteus* sp. 3.7% (Table 1).

Bacillus sp. hardy spore forming species that live in soil and are found in the environment could be transferren on handling with dirty hands, while the presence of *staphylococcus* sp. on money could have been due to the rubbing off or may be surfing from skin flake ⁽¹⁰⁾.

The presence of enteric bacterial isolates on Iraqi paper currency is an indication of faucal contamination which means the poor personal hygiene ⁽⁴⁾.

Table 1: The percentage of bacterial genus isolated from paper currency

Denomi- nation	Numbe r of denomi nation	<i>Bacillus</i> Sp.	<i>S.aure-</i> <i>us</i>	CNS*	<i>Klebsiel-</i> <i>la</i> Sp.	<i>E.coli</i>	<i>Enter</i> - <i>obcter</i> Sp.	<i>Prot-</i> <i>eus</i> Sp.	Total
250	20	13 (19.7)	1 (4)	3 (14.2)	9 (50)	7 (38.8)	2 (33.3)	3 (50)	38 (23.7)
1000	20	17 (25.7)	8 (32)	-	3 (16.6)	8 (44.4)	3 (50)	3 (50)	42 (26.2)
5000	20	16 (24.2)	10 (40)	4 (19)	4 (22.2)	3 (16.6)	1 (16.6)	-	38 (23.7)
10000	10	10 (15.1)	3 (12)	7 (33.3)	-	-	-	-	20 (12.5)
25000	10	10 (15.1)	3 (12)	7 (33.3)	2 (11.11)	-	-	-	22 (13.7)
Total	80	66 (41.2)	25 (15.6)	21 (13.1)	18 (11.2)	18 (11.2)	6 (3.7)	6 (3.7)	160 (100)

* = Coagulase Negative Stphylococci X²= 36.6 p<0.05

This results are agree with Egyptian study which found similar bacterial contaminants such as *Bacillus* sp. , *Staphylococcus aureus*, coagulase negative staphylococci and *Klebsiella pneumoniae* ⁽¹⁾.

In which table these results are present the 1000 denomination was found to have the highest level of bacterial contamination 26.2% followed by other denominations 250 (23.7%), 5000(23.7%), 10000 (12.5%) and 25000 (13.7%) respectively. This accounts for the fact that the small denomination is widely used and exchanged many times ⁽¹¹⁾. There was a statistically significant association between the denomination and bacterial genus.

This study explicated that most number of isolates were founded in grocery and fast Food 24 and 23 isolates respectively (Table 2), suggesting more handling of paper Currency by many people made them more vulnerable to bacteria ⁽¹²⁾.

Other source of collection denominations were: butchery 17, super market 16 restaurant 19 and fisher 19, while the lowest number of enteric bacteria was isolated from officers which indicate that they are more likely to be conscious of safe personal Hygiene as compared to other ⁽⁴⁾. These routes of transmission are of great importance in the health of many populations, where the frequency of infection is a great indication of local hygiene and environmental sanitation levels ⁽¹³⁾. There was a statistically significant association between the source of collection and bacterial isolates.

Table 2: The Source of bacterial isolates in paper currency

Source of denomination	Number of isolates	Type of Denomination	<i>Bacillus</i> sp.	<i>S.aureus</i>	CNS	<i>Klebsiella</i> Sp.	<i>E.coli</i>	<i>Enterbacter</i> Sp.	<i>Proteus</i> Sp.	Total
Fast food	10	250+1000	8	-	3	6	4	-	2	23
Putchers	10	250+1000	6	3	-	2	5	-	1	17
Groceries	10	250+1000	10	3	-	2	4	3	2	24
Supermarket	10	250+1000	6	3	-	2	2	2	1	16
Restaurant	10	5000	8	5	2	1	2	1	-	19
Fishers	10	5000	8	5	2	3	1	-	-	19
Officers	20	10000+25000	20	6	14	2	-	-	-	42
Total	80	-	66	25	21	18	18	6	6	160

$X^2 = 32.8$ $p < 0.05$

Results pointed out that the higher resistance of isolates were with Lincomycin antibiotic (114) followed by Trimethoprime (82) sensitive isolates (Table 3) .The resistance of the isolates to the antibiotics may be due to the fact that the antibiotics are first line drug or may also be as a result of the carriers of some disease as they would have been exposed to different antibiotics over time which may induce resistance in the bacterial isolates ⁽¹⁴⁾ . More often antibiotic resistance among bacterial population occurs due to a plasmid-mediated phenomenon and is transferable in nature, which spread among sensitive bacteria species ^(15; 16) .

Table 3 : Antibiotic sensitivity pattern of bacteria isolated from paper currency

isolates	Number of isolates	CN		AZM		TMP		KF		CTX		L		CLR	
		S**	R*	S	R	S	R	S	R	S	R	S	R	S	R
<i>Bacillus</i> sp.	48	48	-	38	10	5	43	25	23	32	16	11	37	39	9
<i>S.aureus</i>	25	21	4	19	6	20	5	19	6	18	7	4	21	19	6
CNS	17	17	-	10	7	4	13	12	5	12	5	3	14	13	4
<i>Klebsiella</i> sp.	15	15	-	8	7	10	5	8	7	12	3	1	14	9	6
<i>E.coli</i>	16	14	2	12	4	3	13	4	12	16	-	-	16	14	2
<i>Enterobacter</i> sp.	6	6	-	5	1	5	1	-	6	5	1	-	6	6	-
<i>Proteus</i> sp.	6	6	-	6	-	4	2	1	5	4	2	-	6	5	1
Total	133	127	6	98	35	51	82	69	64	99	34	19	114	105	28

CN=Gentamicin , AZM= Azithromycin, TMP= Trimethoprim, KF= Cephalothin, CTX= Cephalothin, L= Lincomycin, CLR= Clarithromycin
 *=Resistance **=Sensitive

While the most effective antibiotic was gentamycin (127) followed by Clarithromycin (105) sensitive isolates, these antibiotics are effective against bacterial strains acting at different cellular sites including protein synthesis inhibition via binding to bacterial ribosome's⁽¹⁷⁾. Other antibiotics have different number of isolates resistance Azithromycin, Cephalothin and Cefotaxime (35, 64 and 34) isolates respectively. Meanwhile, bacterial contamination paper currency may play role in appearance of new resistant isolates which represent risk to health people⁽⁹⁾. Therefore, healthy personal hygiene must create in the public by hand washing with soap and water especially before and after eating.

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