

Original Research Article

Currency Notes as Pathogenic Risk Sources for Street Foods in Ghana: A Study at a Suburb of Kumasi City

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ABSTRACT

Unhygienic practices among street food vendors usually raise public health concerns. This paper assessed one such unhygienic practice of handling currency notes and serving food with bare hands, a potential for pathogenic cross-contamination. Data on 80 vendors was collected at Ayigya community, a commercial enclave of Kumasi in Ghana. 20 currency notes of denominations GHS 1, 2, 5 & 10 were sampled from five vendors for microbial analyses. About 62% of customers mostly used currency notes, and 94% of vendors received customers' monies themselves instead of hired assistants. Vendors whose bare hands touched food while serving were 54% and 45% of all vendors handled money and served food concurrently with their bare hands. All currency notes (100%) were contaminated with microbial loads: 6.3 - 10 log₁₀cfu (GHS 1), 5.2 - 8.6 log₁₀cfu (GHS 2), 7 - 8.3 log₁₀cfu (GHS 5) & 7.6 - 9.3 log₁₀cfu (GHS 10). Microbial load per unit surface area of currency note and specific microbial isolates are discussed in the paper. There is high risk of pathogenic cross-contamination of food due to unhygienic handling of money and serving food with bare hands.

Keywords: currency notes; microbial load; street food; Ghana.

INTRODUCTION

The importance of street foods cannot be ignored in every society especially in developing countries where there is rapid population rise and urbanization. Food vending serves different purposes including: as source of livelihood for families; as a convenient, affordable and varied means of dinner; and others. [1-8] In many developing countries, food vending is seen as part of a larger informal workforce [3,4,9-13] and hence less regulated with weak institutional oversight responsibilities allowing for proliferation of unqualified food vendors. [6] It is not new that vended foods could be a threat to public health especially in developing countries where regulatory systems are

limited, relaxed and/ or weakly enforced [14] and the culprits include street foods. A recent study in Ghana although limited in scope, strongly suggests that there is weak institutional and legal framework for food vending. [15] Food borne diseases are increasing in both developed and developing countries. [16] It is disturbing to find that 70% of global disease outbreaks are linked to street-vended foods and also that food-borne illnesses account for about 2.2 million deaths annually with the worst affected being children (86%). [15] According to the authors the situation in Ghana is equally unpleasant where about 65,000 people die annually with a corresponding economic loss of US\$69 million. [15] This public health challenge is

undoubtedly as a result of cross-contamination of vended food especially because of poor food hygiene and safety practices. There is enough evidence to support potential pathogenic cross-contamination of food from handlers, [17-22] which are mostly from unsanitary personal, food, and environmental practices among street food vendors. [17] One of such critical unhygienic practices fingered immediately among street food vendors in low-income communities is alternately serving and handling food and money (currency) with bare hands. [6,9,10,23-27]

Moreover, several studies show that currencies (banknotes and coins) could be highly contaminated such that they could serve as vehicles for spread of pathogenic diseases. [14,24,28-30] This is particularly so for feco-oral pathogens including *E. coli*, *Staphylococcus sp.*, *Klebsiella sp.*, *Pseudomonas sp.*, *Proteus mirabilis*, *Vibrio sp.*, etc and major fungi that are well isolated and identified in various studies worldwide. [12,23,25,29-39] There is therefore the need to determine the extent of use of bare hands in handling money and serving food among street food vendors, and also quantify the pathogen levels associated with currency notes commonly handled by vendors. This paper therefore provides the evidence that currency notes can serve as vehicles for diseases transmission if unhygienic food-money handling practices are encouraged in street food vending. The study is based on data collection from selected street food vendors at Ayigya, a suburb of the second largest Ghanaian city of Kumasi.

MATERIALS AND METHODS

Study area description

The study area is Ayigya, a suburb of Kumasi (Figure 1). Kumasi is the second largest City of Ghana and also serves as the regional capital of the Ashanti region. The Kumasi City itself has about 10 sub-Metros with total inhabitants

of about 2.04 million representing 42.6% of regional population. [40] Ayigya town, which is within the Oforikrom sub-Metro, is about 10 km from the centre of Kumasi City. [1] Ayigya is also popularly called “Tech Junction” because of its close location and relation with the Kwame Nkrumah University of Science and Technology (KNUST) (see Figure 1). Ayigya community has become one of the commercial enclaves in the city especially serving the University community (KNUST) and its environs. One of the busiest commercial sections of the Ayigya town is a lorry station, which is directly opposite the KNUST hospital on the other side of the Kumasi – Accra highway. The lorry station with its market-based commercial activities, together with hostel facilities that serve a section of the students from KNUST and people patronizing the KNUST hospital have made the place a business centre for street food vendors who trade in diverse dishes to meet the demand of the cosmopolitan inhabitants. Moreover, the agglomeration of different groups of people makes food vending a lucrative business for many unemployed youth, majority of whom could be untrained or unskilled for the food vending trade.

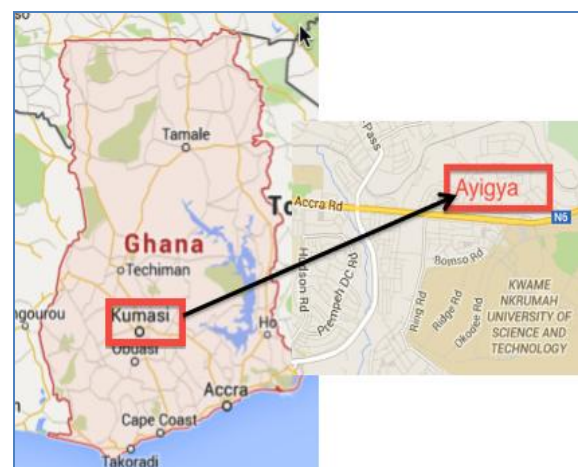


Figure 1: Study area (Adapted from Google Map, 2014)

Materials, data collection and analysis

The data collection took place between June and August 2014 and the whole campaign involved two main

aspects: interviewing street food vendors and observing their practices with food and currency notes handling; and taking samples of currency notes for microbial analysis at the laboratory. A total of 80 street food vendors were surveyed. Also the first four lowest Ghana Cedis currency notes in the denomination of GHS1, GHS2, GHS5 and GHS10 were collected from five different street food vendors who sold five popular dishes [Fufu, Kenkey, Banku, Fast Food (fried rice) and Ampesi] in the area. A total of 20 currency notes from the vendors were deposited into sterile plastic ziploc bags by the food vendors and the vendors were compensated with other currency of same denomination. [41] The sampled currency notes were taken to the laboratory under storage condition of below 8°C within 6 hours, [42] and subsequently the currency notes were washed by shaking in universal bottles with sterile buffered peptone water. [41] The microbial quantification and

identification were based on recommended standard methods. [43,44] The average number of colonies counted was expressed as log colony forming units (log₁₀cfu). [45] The data were analysed using Microsoft Excel and SPSS (IBM SPSS Statistics Software 2012 version 21) and the results are presented as descriptive statistics and cross tabulations to show any associations based on the Fischer Exact Test at 5% significance level.

RESULTS AND DISCUSSION

Profile of food vendors

The basic profile of the street food vendors interviewed in the study is presented in Table 1 below. The results showed that females dominated the respondents, confirming similar studies in Ghana, Nigeria, and Philippines. [1,10,15,25,26,46-48] It strongly appears that street food vending is less preferred by males in the informal sector in certain developing economies like Ghana.

Table 1: Profile of food vendors interviewed

Parameters	Description	Distribution n (%)
Gender	Female	74(92%)
	Male	6(8%)
Age group	<18	2(3%)
	18-30	33(41%)
	31-45	33(41%)
	46-60	12(15%)
Educational background	Basic	21(26%)
	JHS/MSL	36(45%)
	SHS/SSS	23(29%)
Years of experience	1-5	35(44%)
	6-10	24(30%)
	>10	21(26%)
Hired helps	No	35(44%)
	Yes	45(56%)
Type of food sold	Ampesi/rice & sauce-based	26(33%)
	Fast food (fried rice)	13(16%)
	Fufu/banku& soup related	24(30%)
	Kenkey	8(10%)
	Waakye	9(11%)
Major customers	Artisanal workers	8(10%)
	Everyone	58(73%)
	Market traders	5(6%)
	School children	9(11%)
Customers served per day	50 and less	13(16%)
	51-100	23(29%)
	101-150	23(29%)
	151-200	12(15%)
	>200	9(11%)

The study again revealed that all respondents were educated (have formal education) with basic education being the

least level and the highest level was senior high school (SHS/SSS). This was found to be contrary to other studies where a good

number of street food vendors (16%-52%) have no formal education. [15,26,27, 48] However, our findings support the assertion that street food vending is a self-employed job for those with low formal education. [7, 27] In general, street food vending has the potential to absorb at least certain section of employable workforce especially female youth who have not attained higher educational levels since majority (85%) of the vendors were below 45 years and all had low educational background (Table 1). More vendors (44%) had 1-5 years of working experience in the business although a good number of them (26%) were more experienced by over 10 years (Table 1). Majority of respondents (56%) have hired assistants or helpers. Although the specific number of assistants was not captured, it could be around 1-2 assistants as discovered in a similar study of three capital towns. [27] Most of the vendors (58%) claimed their customers were everyone instead of any specific groups of people and majority 74% (n=59) served around 50-150 customers per day (Table 1). The rest of the vendors (26%, n=21) were serving more than 150 customers in a day. Thus, street food vendors serve more people and any health hazards that emerge from unhygienic practices that are known to be a challenge among vendors [24, 45] could threaten public health.

Currency handling practices and pathogenic risks

Majority of vendors (74%) claimed both coins and notes were mostly received but currency notes are suggested to be used more by customers reported to be around 62% if those receiving only notes (25%) were added to at least an equal fraction from “both notes & coins” (Figure 2-A). This means vendors and their customers could be exposed to more health risk since literature indicates that currency notes harbour more pathogens than coins although both could carry microbes. [14, 33] For instance, existing studies assert that Ghanaian cedi notes are not risk free. [44, 49, 50] The pathogenic risks with the currency notes become more real if unhygienic practices of handling the notes exist to facilitate cross-contamination of ready-to-eat food. From the understanding, it to find that majority of vendors (94%, n=75) collected money from customers directly themselves while concurrently serving food (Figure 2-B). The concern is that the existing practice could easily allow direct hand contact with pathogens that could be carried on the monies especially when using bare hands. Meanwhile, over half of our vendors 54% (n=43) while serving food had their bare hands come into direct contact with the food. Worst still, it was observed that close to half of the vendors (45%, n=36) were serving food and handling money concurrently with same bare hands.

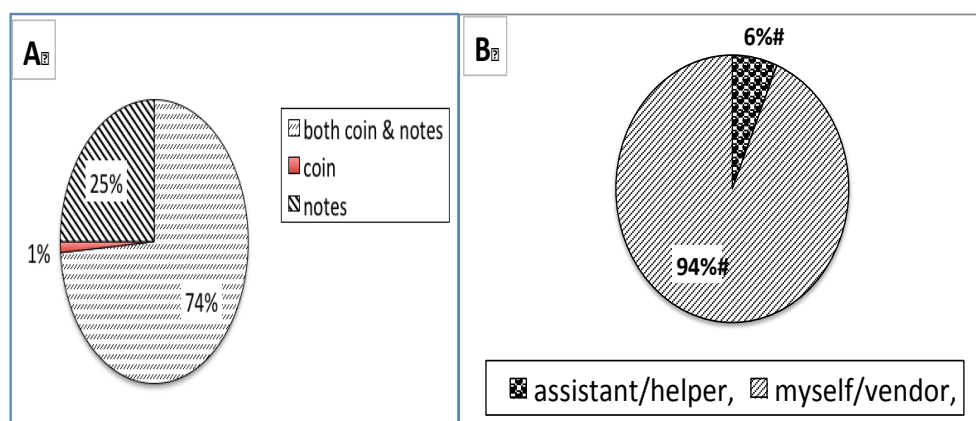


Figure 2: A) Money mostly received from customers B) Person who collects money from customers

Table 2: Average microbial load (Total & Faecal Coliforms) by currency notes and vendors

Ghanaian currency notes	Surface area (cm ²)	Fufu Seller	Kenkey Seller	Banku Seller	Fast food Seller	Ampesi Seller
		Log ₁₀ cfu	Log ₁₀ cfu	Log ₁₀ cfu	Log ₁₀ cfu	Log ₁₀ cfu
GHS1	178.1	6.3	9.9	8.6	10.0	8.0
GHS2	187.6	5.2	8.6	7.6	7.6	7.3
GHS5	191.7	7.0	8.0	8.3	7.3	7.9
GHS10	205.9	7.6	9.3	8.3	8.0	8.0
Load per note		6.5	9.0	8.2	8.2	7.8

Undoubtedly, there is high risk of pathogenic contamination of food from poor handling of money and serving food since the microbial analyses confirm that none of the currency notes were free from pathogens (Tables 2). The currency note with the highest microbial load across the sampled street food vendors was the GHS 1 denomination – 8 to 10log₁₀cfu, closely followed by GHS 10denomination with 7.6 log₁₀cfu. While the GHS 1 dominated microbial loads across four food vendors (from highest: Fast food, Kenkey, Banku and AmpesiSellers), the GHS 10 followed from a Fufu Seller (Table 2).

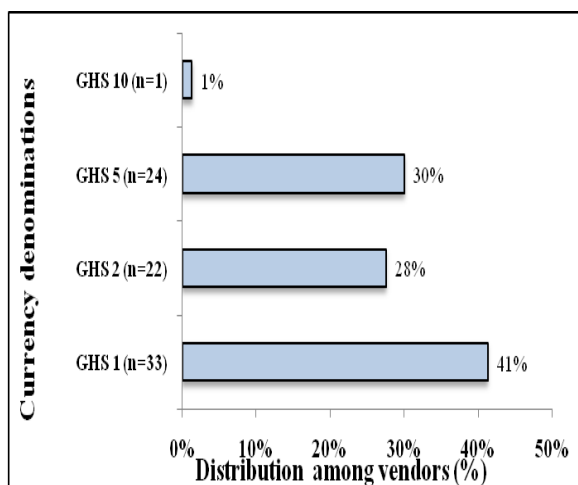


Figure 3: Currency denominations mostly received by food vendors

Generally, the contamination trend was anticipated since the GHS 1 notes(the lowest denomination)were expected to have received more circulation, handling, and mostly used; therefore could exposed to more microbes. [28, 29] Our vendors reported that more customers (41%, n=33) comparatively paid for food with the lowest denomination GHS 1, and in fact, the two lower denominations GHS 1 and

GHS 2were mostly used by over 60% (n=55) of customers (Figure 3). Also, it was reported that the GHS 10 notes were rarely used by customers (Figure 3) but they showed significant microbial loads more likely because the GHS 10 notes were more aged. [24]

Indeed on the average, GHS 10 notes were63 months old at the time of study compared to 43 months old for GHS 1, 35 months old for GHS 5 and 33 months old for GHS 2. Again, the microbial load per currency note from the different food vendors was highest for the Kenkey Sellers (9 log₁₀cfu/note), followed by Bankuand Fast Food Sellers (8.2 log₁₀cfu/note), then Ampesi Sellers (7.8 log₁₀cfu/note), and lastly the Fufu Sellers (6.5 log₁₀cfu/note) (Table 2). The current study showed that currency notes were more contaminated with microbes than a related study in Ghana by [50] who presented 3.45 – 4.6 log₁₀cfu/note.

The microbial load per unit surface area of currency note showed that the GHS 1notes were still more contaminated across almost all the food vendors with figures 0.045-0.056 log₁₀cfu/m² (Table 3) following largely a similar trend presented earlier but with a slight change whereby GHS 5 now have the same load as GHS 10(0.037 log₁₀cfu/m²) (Table 3). Although there was 100% microbial contamination with all currency notes, the relatively more microbial loads associated with GHS 1notesalso established by, [50] leaves the GHS 1 note with a comparatively higher health risk to handling especially with bare hands.

Table 3: Average microbial load per total surface area of currency notes sampled from vendors

Ghanaian currency notes	Fufu Seller	Kenkey Seller	Banku Seller	Fast food Seller	Ampesi Seller
	Log ₁₀ cfu/m ²	Log ₁₀ cfu/m ²	Log ₁₀ cfu/m ²	Log ₁₀ cfu/m ²	Log ₁₀ cfu/m ²
GHS1	0.035	0.056	0.048	0.056	0.045
GHS2	0.028	0.046	0.040	0.040	0.039
GHS5	0.037	0.042	0.044	0.038	0.041
GHS10	0.037	0.045	0.041	0.039	0.039
Load per currency	0.034	0.047	0.043	0.043	0.041

Table 4: Specific microbial loads associated with sampled currency notes from street food vendors

Food vendortype	Total coliforms	Faecal coliforms	E. coli	Streptococcus sp.	Salmonella sp.
	Range (mean±stdev)	Range (mean±stdev)	Range (mean±stdev)	Range (mean±stdev)	Range (mean±stdev)
Fufu	2.60-3.96 (3.33±0.56)	2.60-3.62 (3.20±0.51)	2.60-3.62 (3.03±0.43)	2.60- 3.30(2.86±0.33)	2.60- 3.26(2.84±0.31)
Kenkey	4.38-4.95 (4.59±0.27)	3.62-4.96 (4.38±0.69)	3.36-4.62 (4.08±0.55)	3.11- 3.96(3.53±0.36)	1.18- 2.95(2.41±0.84)
Banku	3.38-4.62 (3.98±0.51)	3.62-4.96 (4.23±0.58)	3.36-4.91 (4.07±0.71)	3.36- 3.86(3.52±0.23)	2.60- 3.11(2.91±0.22)
Fast food	3.38-5.38 (4.09±0.89)	3.62-4.62 (4.15±0.44)	3.36-3.96 (3.72±0.29)	3.32- 3.95(3.60±0.26)	2.60- 3.36(2.97±0.31)
Ampesi	3.38-3.96 (3.73±0.28)	3.36-4.62 (4.08±0.55)	2.95-4.38 (3.58±0.60)	2.97- 3.96(3.42±0.41)	2.60- 2.97(2.78±0.20)

Note: All are in units of log₁₀cfu

Table 5: Educational level of vendors versus food-money handling with bare hands

Education level	No n(%)	Yes n(%)	Fischer Exact Test p level
Basic	8(38)	13(62)	0.63
JHS/MSL	17(47)	19(53)	
SHS/SSS	12(52)	11(48)	

Table 6: Food seller types and association with money and food handling with bare hands

Type of food sellers	No n(%)	Yes n(%)	Fischer Exact Test (p)
Ampesi/rice & sauce-based sellers	14(54)	12(46)	0.05
Fast food/fried rice sellers	10(77)	3(23)	
Fufu/banku & other soup related sellers	8(33)	16(67)	
Kenkey sellers	3(38)	5(62)	
Waakye sellers	2(22)	7(78)	

Specific microbes isolated from currency notes are presented in Table 4. Clearly, none (0%) of the currency notes was free from pathogens and therefore the notes could be implicated in food infections in case of cross-contaminations because key indicator microorganisms like total coli forms and faecal coli forms including *E. coli*, *Salmonella* and *Streptococcus* were isolated (Table 4). The range for microbial loads is 1.18-4.38 log₁₀cfu. The results support the stance that it is highly unacceptable for food vendors to handle money and food alternatively and/ or consecutively with their bare hands, a practice which is currently quite high 45% (n=36) among the street vendors sampled. In fact, the existing practice could increase pathogenic cross-contaminations of street foods from currency notes when serving food to customers. [10, 30]

Also Tables 5 and 6 present the level of association between food-money handling practices and vendor's educational level, and also type of food sold. The results show no significant association (p=0.63) between educational level and food-money handling practices using bare hands, although generally the incidence of the use of bare hands was high, and decreased (62% - 48%) along the educational level (Table 5). This suggests that education level did not necessarily influence hand hygiene practices. However, the type of food sold was significantly associated (p=0.05) with the use of bare hands for handling food and money (Table 6). Among the three vendor groups, thus Fufu/ Banku, Kenkey and Waakye sellers, over 60% were using their bare hands, followed by Ampesi/Rice & sauce-based sellers with 46%. The high incidence of bare hands usage existed

among the street food vendors because of convenience by the nature of the food sold. It was however different for Fast food/fried rice sellers, who mostly avoided the use of bare hands (77%) (Table 6). The study suggests that the risk of pathogenic cross-contamination could be lower among Fast food (fried rice) sellers but quite higher among all other vendors.

CONCLUSIONS AND RECOMMENDATIONS FOR PRACTICE

The currency notes involved in the street food vending had 100% microbial contamination. The most contaminated currency note was GHS 1, also mostly used by customers (41%). Specific microbial isolates were total coli forms, faecal coli forms, E. coli, Streptococcus sp. and Salmonella sp. with average load of 1.18 to 4.38 log₁₀cfu. Using bare hands for handling money and consecutively serving food was high among vendors (45%), obviously suggesting high health risk from potential cross-contamination. The educational level of vendors did not necessarily influence hand hygiene practices; however, the type of food sold was significantly associated with the use of bare hands for handling food and money. It is highly recommended that authorities ensure immediate adoption of some basic best practices among the vendors, which should include: sales assistants to collect monies instead of the person dishing out food; under no circumstance should bare hands be used to dish out food; and intensive education on the dangers of using bare hands in serving street-vended foods.

Conflict of Interest: The authors declare no conflict of interests. The study is funded from the authors' own resources.

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Authors' Contributions

RAK: Contributed in study conception and design, reviewed data collection protocols, supervised data collection and analysis, supported in data analysis and interpretation, and assisted in writing of this manuscript. **BDA:** Made substantial contributions to conception and design of the study, reviewed data collection protocols, supervised data collection and entry, led the data analysis and interpretation, led the writing of the manuscripts. **KC:** Made substantial contributions by developing the data collection tools, data collection, processing and entries, supported in the data analysis, drafting and revising of the manuscript.

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