



## Food safety knowledge and practices among fresh coconut vendors



C. Oduro-Yeboah, N.B. Ackah, P.T. Akonor\*, S.K. Amponsah, F.P. Mboom

Food Technology Research Division, CSIR-Food Research Institute, P.O.Box M30 Accra, Ghana

### ARTICLE INFO

#### Article history:

Received 21 September 2019

Revised 25 March 2020

Accepted 31 March 2020

#### Keywords:

Coconut

Food safety

Coconut vendors

Knowledge

### ABSTRACT

The study examines the distribution and sale practices of coconut vendors, identifies and analyzes food safety bottlenecks associated with street vending of fresh coconuts in Accra, Ghana. A cluster random sampling technique was used in which the study area was classified into three zones. One hundred fresh coconut vendors responded to a structured questionnaire. The results showed that vendors were predominantly male, most of who were educated up to secondary school level. Many (70.8%) of them learnt the trade through apprenticeship. The vendors were either stationed at a particular location (46.1%), or moved around as itinerant traders (53.8%), with their product displayed on pushcarts or head pans. The respondents revealed that more than 30% of consumers patronize fresh coconut because of its water. Food safety challenges identified in the coconut business include potential cross contamination of packaging materials by fresh coconuts, dipping pared coconut into alum solution to preserve freshness, and improper waste handling during and after sales. Education had a positive influence on food safety knowledge among the fresh coconut vendors ( $\chi^2 = 12.8$ ,  $p < 0.05$ ). Generally, vendors' knowledge in food safety was encouraging but there ought to be an improvement in these areas of their operations to safeguard the health of consumers.

© 2020 The Authors. Published by Elsevier B.V. on behalf of African Institute of Mathematical Sciences / Next Einstein Initiative.  
This is an open access article under the CC BY license.  
(<http://creativecommons.org/licenses/by/4.0/>)

### Introduction

Coconut (*Cocos nucifera*) is a member of the family *Arecaceae* (palm family) and the only species of the genus *Cocos*. It is an agricultural and livelihood crop for many people in Southeast Asia, the Pacific region, Africa and some countries in Latin America [7]. Often named 'tree of life' because of its versatility, coconut is a vital multipurpose crop grown throughout the tropical regions of the world. Coconut palms can grow in fragile environments and poor quality soil, where few alternative crops would thrive. Nearly one third of the world's population depend on coconut as their source of food and their economy [7]. In Ghana, it is an economic crop with a wide range of uses, including provision of fuel, food and indigenous building materials [18]. Coconuts are found along the entire coast of Ghana and its density wanes moving inland towards the northern and eastern directions [6]. According to Abankwah et al., [1], in Ghana, coconut provides employment for about 76,000 people nationwide and generates income for many rural dwellers.

\* Corresponding author.

E-mail address: [papatoah@gmail.com](mailto:papatoah@gmail.com) (P.T. Akonor).

**Table 1**  
Study zones and locations (N = 104).

Location	Frequency (n)
Zone1 LEKMA area	22
Zone2 Accra East	33
Zone3 Accra West	49
Total	104

The coconut fruits serve as the source of raw material in many food products such as coconut milk and cream, desiccated coconut, coconut chips, coconut water, coconut oil, etc. Aside from the use of coconut water as tropical beverage, it is also used as a microbiological growth medium [21]. Coconut water is sterile within the nut and is free from microorganisms but when exposed to air or to the environment, the product is prone to microbial contamination and deterioration. Factors that may negatively affect the quality of coconut water during production include pesticide residues and heavy metals. These chemical contaminants can be absorbed from soil or water. Published data also indicate that fresh coconut water supports the growth of *E. coli*, *K. pneumonia* and *Listeria monocytogens* if contaminated with these organisms ([4]; Walter et al., 2009). Therefore proper handling and management throughout the post-harvest and processing are important to ensure coconut water and other edible parts, retain their inherent qualities (FAO, 2007).

In Ghana and many other developing economies, street vending of fruits, vegetables and other cooked and or minimally processed foods is commonplace. Some of these products have exceeded regulatory limits for microbiological contamination, thus raising food safety concerns [20,24]. Available information shows that poor food handling practices are the main cause of the outbreak of foodborne illnesses (WHO, 2002). Ababio and Adi (2012) ascribed this to the fact that many food handlers do not understand the basis for observing safe food practices. To ensure that coconut water remains safe at the point of consumption, proper handling, processing and storage by the vendor is crucial. Vendors need to take proper precautions to reduce microbial contamination of their products since they constitute a major line of defense against foodborne diseases.

Despite the many health benefits which are derived from consuming coconut water and other coconut products, the handling and preparation processes may pose a safety risk to consumers. The aim of this study was therefore to evaluate distribution and sale practices of coconut vendors, identify and analyze food safety bottlenecks associated with the street vending of fresh coconuts.

## Methodology

### Study location setting

A survey of coconut vendors was conducted in the selected communities of Accra Metropolis in Ghana, where fresh coconut is predominantly sold along major streets and avenues. These areas are urban and reflect a typical modern society in which consumers are inclined to patronizing the convenience presented by street vended food products. The study area was structured into three locations (Table 1), and at least four suburbs randomly selected from these locations for questionnaire administration.

### Data collection instrument

A questionnaire was designed to obtain information on retailing of coconut and safety aspects associated with its sales. The first section of this questionnaire was essentially to gather information on the demographic characteristics of the coconut vendors including age group, gender, marital status and religion. The second section of the questionnaire contained questions for gathering information on varieties of coconut sold, fruits sold in a day, where and how long fruit can keep and food safety practices employed. This section generally contained closed ended questions and a few open ended ones. Enrolment was mainly based on availability and willingness to participate in the study. The consent of respondents were sought after a detailed explanation of the study. For respondent who could not read or write in English, the questions were read and interpreted in vernacular and the responses translated directly onto the questionnaire. The questionnaires were pre-tested in a pilot survey using twenty (20) coconut vendors located within the study area. Based on the responses obtained, the questionnaire was modified to make it suitable as a research tool for collecting the relevant data. The pre-test questionnaires were not included in the final data analysis. Cronbach's alpha, used to determine the internal consistency of the questionnaire, showed that the questionnaire was reliable ( $\alpha = 0.83$ ).

### Sample size determination

The total sample size of the respondents to be interviewed for the study location was calculated using the relation,

$$N_i = 4X p_i(1-p_i)/d^2$$

Where,  $N_i$  is the total number of respondents (Chadare et al., 2008).

**Table 2**  
Demographic information of respondents (N = 104).

Variables	Groups	Frequency (n)	Percent (%)
Age (years)	<20	9	8.6
	20–29	46	44.2
	30–39	35	33.7
	40–49	13	12.5
	50+	1	1.0
Sex	Male	103	99.0
	Female	1	1.0
Marital status	Single	68	65.4
	Married	29	27.9
	Others	7	6.7
Educational status	None	15	14.4
	Primary	65	62.5
	Secondary	24	23.1
Role in household	Head	84	80.8
	Dependent	20	19.2
Primary livelihood (coconut trade)	Yes	95	91.3
	No	9	8.7
Experience (years)	<1	13	12.5
	1–2	35	33.7
	3–5	48	46.2
	>5	8	7.7

$P_i = n_p/N_t$ ; the proportion  $n_p$  of the product producer, vendors and consumer among the  $N_t$  randomly interviewed and the expected error margin fixed at 0.05 (Dagnelie 1998). A statistical power of 80% was achieved based on this equation and its parameters used in the sample size calculation.

#### Data entry and analysis

Questionnaire responses were entered into a template (SPSS 17.1, SPSS Inc.) designed purposely for this study. Entries in the software template were validated by manually comparing these against responses on each questionnaire (hard copy). Additional categories were generated for “other” responses, if several respondents answered them similarly. A total of 115 questionnaires were distributed but 104 were included in the data analysis. The remaining 11 were excluded because they were either incomplete or responses were notably inconsistent. Data was analyzed using descriptive statistics and chi square test conducted to establish association between respondents’ demography and food safety variables.

## Results and discussion

#### Demography of respondents

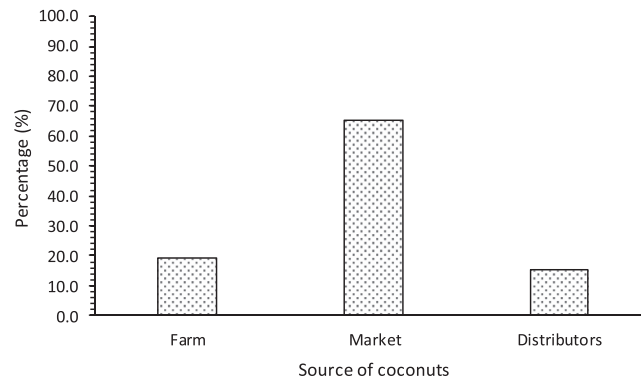
The demographic profile of respondents is outlined in [Table 2](#). In contrast to the assertion that women have a monopoly over street foods [[15,14](#)] in Ghana and other developing countries, this study population was male dominated. This is possibly due to the strenuous nature of coconut vending, a task which involves carrying, dehusking and paring coconuts. The respondents were mostly unmarried and a majority (77.9%) aged between 20–39 years. Quite a few teenagers were also encountered in the study ([Table 2](#)). Majority (62.5%) of respondents had basic education, some (14.4%) had secondary education and the rest had no formal education. In the words of Abankwah et al. [[1](#)], fresh coconut marketing “has been identified as a safe net for school drop outs, proving meaningful employment for them”. Coconut vendors’ households were made up of an average of four members (data not shown).

#### Business setup and distribution practices

The results showed that coconut vending was the primary source of livelihood for more than 90% of respondents, with close to 93% of them having engaged in the coconut vending business for up to five years. In addition to coconut selling, the remaining 8.7% of respondents were engaged in other income generating activities such as working as manual laborers or trading in other food produce. This results reflect the finding of previous studies (Azanza et al., 2000; [[12,8](#)]) which reported street food vending to constitute the main income generation activity for many people in developing countries. While some respondents (7.9%) got into the coconut vending trade through family, others (70.8%), who incidentally were in the majority, acquired the skill through apprenticeship. Another category of respondents, who constituted about 20% of the study population started the business on their own, without prior training or under studying. Even though the vendors had been engaged in the business for long, only a few (15.7%) of them employ additional hands. All respondents within this category (those who employ additional hands) had a maximum of two employees to assist in their business.

**Table 3**  
Varieties of coconut sold by vendors and mode of distribution ( $N = 104$ ).

Variable	Response	Frequency	$\chi^2$	$p$ -value
Coconut variety	Local	46	6.08	0.043
	Exotic	26		
	Both local and exotic	32		
Mode of distribution	Stationed	48	0.64	0.424
	Itinerant	56		



**Fig. 1.** Source of coconut sold by vendors.

Inconsistent with the characteristics of street food vending, majority of fresh coconut sellers were not stationed at a particular location (Table 3). Perhaps, as a business strategy, these respondents roam within a particular locality with the fresh coconuts loaded in wheel burrows or push carts. The remaining itinerant coconut sellers, carry the nuts in head pans. Coconut vendors who are stationed at a particular location also make use of push carts or wheel burrows to display their product. The results showed that an average of 53 coconuts were sold per day

The choice of coconut variety to sell, according to respondents, was generally informed by the preference of the consumer. Therefore in order to reach out to a wider consumer base some vendors revealed that they sell both “local” (West African Tall) and exotic varieties such as Sri Lanka Dwarf. A section of respondents were inclined to sell only the exotic variety (Table 3) because, according to them, the nuts are bigger and contain more water and meat than the “local” varieties which appear smaller. The perception that improved varieties are grown with a lot of agrochemicals was also identified, albeit seemingly peripheral, as a reason for not selling improved varieties. constitute the source of fresh coconuts for these vendors were obtained from local markets, farm gates and distributors/aggregators (middlemen) (Fig. 1).

#### *Food safety conditions and practices among vendors*

According to the coconut sellers, whereas 65% of consumers buy coconut for its water and meat, more than 35% mainly buy for the water alone. Coconut water is refreshing and therapeutic, and according to Singh et al., (2007), it is gaining popularity as a healthy beverage. Therefore it was unsurprising that more than one third of consumers patronize coconuts exclusively for its water. The vendors revealed that most customers consume coconut water directly from the fruit, while for others, it is packaged in clear flexible low density polyethylene (LDPE) bags. After draining the water, the nut is split into two halves and the white flesh scooped out of its shell using either a spoon, the paring knife or a uniquely shaped slit of coconut fiber. Similarly, the flesh is also packed in LDPE bags. These polybags, which are provided by the vendors, are usually kept together with the raw coconuts. As a result there is a high potential for cross-contamination of the packaging material to occur. Only a handful of vendors (29%) keep packaging material separately and away from the raw coconuts.

Although washing and sanitizing fruits contribute effectively to food safety, results of the study showed that these were not widely practiced among the respondents. This observation may be attributed to the perception that the edible parts of coconut may not be contaminated because it is within the inner cavity of a hardened shell. Some studies have established the sterility of coconut water, but in these studies, the water was aseptically extracted [13,4]. A previous report however suggests that contamination could occur because the shell has been found to harbor heavy populations of several microbes [9]. Therefore proper handling after harvest and during processing is key in ensuring that product remains safe. After paring, nearly half of the respondents (43.7%) revealed that they wash the nuts with a solution of alum to maintain freshness, prevent discoloration and make the coconuts attractive. The health implication of this practice, however, is yet to be ascertained.

The results showed (Table 4) that responses to hand washing practices inquired from the vendors was quite encouraging. Nearly 72% intimated that they wash their hands in between servings. Similarly, about 73% wash their paring knives and

**Table 4**  
Hand and equipment washing practices.

Activity	Response	Percentage (%)
Hand washing in between servings	Yes	71.6
	No	28.4
Frequency of hand washing	Always	14.8
	Sometimes	56.8
	Never	28.4
Washing of paring knives and scoops	Yes	70.7
	No	29.3
Frequency of washing knives and scoops	Always	10.2
	Sometimes	62.5
	Never	29.3

scoops in between servings or after use. Even though running water was unavailable at the vending sites as observed in the study by Mensah et al., [14], a few vendors had water stored in handy buckets or gallons at their vending sites. As indicated, close to 30% of vendors encountered hardly wash their hands or their working aids. Our results showed that a majority of people within this category ( $\chi^2 = 23.53$ ,  $p < 0.01$ ) were itinerant coconut vendors, who probably may not have access to water for washing. Apart from Mensah et al. [14], other researchers [23,16] also noted the absence of water for washing among street food vendors from different countries. The vendors who do not adhere to good hand and equipment washing practices argued that the edible parts of coconuts cannot be contaminated and therefore hand-washing does not affect the safety status of coconuts. Even though the proportion of respondents who held this view is noteworthy, their numbers may not necessarily pose a public health challenge. Their situation could be managed through education, food safety and public health advocacy possibly through new media technologies, as suggested by Jacob et al., (2010). In this regard effective messages developed with the needs of the target audience in mind must be designed [11].

The waste (mainly coconut husk and shell) generated from the operations of the vendors is kept together with the fresh coconuts on the same vending cart or head pan until close of the day's business. Subsequently, the waste is disposed-off in a refuse dump or by heaping and burning at a later time when the fiber is dry. In the face of increasing coconut waste, these methods of managing the waste appears to be unsustainable, because it takes a long time for the fiber and shells to dry. Ofori-Agyeman [19] estimated that about 98–155 kg of coconut waste is generated daily in some Ghanaian cities. This may pollute the environment or serve as breeding grounds for insects and rodent pests if not properly managed. The potential of using coconut husk and shell for some commercial products have previously been identified [10]. Therefore, a better approach to handling coconut biomass would be to use it as a raw material in the manufacture of door mats, ash tray and other craft products. Regrettably, only a few vendors get to sell the fiber to artisans in this trade because the market is not large enough to mop up significant amounts of coconut waste. Alternatively, the biomass could serve as an energy source through combustion.

#### Food safety knowledge among vendors

Generally, knowledge among the fresh coconut vendors regarding some key food safety issues, was encouraging. For example, the vendors were aware of the importance of wearing clean apparels and keeping a tidy selling environment to reduce the risk of food borne diseases. As observed by Akonor and Ayim Akonor [2] and Muyanja et al., [17], majority (82%) of the vendors agreed that washing of hands with soap during operation and after handling money enhances food safety. The remaining 18% were either indifferent or they completely disagreed with this assertion. According to Barro et al., [5] street food vendors hand and money harbor food borne pathogens such as coliforms, *salmonella* and *staphylococcus* and therefore failure to practice good hand washing may result in food contamination.

In regards to coconut water being an avenue for contracting food borne diseases, there was a marginal difference between the responses from the vendors. The majority, however reasoned that it is possible and therefore were mindful of the hygiene status of the product they sell to consumers. The results showed that the higher the educational level, the more likely ( $\chi^2 = 12.81$ ,  $p = 0.024$ ) it is for a vendor to attach importance to the hygiene status of the coconuts. Majority of the respondents with primary (54.2%) and secondary education (73.7%) indicated that consumers can contract food borne diseases through mishandling coconut. On the other hand, most of the respondents (70%) who did not have any formal education opined that food borne diseases cannot be contracted through fresh coconut products (Fig. 2). This suggest that education may have influenced their food safety knowledge as noted by Soares et al. [22]. Consistent with other previous studies [3,22] age, gender and other demographic indices had no influence on the knowledge of the study population ( $p > 0.05$ ).

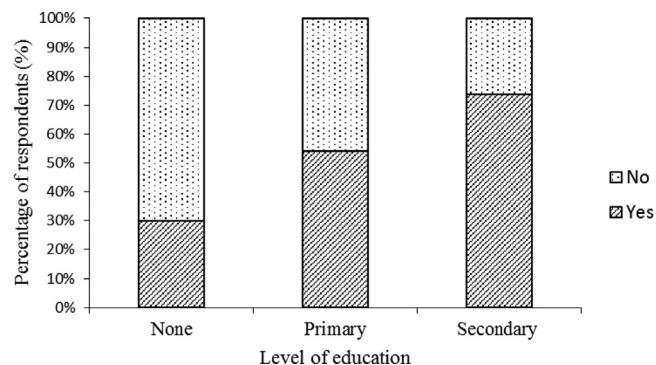


Fig. 2. Relationship between educational level and food safety knowledge.

## Conclusion

The study showed that coconut vending is generally a male dominated business, with majority having basic education (primary school). Vendors either had a unique selling location or were found to roam the streets within the study area with their goods displayed on head pans or push carts. These vendors obtain fresh coconuts from local markets, farm gates or from middle men who serve as wholesale agents. The vendors revealed that only about 30% of consumers buy coconuts exclusively for its water. Generally respondents' knowledge in food safety was encouraging, and was positively influenced by level of education. That notwithstanding, some food safety challenges such as potential cross contamination of packaging materials and difficulty in handling and disposing of coconut waste were identified. Good sanitary practices and other public health and food safety advocacy may be adopted to complement the knowledge of vendors.

## References

- [1] V. Abankwah, R. Aidoo, B. Tweneboah-Kodua, Margins and economic viability of fresh coconut marketing in the Kumasi metropolis of Ghana, *J. Dev. Agric. Econ.* 2 (2010) 432–440.
- [2] P.T. Akonor, M. Ayim Akonor, Food safety knowledge: the case of domestic food handlers in Accra, *Eur. J. Nutr. Food Saf.* 3 (2013) 99–111.
- [3] G. Annor, E.A. Baiden, Evaluation of food hygiene knowledge, attitude and practices of food handlers in food businesses in Accra, *Food Nutr. Sci.* 2 (2011) 830–836.
- [4] A.K. Awua, E.D. Doe, R. Agyare, Potential bacterial health risk posed to consumers of fresh coconut (*Cocos nucifera* L.) water, *Food Nutr. Sci.* 3 (2012) 1136–1143.
- [5] N. Barro, A.R. Bello, A. Savadogo, C.A.T. Ouattara, A.-J. Ilboudo, A.S. Traore, Hygienic status assessment of dishwater, utensils, hands and pieces of money in street foods vending sites in Ouagadougou, Burkina Faso, *Afr. J. Biotechnol.* 5 (2006) 1107–1112.
- [6] B.R. Caulum, Coconut Palm On the Coastline of Western and Central Regions of Ghana. Professional paper Submitted in Partial Fulfilment of a Master of Forestry Degree, Northern Arizona University, 2012.
- [7] CRC. 2004. Coconut. Coconut Research Centre Newsletter. Accessed on September 24, 2017 from: <http://www.coconutresearchcentre.org>
- [8] FAO, Street Food Vending in Accra, Ghana. Food and Agriculture Organization of the United Nations, Field Survey Report 2016, S. Marras, M. Ag Bendeck, A. Laar (Eds.), FAO, Rome, 2016 Available online at <http://www.fao.org/3/a-i6369e.pdf> Accessed on 15/08/18.
- [9] T. Kajs, C. Vanderzant, K.F. Mattil, Microbiological evaluation of coconut and coconut products, *J. Food Sci.* 41 (1976) 352–356.
- [10] J.P. Luisito, Production of handicrafts, wares and novelty items from coconut wood, fronds and coconut fruit residues, *CORD 23* (2007) 84–91.
- [11] R. Lundgren, Risk Communication: A Handbook of Communication of Environmental Safety and Health Risk, Battelle Press, Columbus, 1994.
- [12] G. Lyenda, Street food and income generation for poor households in Kinshasa, *Environ. Urban* 13 (2001) 233–241.
- [13] K.N. Matsui, J.A.W. Gut, P.V. de Oliveira, C.C. Tadini, Inactivation kinetics of polyphenol oxidase and peroxidase in green coconut water by microwave processing, *J. Food Eng.* 88 (2008) 169–176.
- [14] P. Mensah, D. Yeboah-Manu, K. Owusu-Darko, A. Ablordey, Street foods in Accra, Ghana: how safe are they, *Bull. World Health Organ.* 80 (2002) 546–554.
- [15] Mitullah, W.V. 2003. Street vending in African cities: A synthesis of empirical findings from Kenya, Cote D'Ivoire, Ghana, Zimbabwe, Uganda and South Africa. Background paper for the 2005 World Development Report of the World Bank.
- [16] O.K. Muinde, E. Kuria, Hygienic and sanitary practices of vendors of street foods in Nairobi, Kenya, *Afr. J. Food Agr. Nutr. Dev.* (2005) 5.
- [17] C. Muyanja, L. Nayiga, B. Namugumya, G. Nasinyama, Practices, knowledge and risk factors of street food vendors in Uganda, *Food Control* 22 (2011) 1551–1558.
- [18] E.L. Okorley, E. Haizel, Farmers' attitude and problems associated with the adoption of Cape Saint Paul resistant coconut hybrid in the Western region of Ghana, *Agron. Afr.* 16 (2004) 83–89.
- [19] C. Ofori-Agyeman, Assessment of Quantity of Coconut Waste Generated and Mangement in the Kumasi Metropolis, Ghana. A BSc thesis Submitted to the Department of Agricultural Engineering, KNUST, 2016.
- [20] G.A. Pesewu, J.N. Agyei, K.I. Gyimah, M.A. Olu-Taiwo, S. OseiDjarbeng, F.S. Codjoe, P.F. Ayeh-Kumi, Bacteriological assessment of the quality of raw-mixed vegetable salads prepared and sold by street food vendors in Korle-Gonno, Accra Metropolis, Ghana, *J. Health Sci.* 2 (2014) 560–566.
- [21] A. Prades, M. Dornier, N. Diop, J.-P. Pain, Coconut water preservation and processing: a Review, *Fruits* 67 (2012) 157–171.
- [22] L.S. Soares, R.C.C. Almeida, E.S. Cerqueira, J.S. Carvalho, I.L. Nunes, Knowledge, attitudes and practices in food safety and the presence of coagulase positive staphylococci on hands of food handlers in the schools of Camacari, Brazil, *Food Control* 27 (2012) 206–213.
- [23] T.N.C. Thanh, Food Safety behavior, Attitudes and Practices of Street Food Vendors and Consumers in Vietnam. A MSc. Thesis submitted to the Faculty of Bioscience Engineering, Universiteit Ghent, 2015.
- [24] M. Wiafe-Kwagyan, A.J. Dzifa, G.I. Mensah, Assessment of microbiological load and safety of selected pre-cut fruits and vegetables sold at two major markets in Accra-Ghana, *Acta Sci. Nutr. Health* 3 (2019) 99–108.