

Original research article

Hygiene Level of Street Foods in the City of Beni, Democratic Republic of Congo.

Comment [u1]: Assessment of.....

ABSTRACT

Introduction: Street food is a cheap option for people in eastern DRC, but the unhygienic practices of street vendors and their customers create an environment that causes disease and other health problems, the release of waste into the environment. This is a descriptive cross-sectional study with the objective of assessing the hygiene status of street foods. It focused on food vendors and consumers in Nyamwisi Boulevard in 2021.

Comment [u2]: and as well the introduction of food wastes into the environment is worrisome.

Comment [u3]: Correct as re-write above

Methods: The study population was infinite with a non-random sample whose number was fixed by the PEDUIZZI formula ($n=K*10$); K being the number of variables or 100 people.

Results: The results showed that 64% of the sellers are women while 58% of the consumers are men, the motivation for them being the creation of employment for 49% of the sellers, the home being far away for 40% of the consumers. The level of hygiene of the food sold on Nyamwisi Boulevard remains a concern with regard to elements such as 59% use well water, which could be the basis of food-borne diseases, 45% of the respondents are clean, only 8% with protective clothing, 12% wash their hands regularly before serving customers, 26% have dustbins, presence of rubbish at 38%; 36% protect against breath and flies, 55% of utensils are clean, 49% have workstations.

Comment [u4]: Replace 'with' to 'used'

Conclusion: Generally speaking, the hygiene rules for food sold on the public highway on Nyamwisi Boulevard are not in place. Certain practices are said to be at the root of the lack of hygiene of food intended for consumption.

Keywords: Hygiene level, Foodstuffs, Public thoroughfare.

1. INTRODUCTION

Hygiene is a key issue at both local and national levels. The control of food safety has become a concern for international organisations, public services, consumers, etc. Food can transmit diseases from person to person, but also serve as a means of growth for certain bacteria (both on the surface and inside the food). Food can transmit diseases from person to person but also serve as a growth medium for certain bacteria (both on the surface and inside the food) that can cause diseases such as food poisoning [1].

Comment [u5]: Repeation. Pls delete

Food safety is a public health priority. Unsafe food is a global health threat that puts everyone's life at risk. These foods create a vicious cycle of diarrhoea affecting the physical condition of the most vulnerable. According to WHO (2007), 220 million children contract diarrhoeal diseases every year. Children under five bear 40% of the disease burden from foodborne diseases and 125,000 die each year [2].

An estimated 2.5 billion people consume street foods, 65.3% of which are essential for urban and rural diets, and are responsible for hygiene-related diseases: 60% of diarrhoea cases, 45% of cholera cases and others including verminosis, typhoid fever and dysentery [3].

It is estimated that 600 million people, or nearly 1 in 10 worldwide, fall ill each year after eating contaminated food, and 420,000 die as a result. Diarrhoeal diseases are the most common illnesses resulting from eating contaminated food, affecting 550 million people a year and killing 230,000 a year. Foodborne diseases hamper socio-economic development by placing a heavy burden on health care systems, and by damaging national economies, tourism and trade [2].

Food hygiene includes all practices aimed at ensuring that food placed on the market is neither harmful (detrimental to health) nor unacceptable for consumption due to spoilage by non-harmful micro-organisms. Hygiene is therefore said to have two components, safety and wholesomeness. Food safety is also called food security or food safety [4].

Comment [u6]: Delete, this is an unnecessary repartition.

The fact that most of the world's population lives in urban areas today is due to the rapid growth of cities and peri-urban areas in recent decades, particularly in developing countries. In many urban areas, health problems are compounded by uncontrolled urbanisation, which in many cases is not adequately funded. As a result, municipal authorities often lack the means to provide the basic health and environmental infrastructure and services that are the minimum requirements for a healthy population [5].

In the developed world, certain foods have been repeatedly incriminated in food-borne outbreaks. In France, for example, the Centre de Contrôle des Maladies estimates that there are 250,000-750,000 cases of food poisoning per year, of which 70,000 are referred to emergency departments, 150,000 people are hospitalised and 400 people die [1].

In the developing world, the consumption of street foods is very high, 76.1% of which are also at risk of contamination by "Salmonella" bacteria due to the lack of hygiene in the stalls, refrigerators and cooking facilities required [3].

Comment [u7]: Always italicise or underline scientific words, especially bacteria and other microorganisms. *Salmonella* or Salmonella

Following the example of other developing countries, the Democratic Republic of Congo, on the basis of surveys conducted from 1998 to 2010, reported a serious deterioration in the nutritional situation of food sold on the public highway. Thus, a law was promulgated in 2015 stipulating in its article 10 that "The sale of foodstuffs in the vicinity of public buildings, schools, pre-schools and universities must be carried out in conditions that ensure good preservation and effective protection of these foodstuffs against flies, dust and other disease vectors" [6].

In addition, it is a source of ready-to-eat food for most of the population working during the day or away from home. Their ease of access and availability is of interest to the consumer, and because of their lower cost, i.e. low or no rent for the site occupied, low investment (equipment, and purchase of raw materials), they offer basic food at a better price than restaurants [7].

Furthermore, WHO advocates that a healthy market involves collaboration between all interested parties to provide healthy and nutritious food for the whole community. **That said**, markets can facilitate the spread of disease, as has been the case with cholera in Latin America and Severe Acute Respiratory Syndrome (SARS) in Asia. Therefore, local authorities, market managers, suppliers, vendors and all those who work in markets, as well as consumers themselves, must all agree on the critical role of markets in promoting community health and well-being [4].

Comment [u8]: Replace 'That said' with 'This implies that'

Moreover, studies in many countries show the dominant role played by women in this type of trade [3]. According to Konan, **N**, foodborne diarrhoeal diseases are one of the most common diseases worldwide. In developing countries, they are responsible for 1.8 million deaths of children under five each year. As many as 70% of these cases are caused by foodborne pathogens. The incidence of foodborne disease is difficult to estimate accurately, even in developed countries, because many episodes go untreated and therefore unreported [8].

Comment [u9]: Delete the letter 'N'

The US Centers for Disease Control and Prevention estimates that approximately one in three people in the United States contract a foodborne disease each year. Similar estimates have been made in the Australian population. Children, pregnant women, the immunocompromised and the elderly are particularly at risk of these diseases and of more serious complications. Other health problems associated with this type of disease are common. For example, 2-3% of all salmonellosis cases result in long-term health problems due to reactive arthritis [9].

In the Democratic Republic of Congo, street food is a social reality. However, the lack of hygienic conditions in the setting up of these foods constitutes a threat to the health of 65.8% of the population who suffer from hygienic diseases such as typhoid fever. In North Kivu, food poisoning and illnesses transmitted by street food represent 61.4% of consumers and vendors [10].

In Kisangani, as in all cities in the Democratic Republic of Congo, the trade and consumption of street food is a reality. To address these challenges, a study was conducted to monitor the hygienic quality of street foods. A survey was conducted to determine whether vendors in the central market restaurants were following **hygienic** practice. The quality of three samples was assessed by microbiological analysis and the results showed that 11% of vendors did not attend school, 44% of vendors were limited to primary school and 45% of vendors did not reheat their food before serving it. 100% of the samples were unsatisfactory for **Bacillus** spore and Total Aerobic Mesophilic Flora (TAFM). These results allow the different services concerned to better control these foods [11].

Comment [u10]: Pls write in full : Good hygiene practices (GHP)

Comment [u11]: Italise or underline this pathogenic Bacteria

Sold in unhealthy conditions, the food constitutes a real danger for the health of the population, because, the environment being polluted, these food products are totally exposed to microbes of all kinds. The consumption of these foods is often a source of many diseases.

Comment [u12]: This sentence is not flowing in this sentence and paragraph.

In Beni, infectious food diseases exist but seem to be ignored. They led to more than 70% of cases of diseases due to lack of hygiene in 2017 and 50.6% of deaths [12].

Through this study, we want to know the conditions in which street food is sold on Nyamwisi Boulevard in Beni city, which can serve as a starting point for scientists to look for strategies and control measures to improve this sector. This situation led us to ask a specific question, namely:

Comment [u13]: Replace 'namely' with 'including'

- What is the level of hygiene of the foodstuffs sold on Nyamwisi Boulevard, in terms of cleanliness of the vendors, foodstuffs, environmental sanitation, the type of water used and the position of the foodstuffs?

In general, the objective of the study is to assess the level of hygiene of street foods.

This study has a double interest: social and scientific. From the social point of view, this study is a contribution to the fight against the lack of food hygiene in public area and a challenge to political and medical leaders and vendors to take appropriate measures to maintain and observe food hygiene in the market in order to prevent diseases linked to poor hygiene.

Comment [u14]: Add 'approach'

From a scientific point of view, the study paves the way for other researchers by providing a frame of reference for further research on the same topic.

2. METHODOLOGY

Comment [u15]: Citation of the adopted methodology is missing. Pls include it.

This is a descriptive study with a cross-sectional focus that was mainly interested in the sellers and consumers of foodstuffs on the public highway at Nyamwisi Boulevard in 2021, in the town of Beni in the Democratic Republic of Congo.

Our study population is infinite with a non-random sample whose number was fixed by the PEDUIZZI formula ($n = K*10$), K being the number of variables.

The sample consisted of 100 subjects, including sellers and consumers of foodstuffs sold and purchased on Boulevard Nyamwisi in Beni territory.

Those who would be included in our research are all regular and available foods, but also the sellers and consumers available during this survey period.

In order to obtain information relevant to our research, we used the following techniques:

- Participatory direct observation: which allowed us to personally come into contact with the state of food safety and observe the state of the vendors.
- Structured interview based on a questionnaire addressed to vendors and consumers, i.e. we formulated closed questions that we submitted to each respondent.
- Literature review: to reconstruct the problematic, the theory and the discussion of our work.

Comment [u16]: Replace 'problematic' with 'Statement of problem'

Ethical aspect

The participation of the respondents in this study was voluntary. Consent was free, informed but only verbal. The respondents were told that if they agreed to participate in this study, a

questionnaire would be administered to them. The respondent who freely agreed to be recruited could withdraw from the survey at any time without any prejudice.

3. RESULTS

3.1 Demographic characteristics

Table 1: Distribution of subjects by demographic characteristic (n=100)

Variables	Effectives	%
<u>Gender</u>		
Male	36	58
Female	64	42
<u>Age</u>		
11 to 20 years	38	12
21 to 30 years	25	43
31 to 40 years	22	34
41 and more	15	11
<u>Qualification</u>		
Illiterate	16	31
Primary	48	18
Secondary	28	56
University	8	5
<u>Marital Status</u>		
Single	38	46
Married	25	28
Divorced	22	19
Widowed	15	7

From the analysis of this table, we see that 64% of sellers are women and 36% men, 58% of consumers are male and 42% female. In terms of age, 38 individuals, or 38% of the salespeople surveyed, were between 11 and 20 years old. With regard to level of education, 48% of the subjects surveyed were primary school teachers, while 31% of the consumers were illiterate. With regard to marital status, 38% of the sellers surveyed were single and 46% of the consumers were single.

Comment [u17]: Write Table 1, instead of table.

Comment [u18]: Males and females o replace male and female.

Comment [u19]: Replace 'were' with 'are'. Make sure that are used instead of were under this sentences

3.2 Type of foodstuffs sold on the boulevard

Table 2: Distribution of subjects by type of food sold on the boulevard

Foodstuffs	Effective	%
Fruit	22	22
Beverages	18	18
Dairy products	6	6
Cereals	7	7

Tubers	18	18
Pulses	16	16
Animal products	13	13
Total	100	100

In addition, 22% of respondents sell fruit, followed by a tie of 18% who sell tubers and beverages and 6% of respondents who sell dairy products.

3.3 Motivation for selling and consuming street food

Table 3: Distribution of subjects according to motivation to sell and consume street food
n = 100

Variables	Sellers				Consumers			
	More accessible customers	Job opportunities	Escaping from taxes	Lower cost for the occupied site	Best price	Home away from home	No time for cooking	Insufficient food at home
Gender								
Male	5	12	17	2	12	14	24	8
Female`	16	37	6	5	8	26	5	3
Age								
11 to 20 years	10	22	6	0	2	7	1	2
21 à 30 years	7	11	6	1	7	18	15	3
31 à 40 years	2	11	6	3	6	12	11	5
41 and more	2	5	5	3	5	3	2	1
Marital status								
Single	7	21	8	2	6	17	18	5
Married	2	10	10	3	9	15	2	2
Divorced	7	12	3	0	4	5	7	3
Widowed	5	6	2	2	1	3	2	1

In this table, 49% of sellers cited the possibility of employment, 23% the avoidance of taxes, 21% the accessibility of customers and 7% the lower cost of the site occupied, while 40% of consumers cited the distance from home, 29% the lack of time to prepare, 20% the better price and 11% the lack of food at home.

3.4 Sellers' and consumers' knowledge about food

Table 4: Distribution of subjects according to knowledge about food

Knowledge elements	Sellers			Consumers		
	TB	B	M	TB	B	M
Role of food	18	31	51	23	36	41
Method of preserving food	28	20	52	32	44	24
Measures to avoid contamination of food (food hygiene)	18	33	49	17	25	58

Consequences of poor food hygiene	19	46	35	37	39	24
Food-borne diseases	22	45	33	42	38	20

The analysis of this food knowledge table shows that 21% of sellers have very good knowledge, 35% have good knowledge and 44% have poor knowledge, while 30% of consumers have very good knowledge, 37% have good knowledge and 33% have poor knowledge.

Comment [u20]: Replace Table 4 with 'table' in this sentence.

3.5 Degree of food and environmental hygiene

Table 5: Distribution of subjects according to the degree of food and environmental hygiene:
n = 100

Observational elements	Effectives	%
Protection against bad smells, flies and dust	36	36
Clean utensils	55	55
Clean sellers	45	45
Vendors with protective clothing Foodborne illness	8	8
Hand washing before serving customers	12	12
Clean environment	39	39
Presence of bins	26	26
Presence of rubbish	38	38
Existence of workstations	49	49
Proper handling of foodstuffs	64	64

According to this table, 45% of respondents are clean, only 8% have protective clothing, 12% wash their hands regularly before serving customers, 26% have bins, 38% have rubbish, 36% protect against breath and flies, 49% have work stations.

Comment [u21]: Replace Table 5 with table in this sentence.

3.6 Water quality for dishwashing and cooking

Table 6: Distribution of subjects according to the quality of water used for cleaning and cooking

Water quality	Effectives	%
Well water	59	59
Régideso water	20	20
Spring water	14	14
River water	7	7
Total	100	100

The **table** shows that 59% of respondents use well water, followed by 20% who use Regideso water, 14% who use spring water and 7% who use river water for cleaning dishes.

Comment [u22]: Replace Table 6 with 'table' in the sentence.

3.7 Supervision of vendors on food hygiene in the market

Table 7: Distribution of subjects according to the supervision of vendors on food hygiene at the market

Framing	Yes	No
Training	24	76
Structural	0	100

According to this **table**, only 24% of the respondents have received training in food hygiene; there is no organisation in this sector.

Comment [u23]: Replace Table 7 with 'table' in the sentence.

4. DISCUSSION

We found that among the 100 respondents, women were more involved in food selling activities along Nyamwisi Boulevard, 64% compared to 36% of male subjects, while of the consumers 58% were men and 42% were women. Similarly to Iyenda (2001), in her study of the 256 respondents interviewed, the majority were women (55.1% versus 44.9%). More than a quarter of the women were heads of household in the Democratic Republic of Congo. Similarly, Secke in 2007, in her thesis, also showed that on a global scale, street food trading is more common among women than men.

Comment [u24]: Replace : This study reveals that with 'we found that'

But also all ages practice this activity with a **predilection** between 11 and 20 years old with 38%. Those of primary level are more represented with 48%. Kanyere [13] estimated that the minimum age of street vendors in Beni was 24 years, while their maximum age was 40 years, she also states that most street food vendors have acquired a primary and secondary level of education. This is in line with Henriette's 2009 study which revealed that street food selling generates employment opportunities especially for the uneducated or less educated.

Comment [u25]: You mean 'prediction'. Pls verify this word (Predilection).

In terms of marital status, **we found** that 46% of consumers are single, followed by married (28%), most of whom are students and labourers. This is in line with Telamanu BE et al in 2020, report on street food selling, which states that the clients of street food selling were classified as civil servants, students, construction workers, parents with their children, **hungry** residents of Kinshasa. People who are not so rich to afford standard restaurants and people who are socially unstable. It is widely accepted that street food is for people of medium and low socio-economic status [14].

Comment [u26]: Replace 'we found' with this study opines....

Comment [u27]: Replace "hungry residents...." with less privileged residents

In terms of the types of food involved and surveyed, it was found that the most common foods found and sold on Nyamwisi Boulevard were fruits 22%, beverages 18%, tubers 18%, pulses 16%, animal products 13%, cereals 7% and dairy products 6% **of respondents**. This result is in **line** with Secke's [15] study that street foods are traditional foods and are all variable, easily accessible, cheaper than in restaurants and available to consumers.

Comment [u28]: Delete of respondents.

Comment [u29]: Replace 'line' with agreement.

Regarding the motivation for selling street food among sellers, 49% of respondents considered this activity as an employment opportunity, 23% to avoid paying tax, 21% invoke an accessible clientele and 7% consider the lower cost for the occupied site, while 40% of consumers buy street food because their home is far away, 29% do not have time to prepare, 20% resort to it because of the better price and 11% because of the lack of food at home.

This is in [line](#) with the ideas of Secke [15], who states in his study that this activity creates employment and brings in an income 3 to 5 times higher than the minimum wage in the country. This is like Kanyere [13] who found that the minimum earnings for most of them in a day is about 900 Congolese francs per day and the maximum is 20,000 Congolese francs, allowing them to meet their basic needs such as food, school fees, rent, hospital.

Comment [u30]: Replace line with support

While Kristina Roesel et Delia Grace [16] note that most vendors have chosen to place their stalls at the intersection of major roads to access the combination of commercial, residential and business properties and the high volumes of pedestrian and vehicle traffic at all hours.

Regulations and policies developed by the government would allow for safe practices, monitoring and formality of the sector. This would have contributed significantly to the national economy if well organised and channelled.

For their part, Makelele et al [12] add that the income of street food vendors is so low that the tax from government and other agencies will be a burden on them. In terms of tax and levy negotiations, street vendors have to bear many costs - both legitimate costs such as paying for permits or licenses; regular daily, weekly, monthly or annual payments to national or local authorities for their sites; payment for certain services such as storage space, use of water or sometimes even toilets, etc.

In addition, it was shown that 21% of respondents have good knowledge about food, 35% have average knowledge and 44% have poor knowledge. However FAO [3], stresses the facts that food handlers should have the knowledge and skills to do so hygienically and that consumer education is necessary. They noted that the majority of street food operators engage in this activity without prior knowledge of food handling, preparation, storage and preservation, which is a potential risk to consumers and is of urgent public health concern. It would therefore be desirable for the services concerned to train and inform these vendors in order to improve the quality of the service provided. However, [table 7](#) shows that 76% of vendors have not been trained in this area, and there is no structure in this sector.

Comment [u31]: Table to replace table.

With regard to the results recorded on the degree of hygiene of foodstuffs and the environment and on the quality of water used for cleaning dishes and cooking, 59% of respondents use well water, which could be the cause of food-borne diseases, 45% of respondents are clean, only 8% [with](#) protective clothing, 12% wash their hands regularly before serving customers, 26% have bins, 38% have rubbish disposal, 36% protect against bad smells and flies, 55% of utensils are clean, 49% have workstations.

Comment [u32]: Replace 'with' to 'use'

Monica F. [17] emphasises, in the same vein, that those responsible for food establishments must ensure that foodstuffs are not adversely affected by micro-organisms, residues, contamination or other causes, and that utensils are not damaged.

Comment [u33]: Delete F.

According to Otsmane, this practice is illegal with adverse effects on consumers, deterioration of product quality because exposure to sunlight that transforms the chemicals to bins that carry the juice, dairy products are not regularly washed, which exposes consumers to foodborne illnesses.

This result is shared by Navereau B. and Espinasse P. [20], who critically analyse food safety in Africa in their study. According to them, foodborne diseases are a public health problem. Every year people suffer from diseases caused by contaminated food. Lack of hygiene affects the exposure of street foods. The risk of food poisoning remains a major health problem for the population.

Comment [u34]: Delete B and P used i the citation

Comment [u35]: Delete letter P

Comment [u36]: Delete small letter 'a'

In the associations' practical guide, it is noted that the handling, storage and preparation of foodstuffs requires great vigilance. It is out of the question to leave them on the floor or on tables, and it adds that training for people working in this field is necessary. Each of them must be aware of the principles of hygiene.

Comment [u37]: Replace 'for' with of

Comment [u38]: Delete letter A.

These results corroborate those of Traoré A. [18], who states that the dysfunctions and inadequacies at the level of the administrations concerned are due to the behaviour and attitudes of the population in the management of public hygiene. Furthermore, awareness of the relationship between human activities, the environment and health remains an objective to be achieved. In reality, it is necessary to take into account the involvement of the population in hygiene management programmes.

Comment [u39]: Delete letter J

According to Appiah J. [19], food can transmit diseases from person to person but also serve as a medium for the growth of certain bacteria (both on the surface and inside the food) that can cause food poisoning. Unattended food can spread disease. From the moment of production to the moment of consumption, food is constantly exposed to possible contamination, both by natural agents and by human intervention.

The consequences of poor hygiene management of foodstuffs and the market environment expose consumers to illnesses and food poisoning such as cholera, diarrhoea, coughing, vomiting and many others. It was mentioned that personal hygiene can contaminate foodstuffs, and anything can be transferred to food through the handling of hands. The diseases raise both food safety and occupational hygiene issues, which can only be resolved by improving sanitary conditions in the markets.

Comment [u40]: Correct the sentence to : 'poor personal hygiene can lead to the contamination of foodstuffs'

CONCLUSION

The principal aim of this study was to assess the level of hygiene on food sold on Nyamwisi Boulevard in Beni, DR Congo.

Comment [u41]: Delete this sentence.

As a result, it was observed that the level of hygiene of the food sold on Nyamwisi Boulevard remains a concern with regard to elements such as 59% use well water, which could be the basis of food-borne diseases, 45% of the respondents are clean, only 8% with protective clothing, 12% wash their hands regularly before serving customers, 26% have dustbins, presence of rubbish at 38%; 36% protect against breath and flies, 55% of utensils are clean, 49% have workstations.

In conclusion, we believe that the hygiene of food sold on Nyamwisi Boulevard in Beni is not strictly observed and that consumers, characterised by proven ignorance, continue to buy and consume food sold in disregard of the rules of hygiene at the market, thus exposing themselves to diseases linked to the lack of hygiene. However, one of the specific issues that actors (state structures and traders) are concerned with is financial resources. Food hygiene measures are not taken into account by them.

As poor hygiene at the market not only affects the food, but can also impact on consumer health safety, we suggest

1) To the municipal authorities

- to scrupulously enforce the rules of food hygiene at the market;
- to build stalls to be made available to sellers;
- to create a permanent monitoring and control service for food hygiene measures at the market.

2) For sellers

- to carefully respect the hygiene rules laid down by the market authorities;
- to sell food on clean stalls
- to regularly ensure the sanitation and healthiness of the market.

3) To consumers

- not to buy and consume food sold in the open air, without clean stalls;
- to apply hygiene to food sold in the market before consumption.

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Comment [u42]: This lengthy discussion should have been written under the discussion. Take it to the discussion part.

Comment [u43]: Replace 'we believe that' with : This study reveals that.....

Comment [u44]: These are recommendations of the authors. If so, then state it clearly with a heading after the Conclusion.

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