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Street food as potential sources of covid-19 disease propagation in central and West Africa: A short review

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Abstract

In December 2019, a local pneumonia outbreak of initially unknown cause was detected in Wuhan (Hubei, China) and was quickly determined to be caused by a novel coronavirus, named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). This pandemic spread very quickly around the world and has begun its proliferation in Africa. Respect of hygienic rules is one of the best preventive methods. This study explored street ready to eat foods as potential vehicle of human contamination with SARSCoV-2. For this, a bibliographic search was carried out from March 15 to December 7, 2020. From the results, it is well known that the transmission of the coronavirus by direct digestive route is ruled out for now. However, some studies are trying to demonstrate gastrointestinal manifestations and potential fecal-oral transmission of the virus. So ready to eat foods such as fruits and vegetables, bread, chips, donut, *gari*, snacks, homemade yogurt, cake, fried yam, roasted products, *kilichi*, ... etc. should get particular attention due to potential risk of contamination by manipulators during conditioning and packaging, to prevent the proliferation of the virus. It then becomes urgent to engage the population's attention concerning what and where they eat.

Keywords: SARSCoV-2; Covid-19 diseases; Pandemic; Street foods; Africa

1. Introduction

The current outbreak of the novel coronavirus SARSCoV-2 (coronavirus disease 2019; previously 2019- nCoV), epicentred in Hubei Province of the People's Republic of China, has spread to many other countries. On January 30, 2020, the WHO Emergency Committee declared a global health emergency based on growing case notification rates in China and international locations [1]. Although the outbreak is likely to have started from a zoonotic transmission event associated with a large seafood market that also traded in live wild animals, it soon became clear that efficient person-to-person transmission was also occurring [2]. According to Nature, the spread of coronavirus disease 2019 (COVID-19) is becoming unstoppable and has already reached the necessary epidemiological criteria for it to be declared a pandemic, having infected more than 100 000 people in 100 countries [3]. At a press conference in Geneva on March 2020, the Director-General of WHO, Tedros Adhanom Ghebreyesus, warned: "The best advice to give to Africa is to

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prepare for the worst and to prepare today. To a question of a Rwandan journalist, the head of the WHO said that while the incidence of the disease is low, the African continent should "prepare for the worst."

Initially spared, the virus now spreads across the African continent. Poverty, inequality, difficulties in accessing basic infrastructure and means of payment, the abundant use of cash in transactions, collective catering and in particular street food are likely to increase the speed of virus spread in this continent [4].

Most street foods are ready-to-eat foods prepared and commercialized in streets and/or in similar public places. Due to its low cost and convenience, street food is consumed each day by thousands of people in Africa [5]. They differ greatly from one country or culture to another. Street foods provide a source of readily available, inexpensive and nutritional meals, while providing a source of income for sellers [6].

Sellers often use stands and carts that are of crude and inefficient construction, running water not easily accessible, and hand and dish washing performed in the same bucket, sometimes without soap. Wastewater is usually discarded in streets, and garbage is discarded nearby, providing attraction, food and harborage for insects and rodents. In many cases, toilets are not available, thus forcing sellers to eliminate their body wastes in nearby areas and to return to their shop sites without washing hands [7].

2. Methodology

TA bibliographic search was carried out from March 15 to April 7, 2020. The following terms were particularly searched, always in combination with "SARS-CoV-2", "corona virus", "COVID 19", "mechanism of infection", "surfaces" and "oral infection". We also looked for the term "street food" in combination with "Africa", "typology", "ready to eat", "microbiological quality". With regard to "SARS-CoV-2", only articles published between December 2019 and December 2020 were considered. In relation to street foods, research was extended to 1993, since several types of considered food have been little studied.

3. Results and discussion

3.1. Description of SARS-COV-2

SARS-CoV-2 is a coronavirus and belongs to the β-coronavirus cluster. COVID-19 is the third known zoonotic coronavirus disease after SARS and the Middle East respiratory syndrome (MERS). SARS-CoV-2 is a coronavirus and belongs to the β-coronavirus luster [8]. COVID-19 is the third known zoonotic coronavirus disease after severe acute respiratory syndrome coronavirus (SARS) and the Middle East respiratory syndrome (MERS). Zhu et al. [9] confirmed that SARS-CoV-2 was a new β-coronavirus belonging to the subgenus botulinum of Coronaviridae. According to the current data, the early COVID-19 cases were related to the Huanan seafood market. The WHO report claimed that the SARS-CoV-2 could be detected in the environmental samples collected from the seafood market [10].

3.2. Infection mechanism of SARSCoV-2and possibility of fecal-oral transmission

3.2.1. Infection mechanism of SARSCoV-2

Zhao *et al.* [11] found that angiotensin-converting enzyme 2 (ACE2) was the receptor for SARS-CoV-2. In the normal human lung, ACE2 is expressed on type I and II alveolar epithelial cells. Among them, 83 % of the type II alveolar cells have ACE2 expression. The binding of SARS-CoV-2 on ACE2 causes an elevated expression of ACE2, which can lead to damages on alveolar cells. Damages to alveolar cells can, in turn, trigger a series of systemic reactions and even death. Wrapp *et al.* [12] found that the receptor-binding ability of SARS-CoV-2 is 10 to 20 times stronger than that of SARS-CoV.

3.2.2. Hypothesis on fecal-oral transmission

It has been sufficiently demonstrated that transmission of the corona virus occurs from human to human from the droplets and postlets of infected persons and to date oral transmission is excluded. Nevertheless, a close relationship with infected animals and consumption of food contaminated with biological fluids from individuals carrying the virus could be possible sources of contamination [13-14]. According to Gu et al. [15], fecal–oral transmission would be plausible. Indeed, amounting evidence from former studies of SARS indicated that the gastrointestinal tract (intestine) tropism of SARS coronavirus (SARS-CoV) was verified by the viral detection in biopsy specimens and stool even in discharged patients, which may partially provide explanations for the gastrointestinal symptoms, potential recurrence

and transmission of SARS from persistently shedding human as well [16-17]. Moreover, the presence of the virus has already been revealed in the feces and urine samples of bats, as well as in the stool of a small proportion of patients suffering from corona virus and SARS-CoV-2 [18]. Under these conditions, improper handling, storage and preparation of food could facilitate this type of contamination, especially for food that no longer undergoes any heat treatment before consumption because it is well known that the virus is rapidly inactivated in the range high temperatures (50 ° C) [8, 9, 19, 20, 21, 22, 23]. Studies in China have shown that the spread of the virus has probably been facilitated by the preparation and consumption of bat sauce [24, 25, 15]. It is therefore highly desirable that future studies examine this possibility of contamination.

3.3. Defining street foods

Street foods are most commonly sold in low- and middle-income countries and the types of commercialized food vary according to socio-economic status of consumers and the food cultural habit of local people [26]. The Food and Agricultural Organization (FAO) of the United Nations defines street foods as ready-to-eat foods and beverages prepared and/or sold in streets and other similar public places [27]. In this study, we focused on ready-to-eat foods, because of the high risk they represent, since they do not undergo any culinary treatment before their consumption.

3.4. Evidence on microbiological characteristics of street food in Africa

It is recognized that street food sellers are often poor, uneducated and without knowledge on food handling. Consequently, street foods are perceived to be a major public health risk. The major problem relates to the health safety of these foods, but we can also point out other difficulties, such as those related to sanitation (accumulation of waste in the streets and congestion of sewers). The risk of serious food poisoning associated with street food remains a threat in many countries of the continent where microbiological contamination is one of the major problems. In 1993, the World Health Organization (WHO) undertook a survey in over 100 countries to assess the situation with regard to street food. The survey noted that most countries reported contamination of food (from raw food, infected handlers and inadequately cleaned equipment) and time and temperature appeared to be the major factors contributing to food-borne disease. This was partially due to the fact that infrastructure development was relatively limited, with restricted access to potable water, toilets, refrigeration, washing and waste-disposal facilities. Moreover, registration, training and medical examinations were not among the selected management strategies [28].

The presence of selected foodborne pathogens in street food samples as well as the presence of nonpathogenic *E. coli* (in food and water samples) was also tested in Johannesburg, South Africa. A mean Enterobacteriaceae counts value of 2.0 (60.4) log CFU/g for food samples and mean coliform counts values of 2.5 (60.3) log CFU/ml and 1.3 (60.3) log CFU/25 cm^2 for water and swab samples respectively, were determined. Mean PC values of 1.6 (60.1) log CFU/g, 1.9 (60.6) log CFU/ml, and 1.4 (60.4) log CFU/25 cm^2 were determined for food, water and swab samples, respectively. *Bacillus cereus* was detected in 22%, *Clostridium perfringens* in 16%, Salmonella spp in 2%, and *E. coli* (non- O157:H1) in 2% of the 51 food samples. *E. coli* was found in 14 water samples (78%) and in 3 food samples (6%). Campylobacter spp., *Listeria monocytogenes*, *Staphylococcus aureus*, *Vibrio cholerae*, and *Yersinia enterocolitica* were also tested for in the food samples, but they were not detected [29-30]. Food-borne outbreaks caused by hepatitis A virus are mainly associated with bivalve mollusks, product (soft fruits and leafy greens) and ready-to-eat meals [31].

Dègnon, *et al.* [7] evaluated the hygienic quality of salad dishes sold in Cotonou (Benin). The results revealed thirteen (13) types of salad dishes. None of the thirty (30) samples analyzed met the microbiological criteria. Table 1 below describes some ready to eat local foods from Africa, potential vectors of SARSCoV-2.

More recently, Asiegbu *et al.* [32] have come to the conclusion that the microbial quality and safety of ready-to-eat sold in the Johannesburg Metropolis remain a serious public health concern. Indeed, studying hygienic quality of street food sold in Johannesburg Metropolis (South Africa), their result showed that of the 205 ready-to-eat street-vended foods samples, 85.37% had aerobic growth. The vast majority (78.18%) of the 110 ready-to-eat SVF samples had Enterobacteriaceae growth. And the prevalence rates of *L. monocytogenes*, *S. aureus*, Salmonella spp., and *E. coli* O15:H7 were 46.36, 31.8, 21.8, and 1.8%, respectively.

In short, these studies reveal that the conditions of processing and marketing of street food do not guarantee their good hygienic quality.

According to Baba-Moussa *et al.* [33] the environment plays a crucial role in the contamination process. Indeed, the stands and improvised structures for the sale of these foods are located along the sidewalks which are the places of sale of its foods. The vendors share the sidewalk with many other street vendors who sell clothes, toys and other items. These facilities are not far from waste water points and garbage. After preparation, the food is placed on tables often on

the ground and briefly covered near busy streets and is no longer heated before being served. most of the time. We note during the monitoring of the sales operations that the itinerant and semi-fixed sellers do not have enough water for the dishes. In addition, the condition and nature of the packaging used is deplorable and consist of old paper, mold, unsuitable plastic bags, and cement bag papers.

The following photos present, for example, the conditions for processing braised meats at the edges of streets in Cotonou. We note that the mutton meats samples were stored in the open air around the streets (Pictures B, D and E), in an unhealthy environment (Pictures A, C and F). These conditions expose the samples to biological dangers (bacteria, organisms producing toxins, viruses, parasites, etc.).

Figure 1 Storage and marketing conditions for cotton or mutton (By Konfo, 2020)

3.5. SARSCoV-2 characteristics which could facilitate the contamination of street food

To determine the coronavirus lifetime in the air, researchers used a nebulizer, a device transforming liquid (droplets containing viral particles of Covid-19) into fine particles. These particles were then sprayed using an aerosol in the ambient air and on various surfaces, in order to reproduce saliva projections of a contaminated person who coughs or who sneezes. Results showed viable suspended particles of coronavirus in the air 3 hours after spraying. This means that coronavirus can remain viable and infectious for up to 3 hours in the air [34]. It is well known that "the transmission of the coronavirus by direct digestive route is ruled out" as stated by the National Agency for Food Safety (ANSES) in a press release in March 2020.

In addition, since contamination of an animal is unlikely, the possibility of direct transmission of the virus through food from a contaminated animal has been excluded by experts. In other words, the coronavirus cannot be transmitted by meat or fish, as soon as they are cooked and/or submitted to high temperature before consumption [35]. However, contamination of the packaging of these foods deserves to be taken seriously. According to Kampf *et al*. [23], human coronaviruses can remain infectious on inanimate surfaces for up to 9 days depending on the surface. However, gastrointestinal manifestations and potential fecal-oral transmission of the virus should be seriously considered [15]. Table 2 shows the lifetime of the virus on different surfaces.

Table 1 Some street foods for which special attention is required.

Countries	Incriminated street food	Brief description	Commonly used packaging forms	References
All Countries	Bread	Filled and fermented wheat flour	Plastic bag, paper, nothing	[36]
Benin	Corn bread	Filled and fermented maize flour	Plastic bag, paper, nothing	[37]
Benin, Cameroon, Congo, Tchad, Gabon	Snacks	Roasted maize	Plastic bag, paper, maize leaves	[37]
Benin, Cameroon, Congo, Tchad, Gabon	Snacks	Boiled maize	Plastic bag, paper, maize leaves	[37]
Benin	Snacks	Fried salty maize based flat cake in form of small balls.	Plastic bag, paper	[37]
Benin, Cameroon, Gabon	Snacks	Boiled or roasted maize and peanut grains	Plastic bag, paper	[37]
Benin	Snacks	Fried seasoned maize based flat cake in chain ball form	Plastic bag, paper	[37]
All countries	Snacks	Pop-corn	Plastic bag, paper	[37]
Benin	Snacks	*Fried maize based flat cake with red oil*	Plastic bag, paper	[37]
Benin	Snacks	Fried maize based flat cake with condiments	Plastic bag, paper	[37]
Benin	Snacks	Pre-cooked, dried and fried rice grain consumed with roasted peanuts	Plastic bag, paper	[37]
Benin	Snacks	Fried spiced maize based flat cake	Plastic bag, paper	[37]
Benin, Cameroon, Gabon	Snacks	Roasted maize flour puff-puff	Plastic bag, paper	[37]
Benin	*Andu*	Roasted maize flour balls	Plastic bag, paper	[37]
Benin	Akpan	Cereal-based yoghurt	Plastic bag and cups	[37]
All Countries	Home-made yogurt	Fermented milk	Plastic packaging and cups	[38]
Senegal, Benin, Cameroon, Tchad	Vegetable drink	Granulated cereals added to fermented milk	Plastic bag and cups	[39]
Benin ; Cameroon, Tchad	Cake	Cowpea donut (puff-puff)	Plastic bag, paper	[40]
All African countries	Wheat donut	Wheat donut (puff-puff)	Plastic bag, paper	[41]
Benin	Fried yam	Fried sliced yam	Plastic bag, paper	[42]
Cameroon	Fried or roasted plantain	Fried or roasted plantain	Plastic bag, paper	[43]
Benin	Wheat Chips	Wheat based snacks	Plastic bag, paper	[41]

Benin, Cameroon, Tchad	Peanut pancake	Partially defatted fried peanut sticks	Plastic bag, plastic buckets, paper	[44]
Benin, Cameroon, Gabon, Ivory Coast, Tchad	Snacks	Boiled peanut	Plastic bag, paper	[45]
Benin, Cameroon	Snacks	Roasted peanuts	Plastic bag, paper	[46]
Benin	*Concada*	Caramel coated peanut in the form of flat balls	Plastic bag, glass and paper	[47]
Benin, Cameroon	*Nougat*	Peanut and sugar candy	Plastic bag, glass and paper	[48]
Ivory Coast, Togo, Ghana, Nigeria, Benin, Cameroon	*Gari*	Granular cassava	Plastic bag	[49] [50]
Ivory Coast, Togo, Ghana, Nigeria, Benin, Cameroon	Pure water	Sachet-packed drinking water	Plastic bag	[51] [52]
All Countries	Fruits (dates, Orange, tangerine, Watermelons, banana, mango…)	Fruits (dates, Orange, tangerine, Watermelons, banana, mango…)	Plastic bag	[53]
Benin, Togo, Burkina, Cameroon	Fruit nectar	Boiled water and flavoured with fruit extracts	Plastic bag, plastic bottle	[54]
All Countries	Raw vegetables (lettuce, carrot …)	Salad, fruit salad	Plastic bowl, bag	[7]
Cameroon, Tchad, Niger	*Kilichi*	Spiced and dried meat	Plastic bag, paper	[55]
Cameroon, Tchad, Senegal, Ivory Coast, Gabon, Benin	Roasted meat and fish	Roasted meat and fish	Plastic bag, paper	[56]

Table 2 Lifetime of the coronavirus on different surfaces

Countries	**Type of packaging**	**Duration of virus survival (Hours)**	**References**
Canada, United States	Cardboard	24	[34]
Canada, United States	Steel can	48	[34]
France	Glass	120	[34]
United States	Plastic	48-72 216	[34], [57]
United States	Paper	5	[57]
	Wood	2	[57]

3.6. Precautions to limit the risks

To minimize the risks, it is advisable to wash hands after shopping and rinse fruits and vegetables with potable water. An infected person can contaminate food by preparing or handling it with dirty hands, or by exposing it to infectious droplets when coughing and sneezing. These are also basic hygiene rules that should be applied even outside an epidemic period. It is also important to steam vegetables and peel fruits and vegetables as a precaution. By analogy with other known coronaviruses, SARSCoV-2 seems sensitive to cooking temperatures. Thus, a heat treatment at 70° C for 4 min (temperature used in collective catering) makes it possible to divide by 10.000 the contamination risk of a food product [35]. In view of all of the above, it is highly recommended to avoid street food, especially ready-to-eat food during a pandemic.

4. Conclusion

The spread of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has already taken pandemic proportions, affecting over 100 countries in a matter of weeks. A global response to prepare health systems worldwide is imperative. Although containment measures in China have reduced new cases by more than 90%, this method cannot be fully applied in Africa where living conditions are more difficult. However, SARSCoV-2 is exponentially expanding in Africa and appropriate responses must be implemented. In this study, we focused on street food as a potential source of contamination of this virus in Central and West Africa. It appears that ready-to-eat foods as bread, donuts, cakes, pancakes, fruits, vegetables etc. and their packaging should be particularly avoided during the pandemic period to limit the effects of this virus.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors agree no conflict of interest.

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