Assessment of the knowledge of contamination-causing microorganisms in food and food products in Ilorin, Kwara State, Nigeria

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Abstract

The contamination of food and its products by microbial agents is a worldwide public-health concern. Many countries have documented significant increases in the incidence of diseases caused by microorganisms in food over the past few decades. This study focused on assessing the knowledge of the public on the microorganisms causing contamination in food and food products. Cross sectional study design was used in this study. The study population was members of the public in Ilorin, Kwara state, Nigeria. This was achieved by administering 223 structured questionnaire forms to willing members of the public in the Ilorin metropolis using stratified random sampling technique and undertaking desk reviews of responses. The result revealed that 67.7% of the respondents could not mention any food contaminants while 66.8% did not know anything about these contaminants while 95.5% only had superficial knowledge based on their response to questions about the subject matter. Male respondents and those above the age of 25 were adjudged to have more knowledge of microorganisms causing contamination in food while the knowledge of respondents with primary school certificate were lowest compared to those with other level of education. This strongly calls for an increase in public health education by all health professionals and the adoption of more innovative strategies for educating the public.

There is a need for more advocacies and social mobilization by the government and non-governmental organizations with renewed vigour in the enforcement of public health regulations to safeguard members of society.
Keywords; Microorganisms, Contamination, Food, Assessment, Knowledge.

Introduction

Food in general is defined as anything eaten or taken orally to the body which provides nutritional support and serves as a source of energy while food products are substances that can be used or prepared for use as food. Food may either be taken in its naturally presented form (e.g. milk, fruits and nuts) or used to prepare meals and dishes (e.g. eggs, meat and vegetables) while food products are either ready-to-eat/drink/heat-prepared/manufactured food (e.g. snacks, bread and prepared dishes etc) or food products used in making meals and dishes (e.g. butter, sugar, oil, salt etc).

Food contamination is the occurrence or introduction of contaminants (chemical or biological agents, foreign-matter, or other substances not intentionally added to food which may compromise food suitability or safety) in food or food environment. Chemical and foreign-matter contaminating food and food products include heavy metals (e.g. lead), pesticides (e.g.dichlorvos), organic pollutants (e.g. perfluorooctanic acid), organic compounds (e.g. formalin), hydrocarbons, cyanide, glass, stones etc. Different pathogenic microorganisms of public health importance have been reportedly isolated from food and food products, causing diseases like salmonellosis, colibacillosis etc. The consumption of food contaminated by microorganisms will result in food-borne illnesses which could be either toxic or infectious therefore foodborne illnesses are often caused by food associated with contamination (Shames, 2007, Bintsis, 2017, WHO, 2022).

Since the turn of the third millennium, there has been an increase in the number, severity, and size of food and food products that pose a great risk of illness or death (Dyckman & Lansburgh, 2004; Ollinger & Ballenger, 2003, Gizaw, 2019, FAO, 2019, UN, 2022). It has been estimated that up to one-third of the population of developed countries is affected by food-borne illnesses each year while in developing countries an estimated 2.2 million people die annually as a result of diarrhoea diseases mostly attributed to contaminated food or water (Mensah *et al*. 2002, CDC, 2022a). More than 250 known diseases are said to be transmitted through food (Bryan, 1982; Mead *et al*. 1999, WHO,

2022), CDC, 2022b). In the United States, compiled and analysed information from multiple surveillance systems and other sources estimated that diseases caused by food contamination and known microorganisms result in up to 8 to 14 million illnesses, 325,000 hospitalizations, and 9000 deaths each year (Bennett *et al*., 1987; Todd, 1989; Archer and Kuenberg, 1995, Dewey-Mattia, 2018).

Many microorganisms cause contamination and food-borne illnesses (Lebelo *et al*., 2021, Sorbo *et al*. 2022, WHO, 2022). This disease-causing-microorganism include *E. coli*, *Salmonella*, (FDA, 2008, Gargiulo, 2022), *Clostridium botulism, Shigella* spp., hepatitis A virus, *Cryptosporidium* spp. (De Roever. 1999). Others are *Staphylococcus aureus, Bacillus cereus, Giardia lamblia*, (Bean and Griffin, 1990; CDC, 1996, WHO, 2022), *Campylobacter jejuni, Clostridium perfrigens, Mycobacterium tuberculosis, Brucella abortus, Listeria* spp. (De Roever. 1999), *Klebsiella pneumonia, Enterobacter* spp., *Proteus* spp., *Aspergillus* spp., *Penicillium* spp., *Saccharomyces* spp., *Torulopsis* spp. (Snowdon and Cliver, 1996, Wang *et al*., 2022). *Vibrio cholera, Entamoeba hystolytica, Ascaris lumbricoides, Trichuris* spp. (Angelillo *et al*, 2000; Idowu, 2000, Osafo *et al*., 2022).

Considering the public health importance of microorganisms that contaminate food, there is a need for the public to be knowledgeable about them to make informed decisions about food intake, their health and safety (Karadon and Sahin, 2010, Tropea, 2022). It has been established that individuals' perception of microorganisms is connected to their knowledge of hygiene which ultimately affects personal and social health. There is a need therefore, to educate the public on microorganisms causing contamination in food and food products (Jevsnik *et al*., Karadon and Sahin, 2010, Lorenzo, 2018) thereby improving food safety in society (Bryan, 1991, Onyeaka *et al*., 2021).

Purpose of the Study

The objective of this study is to assess the knowledge of members of the public within Ilorin metropolis on microorganisms causing contamination in food and food products.

Research Questions

i. Do members of the public within Ilorin metropolis have knowledge of microorganisms causing contamination in food and food products?

ii. Is there significant difference in the male and female respondents' knowledge of microorganism causing contamination in food and food products?

iii. Is there significant difference in the knowledge of microorganisms causing contamination in food and food products on the basis of respondents' age?

iv. Is there significant difference in the knowledge of microorganism causing contamination in food and food products based on the educational level of the respondents?

Methodology

Research design used for the study is cross-sectional design which was used to determine the relationship between the knowledge of contamination causing microorganism sex, age and level of education. The study population consisted of members of the public in Ilorin, Kwara State, Nigeria. Ilorin is the capital city of Kwara State in Western Nigeria, it is located between latitude 8.5373° N and longitude 4.5444° E. It has an average daily temperature of 25.6^0C and average rainfall of 7.6mm. The sample size was calculated using the formula by Mahajan (Mahajan, 1997).

$$\mathrm{n} = \frac{Z^2 pq}{d^2}$$

Where, n = sample size, p = prevalence of 15%, q = 1 – p, Z = appropriate value for the standard normal deviation for the desired confidence = 1.96 and d = allowable error; 5 %

$$n = \frac{1.96^2 \times 0.15(1-0.15)}{(0.05)^2} = 196$$

This represents the minimum sample size to be used. However, a total of 223 respondents were engaged for the study using a stratified random sampling technique and undertaking desk reviews of responses. A well-structured self-administrable questionnaire designed with questions that required 'Yes' or 'No' answers was used to obtain information from members of the public in and around Ilorin, Kwara State, Nigeria about the possibility of food contamination, awareness of the existence of microorganisms causing contamination in food, names of the microorganisms and sources of information, and education about these microorganisms. In addition, other questions related to the demographic characteristics of respondents e.g., level of education, gender, and age were

asked. Initial content and construct validity of the instrument of the research was done by administering it to representative respondents of 25 to determine the suitability and appropriateness of the questionnaire and its content. Sampling for the study (n=223) was done in eleven locations in the town and administered using stratified random sampling. Each of the 11 locations was stratified into two, based on the perceived level of education of members of the communities. Twenty and 21 questionnaires were administered in eight (10 from each stratum) and three (10 and 11 from each stratum) locations respectively. Responses from respondents were entered into and analysed using Microsoft Excel 2016 lnk®. Results were presented using tables and percentages.

Result

Table 1: Demographic data of Respondents to the knowledge of food-contaminating Microorganisms

Matrix	**Number (%)**
Sex	
Male	142 (63.7)
Female	81 (36.3)
Age	
≤25	92 (41.3)
>25	131(58.7)
Educational level	
Primary School	23 (10.3)
Secondary School	87 (39)
Diploma	53 (23.8)
First Degree	49 (22)
Second degree	11 (4.9)

The table 1 above reveals that most of the respondents (63.7%) were male. The average age of respondents was 37.98 (SD 11.16). The educational level of most of the respondents was secondary school leaving certificate (39%), diploma (23.8%), and first degree (22%), while 10.3% and 4.9% have a primary school leaving certificate and second degree and above respectively.

Research Question One: Do members of the public within Ilorin metropolis have knowledge of microorganisms causing contamination in food and food products?

Table 2: Respondents' response to knowledge of food-contaminating microorganisms

S/N	Question	Response	
		Yes (%)	No (%)
1	Are you aware of the possibility of food contamination by microorganisms?	210 (94.2)	13 (5.8)
2	Do you have knowledge of food-contaminating microorganisms?	149 (66.8)	74 (33.2)
3	Can you name any food-contaminating microorganism?	72 (32.2)	151 (67.7)
4	Do you have in-depth knowledge of food-contamination-causing organisms?	10 (4.5)	213 (95.5)

Table 2 above reveals that of the 223 respondents, 94.2% (n=210) were aware of the existence of contaminants that affect food. 66.8% (n=149) claimed they did not know about microorganisms causing food and food products' contamination while 33.2% (n=74) had some form of knowledge about them. 67.7% (n=151) did not know any microorganism by name while 32.3% (n=72) could mention some microorganisms by name. Out of the 32.3% that knew microorganisms by name, 27.4% (n=61) could name only one microorganism while only 4.9% (n=11) could name up to two microorganisms. The majority of the respondents 95.5% (n=213) claimed to have a superficial knowledge of contamination-causing microorganisms only 4.5% (n=10) had in-depth knowledge.

Research Question Two: Is there significant difference in the male and female respondents' knowledge of microorganism causing contamination in food and food products?

Table 3: Respondents' response to knowledge of food-contaminating microorganisms based on gender

S/N	Question	Response			
		Sex			
		Male		Female	
		Yes (%)	No (%)	Yes (%)	No (%)
1	Are you aware of the possibility of food contamination by microorganisms?	139 (62.3)	3 (1.4)	71 (31.8)	10 (4.5)

2	Do you have knowledge of food-contaminating microorganisms?	99 (44.4)	43 (19.3)	50 (22.4)	31 (13.9)
3	Can you name any food-contaminating microorganism?	49 (22)	93 (41.7)	23 (10.3)	58 (26.0)
4	Do you have in-depth knowledge of food-contamination-causing organisms?	31 (13.9)	111 (49.8)	4 (1.8)	77 (34.5)

In table 3 above, more male respondents (62.3%, 44.4%, 22% and 13.9%) indicated they had better knowledge of contamination causing microorganism compared to female respondents (31.8%, 22.4%, 10.3% and 1.8% respectively). The proportion of female respondents (13.9%, 26% and 34.5%) that had less knowledge about contamination causing microorganisms were more than that of the male respondents (19.3%, 41.7% and 49.8% respectively). Although 4.5% female respondents initially indicated they were aware of the possibility of food contamination causing by microorganism compared to male respondents (14%).

Research Question Three: Is there significant difference in the knowledge of microorganisms causing contamination in food and food products on the basis of respondents' age?

Table 4: Respondents' response to knowledge of food-contaminating microorganisms based on age

		Response			
		Age (Years)			
		≤25		**>25**	
S/N	**Question**	**Yes (%)**	**No (%)**	**Yes (%)**	**No (%)**
1	Are you aware of the possibility of food contamination by microorganisms?	87 (39)	5 (2.2)	123 (55.2)	8 (3.6)
2	Do you have knowledge of food-contaminating microorganisms?	67 (30)	25 (11.2)	82 (36.8)	49 (22.0)
3	Can you name any food-contaminating microorganism?	21 (9.4)	71 (31.8)	51 (22.9)	80 (35.9)
4	Do you have in-depth knowledge of food-contamination-causing organisms?	4 (1.8)	88 (39.5)	6 (2.7)	125 (56.0)

In table 4 above, respondents that were above 25 years had higher knowledge of contamination-causing microorganisms (55.2%, 36.8%, 22.9% and 2.7%) compared to those that were 25 years and below (39%, 30%, 94% and 1.8% respectively). The

proportion of respondents that were over 25 years of age that could not name any food contaminating microorganism (35.9%) and that did not have in-depth knowledge of food-contamination-causing organisms (56%) were also higher than that of respondents that were 25 years and below (31.8% and 39.5% respectively).

Research Question Four: Is there significant difference in the knowledge of microorganism causing contamination in food and food products based on the educational level of the respondents?

Table 5: Respondents' response to knowledge of food-contaminating microorganisms based on Educational level

		Response									
		Educational level									
		Primary school		Secondary school		Diploma		First degree		Second degree	
S/N	Question	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)
1	Are you aware of the possibility of food contamination by microorganisms?	19 (8.5)	4 (1.8)	84 (37.7)	3 (1.3)	50 (22.4)	3 (1.3)	47 (21.1)	2 (0.9)	10 (4.5)	1 (0.5)
2	Do you have knowledge of food-contaminating microorganisms?	5 (2.2)	18 (8.1)	55 (24.7)	32 (14.4)	38 (17.1)	15 (6.7)	42 (18.8)	7 (3.1)	9 (4.0)	2 (0.9)
3	Can you name any food-contaminating microorganism?	5 (2.2)	18 (8.1)	21 (9.4)	66 (29.6)	11 (4.9)	42 (18.8)	27 (12.1)	22 (9.9)	8 (3.6)	3 (1.4)
4	Do you have in-depth knowledge of food-contamination-causing organisms?	0 (0)	23 (10.3)	1 (0.4)	86 (38.6)	2 (0.9)	51 (22.9)	4 (1.8)	45 (20.2)	3 (1.3)	8 (3.6)

The knowledge of contamination causing microorganisms in food and food products was lowest in respondents that possessed primary school certificate (8.5%, 2.2%, 2.2% and 0%) compared to respondents that had secondary school certificate (37.7%, 24.7%, 9.4% and 0.4%), diploma certificate (22.4%, 17.1%, 4.9% and 0.9%), first degree education (21.1%, 18.8%, 12.1% and 1.8%) and respondents with second degree (4.5%, 4.0%, 3.6% and 1.3%) respectively. The proportion of respondents that were aware of the possibility of food contamination causing microorganisms among second degree holders (4.5%) was however lower than that of primary school holders (8.5%) (Table 5)

Table 6: Respondents' sources of information about food-contaminating microorganisms

S/N	Source of information on contamination causing microorganisms	Number/%
1	Previous educational background	26 (11.7)
2	Electronic/Print/Social-media	54 (24.2)
3	I can't remember how I got the information	21 (9.4)
4	I don't have any information/knowledge of contamination-causing microorganism	143 (64.1)

In the table 6 above the primary sources of health information indicated by most respondents were previous educational background (11.7%), electronic/print or social media (24.2%), and (9.4%) did not remember how they got their information while 64.1% indicated they did not have any source through which they receive education about microorganisms.

Discussion of findings

This study revealed that most of the members of the public in the study area had poor knowledge of microorganisms that cause food contamination even though they claimed to know. Although many were aware of the existence of these contaminants, they did not know their names and properties, and they were also not able to link them with any food-borne disease. This is in agreement with Walker et al. who reported 93% of respondents had awareness of the possibility of food contamination by microorganisms with limited knowledge of the contaminants (Walker et al., 2003) and Karadon and Sahin, 2010, who reported that more than half of the respondents, could not name microorganisms or link them with disease (Karadon and Sahin, 2010).

Moreover, Male respondents in this study had better knowledge of food contamination by microorganisms compared to female respondents. The reason for the higher level of knowledge by male respondents in the study area may be the higher level of activity of the male gender compared to females. The higher level of activity may have endeared and exposed male respondents to more knowledge.

Furthermore, it was shown that respondents that were above 25 years of age had better knowledge of food contamination causing microorganisms compared to respondents

that were 25 years and below in this study may be due to higher level of exposure due to more life experiences because they were the older group of respondents.

In addition, the reasons respondents with educational levels higher than primary school certificate in this study had better knowledge of food contamination causing microorganisms may be the higher level of learning in schools by respondents with secondary, diploma, first and second degrees who would have spent more years learning and studying to earn higher certificates, degrees and formal knowledge.

It was also shown that most respondents in this study claimed they don't have any information/knowledge of contamination-causing microorganisms that can affect food and do not know any source of such education while only a few respondents indicated that electronic, print, or social media and previous educational background were places they learned about microorganism-causing food contamination. This is in agreement with the findings of Karadon and Sahin who reported that the media, advertisements, cartoons, television programs, etc. have important roles in informing people about microorganisms (Karadon and Sahin, 2010).

The general low level of knowledge of microorganisms causing contaminants in food and food products could be due to members of the public's lack of interest in such aspects of health education and their negative attitude towards it (FAO, 2004, Vloreen, et al., 2014). The superficial knowledge of the respondents in the study area could also be due to inadequate awareness and low publicity of the activities of health educators and public health professionals (Shojaei et al., 2022). The government's lack of interest in such a form of education, the government's unwillingness to commit resources to this course, and the absence of the political will to implement proposed and recommended policies could be contributing factors (IMF, 2004, Leicht et al., 2018).

Conclusion

The knowledge of microorganisms causing food contamination, illnesses, and death may as well start from knowing their names and other basic properties. This basic understanding will help to evolve ways to prevent food contamination and avoid the consumption of contaminated food and food products. Although a good number of people claimed they have general and in-depth knowledge of microorganisms that cause

contamination and spoilage in food and food products, fewer number have specific knowledge about the organisms which includes the names of such organisms.

Recommendations

Based on the findings of the study, the following recommendations were made:

i. There is a need, therefore, to educate the public on the basic characteristics and mode of transmission/contamination of these organisms including the process of disease causation and type/sign of disease.
ii. More attention could be given to female members of the public, youth 25 years and below and those with lower levels of education in the conception, design and execution of the public health education strategies to be implemented.
iii. Although there are several sources from which information and knowledge of these microorganisms could be obtained. There is a need to come up with other means and channels which could be more efficient through which the public can be given this education.
iv. Already identified means/sources of education like schools, television, radio, advertisement, cartoons, home training by parents, etc. could be explored for better results.
v. Health educators through research could come up with tested methods, strategies, and policies that will produce optimal results compared to what is presently obtainable.

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