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FOOD SAFETY KNOWLEDGE AND PRACTICES OF FOOD HANDLERS AT A PUBLIC SUDANESE UNIVERSITY

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KEY WORDS:

food safety, knowledge, practices, food handlers

ABSTRACT

The study was conducted to evaluate food safety knowledge and practices of food handlers in twenty-four food premises at nine campuses of Sudan University of Science and Technology (SUST), Khartoum State, Sudan. A structured questionnaire about demographic characteristics, food safety knowledge and practices of one hundred and five respondents was used. Data showed that 95.2% of respondents were Sudanese; 99% were males, the majority were singles, 43.8% were university graduates, 64.8% were in the age group 20–30 years, 100% had good knowledge regarding the importance of maintaining a clean environment in food premises, preparing food in a safe way, danger of food poisoning and 95.4% agreed that it is their responsibility to prevent food poisoning. Food handlers had in general satisfactory practices of personal hygiene; however, 64.8 to 69.5% had some poor practices, particularly not wearing clean aprons, masks, gloves and hair nets. Among the respondents 68.6% received basic training in food safety. The study suggests that mandatory food safety education and training should be organized to strengthen food handlers' knowledge, attitudes and practices in food safety areas which are either weak or lacking. The HACCP system should be implemented in food premises at the university campuses.

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ЗНАНИЯ И ПРАКТИКИ БЕЗОПАСНОСТИ ПИЩЕВОЙ ПРОДУКЦИИ ПРОИЗВОДСТВЕННОГО ПЕРСОНАЛА В ГОСУДАРСТВЕННОМ СУДАНСКОМ УНИВЕРСИТЕТЕ

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КЛЮЧЕВЫЕ СЛОВА: АННОТАЦИЯ

безопасность пищевой продукции, знания, практики, производственный персонал

Проведено исследование для оценки знаний и практик производственного персонала в отношении безопасности пищевой продукции в 24 помещениях для обработки пищевых продуктов в 9 кампусах Суданского университета науки и технологии (SUST), в штате Хартум, Судан. Был использован структурированный вопросник о демографических характеристиках, знаниях и практиках в отношении безопасности пищевой продукции 105 респондентов. Данные показали, что 95,2% респондентов были суданцами; 99% были мужского пола, большинство были одиночками, 43,8% были выпускниками университетов, 64,8% были в возрастной группе 20–30 лет, 100% обладали хорошими знаниями относительно важности поддержания чистой окружающей среды в помещениях для обработки пищевых продуктов, безопасного приготовления пищи, опасности пищевых отравлений, и 95,4% согласились с утверждением, что предотвращение пищевых отравлений является их ответственностью. Производственный персонал в целом имел удовлетворительные практики личной гигиены; однако, у 64,8–69,5% отмечены некоторые неудовлетворительные практики, в частности, отсутствие чистых фартуков, масок, перчаток и сеток для волос. Среди респондентов, 68,6% прошли базовое обучение по безопасности пищевой продукции. Данное исследование говорит о том, что необходимо организовать обязательное образование и обучение в отношении безопасности пищевой продукции для улучшения знаний, отношений и практик в области безопасности пищевой продукции, которые являются слабыми или отсутствуют. В помещениях для обработки пищевых продуктов должна быть внедрена система HACCP.

1. Introduction

Food safety is a public health issue of increasing importance. The growing problem of diseases caused by eating unhealthy food is very dangerous, not only for the general public but also for school and university students, which is more alarming. Several authorities worldwide have made great efforts in the field of food safety and related health issues. However, there are still many issues of food safety to be addressed, particularly in developing countries. Food safety is defined as “assurance that food will not cause harm to the consumer when it is prepared and/or eaten according to its intended use” [1]. According to the WHO definition, foodborne diseases are “diseases, usually either infectious or toxic in nature, caused by agents that enter the body through the ingestion of food” [2]. Everyone

is at risk of contracting food borne diseases, but a level of risk may vary and people with a higher risk of foodborne diseases are those who have no or very low knowledge of food safety.

Studies have shown that knowledge of food safety is socially, demographically, and academically related and increases with age [3]. Monitoring food safety knowledge and practices among males and females showed that women had higher level of correct practices than males, and in terms of knowledge, males and females were at the same level [4]. Evans et al. [5] evaluated awareness and attitudes of student dietitians from three international universities (Columbus, OH, USA, Cardiff, Wales, UK and Beirut, Lebanon) towards food safety and found that students lacked awareness of key food safety concepts. Stratev et al. showed that undergraduate stu-

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dents had incomplete knowledge and inappropriate practices regarding healthy food handling, which suggests that they were at greater risk of food poisoning and contracting foodborne diseases [6]. Al-Shabib et al. [7] studied food safety knowledge, attitudes and practices (KAP) of male food handlers in restaurants of King Saud University, Saudi Arabia, and concluded that their level of knowledge, attitude and practice was satisfactory with the exception of some aspects related to hygiene and time and temperature control, and recommended organization of continuous education and training to strengthen food handlers' knowledge. Results of a study of food safety knowledge of foodservice workers at a university campus in Trinidad and Tobago [8] showed that regardless of the education level, the employees' performance in the survey was less than satisfactory and is a cause for concern. Although, two thirds of foodservice employees received basic training in food safety, there was no significant difference of the mean knowledge scores between those who received basic food safety training and those who did not. Lee et al. [9] assessed KAP of food handlers in a university located in Kuala Lumpur and concluded that the food handlers had adequate food safety knowledge, but perceived knowledge failed to be translated into practices at work. Aklilu et al. [10] revealed a high prevalence of intestinal parasites among food handlers of the student's cafeteria in Addis Ababa University suggesting that they could contaminate food and be a source of infection to consumers via the food chain. A study of food handlers in a Malaysian public university found that they lacked knowledge about time and temperature control and cross-contamination [11]. Osaili et al. [12] showed that foodservice staff at the universities in Jordan had very poor knowledge on the fundamental information of the HACCP system and recommended consistent training of foodservice staff and effective implementation of the HACCP system to reduce the risk of food poisoning in foodservice establishments at the universities in Jordan.

Several studies were conducted in Sudan on food safety in street foods and food handlers [13,14], hospital food handlers [15,16], and Abattoir workers [17]. However, to our knowledge, there is no published research on food safety knowledge, attitudes and practices of food handlers in Sudanese higher education institutions. Foodborne illnesses, resulting from contaminated foods and drinks are known to adversely affect students' health status, may indirectly affect their academic performance, add economic burden on their families and put pressure on health resources of the university. Therefore, there is a need to evaluate food safety knowledge and practices of food handlers at a higher education institution in Sudan with the aim to assess the situation and encourage efforts to cause behavioral change among food handlers as it is a major defense line against foodborne diseases.

Sudan University of Science and Technology (SUST) is one of the largest Sudanese public universities [18]. It has approximately 70,000 students, 2,815 staff members (academic and non-academic), 10 campuses and 25 colleges.

The majority of students have an average of two meals per day in SUST food premises which provide a variety of foods and drinks prepared and served in these outlets.

The aim of the study is to assess the level of food safety knowledge and practices of food handlers in cafeterias and buffets of Sudan University of Science and Technology (SUST).

2. Material and methods

2.1. Study area and study population

The study was conducted at Sudan University of Science and Technology (SUST) in Khartoum State. The University has ten campuses, six of which are in Khartoum and four in Khartoum North. Food handlers in nine campuses (except Soba campus) were included in the study.

A convenience sample of one hundred and five food handlers in twenty four food premises (cafeterias and buffets) distributed in nine campuses of Sudan University of Science and Technology (SUST) was used.

2.2. Questionnaire

A structured questionnaire of three parts containing questions about demographic characteristics (10 questions), food safety knowledge (5 questions) and food safety practices (18 questions) of respondents was designed and written in English, then translated into Arabic language (lingua franca of the respondents). Data was collected during October and November 2021 with 100% response rate. The questionnaire was filled out with the personal consent of the respondents and that of the food premises managers. Each respondent was given 30 minutes to fill out the questionnaire and each of them filled out the questionnaire by himself/herself. Help was provided when further explanation of a question was needed. The filled questionnaire was then translated back into English for publication purposes.

2.3. Data analysis

The data obtained were analyzed using Statistical Package for Social Sciences (SPSS) software version "24.0" (SPSS Inc., Chicago, Illinois, USA). Frequencies as well as the percentages of responses were computed.

3. Results and Discussion

3.1. Demographic characteristics of food handlers

The results of the analysis of the demographic characteristics are shown in Table 1. Approximately 99.0% of food handlers were males while 1.0% were females. Mwove [19] found that 63.2% of street food vendors in Kiambu County, Kenya, were males, 36.8% were females. Afolaranmi et al. [20] reported that 68% of food vendors in primary schools in Jos, North Central Nigeria were females. These results of gender roles may be a reflection of socio-economic and cultural aspects of the specific society. Among SUST food handlers, 95.2% were Sudanese nationals. As regards the age of the respondents, 64.8% were in the age group 20–30 years, 20.0% were at the age of 30–40 years, and 15.2% were more than 40 years old. Age results of food handlers in this study are in agreement with those reported in Malaysia, Slovenia, and Nigeria by Zain et al. [21], Jevnsnik et al. [22], Chukuezi [23], and Afolaranmi et al. [20].

Table 1. Demographic characteristics of food handlers in the food premises of Sudan University of Science and Technology

Таблица 1. Демографические характеристики работников в пищеблоке Суданского университета науки и технологии

	Variable	Frequency (n=105)	Percent
Nationality	Sudanese	100	95.2
	Non Sudanese	5	4.8
Gender	Male	104	99.0
	Female	1	1.0
Age in years	Less than 20	13	12.4
	20–30	68	64.8
	30–40	21	20.0
	More than 40	3	2.9
Education level	Informal	7	6.7
	Basic School	14	13.3
	Secondary School	38	36.2
	University	46	43.8
Monthly income (Sudanese pounds)	Less than 15,000	25	23.8
	15,000–25,000	57	54.3
	25,000–35,000	13	12.4
	35,000–40,000	4	3.8
	More than 45,000	6	5.7
Marital status	Married	25	23.8
	Single	78	74.3
	Divorced	2	1.9
Practical experience (years)	Less than two years	24	22.9
	2–4	46	43.8
	5–7	11	10.5
	More than 7	24	22.9
Job duties	Cleaning and washing	12	11.4
	Cooking	35	33.3
	Raw material preparation	13	12.4
	Waiters	23	21.9
Received basic training in food safety	Other jobs	22	21.0
	Yes	72	68.6
	No	33	31.4
Vaccinated against typhoid fever	Yes	48	45.7
	No	57	54.3

The results of the analysis of the level of education showed that 43.8% of the respondents were university graduates, 36.8% received secondary school education, and 13.3% received basic school education, while 6.7% had informal education. Afolaranmi et al. [20] found that the education level of 55.2% of food handlers was secondary school. Education levels of the respondents in this study are different from those reported in other studies, where most respondents attended secondary schools [24,25].

The majority of the respondents (54.3%) were in the lowest monthly income range of 15,000–25,000 SDG. The lower income level could discourage the food handlers from paying attention to food safety knowledge and practices details and may be reflected in poor attitudes. Results showed that 22.9% of food handlers had work experience of less than two years, 43.8% of food handlers had 2–4 years of practical experience in food business, 22.9% had more than 7 years' experience in the field and 10.5% had 5–7 years of experience. Jevsnik et al. [22] reported an average of 17.3 years of experience for food handlers in Slovenia, while in a study in Thailand, Cuprasittrut et al. [26] reported an average of about six years work experience. The short duration of work experience in this study may be an indication of instability of handlers and could be reflected in some poor practices of the food handlers. Results of marital status showed that 74.3% were unmarried, 23.8% were married and 1.9% were divorced. These results are in disagreement with Zain et al. [21], Abdalla et al. [27] and Afolaranmi et al. [20], who reported that the majority of the food handlers were married. It is probable that the younger age of the respondents and the low income in this study are the main factors in this marital status results.

The percentage of those who received basic training in food safety was 68.6%, while 31.4% received no training. In a study in Ethiopia, Kibret et al. [28] found that 78.2% of the respondents had not attended any training in food safety. Results showed that the majority of food handlers (54.3%) were not vaccinated against typhoid fever. It is clear that percentage of vaccination against typhoid fever is low, which poses a risk of food contamination, infection, or food poisoning, which is an indication of a serious violation of food safety.

3.2. Food safety knowledge of food handlers

The results of the analysis of food safety knowledge are shown in Table 2. All (100%) food handlers showed good knowledge of food safety in terms of importance of maintaining a clean environment in food premises, 100% stated that food safety is more important than its taste, and knowledge of food safety is important to ensure safety of food. Likewise, 100% of respondents knew that food which is not prepared or presented in a safe manner is dangerous to health. It was also found that 96.2% of respondents agreed that food handlers are responsible for food poisoning incidents, 1.9% believed that the university is responsible for food poisoning cases and 1.9% answered that the government is responsible for food poisoning cases. These findings indicate satisfactory general knowledge of food safety among food handlers. Al-Shabib et al. [7] found that the majority of male food handlers in King Saud University, Saudi Arabia, had good knowledge about personal hygiene. Similar results were obtained by Sani and Siow [29] who revealed good knowledge about personal hygiene among food handlers in a Malaysian public university.

The level of knowledge of respondents in this study might be related to the high percentage of university graduates among them and the basic food safety training they have received. This result is in agreement with Gillespie et al. [30] who stated that education and training are considered effective means to increase food safety knowledge.

Table 2. Food safety knowledge of food handlers in food premises of Sudan University of Science and Technology

Таблица 2. Знания в области безопасности пищевых продуктов, полученные специалистами по обработке пищевых продуктов в пищеблоке Суданского университета науки и технологии

Statement	Yes (%)	No (%)
Maintaining a clean environment is a good way to maintain food safety	100	0
Food safety is more important than its taste	100	0
Knowledge of food safety is important to ensure that food is prepared in a safe way	100	0
Food poisoning is dangerous	100	0
Prevention of food poisoning is the responsibility of food handlers	96.2	3.8

3.3. Food safety practices of food handlers

The results of the analysis of food safety practices are shown in Table 3. It was found that 100% of respondents wash washed their hands before preparing food; 94.3% washed their hands and 5.7% did not wash their hands after preparing food; 91.4% washed their hands and 8.6% did not wash their hands before touching ready-to-eat food; 75.2% washed their hands after cleaning utensils and surfaces; 95.2% washed their hands after dealing with waste and food leftovers; 76.2% washed their hands and 23.8% did not wash their hands after sneezing. With regard to hand-washing practices, it was found that all handlers appear to maintain a high level of food safety practice. Al-Shabib et al. [7] found that 95.4% of food handlers in the restaurants of King Saud University washed hands after coughing and sneezing. In a study by Manning and Snider [31] of food handlers in public eating places, only 2% of respondents washed hands thoroughly. According to Soares et al. [32], food handlers tend to overstate their reported practices, indicating what is probable rather than what they actually do within food premises environment. Poor personal hygiene practices can make food handlers become sources of pathogenic microorganisms and cross-contamination [33].

Table 3. Food safety practices of food handlers in the food premises of Sudan University of Science and Technology

Таблица 3. Методы обеспечения безопасности пищевых продуктов, применяемые специалистами по обработке пищевых продуктов в пищеблоке Суданского университета науки и технологии

Statement	Yes (%)	No (%)
I wash my hands before preparing food	100	0.0
I wash my hands after preparing food	94.3	5.7
I wash my hands before touching food to be served	91.4	8.6
I wash my hands after cleaning surfaces	75.2	24.8
I wash my hands before touching ready-to-eat food	100	0.0
I wash my hands after receiving money	73.3	26.7
I wash my hands after handling waste	95.2	4.8
I wash my hands after sneezing and nasal hygiene	76.2	23.8
I clip my nails short	75.2	24.8
I wear hair net, cap or helmet while working	30.5	69.5
I wear gloves while working	49.5	50.5
I wear clean apron	34.3	65.7
I wear clean clothes	98.1	1.9
I use clean towel to dry my hands	69.5	30.5
I don't cough while preparing food	81.0	19.0
I use a mask while preparing food	35.2	64.8
I take care not to handle food while sick	98.1	1.9
There are enough bins for waste disposal, and I always use them	100	0.0

The majority of food handlers in this study (75.2%) clipped their nails short, which is in agreement with Webb and Morancie [8] who found that 93% of foodservice workers at the campus of the University of the West Indies were fully aware that it was inappropriate to handle food with long finger nails. It was found that 69.5% of SUST food handlers did not wear a hair net, cap or helmet during work time, while 30.5% did so. Moreover, 50.5% of respondents did not wear gloves while handling food. Clean towels were used by 69.5% of respondents to dry their hands. While serving and preparing food, 34.3% wore clean apron, 98.1% wore clean work clothes, while 35.2%, used a mask. Al-Shabib et al. [7] reported that 96.6% of food handlers in restaurants of King Saud University wore uniforms and caps, and maintained safe food practices. Almost all respondents (98.1%) in this study took care not to prepare and serve food while sick, and 100% of food handlers used waste disposal bins appropriately.

The most obvious food safety violations of respondents in this study were not wearing masks while preparing and serving food, not wearing clean apron, not wearing gloves when required, and not wearing hair net, cap or helmet. Almost all food handlers in the food premises of the SUST were males, and it has been reported that food handling practices of males are poorer compared with that of females regardless of the level of education and knowledge [4].

Food handlers in cafeterias and buffets at SUST campuses lacked sufficient training in food safety knowledge and practices, and there were no mandatory food safety requirements apart from a health certificate which is a mere indicator of the health status of a food handler at a certain point of time. There was no regular institutional inspection or follow up of the health status of food handlers or the food safety situation in these facilities. Moreover, there was no food safety system (HACCP, ISO 9001, TQM) applied in these food premises to ensure compliance and minimize food poisoning incidents and diseases transmitted by food. These facts may suggest unsatisfactory food safety situation, a possibility of health risk and the need for necessary corrective actions.

4. Conclusion

In conclusion, the level of food safety knowledge among food handlers is satisfactory as well as their food safety practices; however, there are some obvious food safety practice violations by the respondents. The level of food safety training of food handlers at the university food premises is low and it is essential that they should undergo a regular mandatory food safety and hygiene training. No food safety systems are applied in cafeterias and buffets of SUST. A supervisory authority of food safety at Sudan University of Science and Technology is necessary, and its existence should be ensured to enforce the HACCP system, monitor food safety situation and minimize a risk of food poisoning. Microbial analysis of foods served at the university cafeterias and buffets should be carried out to evaluate their safety level.

REFERENCES/БИБЛИОГРАФИЧЕСКИЙ СПИСОК

- Codex Alimentarius. (2009). Food Hygiene (Basic texts) — Fourth edition. Retrieved from <https://openknowledge.fao.org/server/api/core/bitstreams/7172327e-fd19-41ab-8e94-faf3e72f2ad9/content> Accessed February 15, 2024.
- World Health Organization (WHO). (2007). Food safety and food borne illness. Fact sheets №237. Retrieved from <https://web.archive.org/web/20130127074439/http://www.who.int/mediacentre/factsheets/fs237/en/> Accessed February 15, 2024.
- Osaili, T. M., Obeidat, B. A., Abu Jamous, O. D., Hiba, A. B. (2010). Food safety knowledge and practices among college female students in North of Jordan. *Food Control*, 22(2), 269–276. <https://doi.org/10.1016/j.foodcont.2010.07.009>
- Sanlier, N. (2010). Food safety knowledge and the safe food handling behaviours of female and male consumers. *Pakistan Journal of Medical Sciences*, 26(3), 653–658.
- Evans, E. W., Redmond, E. C., Alwan, N., Ilic, S. (2021). Awareness and attitudes of student dietitians in Lebanon, UK and USA towards food safety. *Foods*, 10(8), Article 1875. <https://doi.org/10.3390/foods10081875>
- Stratev, D., Odeyemi, O. A., Pavlov, A., Kyuchukova, R., Fatehi, F., Bamidele, F.A. (2017). Food safety knowledge and hygiene practices among veterinary medicine students at Trakia University, Bulgaria. *Journal of Infection and Public Health*, 10(6), 778–782. <https://doi.org/10.1016/j.jiph.2016.12.001>
- Al-Shabib, N. A., Mosilhey, S. H., Husain, F. M. (2016). Cross-sectional study on food safety knowledge, attitude and practices of male food handlers employed in restaurants of King Saud University, Saudi Arabia. *Food Control*, 59, 212–217. <https://doi.org/10.1016/j.foodcont.2015.05.002>
- Webb, M., Morancie, A. (2015). Food safety knowledge of foodservice workers at a university campus by education level, experience, and food safety training. *Food Control*, 50, 259–264. <https://doi.org/10.1016/j.foodcont.2014.09.002>
- Lee, H. K., Abdul Halim, H., Thong, K. L., Chai, L. C. (2017). Assessment of food safety knowledge, attitude, self-reported practices, and microbiological hand hygiene of food handlers. *International Journal of Environmental Research and Public Health*, 14(1), 55. <https://doi.org/10.3390/ijerph14010055>
- Aklilu, A., Kahase, D., Dessalegn, M., Tarekn, N., Gebremichael, S., Zenebe, S. et al. (2015). Prevalence of intestinal parasites, salmonella and shigella among apparently health food handlers of Addis Ababa University student's cafeteria, Addis Ababa, Ethiopia. *BMC Research Notes*, 8(1), Article 17. <https://doi.org/10.1186/s13104-014-0967-x>
- Bakar, N. A. N. A., Abdullah, N. (2020). Knowledge, attitude, and practice of food safety among on-site premises in public universities. *Journal of Tourism, Hospitality and Culinary Arts*, 12(3), 1–14.
- Osaili, T. M., Al-Nabulsi, A. A., Krasneh, H. D. (2018). Food safety knowledge among foodservice staff at the universities in Jordan. *Food Control*, 89, 167–176. <https://doi.org/10.1016/j.foodcont.2018.02.011>
- Abdalla, M. A., Suliman, S. E., Bakhiet, A. O. (2009). Food safety knowledge and practices of street food-vendors in Atbara City (Naher Elneel State Sudan). *African Journal of Biotechnology*, 8(24), 6967–6971.
- Babiker, M. A., Ali, M. S., Ahmed, E. S. (2009). Frequency of intestinal parasites among food-handlers in Khartoum, Sudan. *EMHJ — Eastern Mediterranean Health Journal*, 15(5), 1098–1104.
- Ahmed, O. B., Mohamed, S. S., Dabool, A. S., Elawad, M. A. (2020). Food hygiene knowledge, attitude and practices among hospital food handlers in Elmanagil City, Sudan. *African Journal of Microbiology Research*, 14(4), 106–111. <http://doi.org/10.5897/AJMR2020.9323>
- Salam, H. H. B., Eldoom, E. A., Ali, F. F., Mohammed, A. M. (2021). The effect of training of food handlers in hospitals kitchen in Khartoum State, Sudan. *Magna Scientia Advanced Biology and Pharmacy*, 03(01), 001–012. <https://doi.org/10.30574/msabp.2021.3.1.0028>
- Latif, M. A., Suliman, S. E., Angara, T. E., Abd Allah, M. A. (2014). Evaluation of food safety knowledge, attitudes and practices among abattoir workers' in Khartoum State. *Sudan Journal of Science and Technology*, 15(1), 19–27.
- Mayada, B. M., Ahmed, N. E., Mohamed, M. E. (2020). Higher education and scientific research in Sudan: Current status and future direction. *African Journal of Rural Development*, 5(1), 115–146.
- Mwove, J., Imathiu, S., Orina, I., Karanja, P. (2020). Food safety knowledge and practices of street food vendors in selected locations within Kiambu County, Kenya. *African Journal of Food Science*, 14(6), 174–185. <https://doi.org/10.5897/AJFS2020.1929>
- Afolaranmi, T. O., Hassan, Z. I., Bello, D. A., Misari, Z. (2015). Knowledge and practice of food safety and hygiene among food vendors in primary schools in Jos, Plateau State, North Central Nigeria. *E3 Journal of Medical Research*, 4(2), 016–022.
- Zain, M. M., Naing, N. N. (2002). Sociodemographic characteristics of food handlers and their knowledge, attitude and practice towards food sanitation: A preliminary report. *Southeast Asian Journal of Tropical Medicine and Public Health*, 33, 410–417.
- Jevšnik, M., Hlebec, V., Raspor, P. (2008). Food safety knowledge and practices among food handlers in Slovenia. *Food Control*, 19(12), 1107–1118. <https://doi.org/10.1016/j.foodcont.2007.11.010>
- Chukuezi, O. C. (2010). Food safe and hygiene practices of street food vendors in Owerri, Nigeria. *Studies in Sociology of Science*, 1(1), 50–57.
- Sibanyoni, J. J., Tshabalala, P. A., Tabit, F. T. (2016). Food safety knowledge and awareness of food handlers in school feeding programmes in Mpumalanga, South Africa. *Food Control*, 73(B), 1397–406. <https://doi.org/10.1016/j.foodcont.2016.11.001>
- da Vitória, A. G., de Souza Couto Oliveira, J., de Almeida Pereira, L. C., de Faria, C. P., de São José, J. F. B. (2021). Food safety knowledge, attitudes and practices of food handlers: A cross-sectional study in school kitchens in Espírito Santo, Brazil. *BMC Public Health*, 21(1), Article 349. <https://doi.org/10.1186/s12889-021-10282-1>
- Cuprasittrut, T., Srisorachatr, S., Malai, D. (2011). Food safety knowledge, attitude and practice of food handlers and microbiological and chemical food quality assessment of the food for making merit for Monks in Ratchathewi District, Bangkok. *Asia Journal of Public Health*, 2, 27–34.
- Abdalla, M. A., Suliman, S. E., Alian, H. A., Bakhiet, A. (2008). Food safety knowledge and practices of street food vendors in Khartoum City. *Journal of Veterinary Science and Animal Husbandry*, 47, 126–131.
- Kibret, M., Abere, B. (2012). The sanitary conditions of food service establishments and food safety and knowledge and practices of food handlers in Bahir Dar town. *Ethiopian Journal of Health Sciences*, 22(1), 27–35.
- Sani, N. A., Siow, O. N. (2014). Knowledge, attitudes and practices of food handlers on food safety in food service operations at the University Kebangsaan Malaysia. *Food Control*, 37, 210–217. <https://doi.org/10.1016/j.foodcont.2013.09.036>
- Gillespie, I., Little, C., Mitchell, R. (2000). Microbiological examination of cold ready-to-eat sliced meats from catering establishments in the United Kingdom. *Journal of Applied Microbiology*, 88(3), 467–474. <https://doi.org/10.1046/j.1365-2672.2000.00981.x>
- Manning, C. K., Snider, O. S. (1993). Temporary public eating places: Food safety knowledge, attitudes and practices. *Journal of Environmental Health*, 56(1), 24–28.
- Soares, L. S., Almeida, R. C. C., Cerqueira, E. S., Carvalho, J. S., Nunes, I. L. (2012). Knowledge, attitudes and practices in food safety and the presence of coagulase positive staphylococci on hands of food handlers in the schools of Camaçari, Brazil. *Food Control*, 21(1), 206–213. <https://doi.org/10.1016/j.foodcont.2012.03.016>
- Baş, M., Ersun, A. S., Kivanc, G. (2006). The evaluation of food hygiene knowledge, attitudes, and practices of food handlers in food businesses in Turkey. *Food Control*, 17(4), 317–322. <https://doi.org/10.1016/j.foodcont.2004.11.006>

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