

Assessment of Hygienic Practices and Microbial contaminants among Canteen Workers in Kano State Polytechnic, Kano State, Nigeria

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Abstract: Food hygiene is very vital in the fight against some pathogens and contaminants which are the major global health problem and are the leading cause of morbidity. Food handlers are sometimes the major carriers of pathogens due to poor personal hygienic condition. Working in Food Service Establishment (FSE) could be a potential source of infection due to pathogen organisms. Fungal contaminants from the hands of food handlers in School of Technology, Kano State Polytechnic were analyzed using sterile hand swabs to collect the sample from participants. 9 sample specimens from different FSE centers in School of Technology Kano were collected and subjected to fungal isolation and identification using Streaking method and Microscopy analysis. The fungal contaminants isolated were identified as *Aspergillus* spp., *Penicillium* spp., *Fusarium* spp., *Nigrospora* spp. and Yeast cells of which, all are concerned with food spoilage. Therefore, the association of food with these fungi can possibly cause contamination which might lead to outbreak of human diseases. Thus, good personal hygiene that could inhibit or eradicate these fungi is very important to ensure the safety of food from food-handlers especially in the School of Technology, Kano State Polytechnic, Nigeria.

Keywords: Food-hygiene; food-handlers; fungal isolate; microscopy analysis.

INTRODUCTION

Fungi are important part of the natural environment and, therefore, play significant roles in relation to food: some fungi are used in food production, while some fungi are food sources themselves however; some are agents of food spoilage [1]. Some fungi that contaminate food can also be harmful to human health, and this could be due to fungi or their byproducts, such as poisoning by mushrooms or mycotoxins [2]. Some fungi that contaminate or spoil food are known pathogens, such as *Alternaria*, *Aspergillus*, *Candida*, *Fusarium*, and mucormycetes [3, 4]. About 300 of the estimated 1.5 million fungal species on Earth are known to cause illnesses ranging from allergic reactions to life-threatening invasive infections [5].

Food handlers are people who work for a food business and handle food, regardless whether they prepare or serve it [6]. They could transmit microbes to the food from their skin, nasal secretions, and bowel, also from the contaminated food prepared or served by them [7]. Food-borne diseases could be a potential source of contamination that results from poor environmental sanitation or personal hygiene of food handlers in food establishments or kitchen homes. Therefore, hand washing is an important measure to protect against the spread of disease or infection, and is one of the main practices to reduce the transfer of bacteria and fungi between individuals and from individuals to food surfaces [8].

Food-borne illnesses have a dramatic impact in both developing and developed countries. The health status of the

food handlers, their personal hygiene, knowledge and practice of food hygiene play a vital role in food contamination [9]. The hands of food handlers are the main vehicles of food cross-contamination so that improved personal hygiene and hand washing would lead to the basic control of faeces to-hand to-mouth spread of potential pathogenic transient microbes [10]. Many food-borne disease outbreaks are reported every year in the world. Numerous factors, contribute this excessive range of incidents. However, it is important to note that most cases of food-borne diseases are not reported, so the true extent of the problem is unknown [11].

The hands of ready-to-eat food service employees have been observed to be the carriers in the spread of foodborne illness, mainly due to poor personal hygienic condition. Howes *et al.*, [12] states that improper food handler practices contributed immensely up to about 97% of foodborne illnesses in food service establishment centers and homes. Statistical evidence also revealed that food poisoning caused by the catering industry is 70% higher than that caused by any other sector [13]. Hand washing is a fundamental precautionary measure to protect against the spread of disease and is one of the primary practices to reduce the transfer of bacteria and fungi, whether from person to person, or from person to food contact surfaces [14]. The main reason for limiting contact between ready-to-eat foods and people's hands is to prevent the transfer of fungi, bacteria and viruses already present in human bodies [15]. So we should be conscious of health status of school or clinic kitchen food handlers in order to prevent food borne ailments [16].

Food handlers with poor personal hygiene working in food service establishment centers could be potential sources of infection due to microbial pathogens including *bacteria*, *fungi*, *viruses*, *protozoa* and *helminthes* are the major cause of food borne diseases with varying degree of serving ranging from mild in disposition to chronic or life treating illness or both in developing countries are useful and often use as a means of assuming overall sanitation in the environments of food service establishment centers [17].

Additionally, kitchen is likely the most important area harboring and transmitting infections [18]. Germs are normal everywhere in the kitchen; in cutting boards (sink sponges, kitchen utensils, sinks, countertops, towels and even refrigerators. Growth of undesirable contaminating microbes not only causes deterioration in the sensory and organoleptic properties of food but also can cause illnesses. Most pathogenic microbes in food products are intestinal in origin. However, some are discovered in nasal passages, in the throat, on hair, and on skin [19]. Thus, food handlers are regularly a predominant source of infection and cross-contamination. Some fungal organisms and other bacteria like *Campylobacter* spp. and *Salmonella* spp. are easily transferred from chicken to a range of kitchen surfaces, hands and other food items [20]. The ability of microbes to adhere to food contact surfaces compromises the hygiene of those surfaces [21, 22, 23]. Moreover, it has been demonstrated that, even after adhering to ordinary and specific hygienic procedures, pathogenic microorganisms can survive in kitchens, frequently for hours. The main sites in the kitchen responsible for cross-contamination are chopping boards, sinks, taps, dish cloths, knives, and different working surfaces [24].

Furthermore, it was established that a food worker's unwashed hands can transmit pathogens, especially faecal pathogens, to food products after a visit to the toilet. Investigations of food borne illness outbreaks have shown that poor personal hygiene primarily ineffective hand washing is an important contributor to food borne illness [25]. Studying the hand contamination among the food handlers could have great importance to understand the hygienic practices of food handlers. Hands contamination of food handlers can be used as an indicator of their behavior regarding food-related practice and personal hygiene. However, this issue is now not well studied in Nigeria.

Contamination cannot be totally eliminated but however, can be managed to reduce both frequency of occurrence and accompanying adverse effects [26]. Many researches about bacterial contamination associated with food handlers have been reported [27]. To date, little is known about the fungal contamination from food-handlers in Nigeria. Hence, it is important to determine the nature of fungal contaminants in order to devise mitigation techniques before epidemic outbreaks. Thus, this study was aimed to determine fungal contaminants from the hands of food handlers working in

Kano State Polytechnic, Kano State Nigeria, and this study also has to add to the existing knowledge on hand washing and proper personal sanitation in the ready-to-eat food industry and food establishment centers (FESs).

MATERIAL AND METHODS

Study area and sample collection

The study was carried out in three (3) different food establishment centers (FECs) in School of Technology, Kano State Polytechnic. 3 samples each from FEC were collected. The sample procedure was conducted as described by Nizar [8]. Sterile swabs were used for sample collection after which, the unwashed hand palms of food handlers were swabbed. The swab sticks were moisturized in a normal saline and various parts of palm of food handlers were swabbed by gentle rolling the swab stick at different part of the palm. The swabs were used to rub thoroughly within the palms and between the fingers. The swabbed sticks were returned back to the container and sealed with adhesive tape and labeled before transported to the laboratory for further analysis and processing.

Preparation of media

Saboraud Dextrose Agar (SDA) was used for the isolation of fungal isolates. SDA was prepared based on manufacturer's instructions. The sterility of culture media prepared was checked by incubating 5% of the batch at 25 °C for 5 to 7 days and observed for fungal growth. Those Media which showed growth were eliminated and/ or discarded.

Isolation and identification of fungal isolates

Each swab stick collected was inoculated on to the SDA media used for the isolation of fungal colonies. This was done by streaking the surface of the agar medium using the swab stick containing the sample. The culture plates were incubated at 25 °C for about 5 days. After incubation period, all fungal colonies grown on Saboraud Dextrose agar were examined, counted and characterized for identification. Microscopy analysis using simple staining technique was employed for identification of the fungal isolates. The fungal colonies were picked using sterile inoculating needle and spread on a glassslide, followed by few drops of methylene blue stain and then covered with a cover slip. The fungal slides were viewed under the microscope. Characteristics features of fungal were observed (asexual spores, mycelia, etc.) and compared with the atlas for identification of *genera* and *species*.

RESULTS

The results showed that a total number of 119 fungal colonies were isolated from the hands of food handlers in all the 9 samples collected from 3 food establishment centers examined. Table 1 summarizes the results of fungal pathogens isolated from the hands of food handlers in School of

Technology, Kano State Polytechnic. The fungal contaminants were identified as *Aspergillus* spp., *Penicillium*

spp. *Fusarium* spp., *Nigrospora* spp. and *Yeast cells* as shown in Figure 1.

Table 1: Examination of Fungal Pathogens from the Hands of Food Handlers in School of Technology (SOT), Kano State Polytechnic, Nigeria

S/N	Samples	No. of colonies	Description of. colonies	Organisms identified (Microscopy)	Frequency
1	YP/01	19	Spherical, large, black color and smooth, 14 20mm.	<i>Nigrospora</i> spp.	++
2	YP/02	16	Colourless spore green edges and powdering.	<i>Penicillium</i> spp.	+
3	YP/03	8	Oval in shape, brown in colour, larger than bacterial cell.	<i>Yeast</i> cells	+
4	HML/01	17	Spherical, conidia colourless, to cylindrical in dry chains, 2.5 – 7.5mm.	<i>Aspergillums</i> spp.	++
5	HML/02	9	Colourless, pink colonies, developed in chains or slimy heads.	<i>Fusarium</i> spp.	+
6	HML/03	10	Oval in shape, brown in colour, larger than bacterial cell.	<i>Yeast</i> cells	+
7	HWK/01	20	Powdering mildews, spore is sac like structure	<i>Aspergillus</i> spp.	++
8	HWK/02	8	Spherical or oval in shape larger than bacterial cells brown in color.	<i>Yeast</i> cells	+
9	HWK/03	12	Whitish pink colonies, and colorless.	<i>Fusarium</i> spp.	+

Key: YP; Yellow page restaurant, HML; Hamdala restaurant, HWK; Hawkers, +; Isolated, ++; frequently isolated. 3 samples from each restaurant were collected and examined.

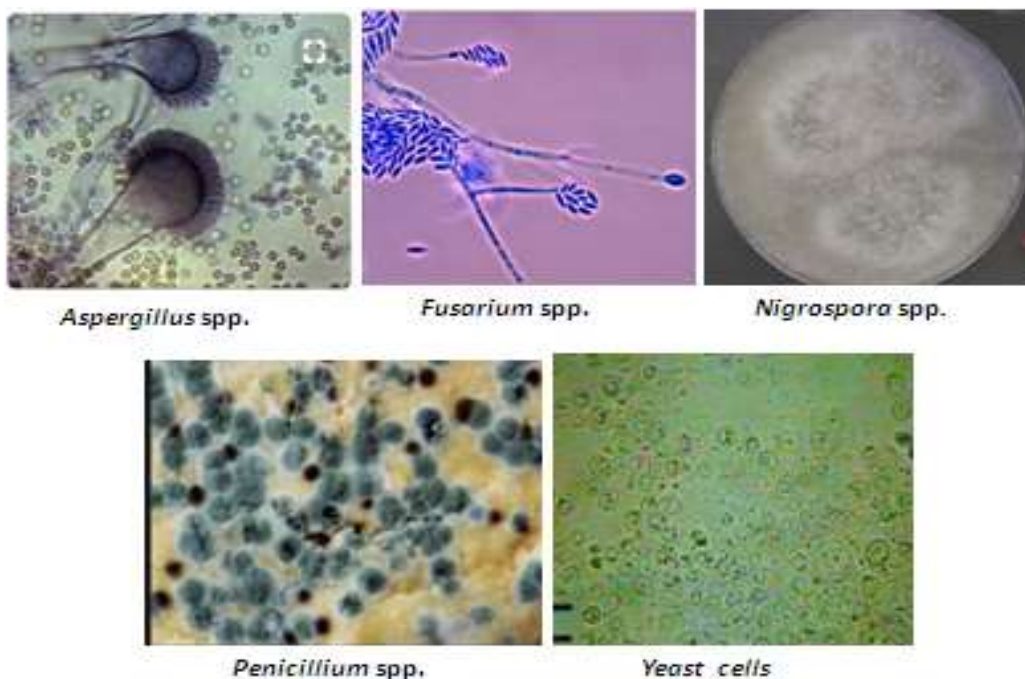


Figure 1: Simple staining observation under the microscope for fungal isolates identified

DISCUSSION

The outbreaks of food borne disease continue to take place, in spite of the progress achieved in food quality and safety for consumption, the restricted research study on food handlers and food handling practices in food establishment centers indicate that food handling issues need to be high- lightened publically. Food handlers act as a vector for microbes posing a potential risk to the public health issue [6, 28].

The present study revealed that 5 different fungal species namely; *Nigrospora* spp., *Penicillium* spp., *Yeast* spp., *Aspergillus* spp. and *Fusarium* spp. were found to be associated with food handlers examined at School of Technology, Kano State Polytechnic, Kano City, Nigeria. All these fungal pathogens were isolated from food handlers collected from 3 different restaurants. It was shown that *Yeast cells* were detected in all the restaurants studied however, *Nigrospora* spp. was found more frequent (++) in YP restaurant, while *Aspergillums* spp. was predominantly detected in Hamdala HML restaurant and Hawkers HWK as shown in Table 1, and this may be due to the nature and untidy condition of the environment and waste disposal near the restaurants, which may easily be transferred by flies and other agents that transfer microbes. Hawkers HWK had *Aspergillus* spp. and *Fusarium* spp. as the common isolates, and *Yeast cells* were occasionally isolated due to the unhygienic nature of the food seller. This is similar to what have been documented by Benedict *et al.*, [1] and Allam *et al.*, [6] who reported that microbes are associated with the food handlers including *Candida*, *Aspergillus*, *Fusarium*, *Rhizophus*, *Penicillium*, *Staphylococcus aureus* and *E. coli*. Sabo [29], also reported that pathogenic bacteria and fungi were found to be associated with the hands of food handlers especially those working in food Service establishments. The handler's contamination could be due to interaction between the currency note and other unsterile materials and thus, currency could be a vehicle of transmitting fungal pathogens including bacteria [30]. The discrepancy in socio-economic status, type of food establishment centers and inadequate personal hygiene between the studied groups of people in this research could be the explanation to the reasons why food handlers are associated with the potential fungal pathogens identified. Mycotoxin-producing strains of some fungi such as *Fusarium* and *Aspergillus* are the leading cause of gastrointestinal disorders [2, 31]. In general, some bacteria and fungi might be expected to exist at least in low numbers in all kinds of food products that are of animal origin or in those that are directly handled by humans, unless heat processing steps are applied to destroy them, they have been found in a large number of commercial foods by many investigations [8].

Therefore, it is believed that hands serve as a transitive for microbes in one way or the other. Food may be contaminated with diseases causing organisms from food handlers (during cooking or processing), air soil, and water are the main

sources of food contamination. Food handlers are advised not work when they are sick until recovery from the illness person who is affected with any disease shall not work in any communicable places such as eating or drinking establishment it has also been a general knowledge that lack of sanitary aspect of the food handlers and the environmental sanitations play a vital role in disease outbreak. According to Miller *et al.* [32], transient microbes can pose serious dangers to the food industries since microorganisms are closely attached to the skin surfaces and can easily contaminated food products if employers cannot wash their hands adequately.

CONCLUSION

In conclusion, the fungal contamination of the hands of food handlers in three (3) different food establishment centers (FECs) in Kano State Polytechnic had been examined. Swab stick samples were collected from food handlers' hands. Culture and Microscopy analysis were used to identify the fungal contaminants as *Aspergillus* spp., *Penicillium* spp., *Fusarium* spp., *Nigrospora* spp. and *Yeast cells* of which all are concerned with food spoilage. Therefore, the association of food with these fungi can possibly cause contamination which might lead to outbreak of human diseases. Thus, good personal hygiene that could inhibit or eradicate these fungi is very important to ensure the safety of food from food-handlers especially in the School of Technology, Kano State Polytechnic, Nigeria.

RECOMMENDATIONS

In spite of regular medical checkup, it is highly recommended that local health authorities should implement continuous intervention programmes such as food handler's training courses on food safety and good hygiene practices from time to time. Also, proper hand washing practices as well as maintenance of a good healthy environment in the form of availability of flyers, posters, etc. should be implemented. Moreover, an antiseptic solution in the kitchen for food handlers is very necessary to improve hygiene practices in food establishment centers (FECs).

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AUTHOR CONTRIBUTIONS

All authors contributed toward data analysis, drafting and critical revision of the paper and agreed to be accountable for all aspects of the research study.

CONFLICTS OF INTEREST

No competing interests exist.

REFERENCES

- [1] Benedict, K., Chiller, T. M., & Mody, R. K. (2016). Invasive Fungal Infections Acquired from Contaminated Food or Nutritional Supplements: A Review of the Literature. *Foodborne pathogens and disease*, 13(7), 343–349. doi:10.1089/fpd.2015.2108.
- [2] Marroquín-Cardona AG, Johnson NM, Phillips TD. (2014). Mycotoxins in a changing global environment--a review. *Hayes AW Food Chem Toxicol*. 69:220-30.
- [3] Brenier-Pinchart MP, Faure O, Garban F, Fricker-Hidalgo H, Mallaret MR, Trems A, Lebeau B, Pelloux H, Grillot R., Mycoses. (2006). Ten-year surveillance of fungal contamination of food within a protected haematological unit. 49(5):421-5.
- [4] Buckley M. The Fungal Kingdom (2018). Diverse and Essential Roles in Earth's Ecosystem. Washington, DC: American Academy of Microbiology.
- [5] Hawksworth DL (2001). The magnitude of fungal diversity: The 1. 5 million species estimate revisited. *Mycol Res*.105:1422–1432.
- [6] Allam H. K., M. A. Al-Batanony, A. S. Seif and E. T. Awad (2016). Hand Contamination among Food Handlers. *British Microbiology Research Journal*. 13(5): 1-8, Article no.BMRJ.24845 ISSN: 2231-0886, NLM ID: 101608140.
- [7] Takalkar AA, Kumavat AP. (2011). Assessment of personal hygiene of canteen workers of government medical college and hospital, Solapur. *National Journal of Community Medicine*. 2(3):448-451.
- [8] Nizar Issa Alrabadi (2017). Bacterial Contamination of the Hands of Food Handlers: Evidence from Jordanian Diary Industries. *Int.J.Curr.Microbiol.App.Sci*. 6(3): 1078-1084.
- [9] Mudey AB, Kesharwani N, Mudey GA, Goyal RC, Ajay K, Dawale AK, Vasant V, Wagh VV. (2010). Health status and personal hygiene among food handlers working at food establishment around a rural teaching hospital in Wardha District of Maharashtra, India. *Global Journal of Health Science*. 2(2):198-206.
- [10] Allwood PB, Jenkins T, Paulus C, Johnson L, Hedberg CW. (2001). Hand washing compliance among retail food establishment workers in Minnesota. *Journal of Food Protection*. 67(12): 2825–2828.
- [11] Fawzi M, Gomaa NF, Bakr WMK. (2009). Assessment of hand washing facilities, personal hygiene and the bacteriological quality of hand washes in some grocery and dairy shops in Alexandria, Egypt. *J Public Health Assoc*. 84(1&2):72-93.
- [12] Howes M, McEwen S, Griffiths M, Harris L. (1996). Food handler certification by home study: Measuring changes in knowledge and behaviour. *Dairy, Food Environ San*.16:737-744.
- [13] Wilson M, Murray AE, Black MA, McDowell DA. (1997). The implementation of Hazard Analysis and critical control points in hospital catering. *Manag Serv Qual*. 7(3):150- 156. DOI: 10.1108/09604529710166941.
- [14] Chinakwe EC, Nwogwugwu NU, Nwachukwu IN, Okorondu SI, Onyemekara NN, Ndubuisi-Nnaji UU. (2012). Microbial quality and public health implications of handwash water samples of public adults in Owerri, South-East Nigeria. *Inter Res J Microbiol*. 3(4):144-146.
- [15] Lues JFR, van Tonder I. (2007). The occurrence of indicator bacteria on hands and aprons of food handlers in the delicatessen sections of a retail group. *Food Control*. 18:326-332. DOI: 10.1016/j.foodcont.2005.10.010.
- [16] Aycicek H, Aydogan H, Kucukaraaslan A, Baysallar M, et al. (2004). Assessment of the bacterial contamination on hands of hospital food handlers. *Food Control*. 15(4):253–259.
- [17] Lambrechts AA, Human IS, Doughari JH, Lues JFR. (2014). Bacterial contamination of the hands of food handlers as indicator of hand washing efficacy in some convenient food industries. *Pak J Med Sci* 2014;30(4):755-758. doi: http://dx.doi.org/10.12669/pjms.304.4400.
- [18] Scott E, Bloomfield SF, Barlow CG. (1982). An investigation of microbial contamination in the home. *J Hyg (Lond)*. 89:279–293.
- [19] Farooq S, Hashmi I, Qazi IA, Qaiser S, Rasheed S. (2008). Monitoring of coliforms and chlorine residual in water distribution network of Rawalpindi, Pakistan. *Environ Monit Assess*, 140:339–347.
- [20] De Boer E, Hahne M. (2011). Bacteriological analysis of air of kitchens in Zrural and Urban areas of Panipat district in Haryana (India). *Int J Pharm Bio Sci*; 2:248–256.
- [21] Alves MM, Pereira MA, Novais JM, Polanco FF, Mota MA. (1999). New device to select microcarriers for biomass immobilization: application to an anaerobic consortium. *Water Environ Res*; 1:209–217.
- [22] Fonseca AP, Granja PL, Nogueira JA, Oliveira DR, Barbosa MA. (2001). *Staphylococcus epidermidis* RP62A adhesion to chemically modified cellulose derivatives. *J Mater Sci Mater Med*. 12:543–548.
- [23] Teixeira P, Oliveira R. (1999). Influence of surface characteristics on the adhesion of *Alcaligenes denitrificans* to polymeric substrates. *J Adhes Sci Technol*; 13:1287–1294.
- [24] Mattick K, Durham K, Domingue G, Jørgensen F, Sen M, Schaffner DW, Humphrey T. (2003). The survival of foodborne pathogens during domestic washing-up and subsequent transfer onto washing-up sponges, kitchen surfaces and food. *Int J Food Microbiol*. 85:213–226.
- [25] Scarborough, MF. (2002). Hand Washing in Georgia's Public Schools – A Community Needs Assessment and Intervention Study. Masters thesis. Atlanta, United States: Emory University.
- [26] Mendoza, J., Caso, W., Valdez, C., Pons, M., Valle, L., Ore, V., Michelena, D., Mayra, J., Gavidea, V., Vargas, M. and Ruiz, J. (2014). Diagnosis of carrion's disease by direct blood PCR in thin blood smear negative samples. *Journal of Clinical Microbiology*, 9: 92-183.
- [27] Porte, L., Soto, A., Andrighetti, D., Dabanch, J., Braun, S., Saldivia, A., Flores, J., Wozniak, A., Garcia, P. and Weitzel, T. (2012). Catheter-associated bloodstream infection caused by *Leifsonia aquatica* in a haemodialysis patient. A case report. *Journal of Medical Microbiology*, 61: 868–873.

[28] Campos AKC, Cardonha AMS, Pinheiro LBG, Ferreira NR, Azevedo PRM, Stamford TLM. (2009). Assessment of personal hygiene and practices of food handlers in municipal public schools of Natal, Brazil. *Food Control*. 20(9):807–810.

[29] Sabo A. Abdullahi (2017). Isolation and Characterization of Bacterial Pathogens from Foods and Food Handlers at Sa'adatu Rimi College of Education, Kumbotso, Kano. *The Kumbotso Teacher Educator(KUTEJ): A Journal of Multidisciplinary Studies*. Pp; 11-19. ISSN: 1597-8796.

[30] Abdulmalque, Y. M. (2013). Microbiological Safety of Drinking Water and Food. *Annual Review of Microbiology*. 54; 81-127.

[31] Shojaei H., Shooshtaripoor J, Amiri M. (2006). Efficacy of simple hand-washing in reduction of microbial hand contamination of Iranian food handlers. *Food Research International*.39(5):525–529.

[32] Miller, J. K., Rain, O. T., Ruth, H. M and Moninta, G. (1998). Scientific Working Group on Infections due to Diarrheal Causing Bacteria. *Reorts*; 11, (42). Geneva.