MRS Journal of Multidisciplinary Research and Studies
ISSN *(Online) 3049-1398*
Vol-3, Iss-1 (January-2026)
Journal homepage: https://mrspublisher.com/journals

Isolation and Identification of Fungi from Dried Fishes sold at Garindau, Wudil Local Government Area Kano State

Sumayya Isma'il Tanko[1], Farida Isah El-Hassan[1*], Tasiu Mahmud[1], Yahaya Ubah Ya'u[2] & Yakubu Abubakar Bala[1]

Department of Microbiology, Aliko Dangote University of Science and Technology Wudil

Department of Science Lab. Technology, Aliko Dangote University of Science & Technology Wudil

Corresponding Author: **Farida I. El-Hassan** (Department of Microbiology, Aliko Dangote University of Science and Technology Wudil)

Received: 13 / 12 / 2025	Accepted: 09 / 01 / 2026	Published: 19 / 01 / 2026

Abstract: This study was aimed at isolating and identifying fungal contamination of dried fish sold at Garin dau Market, Wudil Local Government Area, Kano State, Nigeria. A total of ten samples of dried fish were collected and analyzed using standard microbiological techniques to determine fungal load and species identification. The results revealed fungal counts ranging from $9.00x10^3$ to $2.90x10^4$ CFU/ml, significantly exceeding the safety threshold set by NAFDAC/WHO, which is $1.00x10^2$ CFU/ml. Five fungal species were isolated from the samples, including Aspergillus niger (33.33%), Mucor spp. (29.63%), Aspergillus flavus (14.81%), Candida spp. (14.81%), and Penicillium spp. (7.41%). The presence of Aspergillus flavus, a known producer of aflatoxins, poses a serious public health concern due to its carcinogenic potential. These fungi such as Mucor and Candida species are also associated with infections, particularly in immunocompromised individuals. These findings highlight the need for improved preservation methods, including more effective drying techniques and proper storage practices, to reduce fungal contamination. These measures are vital for safeguarding public health and maintaining the economic value of dried fish in local markets.

Keywords: *Dried fish, fungal contamination, aflatoxins, food safety, microbial load.*

Cite this article: Tanko, S. I., El-Hassan, F. I., Mahmud, T., Ya'u, Y. U., Bala, Y. A. (2026). Isolation and Identification of Fungi from Dried Fishes sold at Garindau, Wudil Local Government Area Kano State. *MRS Journal of Multidisciplinary Research and Studies, 3(1),38-42.*

Introduction

Fish is a vertebrate animal living in fresh and seawater. The importance of fish in human and animal nutrition cannot be overemphasized. According to Mei *et al.*, (2019), fish is a low fat food, a great source of protein, vitamins and minerals. Fish harvesting, handling, processing and distribution provide livelihood for millions of people. It is the most important animal protein food available in the tropics, and it represents about 14% of all animal protein on a global basis. In Nigeria, fish is eaten fresh, preserved or processed (Dried) and form a much-relished meal that spans socio-economic, age educational and religious barriers. Abebe *et al*. (2020) reported that the demand for fish in Nigeria greatly exceeds supply. This problem is aggravated by the low level of domestic fish production against the increase in human production. Fish is highly nutritious food of about 60-80% water, 15-25% protein, 11-22% fat, 20% mineral and 1% carbohydrate (Iacumin *et al.*, 2022). Most of the catches come from oceans, seas, rivers and lately man-made ponds. It is often cheaper than meat and so it is a rich protein source for both the poor and wealthy (Dehghani *et al.* 2018).

The preservative effect of salt has been recognized as being due to a decrease in water activity, less availability to microbial attack and enhancement of functional properties, leading to an increase of the shelf life time. Meanwhile, dried fish and shellfish products have been reported to be a source of microbial hazards including *Listeria monocytogenes, Salmonella* spp. and *Clostridium botulinum.* Outbreaks of botulism, listeriosis, and salmonellosis resulting from dried fish have been reported for over 30 years. Also, Chitrakar *et al.,* (2019) reported that dried fish samples from four local Markets in Kainji Lake area of Nigeria were dominated by gram-positive bacteria, potential pathogens, coagulase-positive *Staphylococcus* and *Escherichia coli*(Abebe *et al*. 2020). Delay or prevention of microbial spoilage of fish may be achieved by different preservative methods that include the use of dried and brining (Hicks, 2016).

In certain instances, sodium chloride is added mainly as a flavoring and functional ingredient and hence in these cases the effect could be "indirect" (Kuley *et al.*, 2020). Another reason that the antimicrobial effect of sodium chloride may be called indirect is that it reduces the water activity in many foods and this by indirectly prevents microbial growth (Kuley *et al.*, 2020). The steps in the dried process are necessary not only for safe preservation, but also to produce good flavour and aroma. Hence dried fishes are less prone to microbial spoilage than fresh fish. However, spoilage still occurs as a result of growth of microbes due to partial dehydration during dried (Bratt, 2020). Dried fish products can be a source of microbial hazards including *Listeria monocytogenes, Salmonella* spp., *Clostridium botulinum* etc. Abraha *et al*. (2018) due to unhygienic handling, marketing and storage or due to the partial removal of water activities during production. Raw Dried fish are generally eaten in many countries (Ikape, 2017). If the

Dried fish are contaminated with pathogenic microbes, this can cause the fatal diseases in the human body (Cheng *et al.,* 2015).

In many developing communities, dried fish are usually hawked without taking cognizance of the microbial contamination from the environment. In Nigeria, Dried fish products could be contaminated with microorganisms from the processing units and the market centers before reaching the consumers because many processors and hawkers usually display them openly in a manner that could be potential sources of microbial contamination (Howell *et al.* 2015). For this reason, it is necessary to estimate the bacterial load along with some pathogenic bacteria and fungal contamination in fresh and stored dried fish (Arason *et al.,* 2014). Despite the widespread consumption and economic importance of dried fish in many regions, particularly in developing countries, spoilage remains a significant challenge. This spoilage is primarily caused by various microorganisms that thrive even in low-moisture conditions, leading to substantial food losses, economic setbacks, and potential health risks due to toxin production.

Dried fish is a significant source of protein and of these essential nutrients, particularly in regions where access to fresh fish is limited. However, despite its reduced moisture content, dried fish is susceptible to spoilage, primarily due to microbial activity. Understanding the microorganisms associated with the spoilage of dried fish are crucial for developing effective preservation methods, ensuring food safety, and minimizing economic losses.

Material and Methods

Study Area

Garindau Market Wudil local government area, Kano was coordinated on the latitude 11^{o} 8.2127'N and longitude 8^{o}5'E of the Greenwich Meridian. It is surrounded by Wudil Local Government to the North and East, Gaya to the East, Dawakin Kudu to the West. The 2006 census puts the population of the area at 115,189 with an estimate land mass of 332 km² (NIPOST, 2006).

Sample Collection

According to Chakraborty and Chakraborty (2017), ten (10) sample of dried fish were randomly collected from different vendors from Garindau market, Wudil L.G.A. the sample dried fish were carefully packed and transported to the laboratory of department of microbiology, Aliko Dangote university of science and technology Wudil, where they were properly identified according to the identification keys described by Chakroborty and Chakraborty (2017), weighed individually and stored in a refrigerator prior to mycological analysis.

Enumeration of Fungi

Sample preparation

For isolation of fungi, pour plate technique was used in which a portion of 10ml of the sample was added into a flask containing 90ml of distilled water that was mixed carefully. A portion of 1ml of the homogenate was transferred into a test tube containing the 9ml of the diluents, it was mixed carefully with a fresh pipette by aspirating 10 times then from the second dilution with the same pipette another 1ml was transferred into the next tube containing 9ml of the sterile diluents, it was then mixed with a fresh pipette and repeated with the same steps using 1st, 2nd, 3rd, 4th and 5th tubes of the diluent. A portion of 1ml of the sample dilution was pipetted from the 1st, 2nd, 3rd, 4th and 5th tube into each of the appropriately marked sterile petri-dish. CFU/ml (Anihouvi *et al*., 2019).

Isolation and Identification of Fungi

A portion of 15ml of acidified PDA (kept at 44 to 46^{o}C in water bath) was poured into each of the Petri dish, the sample dilution and agar medium were mixed thoroughly and uniformly by swirling the petri dishes gently, allowed to set and solidified. The prepared petri dishes were inverted and incubated at 32-37^{o}C (in the cupboard) for 3 to 5 days, growth were counted and the results were recorded as CFU/g (Anihouvi *et al*., (2019).

Sub-culturing

A pure culture of each of colony type were obtained and maintained. The maintenance was done by sub-culturing each of the different colonies on to the SDA plates and incubated at room temperature again for 5 days. In sub-culturing, baiting method which involves the use of a sterile wire loop to pick up growth on the culture and then transferred to the subculture media was implemented, after which the petri dish were labeled according to the color of growth that was transferred into it (Iacumin *et al.*, 2022).

Wet mount microscopy of the Fungi isolates

A portion of 72 hours culture from the plates were picked and place on a clean glass slide. A few drops of lactophenol were added and heated to steam while gently teasing the culture then a few drops of lactophenol cotton blue stain were added and this was also heated to steam for few seconds and removed from heat. The glass slide were covered with a cover slip and the edge of the cover slip was gently pressed and finally observed under a microscope (Abebe *et al.*, 2020).

Results

Fungal Plate Count of the dried fish sample

The fungal plate count, reveals that the fungal contamination levels of the dried fish samples ranged from 9.00x10³ to 2.90x10⁴ CFU/ml. These values are significantly higher than the recommended safety limit set by the NAFDAC/WHO, which is 1.00x10² CFU/ml. This indicates a high level of fungal contamination in all the samples, posing potential health risks to consumers (Table 1).

Table 1: Fungal Plate Count of the dried fish sample

Sample ID	Fungal Counts (CFU/ml)
A	$2.90x10^4$
B	$1.65x10^5$
C	$1.30x10^4$
D	$2.30x10^5$
E	$1.50x10^4$
F	$2.15x10^5$
G	$1.30x10^4$
H	$1.20x10^5$
I	$1.45x10^4$
J	$9.00x10^5$

Key words; CFU/ml – colony forming unit per mills of sample, A – J Samples from different locations.

Cultural and Morphology Characteristics of the Fungal Isolates

Five different fungal species were identified across the fish samples: *Aspergillus niger*, *Mucor* spp., *Aspergillus flavus*, *Candida* spp., and *Penicillium* spp (Table 2).

Table 2: Cultural and Morphology Characteristics of the Fungal Isolates

Cultural Characteristics	Morphological Characteristics	Isolates
Non-branched conidiophores with bulb end carries conidia like sunrays	Blackish colonies on SDA or pin like black growth	*Aspergillus niger*
Non-branched conidiophores with bulb end carries conidia	Pin like green growth	*Aspergillus flavus*
Unicellular cocci or orbid shape, larger than bacterial cell	Flat, smooth large colonies	*Candida* sp.
Sporangia contain spores, do not have rhizoids	Cotton like white growth spotted with black color	*Mucor*sp.
Brush-like conidiophore carries conidia	Green or green greyish color colonies growth over fruits e	*Penicillium* sp.

Frequency of Occurrence of Fungal species

The frequency of occurrence of fungal species showed *Aspergillus niger* was the most prevalent, occurring in 33.33% of the samples, followed by *Mucor* spp. at 29.63%. *Candida* spp. and *Aspergillus flavus* both had an occurrence rate of 14.81%, while *Penicillium* spp. was the least frequent at 7.41%. These fungal species are known for their potential to cause spoilage and pose health risks, with some, such as *Aspergillus flavus*, being capable of producing harmful mycotoxins (Table 3).

Table 3: Frequency of Occurrence of Fungal species

Samples	*Candida* spp.	*Mucor* spp.	*Aspergillus flavus*	*Aspergillus niger*	*Penicillium* spp.
A	+	+	+	+	+
B	+	+	-	+	-
C	-	+	+	+	-
D	-	+	-	-	-
E	-	+	+	+	-
F	-	+	-	+	-
G	+	+	+	+	-
H	+	-	-	+	-
I	-	+	-	+	-
J	-	-	-	+	+
Total	4 (14.81%)	8 (29.63%)	4 (14.81%)	9 (33.33%)	2 (7.41%)

Key words; CFU/ml – colony forming unit per mills of sample, += Positive - = Negative. A – J Samples from different locations

Discussion

Findings from this study shows that fungi, mold and yeast contaminate dried fish. The traditional method of preserving is often employed to produce commonly acceptable dried fish for the consumption. The fish can be transported or stored. Results from this study shows that 10 sample of dried fish were contaminated with fungi species. Fungi produce spores which are moderately resistance to drying and therefore easily implicated in the contamination of spoilage of dry and semi dry materials. This is an agreement with the finding of Eaton and Groopman, (1994) that molds have the ability to survive harsh conditions and low moisture content. The dominant occurrence of *mucor* spp obtained in this research is similar to worker reported by Ahemed *et al*. (2004), Essein *et al*. (2005). Where *candida Spp Rhizopus* spp , A *fumigatus* , A *Flavus* and A. n*iger* in decreasing sequential order the distribution of these fungi probably resulted from the ubigious nature of fungi as elaborated by Ibeh *et al*. (1991). Molds produces numerous air bone conidia which easily disperse by air movement and possibly insects.

Some of the moulds isolated are common in the air and soil and have been linked with the production of various types of toxins under various conditions. *Aspergillus* spp has been proven to produce aflatoxin and ochratoxin. *Penicillium* spp produce aflatoxin and citrin. Mari and Riccioli (2004) reported *A. niger* and A *fumigatus* as being allergenic. The presence of these fungi in the dried fish samples might probably make it consumption hazardous to health, Adebayo Tayo *et al*. (2008) because they might contain metabolites produced by fungi. Although some A *Flavus* strains can produce elevated levels of aflatoxins, while other strain produces negligible levels, Abbas *et al*. (2009). Based on literature myotoxin production by *A. Flavus*, account for 30-40% of known isolates is believed to produces Aflatoxins Frisvad *et al*., (2007). The strain variability is also dependent on several factors such as substrate, the geographical location and the environmental factors (Horn, 2005, Klich, 2007), the potency of these metabolites is not affected by cooking and may cause severe or fatal damage to the liver and kidney (Mitchell, 2007). FACT,(2004)noted that where the relative humidity is above the critical value of 80-90% most *Penicillium* spp and *Aspergillus* spp would grow easily on dried fish .The study also observed mixed growth of fungi in various combinations of two or three fungi from all the market similar to the work of Junaid *et al*., (2010) the data obtained were statistically analyzed for comparison, however there is no significant relationship between the fungal organism isolated and market places where the samples were sourced.

Conclusion

The study aimed to determine the fungal load associated with dry fish sold at Garindau market in Wudil Local Government Area, Kano State. A total of 10 samples were collected from different vendors and analyzed using standard microbiological techniques. The result revealed that *Aspergillus niger* was found with highest number of occurrence of 33.3 % and *Penicillium spp.* with lowest number of occurrence of 7.4%. It will be therefore useful to develop and establish public health standards in processing good hygienic environmental condition in market places as consumption of these fungi exposes the consumers to the possible toxic metabolites produced by some of the isolates. Based on the findings of this study, it is recommend that proper drying techniques, such as mechanical drying, to reduce moisture and inhibit fungal growth in dried fish should be employed. Natural preservatives like salt and organic acids should be used to extend the shelf life and reduce fungal contamination in dried fish.

References

1. Abdel-Aziz, S. M., Asker, M., Keera, A. A., and Mahmoud, M. G. (2016).Microbialfoodspoilage:Control strategies for shelf-life extension. In N. Garg, S. M. Abdel-Aziz and A. Aeron (Eds.), Microbes in food and health (pp. 239-264). Springer.
2. Abebe, E., Gugsa, G., and Ahmed, M. (2020). Review on major food-bornezoonoticbacterialpathogens.*Journal of TropicalMedicine*,1-19. https://doi.org/10.1155/2020/4674235
3. Abraha,B.,Admassu,H.,Mahmud,A.,Tsighe,N.,Shui,X. W., and Fang, Y. (2018). Effect of processing methods on nutritional and physico-chemical composition of fish: A review.*MOJ Food Process and Technology*,6(4),376-382.
4. Adebayo Tayo, B.C, Onilude A.A and Patric U.G.(2008) mycoflora of smoked-dried fish sold in Uyo, eastern Nigeria. World Journal of Agricultural Science, 4(3),pp:346-350.

5. Adebayo-Tayo, A. C., Odu, N. N., Michael, M. U., and Okonko, I.O. (2012). Multi-drug resistant (MDR) organisms isolated from sea-foods in Uyo, South-Southisn Nigeria. *Nature and Science*, 10 (3), 61-70.
6. Anihouvi, D. G. H., Kpoclou, Y. E., Abdel Massih, M., IkoAfé, O. H., Assogba, M. F., Covo, M., Scippo, M. L., Hounhouigan, D. J., Anihouvi, V. and Mahillon, J., (2019). Microbiological characteristics of Dried and Dried–dried fish processed in Benin. *Food science and nutrition*, 7 (5), pp.1821-1827
7. Arason, S., Nguyen, M. V., Thorarinsdottir, K. A., andThorkelsson, G. (2014). Preservation of fish by curing.In I. S. Boziaris (Ed.), Seafood processing: Technology, quality and safety(pp. 129-160).Wiley.https://doi.org/10.1002/9781118346174.
8. Chakrabarti, R., and Varma, P. R. G. (2020). The sensitivity of halotolerant Aspergillus flavus, *Aspergillus niger* and Penicillium sp. to propionate, sorbate and benzoate. *Journal of Food Science and Technology-Mysore*,37(1), 72-74.
9. Chakroborty, T. and Chakraborty, C. S., (2017). Comparative Analysis of nutritional composition and microbial quality of salt-smoke-dried mirror carp (*Cyprinuscarpio* var. Specularis) during storage at 22-28°C and 4°C. *International Journal of Food Science and Nutrition*, 1, pp. 86-89.
10. Cheng, J. H., Sun, D. W., Zeng, X. A., and Liu, D. (2015). Recent advances in methods and techniques for freshness quality determination and evaluation of fish and fish fillets: A review. *Critical Reviews in Food Science and Nutrition*,55(7),1012-1225.
11. Chitrakar, B., Zhang, M., and Adhikari, B. (2019). Dehydrated foods: Are they microbiologically safe. *Critical Reviews in Food Science and Nutrition*,59 (17), 2734-2745.
12. Dehghani, S., Hosseini, S. V. and Regenstein, J. M., (2018). Edible films and coatings in seafood preservation: A review. *Food chemistry*, 240, pp. 505-513.
13. Frisvad J.C, Thrane .U., and Samson R.A (2007). Mycotoxin producers in J.Dijkstahuis and R.Samson (Eds) food mycology: A multifaceted approach to fungi and food. PP-135-159 CRC press.
14. Hicks, D. T., (2016). Seafood safety and quality: The consumer's role. Foods, 5 (4), p. 71.
15. Horn B. (2005). Ecology biology of Aflatoxinic fungi in soil.H.K Abbas (Ed), Aflatoxin and food safety. PP 95-116: CRC press.
16. Howell, K. (2015). Spoilage: Yeast spoilage of food and beverages. *Encyclopedia of Food and Health*, 113-117.
17. Iacumin, L., Pellegrini, M., Sist, A., Tabanelli, G.,Montanari,C., Bernardi, C., andComi, G. (2022). Improving the shelf-life of fish burgers made with a mix of sea bass and sea bream meat by bioprotective cultures. *Microorganisms*, 10(9),1786.
18. Ibeh I.N, Uriah N, and Ognor J.I (1991). Dietary exposure aflatoxin in Benin city, Nigeria: a possible public health concern. International journal of food microbiology (14) PP: 171-174.
19. Ikape, S. I. (2017). Fish spoilage in the tropics: A review. Octa Journal of Biosciences,5(2), 34-37.
20. Junaid, S.A., olarubotin. F.and olabode, O.A,(2010)ray eotic contamination of stock fish sold in jos,niqeria:journal of yeast and fungi research. | (7) pp: 136-14.
21. Klich M.A (2007). Environmental and developments factors influencing aflatoxin production by Asperaillus Flauus and Asperaillus parasiticus my coscience (48) PP: 71-80.
22. Kuley, E., Durmus, M., Balikci, E., Ucar, Y., Regenstein, J. M., and Özoğul, F. (2017). Fish spoilage bacterial growth and their biogenic amine accumulation: Inhibitory effects of olive by-products. *International Journal of Food Properties*, 20(5), 1029-1043.
23. Kuley, E., Özyurt, G., Özogul, I., Boga, M., Akyol, I., Rocha, J. M., and Özogul, F. (2020). The role of selected lactic acid bacteria on organic acid accumulation during wet and spray-dried fish-based silages. Contributions to the winning combination of microbial food safety and environmental sustainability. *Microorganisms*, 8(2), 172.
24. Mari A. Riccioli D. (2004). The allergone website-a data base on allergenic molecules. Aim, structure and data of a web-based resurce. 60th Annual meeting of American Academy of Allergy, ASthma and immunology, journal of Allergy clinical Immunology. PP:113-301.
25. Mei, J., Ma, X. and Xie, J. (2019). Review on natural preservatives for extending fish shelf life. *Foods*, 8 (10), p.490