Advanced Journal of Microbiology Research Vol. 2017
Available online at http://internationalscholarsjournals.org/journal/ajmr

Full Length Research Paper

Mycoflora of stored "Ofada" and "Abakaliki" rice in Lagos and Ogun States, Southwestern Nigeria

Y. M. Somorin[1*] and S. A. Bankole[2]

[1]Department of Microbiology, University of Agriculture, Abeokuta, P. O. Box 851, Ota, Ogun State, Nigeria.
[2]Department of Microbiology, Olabisi Onabanjo University, P. M. B. 2002, Ago-Iwoye, Ogun State, Nigeria.

Accepted 22 June, 2017

The presence of fungal contaminants in Ofada and Abakaliki rice varieties under storage in Lagos and Ogun States, Nigeria were examined. The fungal species isolated from the Ofada rice were *Actinomycetes* spp., *Aspergillus flavus, Aspergillus niger, Aspergillus tamarii, Cladosporium sphaerospermum, Fusarium compacticum, Fusarium oxysporum*, *Fusarium proliferatum, Penicillium oxalicum, Rhizopus nigricans, Rhizopus oryzae and Saccharomyces cerevisiae.* The Abakaliki rice was contaminated with *A. flavus, A. niger, A. tamarii, F. compacticum, F. oxysporum*, *F. proliferatum, Penicillium citrinu*, *P. oxalicum, R. nigricans, R. oryzae and S. cerevisiae*. *A. niger* (80%) was the predominant fungal species while *Actinomycetes* spp. (6.7%) was the least isolated. Some of these fungi are known to produce mycotoxins which have several health and economic implications. The presence of such species as seen in this study may show a potential risk of mycotoxin contamination in Ofada and Abakaliki rice varieties.

Key words: Fungi, contaminants, Ofada, Abakaliki, rice, mycotoxin, mycoflora.

INTRODUCTION

Rice (*Oryza sativa* Linn.) is a wholesome cereal grain that is ideal for diverse nutritional needs. It contains predominantly carbohydrates besides vitamins and fibre and has higher proportion of protein than in wheat, corn, and sorghum (USA Rice Federation, 2002). Rice is a major source of income and nutrition in many food-insecure regions of the world. About 85% of the total production of rice is meant for human consumption (Janick, 2002) . Rice accounts for about 60 - 70% of total food intake in the world and currently, it has become the predominant staple food in about 33 countries of the world including Nigeria (FAO, 2004) . About 90 - 95% of Nigerians consume rice and this cut across all economic class where it is eaten in different recipes (Wudiri, 1992).

In Nigeria, rice is cultivated by local farmers at subsistence levels, enough only to feed their families and a little remain for sale at local markets. Despite being West Africa's largest producer of rice, rice yield in Nigeria is low compared to other parts of the world and this limited rice produced is further reduced during post harvest storage (WARDA, 2002). Storage of rice is done in bamboo-laid ceilings and barns, baskets and sacks. The prevailing high temperature and relative humidity are such that encourage colonization by moulds. Moulds have been found to contaminate maize (Orsi et al., 2000), wheat (Berghofer et al., 2003) and rice (Desjardins et al., 2000; Park et al., 2005; Sales and Yoshizawa, 2005). The presence of moulds in stored grains may lead to various forms of deterioration, visible mouldiness, seed discolouration, musty odours reduction in acceptability or outright rejection of the maize for consumption (Aboaba and Amasike, 1991) and decreased nutritive value (Maxiya- Dixon, 2004). However, the most debilitating effect of mould deterioration of stored grain and seeds is mycotoxin production (Bankole et al., 1999) . Mycotoxins are important in food safety in that they not only lead to deleterious health effects in humans and in animals, they also pose adverse economic implications (Bhat and Vashanti, 2003; Wu, 2008).

The loss of grains in storage, loss of revenue from mouldiness and mycotoxin production and the potential health hazards posed to consumers formed the basis of this study. The present study examines the fungal species contaminating Ofada and Abakaliki rice in Lagos and Ogun states, Nigeria which may serve as an

*Corresponding author. E-mail: yinkasomorin@yahoo.com. Tel: 234-8050901065.

Table 1. Fungi isolated from Ofada and Abakaliki rice.

State	Rice variety	Fungi isolated
Lagos	Ofada	*Rhizopus oryzae, R. nigricans, Penicillium oxalicum, Aspergillus niger, A. flavus, Fusarium oxysporum, Cladosporium sphaerospermum, Actinomycetes* spp., *Saccharomyces cerevisiae, F. proliferatum*
Ogun	Ofada	*S. cerevisiae, R. nigricans, A. niger, P. oxalicum, A. tamarii, F. compacticum*
Ogun	Abakaliki	*R. oryzae, , A. niger, F. oxysporum, P. oxalicum, A. flavus, R. nigricans, P. citrinum, F. proliferatum, A. tamarii, F. compacticum, S. cerevisiae,*

indicator of the potential risk of mycotoxin in Ofada and Abakaliki rice consumed by the populace.

MATERIALS AND METHODS

Ofada and Abakaliki rice samples were collected from different stores in Lagos and Ogun States, southwestern Nigeria. The samples comprised of nine samples of Ofada rice and six samples of Abakaliki rice. Samples were collected from rice stored in jute sacks. 500 g of sample was randomly drawn and from each batch of samples, representative sample weighing about 50 g was obtained and used for the study.

The samples were surface sterilized by dipping in 1% NaOCl solution for one minute, followed by three successive rinses in sterile distilled water. Isolation of fungi was done using the direct plating method described by Pardo et al. (2004). About 5 g (10 grains) of the surface-sterilized grains from each sample were plated on Potato Dextrose Agar complemented with 0.5% chloramphenicol (PDAC) and incubated at 25°C for about seven days. Axenic culture of each isolate was obtained by subculturing on fresh PDAC plates. Identification of the isolated fungi was done based on colony morphology and microscopic examination. Observations were recorded on colony colour, structure, shape, size and pigment and structure of mycelium, its branching, presence of conidiophores, sclerotia and shape which were compared with literature (Pitt and Hocking, 1997; Samson et al., 2004). The experiments were repeated in triplicates.

RESULTS AND DISCUSSION

Thirteen different fungal species were isolated from the rice samples viz., *Actinomycetes spp., Aspergillus niger, Aspergillus flavus, Aspergillus tamarii, Cladosporium sphaerospermum, Fusarium compacticum, Fusarium oxysporum, Fusarium proliferatum, Penicillium citrinum, Penicillium oxalicum, Rhizopus nigricans, Rhizopus oryzae* and *Saccharomyces cerevisiae.*

The fungal species isolated from the Ofada rice were *Actinomycetes* spp., *A. flavus, A. niger, A. tamarii, C. sphaerospermum, F. compacticum, F. oxysporum*, *F. proliferatum, P. oxalicum, R. nigricans, R. oryzae and S. cerevisiae*. The Abakaliki rice was contaminated with *A. flavus, A. niger, A. tamarii, F. compacticum, F. oxysporum*, *F. proliferatum, Penicillium citrinum*, *P. oxalicum, R. nigricans, R. oryzae and S. cerevisiae*.

Table 2. Frequency of occurrence of the fungal isolates.

Isolates	Frequency (n=15)	Incidence (%)
Actinomycetes spp.	1	6.7
Aspergillus niger	12	80
A. flavus	6	40
A. tamari	3	20
Cladosporium sphaerospermum	3	20
Fusarium compacticum	2	13.3
F. oxysporum	2	13.3
F. proliferatum	2	13.3
Penicillium citrinum	2	13.3
P. oxalicum	5	33.3
Rhizopus nigricans	11	73.3
R. oryzae	4	26.7
Saccharomyces cerevisiae	3	20

Table 1 shows the fungal species isolated from Ofada and Abakaliki rice.

Aspergillus (93.3%) was the predominant genera, followed by *Rhizopus* (86.7%), *Penicillium* (46.7%), *Fusarium* (40%), *Cladosporium* (20%), *Saccharomyces* (20%) and *Actinomycetes* (6.7%) . The frequency of the isolated species is shown in Table 2.

Seven of the isolated fungi were classified as storage fungi and four as field fungi according to Christensen and Kauffmann (1965a). The field fungi isolated were *C. sphaerospermum, F. compacticum, F. oxysporum* and *F. proliferatum*. Field fungi infect grains on the field before harvest and they grow at moisture levels prevailing at relative humidity > 90% (Mills et al., 1978). The result of this study is similar to that of Desjardins et al. (2000) who reported prevalence of *Fusarium* in Nepalese rice. Among the species of *Fusarium* isolated from the Nepalese rice were *Fusarium verticillioides, Fusarium fujikuroi* and *F. proliferatum*. However, the incidence of field fungi reduces considerably during storage due to their location on the outer tissues of the grains when they infect grains in the field (Mondal et al., 1981). Also, as the

environmental requirements for the growth of the field fungi are different, the field fungi are eliminated during storage and the population of storage fungi increases (Bankole et al., 1999). The storage fungi isolated in the present study were *R. oryzae, R. nigricans, P. citrinum, P. oxalicum, A. niger, A. flavus* and *A. tamarii*. The storage fungi might have contaminated grains during harvest, or any other phase of processing such asdrying, milling or winnowing.

Aspergillus (93.3%) was the most abundant genera with three species namely *A. niger, A. flavus, A. tamarii*. The other predominating storage fungi were *Rhizopus* (86.7%) and *Penicillium* (46.7%) . This is similar to a report of Bankole (1993) who isolated *Aspergillus, Rhizopus, Penicillium* and *Rhizomucor* from two species of melon seeds stored for up to one year. Berghofer et al. (2003) had reported *Aspergillus* and *Penicillium* in wheat meant for flour production. In polished Korean rice meant for human consumption, Park et al. (2005) reported *P. citrinum* and *Aspergillus candidus* as the most prevalent. The abundance of storage fungi may be due to low relative humidity and reduced moisture levels that prevail during storage (Christensen and Kaufmann, 1965b).

Conclusion

The study indicated that fungi are common contaminants found in Ofada and Abakaliki rice during storage and species of *Aspergillus* are the predominant. Since some of the isolated fungi have been reported to be mycotoxin-producers, further study should be done to assess the occurrence of mycotoxins in Ofada and Abakaliki rice. Considering the huge economic importance of mycotoxins, the growth of mycotoxigenic fungi must therefore be prevented or at least reduced, so as to minimize the exposure of consumers to the dangerous health effects of mycotoxins in foods.

REFERENCES

Aboaba OO, Amasike J (1991). Storage of melon seeds. Nig. J. Bot. 4: 213-219.

Berghofer LK, Hocking AD, Mishelly D, Jansson E (2003). Microbiology of wheat and flour milling in Australia. Inter. J. Food Microbiol. 85(1-2): 137-149.

Bankole SA (1993). Moisture content, mould invasion and seed germinability of stored melon seed. Mycopathologia, 122: 123-126.

Bankole SA, Ikotun B, Ekpo EJA (1999). Fungal deterioration of melon seeds stored in jute sacks and polyethylene bags in Ago-Iwoye, southwestern Nigeria. Mycopathologia, 146: 135-146.

Bhat RV, Vashanti S (2003). Food Safety in Food Security and Food Trade. Mycotoxin Food Safety Risk in developing countries. Focus 10. Brief 3 of 17.

Christensen CM, Kauffmann HH (1965a). Deterioration of stored grains by fungi. Annual Rev. Phytopathol. 3: 69-84.

Christensen CM, Kauffmann HH (1965b). Maintenance of quality in stored grains and seeds. Agricultural Extension Service, University of Minnesota Extension Folder, 226: 4.

Desjardins AE, Manandhar HK, Plattner RD, Manandhar GG, Poling SM, Maragos CM (2000). *Fusarium* species from Nepalese rice and production of mycotoxins and Gibberellic acid by selected species. Appl. Environ. Microbiol. 66(3): 1020-1025.

Food and Agricultural Organization (FAO) (2004). Rice. Available on www.fao.org/rice2004/en/rice2.html) Accessed on December 20, 2005.

Janick J (2002). Tropical Horticulture. Purdue University. (Available on www.hort.purdue.edu/newcrop/tropical/lecture20/rice.html) Accessed on December 20, 2005.

Maxiya-Dixon B (2004). Effects of mycotoxins on nutritional quality of food crops. International Institute of Tropical Agriculture, Ibadan, Nigeria.

Mills JT, Sinha RN, Wallace HAC (1978). Assessment of quality criteria in stored rapeseed, a multivariate study. J. Stored Prod. Res. 14: 121-133.

Mondal GC, Nandi D, Nandi B (1981). Studies on deterioration of some oil seeds in storage I: Variation in seed moisture, infection and seed germinability. Mycologia, 73: 157-166.

Orsi RB, Correa B, Possi CR, Schammass EA, Nogueira JR, Dias SMC, Malozzi MAB (2000). Mycoflora and occurrence of fumonisins in freshly harvested and stored hybrid maize. J. Stored Prod. Res. 36(1): 75-87.

Pardo E, Marın S, Ramos AJ, Sanchis V (2004). Occurrence of ochratoxigenic fungi and ochratoxin A in green coffee from different origins. Food Sci. Technol. Int. 10: 45-49.

Park JW, Choi SY, Hwang H, Kim Y (2005). Fungal mycoflora and mycotoxins in Korean polished rice destined for humans. Int. J. Food Microbiol. 103: 305-314.

Pitt JI, Hocking AD (1997). Fungi and food spoilage. Blackie Academic and Professional, an imprint of Chapman and Hall, Second Edition p. 593.

Sales AC, Yoshizawa T (2005). Updated profile of aflatoxin and *Aspergillus* Section *Flavi* contamination in rice and its byproducts from the Phillipines. Food Additives and Contaminants 22(5): 429-436.

Samson RA, Hoekstra ES, Frisvad JC (2004). Introduction of food-borne fungi. Seventh Edition. Centraalbureau voor Schimmelcultures. p. 389.

USA Rice Federation (2002). Rice Nutrition. (Available on www.usarice.com/foodservice/nutrition.html). Accessed on December 20, 2005).

West Africa Rice Development Association (WARDA) (2002). Nigeria's Potential in the Rice Sector. WARDA and the role of rice in Nigeria. Available online on: www.warda.cgiar.org/News/Nigeria2002.htm). Accessed on December 20, 2005.

Wu F (2008). A tale of two commodities: how EU mycotoxin regulations have affected U.S. tree nut industries. World Mycotoxin J. 1(1): 95-102.

Wudiri BB (1992). Developing appropriate rice processing technologies for Nigeria: the NCRI experience. *In*: Rice Processing in Nigeria. Proceedings of the MFA Workshop in Niger State. Babaleye, T and Nwachukwu, I. (eds). IITA, Ibadan. pp. 24-31.