Fungi Associated with the Deterioration of Garri (a traditional fermented cassava product) in Ogun State, Nigeria.

B.T.Thomas, H.I.Effedua, A.Davies and A.Oluwadun

1.Department of Medical Microbiology and Parasitology, Olabisi Onabanjo University Ago Iwoye, Ogun State, Nigeria.
benthoa2013@gmail.com

ABSTRACT: Garri is an African traditional fermented food product prepared from cassava that is widely consumed by both rural and urban dwelling people with little or no concern about the fungal mycoflora that are associated with its deterioration. This research determined the fungi that are associated with the deterioration of garri in Ogun state,Nigeria using a total of 400 samples (200 each of white garri and 200 each of yellow garri) purchased between February –November, 2010. The isolation and identification of the fungal isolates were by standard microbiological techniques. Fungal contaminants of commercially collected white garri samples were *Aspergillus niger* (42%), *Aspergillus flavus* (33%) and *Penicillium* species (25%) while in yellow garri, the prevalence rate of fungi were *Aspergillus niger* (39%), *Aspergillus fiavus* (34*%), Penicillium* species (18%) and *Saccharomyces cerevisiae* (9%). The frequency of occurrence of the isolated fungi were compared for both yellow and white garri and it was observed that the mean frequency of occurrence of *Aspergillus niger* and *Penicillium* species were significantly higher in white garri than in yellow garri ($P<0.05$) while *Aspergillus flavus* was found to be significantly higher in yellow garri that in white garri ($P<0.05$). It can be concluded that, the garri samples analyzed were contaminated with different potential mycotoxigenic moulds. [B.T.Thomas, H.I.Effedua, A.Davies and A.Oluwadun **Fungi Associated with the Deterioration of Garri (a traditional fermented cassava product) in Ogun State, Nigeria.** Researcher. 2012;4(2):8-12]. (ISSN: 1553-9865). http://www.sciencepub.net. 3

Keywords: Fungi, Garri, Deterioration

1. Introduction

Garri is the most popular cassava food product in Africa (Oluwole *et al*., 2004), that is widely consumed in both rural and urban areas (FAO, 2010). To prepare this food, fresh cassava roots are peeled, washed and grated. The resultant pulp is put in a porous sack (poly propylene bag) and weighed down with a heavy object or hydraulic press while it is fermenting. The dewatered and fermented lump of the pulp is pulverized, sifted and the resulting semi dried mash is toasted in a pan (Nweke *et al.*, 2002). The final granulated product is preferred because it can be consumed dry or with cold water and/or reconstituted with hot water to form dough which is eaten with soup (Oluwole *et al.*, 2004). However, the practices that are associated with its production, processing and post processing handling of garri such as spreading on the floor, mats, display in open bowl in the markets, sale points, and use of various packaging materials to haul finished products from rural to urban areas may exacerbate microbial contamination (Ogiehor and Ikenebomeh, 2006). These microbial contaminants may serve as a source of food borne diseases (Islam *et al.*, 1993;Maria *et al.*, 2001;Venugopal,2001;Ellin, 2002;Omar *et al.*,2003).These mycocontaminants are also of practical significance to producers, processors and consumers because of their ability to alters the chemical composition of the food they are infecting (Akano *et al.*, 1986). According to Basilico *et al.* (2001) and Magnoli *et al*.(2006), fungal contaminants represents substantial effect in stored food stuffs including discolouration, losses in nutritional value, production of offodours, deterioration in technological quality and contamination with mycotoxin. In view of this, there is need to determine the fungi that are associated with the deterioration of garri samples in Ogun State, Nigeria.

2. Materials and Methods

2.1. Study Area: Ogun State, which was the study site constitute one of the largest production and consumption area of garri samples in Nigeria. It is a State in South Western part of Nigeria and it borders Lagos State to the South, Oyo and Osun State to the North, Ondo State to the East and Republic of Benin to the West. This State is made up of twenty local government areas and it have a total area of 16,762 km^2 with over four million people (Thomas *et al*., 2012).

2.2. Sample Collection: A total of 400 samples (200 each of white and yellow garri) were purchased between February-November, 2010. Samples were collected randomly at regular intervals throughout the

study period from 20 selected markets in the four geopolitical zone of Ogun State, Nigeria.

2.3. Microbiological Examination

2.3.1. Preparation of Initial Suspension

This was prepared using the method described by ISO 68877-1 (1999) with slight modification. 10g of each sample was added to 90ml of glucose broth and homogenized by swirling at medium speed. Serial decimal 10 fold dilution were prepared by transfer of one millimeter of initial suspension into a tube containing 9ml of glucose broth. These operation were repeated using a new sterile pipette to obtain 10^{-2} through 10^{-10} dilutions.

2.3.2. Isolation and Identification of Fungi

The suspension of the samples prepared above were inoculated on Sabouraud Dextrose Agar (Samson *et al.*,2004). The plates were incubated at 27ºC for 72 hours after which slide cultures were prepared for microscopic examination and the fungi isolates were identified (Pitt and Hocking,1997).

2.4. Statistical Analysis

The frequency of occurrence of the fungi isolated from the examined garri samples were calculated using the formula,

$$\text{Frequency (\%)} = \frac{n}{N} \times \frac{100}{1}$$

Where n = number of occurrence of fungal species/genus

N = Total number of fungi isolated. Student t test was used to evaluate the relative frequency of occurrence of fungi in Yellow and White garri

3. Results

The fungal contaminants in white garri were represented by *Aspergillus niger* (42%), *Aspergillus flavus* (33%) and *Penicillium* species (25%) while in yellow garri, the prevalence of fungi were *Aspergillus niger* (39%), *Aspergillus flavus* (34%), *Penicillium* species (18%) and *Sacchromyces cerevisiae* (9%) (Table 1). The frequency of occurrence of the isolated fungi were compared for both yellow and white garri and it was observed that the mean frequency of occurrence of *Aspergillus niger and Penicillium* species were significantly higher in white garri than in yellow garri ($P<0.05$). *Aspergillus flavus* was however higher significantly in yellow garri than in white garri ($p< 0.05$) while *Saccharomyces cerevisiae* was recovered from yellow garri only.

Table 1. Prevalence of Fungi Isolated from the examined garri samples

Number	Fungi	White Garri	Yellow Garri
1.	*Aspergillus niger*	42%	39%
2.	*Aspergillus flavus*	33%	34%
3.	*Penicillium species*	25%	18%
4.	*Saccharomyces cerevisiae*	-	9%

Table 2. Relative Frequency of Occurrence of Fungi Found Associated With Marketed Garri Samples From Twenty Selected Markets in the Four Geopolitical Zones of Ogun State, Nigeria.

Number	Fungi isolate	Frequency (%) ± SEM			
		White Garri	Yellow Garri	t value	P value
1.	AN	0.42 ± 0.00	0.39 ± 0.00	3.00	<0.05
2.	AF	0.33 ± 0.00	0.34 ± 0.00	-1.00	<0.05
3.	PS	0.25 ± 0.00	0.18 ± 0.00	7.00	<0.05
4.	SC	0.00 ± 0.00	0.09 ± 0.00	-19.0	<0.05

Table 3. Occurrence of Fungi in the examined white garri samples

Number	Markets	AN	AF	PS	SC
1.	Ilaro	-	+	-	-
2.	Owode Yewa	-	+	-	-
3.	Oja Odan	+	-	-	-
4.	Igbogila	-	+	-	-
5.	Ibese	-	+	-	-
6.	Obada Idieme	+	-	-	-
7.	Joga	+	-	-	-
8.	Ayetoro	-	+	-	-
9.	Ijohun	+	-	-	-
10.	Itosin	+	-	-	-
11.	Kuto	-	-	+	-
12.	Owode Egba	-	+	-	-
13.	Ago Iwoye	+	-	-	-
14.	Ijebu Igbo	+	-	-	-
15.	Oru	-	-	+	-
16.	Mamu	+	-	-	-
17.	Oja Oba, Ijebu-Ode	-	-	+	-
18.	Ilishan	-	-	+	-
19.	Sabo Sagamu	-	+	-	-
20.	Iperu	-	-	+	-

Table 4. Occurrence of Fungi in the examined yellow garri samples

Number	Markets	AN	AF	PS	SC
1.	Ilaro	+	-	-	-
2.	Owode Yewa	+	-	-	-
3.	Oja Odan	+	+	-	-
4.	Igbogila	-	-	+	-
5.	Ibese	-	-	+	-
6.	Obada Idieme	-	-	+	-
7.	Joga	-	-	+	-
8.	Ayetoro	+	-	-	-
9.	Ijohun	-	-	-	+
10.	Itosin	-	-	-	+
11.	Kuto	+	-	-	-
12.	Owode Egba	-	+	-	-
13.	Ago Iwoye	+	-	-	-
14.	Ijebu Igbo	+	-	-	-
15.	Oru	+	-	-	-
16.	Mamu	-	+	-	-
17.	Oja Oba, Ijebu-Ode	-	+	-	-
18.	Ilishan	-	+	-	-
19.	Sabo Sagamu	-	+	-	-
20.	Iperu	-	+	-	-

AN = Aspergillus niger, AF = Aspergillus flavus, PS = Penicillium species, SC = Saccharomyces cerevisiae

4. Discussion

The result of this study depicted that these products (yellow and white garri) harbor arrays of fungal contaminants. Some of these fungi have been reported in various stored foods (Adeniji,1976; Oyeniran,1980;Akano *et al.*, 1984;Akano *et al.*,1986;Edward and Oyedeji,1992; Ogeihor and Ikenebomeh, 2005). The level of mould

contamination recorded in this study may be due to contamination as a result of local method of processing (Amadi and Adebola, 2008). According to Ogeihor and Ikenebomeh (2005), the practices that are associated with the production, processing and post processing handling of garri may be responsible for its contamination while their growth in the food results in changes in the organoleptic, microbiological and nutritive quality and subsequently spoilage. On the other hand, the presence of the isolated fungi in food suggest an imminent public health danger since their metabolites (mycotoxins), if produced in food (Jayeola and Oluwadun, 2010) like garri may lead serious and devastating clinical conditions in the consumers. *Aspergilli* which were the most predominant in our study are among the most abundant and widely distributed organisms on earth (Bennet and Klich, 2003). Member of this genus are saprophytic moulds living in the environment without causing disease (Cheesborough, 2005). Virtually, all the common *Aspergilli* have been recovered at one time or the other from different agricultural products (Samson *et al.,* 2000.) *Aspergillus niger* have the highest occurrence in both yellow and white garri. This ubiquitous species is commonly isolated from soil, plant litter, seeds, dried fruits and nuts (Samson *et al.,*2001). It is one of the most commonly reported fungi from foods and indoor environments (Pitts and Hocking, 1997) with ability to produce ochratoxin A as its major mycotoxins (Klich, 2002). *Aspergillus flavus* which were also recovered in this study from both yellow and white garri have also been isolated from peanuts, corns, grains and other foods (Cheesborough, 2005). *Penicillium* species is an uncommon pathogens in humans. It has however, been reported as a common opportunistic pathogen causing systemic penicilliosis in AIDS patient in Thailand, Southern China and other part of Southern Asia (Cheesborough, 2005). Also, their presence in food put the consumer at risk of ingesting mycotoxin which have been reported to be nephrotoxic at 0.2ppm in pigs and 4ppm in broilers. They may also cause tremors, coagulopathy and enteritis (Ojo, 2009). The occurrence of *Saccharomyces cerevisiae* in yellow garri and its absence in white garri may be due to a better microenvironmental condition in yellow garri which might have been enhanced as a result of addition of palm oil to it. *Saccharomyces cerevisiae* is well known for converting carbohydrates into alcohol and other aroma compounds such as esters, organic acids and carbonyl compounds (Toner *et al.*, 1992). Their presence in food sometimes represent assimilation of glucose, galactose and lactic acid (Yamani and Abu-Jaber, 1999). The role of *Saccharomyces cerevisiae* as a clinically important pathogen has been unclear but a lot of invasive infection with *Saccharomyces cerevisiae* have been reported. Some of this infection resulted in pneumonia, liver abscess and sepsis. Disseminated infection with cardiac tamponade, severe immunosuppression, prolonged hospitalization, prior antibiotic therapy and/or prosthetic cardiac value are setting where *Saccharomyces* infection has been observed (John *et al.,*1990). The result of this study therefore showed that most fungi associated with the deterioration of garri samples are xerophilic moulds such as *Aspergillus niger, Aspergillus flavus and Penicillium* species. It is henceforth important to develop a strategy to antagonize their growth and survival in this food in order to neutralize the potential of these organisms serving as agents of food borne diseases.

Correspondence to:
B.T.Thomas
Department of Medical Microbiology and Parasitology,
College of Health Sciences,
Olabisi Onabanjo University, P.M.B 2002, Sagamu, Ogun State, Nigeria.
Tel. +234-806-401-1412.
Email: benthoa2013@gmail.com

REFERENCES

1.Adeniji MO. Fungi Associated with the Deterioration of Garri. *Niger.J.Plant Prote.*1976;**2**:74-77.
2.Akano DA, Afolabi JF, Kuka FO. Moisture and micro flora content of cassava flour stored in plastics containers. *Rep.Nig.Stored Prod.Res.Inst.Tech Report.*1984; 7:68-73.
3.Akano DA, Afolabi JF, Opadokun JS. Long term storage of garri. *Rep.Nig.Stored Prod.Res.Inst.Tech,Report*. 1986;2:40-43.
4.Amadi JE and Adebola MO . Effect of moisture content and storage condition on the stability of garri. *African Journal of Pure and Applied Sciences.* 2008; 7(24):4591-4594.
5.Basilico JC, De Basilica MZ, Chierizatti C, and Vinderola CG. Characterization and Control of Thread Mould in cheese. *Letters in Applied Microbiology*.2001;32: 419-423.
6.Cheesebrough LM. Identification of bacteria.In: Medical Laboratory manual for tropical countries. Vol II. Butterworth & Co. Publishers.London, UK 1985: 63-69.
7.Edward AWA, Oyedeji NO. Variation in population dynamics of microflora of garri

in storage. *Nig .J. Pure App.sci*.1992;7:199-209.

8.Ellin M. Survival and growth of bacterial pathogens on raw meat during chilling. *Food Research Institute*. 2002;8:1-4.

9.Food and Agriculture Organization. Agriculture Statistics For Food and Agriculture organization. *News Bulletin*.2010;1-10.

10.Islam MS, Hassan MK, and Khan SI. Growth and survival of *Shigella flexneri* in common bangladeshi foods under various conditions of time and temperature. *Applied Environmental Microbiology.*1993;59:652-654.

11.International Organisation for standardization. microbiology of food and animal feeding stuffs-preparation of test samples, initial suspension and decimal dilutions for microbiological examination – part 1. general rules for the preparation of the initial suspension and decimal dilutions (ISO 6887-1:1999). Switzerland: International Organisation for standardization 1999.

12.Klich MA. Differentiation of *Aspergillus flavus* from *A. parasiticus* and other closely related Species. *Trans Br Mycol Soc.2002;* 91: 99-108.

13.Maria LA, Rafael MR, Carolina C and Florencia A. 2001. Effect of storage temperatures on growth and survival of *Escherichia coli* 0157:H7 inoculated in foods from a neotropical environment. *Rev. Biol. Trop.*,49(2): 517-524, 2001

14.Magnoli C, Hallak C, Astoreca A, Ponsone L, Chiazchiera S, and Dalcero AM. Occurrence of ochratoxin A producing fungi in commercial com kernels in Argentina. *Mycopathologia*. 2006;161: 53-58.

16.Nweke FI, Spencer DSC and Iynan JK.The Cassava Press East Lansing USA 2006;7-206.

17.Ogiehor IS and Ikenebomeh MJ. Extension of shelf life of garri by hygienic handling and sodium benzoate treatment. *Afri. J. Biotechnology.* 2005;4(7): 744-748.

18.Ogiehor IS and Ikenebomeh MJ. The effect of difference packaging materials on the shelf stability of garri. *African Journal of Biotechnology.*2006;523:2412-2416.

19.Ojo MO. Foods and Animals-borne Diseases, Microbes, Human and Animals. Vol I.Dart Ventures, Ibadan, Nigeria,2003:64:77.

20.Olumide OB, Olatunji OO and Odunfa SA. A process technology for conservation of dried cassava chips with garri. *Nig. Food J.* 2004; 22: 65-73.

21.Omar AO, Mara C, Nogueira L, David EG. Survival of *E.coli* 0157:H7, *Listeria monocytogenes* and *Salmonella* in juice concentrates. *Journal of Food Protection.* 2003;66(9): 1595-1598.

22.Oyeniran JO. Mould development in garri during storage in polythene bags. *J.Agric.Sci.*1980; 2(2):151-155.

23.Pitt JI and Hocking AD. Current knowledge of fungi and mycotoxins associated with food commodities in Southeast Asia. *ACIAR Technical Reports. 1980;*37: 5-10.

24.Samson RA, Hoekstral ES, Frisvad JC and Filtenborg O. Fungi and Foods. The Netherland .2000;1-32.

25.Thomas BT, Effedua HI, Agu GC, Oluwadun A. Prevalence of antibiotic resistant bacteria in dried cassava powder (garri) circulating in Ogun State, Nigeria. *Academia Arena.* 2012;4(1):9-13.

26.Turner BM, Birley AJ, Lavender J. Histone H4 isoforms acetylated at specific lysine residue define individual chromosomes and chromatin domain in Drosophila *Nuclei*.1992; 69:375-384.

27.Venugopal MN, Karunasagar I and Varadaraj MC. Growth and survival of Kanagawa positive *Vibro parahaemolyticus* in fish and prawn Preparations held at ambient and elevated temperature. *Asian Fisheries Science.* 2001;14(200): 83-88

28.Yamani MI and Abu-Jaber M. Yeast Flora of Labaneh produced by in bag straining of cow milk set youghurt. *J.Dairy.Sci.*1994; 77:3558-3564.

1/10/2012