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TECHNICAL SHEET TO IDENTIFY OF MOULDS RESPONSIBLE FOR THE ALTERATION OF CASSAVA ROOTS AFTER HARVESTING DURING STORAGE

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ABSTRACT
In Côte d'Ivoire, cassava (*Manihot esculenta Crantz*) is a very important product used for the production of several dishes. However, cassava roots are strongly affected by microorganisms; especially mould after it is harvested during storage or conservation. For the reason, 75 mould strains were isolated cassava roots after 2 weeks of conservation at room temperature (37°C). The objective of the present study was to identify the moulds responsible of cassava spoilage during the storage in order to ensure the consumer safety. Results have showed that the presumptive identification of these moulds had allowed to obtain 6 moulds types including 32% *Mucor* ; 22,66 % *Fusarium* ; 10,66 % *Geotrichum* ; 2,66 % *Alternia*; 5, 33% *Cladosporium* and 26,66 % *Aspergillus*. These moulds were capable of producing mycotoxins to harm the health of the consumer.

KEYWORDS: cassava, moulds, presumptive identification, conservation at room temperature.

INTRODUCTION
Cassava, the enlarged root of *Manihot esculenta* Crantz is an important staple food for about 80% of Côte d'Ivoire's population, especially those living in Southern. It has important agronomic advantages such as high yields in poor soils, resistance to drought and diseases, storability in the soil after maturity and comparatively high yield of starch, in comparaison with other starchy sources such as yams (Kouadio *et al.*, 1991). In Côte d'Ivoire, annual cassava production is estimated at 4.56 million tonnes and consumption at 100-110 Kg/year per urban inhabitant (FAO, 2018). Indeed, cassava is used for the production of several finished products classified in two main categories, including non-fermented products such as foutou, attoupkou, braised roots, croquettes and fermented products such as gari, fûfû, placali, attiéké, *etc*. (Kakou, 2000; Yéboué *et al*., 2017). However, cassava-based foods production from cassava was affected by spoilage micro - organisms after storage at room temperature. Microbiological point view from, post-haverst losts were associated to the moulds development, which were able to produce the mycotoxins (Montet *et al.*, 2014). Considering the importance of this food for our populations and the world's growing demand for food and also to avoid or limit food borne diseases, it is crucial to characterize characterise the moulds involved in cassava post-harvest losts in order to ensure consumer safety. Thus, the purpose objective of the present study was to identify the moulds responsible of cassava spoilage during the storage.

MATERIALS AND METHODS
Materials
The cassava fermented samples with moulds growth were collected at the Attieke (cassava food made from the bitter variety IAC (Improved African Cassava), women producers (figure 1).

FIGURE 1. Traditional cassava leaven

METHODS

Sample Source and Moulds isolation

Samples used in the study were collected from three commons (Adjame, Abobo, Yopougon) in Abidjan of Côte d'Ivoire. Two (2) attieke production units within each common were randomly selected and samples collected from processors within these units. In all, 6 samples were collected for isolate moulds samples were collected after two weeks of storage at room temperature from attieke producers. All samples collected were then transported in an icebox directly to the laboratory for analyses. Thus, the moulds isolation was achieved through direct contact according to the method of Djossou et *al*. (2011).The parts of the roots affected by decay have been selected using a microbiological loop to be sown on Potato Dextrose Agar (PDA) gelose with Chloramphenicol (CHL). Petri dishes were then inoculated in an oven at 25°C for 2 to 5 days for isolation of mesophilic moulds. Colonies with fluffy, cottony and powdery forms have been selected for identification. A total of 75 isolates (25 isolates per site) were observed, described and identified.

Moulds identification

Microscopic examination was performed according to the method described by Guiraud *et al*. (1998). The selected fungus was removed with a forceps and placed in a drop of methylene blue, next placed on a slide and covered with a coverslip to be observed under an optical microscope at the objective X 100. The characters observed were the appearance of the mycelium, the shape of the spores, the shape of the conidial heads and the size of the conidiospore after description of the mould strains, a description reference sheet was used to identify the isolated moulds.

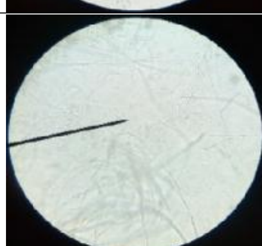
Analyze statistics

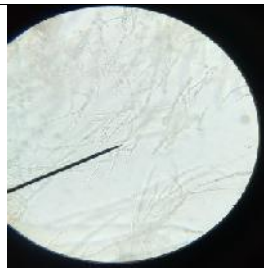
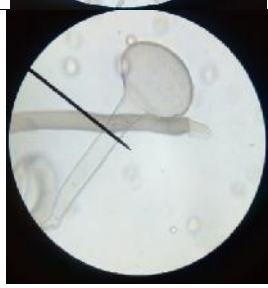
The data obtained were subjected to analysis of variance (Statistica, 99 Edition Alabama, USA). This software made it possible to group the moulds according to their microscopic characteristics described. Calculations and figures were performed using EXCEL 2003 (XP-Microsoft Corp).

RESULTS AND DISCUSSION

Moulds are fungus-like microorganisms, ubiquitous in the form of spores in our daily environment. Any food, whether processed or not, can thus be the seat of these cells. In fact, the appearance of mold often occurs when the food is left outdoors, when it is hot, or even in a humid climate. Indeed, the appearance of mould is not in itself a danger, but it is the mycotoxins they can produce that represent a real health hazard, which can lead to food poisoning (Lecellier, 2013). Thus in our study, the objective is to identify the moulds responsible for the deterioration of cassava roots after harvesting during 2 weeks of storage at room temperature (37°C). For this purpose, microscopic examination of mould isolates was performed, and the characteristics observed were the appearance of the mycelium, the shape of the spores, the shape of the conidial heads and the size of the conidiospore (Table 1). In addition, typical moulds detected in cassava roots after conservation were the genera *Mucor, Fusarium, Geotrichum, Alternia, Cladosporium and Aspergillus* (Table 1).

TABLE 1 : presumptive identification of moulds responsible for the deterioration of cassava roots post-harvest

Strains	Microscopic observation	Morphological characterisitc	Mould genera
ABO3S2		**Mycelium:** cloisonned **Spores:** cylindrical ovoid **Sporocystophores:** unbranched	***Mucor***
ADJ1S1		**Mycelium** : cloisonned **Conidia**: round **Conidiophore** : joined in packages	***Fusarium***
ADJ3S1		**Mycelium** : cloisonned **Conidia :** cylindrical, barrel-shaped to ellipsoidal **Arthrospores:** thick-walled.	***Geotrichum***

ADJ4S2		**Mycelium:** dark cloisonned **Conidia:** dark with variable shapes **Conidiophore:** elongated	***Alternaria***
YOP2S1		**Mycelium:** dark, Cloisonned **Conidia:** branched chains **Conidiospore:** septate	***Cladosporium***
YOP4S1		**Head:** colorless spherical **Mycelium:** not Cloisonned **Conidia:** round **Conidiophore:** colorless smooth	***Aspergillus***

This result is in agreement with that of Obadina *et al*. (2007, 2009), who detected the same genera in fufu stored at different temperatures. Indeed, most mould species grow in a temperature range between 4 and 40°C. The ideal value for their development is between 24 and 30°C (Obadina *et al*., 2009). In addition, the proliferation of moulds, whether pathogenic or not, leads to adverse changes in dietary and organoleptic characteristics, such as appearance, texture, smell and taste of food, with significant economic consequences in the food industry (Lecellier, 2013). In addition, some genera are capable of producing lethal and heat-resistant toxins (Yandju et *al*., 1995). The presumptive identification of these moulds indicated that 22.66% of the moulds were of type *Fusarium* and 26.66% were of type *Aspergillus* (Figure 2).

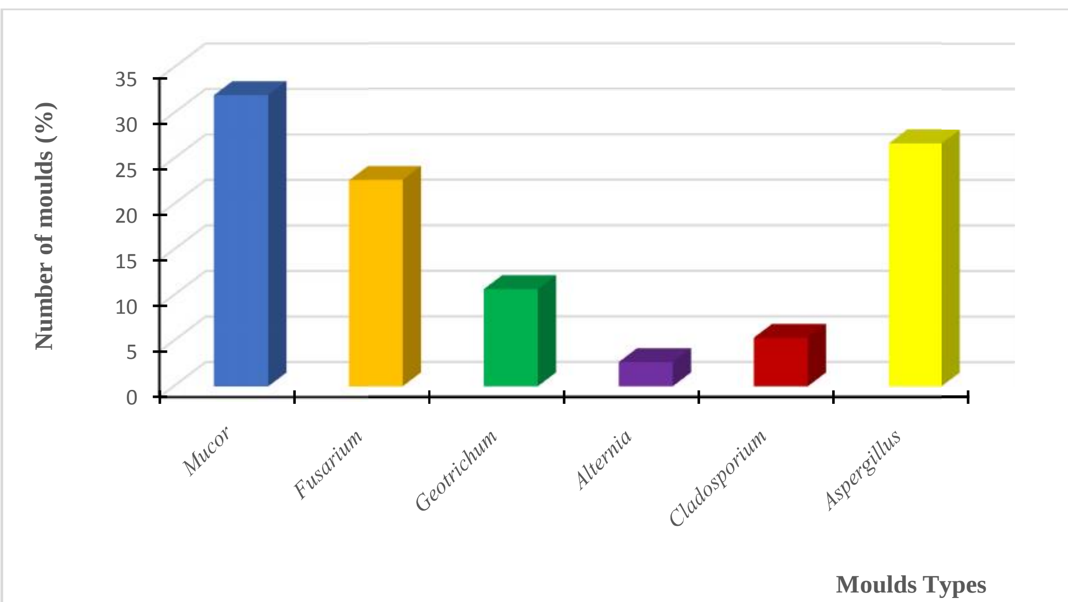


FIGURE 2: regrouping of the types of moulds identified

These moulds were capable to liberate mycotoxins in the food which have important health consequences (Guiraud, 2012). According to Cahagnier *et al*. (1998); Doyle et *al*. (1998); Meyer et *al*. (2004), several moulds including the genera *Aspergillus* and *Fusarium* are known to be contaminants of agricultural products and/or for their ability to produce toxic secondary metabolites. So, particular attention must be accorded to any moulds capable of causing food poisoning.

CONCLUSION

This study made it possible to characterize the mould isolates involved in the deterioration of the cassava roots after harvest. These isolates are grouped into six (6) according to their microscopic description. The types of mould found after description were the types *Mucor; Fusarium; Geotrichum; Alternia; Cladosporium and Aspergillus.* This identification remains presumptive, so a molecular identification will be appropriate

DISCLOSURE OF INTEREST

The authors declare that they have no competing interest.

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