SHORT COMMUNICATION

Mycological Quality of Packaged Ginger Spiced Peanut Cake (*Kuli kuli*) Sold in Umuahia Metropolis, Abia State, Nigeria

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Abstract: *Kulikuli* (peanut cake) is a known street snacks prone to fungal infestation due to poor production, handling and storage measures. The study aimed at evaluating the fungal quality of packaged and ginger spiced *kulikuli* consumed in Umuahia, metropolis, Abia State. Twenty four samples of *kulikuli* were sourced randomly from markets and supermarkets in Umuahia. Standard methods were adopted to assay the incidence of fungi, fungal load and moisture content of the *kulikuli* samples. Fungal isolates were identified based on their microscopic and cultural morphology. The moisture content ranged from 4.4 ± 0.03 - 6.3 ± 0.2%, and the total fungal load ranged from 1.7 ± 0.5 - 5.2 ± 0.7 x 10^5 CFU/g. Forty eight morphologically distinct fungi that belong to 5 genera (*Mucor*, *Aspergillus*, *Penicillium*, *Rhizopus* and *Fusarium*) were isolated. *Aspergillus* had the highest percentage of occurrence (35.4 %) and the least occurring genus was *Fusarium* (8.3%). The least numbers of fungi 4 (8.3%) was recovered from packaged ginger spiced samples. This study suggest that *kulikuli* should be properly handled, packaged and spiced with appropriate quantity of herbs so as to reduce mould contamination of the snacks.
Keyword: *Kulikuli*; Fungi; Packaged; Ginger, Contamination.

INTRODUCTION

Peanut cake commonly known as *kulikuli* is a product of groundnut. *Kulikuli* is an indigenous snacks widely consumed by old and young in the West African coast (Ezekiel *et al*., 2011; Mupunga *et al*., 2017). The process of production of *kulikuli* involves frying of the peanut (groundnut), milling into paste, extraction of oil and then frying or baking the chunk (Adjou *et al*., 2012).

Just as the raw material (groundnut), *kulikuli* contains high protein and crude fat (Ezekiel *et al*., 2011). It is an affordable street food which helps in meeting the essential nutritional needs of the teeming population of the West African coast (Mupunga *et al*., 2017) especially Nigeria. *Kulikuli* is not just consumed by humans only, but also used in the formulation of poultry feed (Ademola *et al.,* 2015).

The high nutritive content and moderate moisture content of *kulikuli* made it a good substrate for the growth of fungi. Fungal contamination of *kulikuli* might take place during production, storage and sells. Among the fungal contaminants previously reported on groundnut and groundnut products are fungi of genera *Aspergillus*, *Fusarium* and *Penicillium.* Most members of these genera are known producers of mycotoxins. Mycotoxins are toxins of fungal origin produced during secondary metabolism that are harmful to humans and animals when ingested (Ráduly *et al*., 2020).

Due to market competition, some producers have devised a way of enhancing their end product acceptability by spicing their *kulikuli* with some herbs such as garlic, ginger, cinnamon etc. Some researchers have reported the ability of some of these herbs and spice to repress the growth of fungi (Agbebi *et al*., 2013; Ayoade & Adegbite, 2016; Chuku, 2014). Some producers and vendors also properly package the *kulikuli* snacks in a sachet or container before sells. Despite these practices being common these days, there is paucity of data on its effect on the microbial quality of *Kulikuli.* Therefore this study is aimed at investigating the mycological quality of packaged and ginger spiced *kulikuli.*

MATERIALS AND METHODS

Sample collection:

A total of 24 samples of *kulikuli* (peanut cake) which comprised of 12 packaged (ginger spiced, 6 and non-ginger spiced, 6) and 12 unpackaged (ginger spiced, 6 and non-ginger spiced, 6), were sourced randomly from Umuahia metropolis markets and supermarkets.

Enumeration, isolation and identification of fungi from *kulikuli* samples

Kulikuli samples were crushed and 10 g of each were homogenized in sterile distilled water (90 ml), and serially diluted (10^{-1} to 10^{-5}). One milliliter of the diluted aliquot was inoculated onto a molten Potato dextrose agar (PDA) supplemented with 0.01% streptomycin sulphate in duplicates using pour plate method. Incubation was carried out for 7 days at 28±2°C, developed distinct colonies were counted and the number of colonies from a plate with 30 – 300 colonies was multiplied by the inverse of the dilution factor to get the CFU/g. Fungal colonies morphologically different were subcultured thereafter identified macroscopically and microscopically using lactophenol cotton blue stain (Singh *et al.,* 1991; Samson *et al.,* 1995).

Moisture content determination

The AOAC (2005) method was adopted in the determination of the moisture content. Five grams of crushed *kulikuli* samples were weighed and placed in crucibles of known weight. In a repeated 2 hourly, the crucibles containing the samples were placed in an oven preheated at 105°C and cooled in a desiccator until a constant weight was obtained. The moisture content was calculated based on the reduction in weight and expressed as a percentage.

Analysis of data

Analysis of data was carried out using SPSS 21.0. Calculated means of data were tested for significance by the Duncan multiple range test ($P = 0.05$).

RESULTS

The result obtained from this study showed that all samples were contaminated, the mean fungal count as presented in Table 1 showed that the un-packaged and un-spiced *kulikuli* samples had high fungal count (5.2 ± 0.7 x 10^5 CFU/g) which was significantly ($P<0.05$) higher than the count obtained in packaged and ginger spiced *kulikuli* (1.7 ± 0.5 x 10^5 CFU/g).

The morphological studies on the fungal isolates revealed that the isolates (48) were members of five genera; *Mucor*, *Aspergillus*, *Penicillium*, *Rhizopus* and *Fusarium.*

The percentage distribution of fungi revealed that *Aspergillus* was found in all samples and had the highest distribution of 35.4%, the least occurring genus was *Fusarium* with a distribution of 8.3%. *Mucor* and *Rhizopus* was not found in the packaged samples Table 2.

The moisture content of the *kulikuli* samples showed an elevated moisture content in the unpackaged samples, which the highest moisture content of 6.3 ± 0.20% was obtained in the non- ginger spiced unpackaged sample, while the least moisture content of 4.4 ± 0.03% was obtained in the ginger spiced packaged samples (Table 3). There was significant difference in the moisture contents of the samples ($P<0.05$).

Table 1: Mean fungal count of *kulikuli* samples

Samples	Fungal count (x 10^5 CFU/g)
PG	1.7 ± 0.5^a
PUG	2.8 ± 1.0^b
UPG	3.7 ± 0.4^c
UPNG	5.2 ± 0.7^d

PG= Packaged ginger spiced *kulikuli.* PNG= Packaged non-ginger spiced *kulikuli.* UPG = Unpackaged ginger spiced *kulikuli.* UPNG = Unpackaged non-ginger spiced *kulikuli.*

Data with the same superscript alphabets are not significantly different at $p \leq 0.05$ using the Duncan multiple range test.

Table 2: percentage of fungal occurrence in *kulikuli* samples

	Samples No. positive				Distribution No. (%)
	PG	**PNG**	**UPG**	**UPNG**	
Mucor spp	-	-	3	5	8(16.7)
Aspergillus spp	3	4	5	5	17(35.4)
Penicillium spp	1	3	5	5	14(29.2)
Rhizopus spp	-	-	2	3	5(10.4)
Fusarium spp	-	1	1	2	4(8.3)
Total No. (%)	4(8.3)	8(16.7)	16(33.3)	20(41.7)	48(100)

PG= Packaged ginger spiced *kulikuli*. PNG= Packaged non-ginger spiced *kulikuli*. UPG = Unpackaged ginger spiced *kulikuli*. UPNG = Unpackaged non-ginger spiced *kulikuli*.

- = not detected

Table 3: Moisture content of the *Kulikuli* samples

Samples	Moisture content (%)
PG	4.4 ± 0.03^{a}
PNG	4.8 ± 0.05^{b}
UPG	5.2 ± 0.10^{c}
UPNG	6.3 ± 0.20^{d}

- PG= Packaged ginger spiced *kulikuli*. PNG= Packaged non-ginger spiced *kulikuli*. UPG = Unpackaged ginger spiced *kulikuli*. UPNG = Unpackaged non-ginger spiced *kulikuli*.
- Data with the same superscript alphabets are not significantly different at $p \leq 0.05$ using the Duncan multiple range test.

DISCUSSION

Mycological analysis of a street vended food gives us insight into the number and types of fungi present therein, which depicts the food quality and possible risk associated with its consumption. All the *kulikuli* samples analyzed were contaminated with fungi which is in agreement with the reports of Adetunji *et al.* (2018), Ayoade & Adegbite (2016) and Ezekiel *et al.* (2011) who recorded the presence of fungi in all the groundnut and groundnut product samples studied.

The mean fungal count was highest in the unpackaged non-ginger spiced samples, this might be attributed to the fact that these *kulikuli* samples were not spiced with ginger which have been associated with antifungal properties (Agbebi *et al*., 2013, Chuku, 2014). Also the fact that these samples were not packaged might have exposed them to fungal spores and conidia. The least fungal count was obtained from the packaged ginger spiced *kulikuli* samples, this means that the ginger repressed the growth of fungi and the pack protected the samples from contamination. Generally, the fungal counts obtained from all the *kulikuli* samples were above the $10^3 – 10^4$ CFU/g acceptable limits in dried food (ICMSF, 2018), but none of these samples met with the criteria, this heavy contamination might have occurred at the pre-processing stage or the processing stage (Ayoade & Adegbite, 2016).

The fungal strains obtained from this study belong to the genera *Mucor*, *Aspergillus*, *Rhizopus*, *Penicillium* and *Fusarium*. These genera have been reported among the commonly associated microflora of groundnut and its products (Ezekiel et al., 2011; Odeniyi *et al*., 2019). Most species of *Aspergillus*, *Penicillium* and *Fusarium* are mycotoxigenic, mycotoxins when ingested are nephrotoxic, hepatotoxic, cytotoxic, genotoxic, carcinogenic and teratogenic (Ráduly *et al*., 2020).

Mucor and *Rhizopus* obtained from this study are known for their biodeterioration ability (Mupunga *et al*., 2017) which will adversely affect the nutritive quality and the organoleptic properties of the *kulikuli*. Also some strains of *Rhizopus* are toxigenic (Othman *et al*., 2018) hence making the presence of these genera in food a thing of concern.

The percentage occurrence of the various fungi showed that *Aspergillus* was found in all samples and had the highest percentage distribution of 35.4% followed by *Penicillium. Aspergillus* is notorious for its high adaptability and dispersibility, this might explain its dominance amongst the samples. In concordance with this report is the result of Adetunji *et al*. (2018) where *Aspergillus* was the dominant fungi and had a percentage distribution of 60% in groundnut samples. *Mucor* and *Rhizopus* were isolated only from the unpacked samples, this is an indication that the contamination must have occurred due to improper handling during storage or sales. *Fusarium* was the least occurring fungi genera from this study, this is in agreement with the report of Adeoye *et al*. (2020) who obtained 5% distribution of genus *Fusarium* in Kulikuli. And contrary to that of Odeniyi *et al*. (2019) where *Fusarium* occurred at 33% in Kulikuli, this disagreement might be as a result of variation in production procedure and environmental factors.

The moisture content obtained in this study is consistent with the report of Odeniyi *et al*. (2019) who obtained a moisture content of 4.55 – 6.3 % range in *kulikuli* samples from two south west (Lagos and Ogun State) Nigerian geopolitical zone. The moisture content in the unpackaged *kulikuli* snacks exceeded the acceptable moisture content limit of > 5% for nuts and nuts products storage (Adetunji *et al*., 2018), this might have resulted from the unpackaged samples absorbing moisture from its surrounding environment. According to Magan *et al.* (2010) moisture content is critical in the accumulation of fungi and mycotoxin in food.

CONCLUSION

The *kulikuli* samples studied were all contaminated with fungi, this call for concern as proliferation of these fungi in a favorable condition might make the snacks a medium for food intoxication. The study revealed packaged and ginger spiced *kulikuli* samples had reduced load of fungi ($1.7 \pm 0.5 \times 10^5$ CFU/g) compared to the unpackaged and un-spiced kulikuli samples ($5.2 \pm 0.7 \times 10^5$ CFU/g). Fungal counts obtained from all samples were above the International Commission for Microbiological Specification for Food (ICMSF) acceptable limits of 10^3 - 10^4 CFU/g of groundnut products sample. Several moulds were isolated with the most occurring genus being *Aspergillus*, many of these moulds have been implicated in the production of mycotoxins. These findings implies that consumers are possibly exposed to mycotoxins, hence a need for public health interventions.

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