Microbial Deterioration of Agidi During Storage

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Microbial deterioration of Agidi during storage at room temperature was investigated in the laboratory. Microbial population of Agidi increased from 0.3×10^2 to 5.4×10^4 cfu/g after 48h. Change in odour, taste, colour and physical appearance occurred 48h after preparation. *Bacillus* sp, *Penicillium* sp, *Aspergillus* sp and *Mucor* sp were the organisms encountered. Growth of microorganisms in heat treated Agidi was inhibited for 2 weeks. A similar trend was observed with *Bacillus* sp – inoculated agidi. It can be concluded that heat treatment (100°C for 1 – 5 mins) can extend the shelf life of Agidi for 2 weeks.

Keywords: Microbial deterioration, Agidi, Heat treatment, Sterilized, Storage, Shelf-life.

Agidi is a cream to glossy colored gel-like traditional fermented food produced from maize Zea mays), although millet and sorghum can also be used. It is a popular food with acceptability cutting across many ethnic groups and socioeconomic classes in southern Nigeria. It is consumed alone or with vegetable soup, stew, bean-cake ("akara") or "moi-moi" and it serves as a weaning food for infants and as a light meal especially for post-operative patient (Banigo and Muller, 1972). The popularity is underscored by the observation that the different ethnic groups have different names for it - "eko" (Yoruba), "akasan" (Bini), "komu" (Hausa) and "agidi" (Ibo). It is a convenient breakfast diet that is attractive to many urban dwellers whose schedules leave them with little time for preparing breakfast. It is prepared from corn. The corn is ground and dried and made into a powder. This powder is then placed in boiling water and cooked until it has a thin smooth structure which is allowed to cool and wrapped in leaves. Different types of plant leaves are used depending on the locality

but the most common type of leaf is the banana leaf (*Musa sapientum*). The sale outlets include street hawkers, roadside stores and the open market where they are sold wrapped in plant leaves. This manner of distribution render them vulnerable to spoilage and pathogenic organisms. The shelf-life of agidi is short as spoilage sets in 24-48h after preparation and is characterized by slimy appearance and sour taste.

In view of its popularity in the usually densely populated urban centres, it is important that the pattern of deterioration of Agidi be studied as a possible prelude to determining appropriate preservation strategies. Besides the unreliability of electricity supplies in Nigeria, refrigerated Agidi looses the aesthetic and gel-like properties and this is unattractive to consumers. This study focuses on the isolation of spoilage organisms of Agidi; determination of their growth patterns and the effects of post-preparation heat treatment on the growth of such isolates. This is with a view to increasing the shelf-life of Agidi.

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MATERIALS AND METHODS

Traditional Preparation of Agidi

This was carried out using the method reported by Ogiehor et al., (2005). 50g of Agidi paste was wrapped aseptically in banana leaves (Musa sepientum), previously sterilized by soaking in 95% ethanol for 5 - 10 mins, and stored at room temperature $(30 \pm 2^{\circ}C)$ for 1h and allowed to set. **Determination of Microbial Population**

Slices weighing 1g each were cut from Agidi stored for 24 or 48h, homogenized and serially diluted. Thereafter nutrient agar plates were inoculated with 1ml Agidi suspension and incubated at room temperature for 48h. After plate counts, colonies were subcultured, purified and identified using methods reported in Cowan and Steel (1985) and Holt et al., (1994).

Growth of Isolates on Sterilized Agidi and Nutrient Broth

Sliced freshly prepared Agidi of 2 x 2 x 2cm dimensions were placed in 250ml flasks, sterilized by autoclaving and on cooling, inoculated with $1 \text{ml} 10^2 \text{ cfu/g suspension of isolates.}$ After 6, 12, 18 and 24h, slices were withdrawn using sterile

forceps and the microbial population was determined by plate count as before.

Determination of Effects of Heat Treatment on Growth of Bacillus sp in Sterilized Agidi

Slices of Agidi were each inoculated with 1ml 10² cfu/g suspension of Bacillus sp and immersed in boiling water for 1, 2, 3, 4 or 5mins before incubation for 24 - 48h at room temperature. Thereafter the population of the *Bacillus* sp was determined by plate count as before.

Determination of Organoleptic Properties of Agidi

A 5-member taste panel daily determined the colour, odour, visual appearance and taste of the prepared Agidi stored at room temperature.

RESULTS AND DISCUSSION

Microorganisms were not isolated from freshly prepared Agidi until after 24h (Table 1). The microbial growth after 24h was not enough to produce changes in odour, taste, colour and physical appearance until after 48h (Table 1). The organisms isolated were Bacillus sp, Aspergillus sp, Penicillium sp and Mucor sp.

| Storage Period (h) | Mean Microbial Count (cfu/g) | Organoleptic Properties Odour Colour Taste | | |
|-----------------------|---------------------------------|---|----------|--------|
| | (6) | | (Visual) | |
| 0 | - | Normal | Moved | Normal |
| 24 | 0.3 x 10 ² | Normal | Moved | Moved |
| 48 | 5.4 x 10 ⁴ | Foul | Slimy | Sour |

Table 1. Microbial Counts of Agidi during Storage

Growth of Bacillus sp introduced to freshly prepared Agidi did not occur immediately after heat treatment until after 2wks (Table 3) and exhibited an inversely proportional relationship with period of heat treatment.

Bacillus sp had the same growth pattern on both sterilized Agidi and nutrient broth but the growth on the latter was more being a defined medium (Table 2). At 24h, growth was in the log phase in both the sterilized Agidi and nutrient broth.

Time (h) Microbial Counts (x10²cfu/g) Sterilized Agidi

| | - | |
|----|------|------|
| 6 | 0.06 | 0.20 |
| 12 | 0.15 | 0.50 |
| 18 | 0.30 | 0.90 |
| 24 | 0.48 | 0.95 |

Table 2. Growth of Bacillus sp on

Sterilized Agidi and Nutrient Broth

Nutrient Broth

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| Heat treatment 100°C for (mins) | Growth after Heat Treatment (x10 ² cfu/g) | Growth after Storage for 2wks (x10 ² cfu/g) |
|------------------------------------|---|--|
| 1 | 0 | 650 |
| 2 | 0 | 425 |
| 3 | 0 | 30.5 |
| 4 | 0 | 2.1 |
| 5 | 0 | 1.0 |

| Table 3. Growth of Bacillus sp on freshly prepared Agi | idi | | | |
|--|-----|--|--|--|
| stored for 24h and heat treated. | | | | |

Growth of *Bacillus* sp introduced to sterilized Agidi showed the same growth pattern

with the heat treated freshly prepared Agidi after storage 24h at room temperature (Table 4).

| Bacillus sp in Sterilized Agidi | | | | |
|------------------------------------|---|--|--|--|
| Heat treatment 100°C for (mins) | Growth after Heat Treatment (x10 ² cfu/g) | Growth after Storage for 2wks at Room Temp. (x10 ² cfu/g) | | |
| 1 | 0 | 360 | | |
| 2 | 0 | 250 | | |
| 3 | 0 | 1.50 | | |
| 4 | 0 | 1.00 | | |
| 5 | 0 | 0.60 | | |
| | | | | |

 Table 4. Effect of Heat Treatment on Growth of Bacillus sp in Sterilized Agidi

The results show that microorganisms might have gained access to the prepared Agidi through the leaves used in wrapping the prepared food. Bacillus sp was the only bacterial isolate being a soil-inhabiting organism and a pore former. The spores must have survived the heat treatment inherent in the preparation of Agidi. However resumption of growth after 2wks storage at room temperature indicate recovery of the spores which propagated vegetative cells after 2wks storage. Thus the heat treatment alone, while ensuring shelf stability for 2wks, is not enough to ensure increase in shelf life of Agidi beyond 2wks. There is therefore the need to combine heat treatment with other hurdles to achieve a prolonged shelf-life of Agidi beyond 2 wks.

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