

Storability of “DodoIkire” (over -ripe plantain-basedsnack) at ambient temperature (28 ± 2 °C)

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Abstract: “DodoIkire” is an example of traditional snack commonly consumed in western part of Nigeria. Effects of storage packaging modes and durations on its microbiological quality and sensory attributes at room temperature were investigated. Samples were collected from commercial sellers in Ikire, Apomu and Ikoyi Towns. They were packaged and stored at room temperature (28 ± 2 °C) in three different materials namely; Open storage in disposable cup (OS), low density nylon (LD) and high density polyethylene (HD) for a month. A sample of DodoIkire was prepared in the Food processing Laboratory of Wesley university of Technology, Ondo, to serve as Control. Total viable counts and fungi counts were conducted at intervals of two weeks using pour plate method. Sensory evaluations were carried out at these intervals using semi-trained panelist on a nine point hedonic scale. The results showed that the ‘DodoIkire’ offered for sale has low level of initial microbial loads. The choice of packaging system and duration of storage significantly influenced ($p < 0.05$) the level of infestation within one month of storage in different materials, with OS permitting the highest, followed by LD and then HD. Similarly, these two parameters also significantly influenced ($p < 0.05$) the rate at which sensory attributes were lost in the same order. High density polyethylene (HD) offered best protection and is hereby recommended for the storage of DodoIkire. However, consumption of DodoIkire after a month of storage should be discouraged.

Keywords: DodoIkire, plantain snack, microbial change, sensory quality loss, storage modes.

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1 Introduction

The consumption of ready-to-eat snacks is currently gaining ground in the world and Nigeria is not an exception, as consumers are feeling the impact of snacks daily, mostly in big cities (Ukpakure, 1985; Giami et al., 2003; Odedeji and Oyeleke, 2011). This is largely believed to be associated with convenience driven lifestyles, job demands and dietary habits (Gabriel and Faith, 2014). There is a wide variety of ready-to-eat foods. These include, but are not limited to sandwiches, kebabs, sushi, takeaway foods and bakery products. Ready-to-eat

foods usually contain a number of ingredients which may or may not be cooked (Odedeji and Oyeleke, 2011). Snacks are expected to be balanced nutritionally, healthy, easy to eat, provide quick energy and should be of great taste. Snack foods have also been reported to add variety to diet, which partially explain their popularity (Olapade *et al.*, 2012). However, excessive

consumption of many sugary snacks has been attributed to incidences of obesity, diabetes and celiac diseases, especially the foreign snacks (Ajieroh, 2010). Ironically they are expensive and majorly affordable to average and high income earners and consequently low income earners, mainly in rural communities have to fall back on locally available materials for their snacks production, which sometimes are healthier and cheaper alternatives.

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“DodoIkire”—a popular, age long over-ripe plantain-based snack, is an example of a local snack that can be consumed to alleviate the spite of hunger in people. It is a specially fried plantain snack, which is commonly produced in Ikire town and its environs, in Osun state, western part of Nigeria, hence the name “DodoIkire”. It fulfills the saying “waste not, want not” as fairly over-ripe plantain fruits are used to prevent them from waste (Fayemi, 1999). It is savoury product that is capable of being held at ambient temperature for a reasonable length of time. In most cases, consumption is for temporary measure after which the actual meal is taken, but it can also serve as real menu. Nutritionally, consumption of plantain based products like DodoIkire promotes weight loss in obese individuals and caters to the calorific need of many developing countries (Kayode et al., 2013).

For commercial purpose, women and young boys in these communities are passionate about the act of making and selling this snack to travellers, in order to support their incomes. In their bids to make more income, the trend in frying this “DodoIkire” has gone far from era of prevention of wastage of plantain as it is now the practice to mix (adulterate) banana with plantain, for the snack and then either wrapped and displayed in low density nylon or open plastic/metal containers, with little or no attention to loss of sensory attributes and microbiological quality. These two indices are commonly used for monitoring the shelf stability of food products. The type of packaging system and storage environment may influence its sensory and microbial characteristics and by inference, its shelf stability. Information on its chemical composition, microbial counts and fortification were reported by (Kayode *et al.*, 2013; Oluwalana, 2014). Study on its storability at room temperature is scanty. Therefore, this study was carried out to determine its storability at room temperature (28 ± 2 °C) indifferent packaging materials.

2 Materials and methods

2.1 Sources of materials

Fairly fresh (3-4 days old) samples of DodoIkire, wrapped with nylons and displayed on metallic trays for sale were obtained from three different commercial sellers, each from Ikire town and its neighbouring towns—Apomu and Ikoyi. They were aseptically contained in sterilized glass containers, covered and taken to the laboratory. Low density nylon, high density polyethylene and a disposable cup were obtained from Oja-Oba market in Ondo town. Other materials purchased from this market includes bunches of matured ripe plantain fruits; palm oil (1L), habanero pepper (15g), onions (100g) and salt; for preparation of control samples.

2.2 Sample preparation and storage

Collected samples were carefully mixed to form three composite samples and 20g each of the developed composite samples was placed in disposable cup, low density nylon and high density polyethylene, labelled as OS, LD and HD respectively and stored at (ambient temperature 28 ± 2 °C and 70% RH) for 4 weeks. A special sample was obtained from a vendor immediately after processing, tagged ‘fresh’ and used as external control. Internally prepared control samples were made every two weeks.

2.3 Preparation of the control sample

Control samples were prepared in the food processing Laboratory of the Department of Food Science and Technology, Wesley University of Science and Technology, Ondo, using a recipe described by Kayode *et al.*, (2013). Two kilogrammes of over ripe plantain were washed with clean water; peeled using stainless kitchen knife and the pulp was cut into 4cm thick and 2kg of the pulp was weighed into aluminium dish. Then, 10g of salt was added to the pulp to taste after which palm oil (1L) was heated up in a deep frying pan to hot but not smoking before onion was added to give desired aroma, 500g of habanero pepper was added and it was fried steadily for (45mins) after which it changes to golden brown. For moulding, plastic funnels were filled with the fried Dodo particles using a stainless spoon followed by pressing with a wooden pestle. The funnel was later inverted and

hammered on metallic trays for it to come as cone-shaped DodoIkire. It was allowed to cool for 3hrs, before packaging and storage.

2.4 Microbiological analysis

The aerobic plate count was carried out on the fried snack samples according to methods of AOAC (1990). Serial dilution and pour plate techniques were used. Nutrient agar (NA) for mesophilic bacteria; Potato Dextrose Agar (PDA) was used for fungi. Viable colonies were recorded as colony forming units (cfu/g)

2.4.1 Total plate count

One gramme (1g) of each sample was suspended separately in 9 ml of sterile distilled water, and then later diluted to obtain a five-fold decimal dilution (10^{-5}). One millilitre of each suspension was placed in Petri-dish containing sterile Nutrient Agar (NA). Then 1ml of the 10^{-3} suspension was seeded into another Petri-dish and overlaid with NA for fresh DodoIkire sample. These were then incubated at 37°C for 72hrs, but for subsequent ones (OS, LD and HD), 10^{-5} diluents were picked.

2.4.2 Yeast and mould

One gramme (1g) of each sample was suspended separately in 9 ml of sterile distilled water, and then later diluted to obtain a five-fold decimal dilution (10^{-5}). One millilitre of each suspension was placed in Petri-dish containing sterile Potato Dextrose Agar (PDA). Then 1ml of the 10^{-3} suspension was seeded into another Petri-dish and overlaid with (PDA) for fresh DodoIkire sample. These were then incubated at 37°C for 72hrs, but for subsequent ones (OS, LD and HD), 10^{-5} diluents were picked.

2.5 Sensory Evaluation of DodoIkire

The sensory evaluation was carried out on samples in respect of taste, appearance, aroma, texture and overall acceptability using a panel of twenty members (semi-trained), comprising of students of Wesley

University of Science and Technology, Ondo. Nine point hedonic scale was used, where 1 corresponds to dislike extremely and 9 correspond to like extremely. Data obtained were analyzed using analysis of variance technique and Duncan multiple range employed to separate the means.

3 Results and discussion

3.1 Microbial changes in DodoIkire stored in sealed polyethylene and open storage

Result of bacterial counts of DodoIkire samples stored with different packaging systems is presented in Figure 1. The Initial bacterial count of the sample was (2.0cfu/g) before storage while that of prepared control was growth free. This agrees with (Adam and Moses, 1995); foods that we eat are rarely sterile, if ever. The little infestation in purchased sample even at this initial stage of the experiment may be due to poor handling on the part of processors, use of unhygienic cooking utensils and sub-standard packaging system. Significant difference exist ($p \leq 0.05$), after two weeks of storage in different packaging medium, i.e. Open storage (OS), Low density (LD) and High density (HD); with the bacterial counts in OS, LD and HD being (6.0×10^5 cfu/g), (5.0×10^5 cfu/g) and (3.0×10^5 cfu/g) respectively. The growth increased to (10.0×10^5 cfu/g), (8.5×10^5) and (6.0×10^5 cfu/g) after one month of storage. It's indicated that both storage systems and periods of storage have influence on the growth of total viable counts. Oluwole *et al.*, (2013) gave similar report on extruded snacks stored differently. Increase in microbial growth with duration of storage was reported Adeboye *et al.*, (2013). With OS and LD, the snack was exposed to more environmental factors (air, moisture and even dust) whose presence favours the growth of micro-organism than HD.

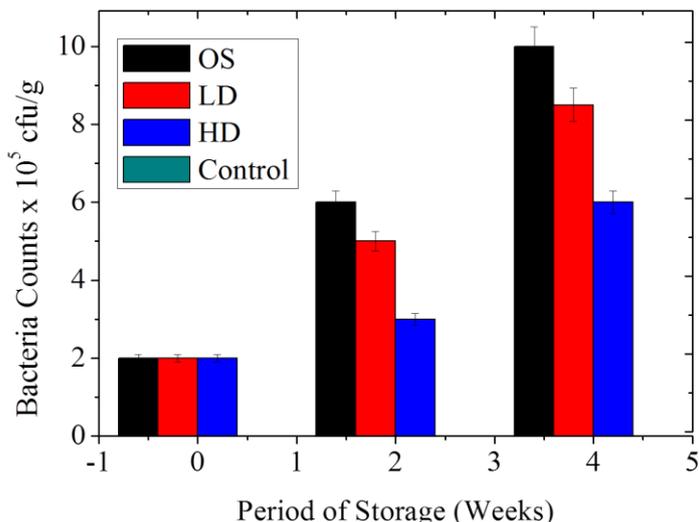


Figure 1 Graph of Bacterial counts on DodoIkire Stored in Different modes and Durations

Fungal counts of this snack are represented in Figure 2. Both freshly purchased and control samples had no growth on the plate at 0 week and this was maintained until after 2 weeks. It may be due to the lethal effect of deep fat frying. However, after one month of storage it shows that the OS has grown (2.50×10^5 cfu/g), LD (2.0×10^5 cfu/g) and HD, (0.5×10^5 cfu/g), a trend that is similar to those of total viable counts in the samples. This is in line with a microbiological claim which specified that, most microbiological spoilage of common snacks may be attributed to fungi growth (Cauvain and Young, 2007; James, 2010). The maximum permissible level of total aerobic colony of ready-to-eat foods as given by Fylde

Borough Council extracted from manual of PHLSG (2008) was 10^4 to less than 10^6 cfu/g of ready-to-eat food products. Similarly, international commission on microbiological specification for foods (ICMSF, 2010), asserted that, ready-to-eat foods with standard total count below 10^4 cfu/g are still considered safe for human consumption. It is presumptive therefore that shelf life of DodoIkire investigated in this study should not exceed a month, after which safety of its consumption is not guaranteed. Moreover, since the level of infestation was minimal in HD, use of traditional packaging systems (OS and LD) should be discouraged.

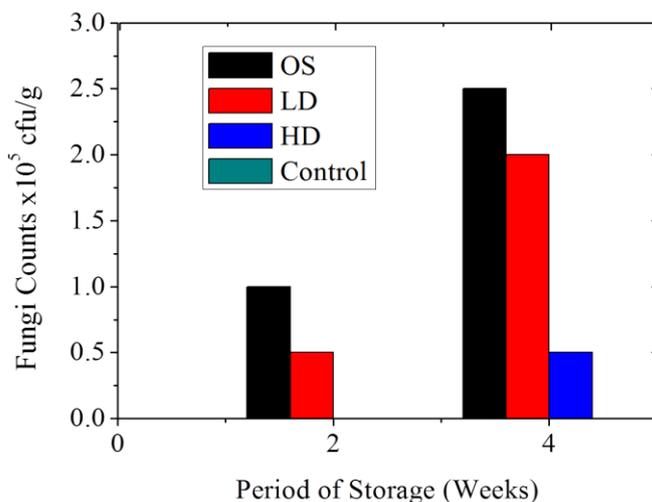


Figure 2 Graph of fungi counts on DodoIkire Stored in Different modes and Durations

3.2 Changes in sensory attributes of DodoIkire stored in sealed polyethylene and open storage

The results of sensory loss with length of storage in different packaging medium are shown in Table 1. There were significant difference ($p < 0.05$) between samples stored differently for the same duration. The ranges of taste, appearance, aroma, texture and overall acceptability ranged between (1.81±0.01-6.00±0.01), (1.21±0.01-5.01±0.02), (1.21±0.01-4.01±0.01), (1.81±0.02-4.00±0.00) and (2.22±0.02-5.22±0.02) with highest score in fresh sample and the least either in OS or LD and at fourth week of storage. Uses of human sense for

consumer acceptance have been documented (Kayode *et al.*, 2013; Adeboye, 2013; Oluwalana, 2014). Variations in these losses in sensory attributes exist with the use of different packaging medium in such a way that, highest decrease was experienced in OS, followed by LD and then HD. Also, there were gradual decreases in scores for most of these attribute with duration of storage. Freshly obtained samples possessed least attributes in all cases. One can suggest that, consumption of this snack beyond this length of time was not in the best interest of these judges and the snack should be discarded.

Table 1 Changes in Sensory attributes of DodoIkire stored in sealed Polyethylene and Open storage

Samples	Taste	Appearance	Aroma	Texture	Overall Acceptability
FRESH	6.00±0.01 ^a	5.01±0.02 ^a	4.01±0.01 ^b	4.00±0.00 ^a	5.22±0.02 ^a
OS (1 ST 2WKS)	4.21±0.01 ^c	3.21±0.01 ^d	3.02±0.02 ^c	2.21±0.01 ^c	3.41±0.02 ^d
LD (1 ST 2WKS)	3.20±0.17 ^d	4.00±0.02 ^c	2.80±0.03 ^d	2.00±0.02 ^d	3.81±0.01 ^c
HD (1 ST 2WKS)	4.81±0.01 ^b	4.60±0.02 ^b	4.59±0.01 ^a	3.00±0.01 ^b	4.41±0.02 ^b
OS (2 ND 2WKS)	1.81±0.01 ^f	2.02±0.02 ^f	1.81±0.02 ^f	1.6±0.03 ^f	2.60±0.02 ^e
LD (2 ND 2WKS)	1.81±0.01 ^f	1.21±0.01 ^e	1.21±0.01 ^e	1.81±0.02 ^e	2.22±0.02 ^f
HD (2 ND 2WKS)	2.61±0.02 ^e	2.62±0.03 ^e	2.23±0.03 ^e	2.23±0.03 ^e	3.80±0.02 ^c

Note: Like extremely=9 ,Like very much=8 ,Like moderately=7 ,Like slightly=6 ,Neither like nor dislike=5 Dislike Slightly=4 ,Dislike moderately=3 ,Dislike very much=2 ,Dislike extremely=1. OS, LD and HD for open storage, low density and high density respectively

4 Conclusions

The study revealed that DodoIkire offer for sale has low level of initial microbial loads (2.0cfu/g), perhaps from processors' poor handling, use of unhygienic cooking utensils and sub-standard packaging systems. The choice of packaging system and duration of storage significantly influenced ($p < 0.05$) the level of infestation after two weeks of storage in different media and with OS permitting the highest, followed by LD and then HD. Similarly, these two parameters also significantly influenced ($p < 0.05$) the rate at which sensory attributes are loss in the same order. The microbial infestation and loss of sensory properties are presumed to be consequences of exposing this food to environmental factors (air, moisture, relative humidity and even dust) whose presence, favours the growth of micro-organism. The higher the protection, the lower the level of infestation of micro-organisms and the lowest rates of sensory quality losses. In this study, High density polyethylene (HD) offered best protection

against these properties and is therefore recommended for the storage of DodoIkire. However, consumption of DodoIkire after a month of storage should be discouraged.

References

- Adams, M.R., and M.O.Moses.1995. Food Microbiology. *New age international publishers*, 4835/24, Ansar road daryagnj, New Delhi ISBN81-224-1014-6.
- Adeboye, A.S., J.M.Babajide, T.A.Shittu, A.M. Omemu, and O.J.Oluwatola.2013.Effect of Honey as partial Sugar Substitute on Pasting Properties, Consumer Preference and Shelf stability of Cassava-Wheat Composite Bread. *Nigerian Food Journal*,31(1): 13-22.
- Ajieroh, V. 2010. A Quantitative Analysis of Determinants of Child and Maternal Malnutrition in Nigeria. *IFPRI Nigeria Strategy Support Program*, Brief No. 11.
- AOAC. 1990. Official Methods of Analysis; Association of Official Analytical Chemists, 15th ed., Washington D.C.
- Cauvain, S.P., and L.S. Young.2007. Microbiological spoilage of bread. In technology of bread making, second edition, Spinger publishers. Retrieved on 02/11/2009. Available at <http://www.googlebooks.com>
- Fayemi, P.O.1999. Nigerian Vegetables, Hemmann Educational Books (Nigeria) plc, 195-255.

- Gabriel, I.O., and C.U.Faith.2014.Production and evaluation of cold extruded and baked Ready-to eat snacks from blends of breadfruit (*Treculiaafricana*), cashewnut (*Anacardiumoccidentale*) and coconut (*Cocos nucifera*). *Food Science and Quality Managemen t*ISSN 2224-6088 (Paper)(Online) 23.
- Giami, S.Y, M.O.Akusu, and I.R.Jaja.2003. Production, organoleptic assessment and nutritional properties of 'Akara' from cowpea/maize flour blends. *Plant Foods for Human Nutrition*, 58:1-9.
- ICMSF. 2010. International Commission on Microbiological Specification for foods. USDA information office. Available at: <http://fsrio.nal.usda.gov/sanitation-and-qualitystandard/microbiological-standards-and-guidelines>.
- James, M. 2000. *Modern food microbiology* Sixth edition.Aspen publishers, Gaithersburg, Maryland USA.
- Kayode, R.M.O., A. T. Ajiboye, A. A.Babayeju, B.I.Kayode,C.O.Oladoye,andK.T. Adu.2013. Proximate, Mineral composition and Microbial counts of over-ripe fried plantain (Dodo-Ikire) sold by vendors in Ikire Town, Nigeria. *The International Journal of Biotechnology*, 2(4):68-82.
- Odedeji, O.J., and W. A.Oyeleke.2011.Proximate, Physicochemical and organoleptic properties of whole and dehulled cowpea seed flour (*Vignaunguiculata*). *Pakistan Journal of Nutrition*, 10(12): 1175-1178
- Olapade, A.A., and O.C. Aworh.2012.Evaluation of extruded snacks from blends of acha (*Digitariaexilis*) and cowpea (*Vignaunguiculata*) flours,*AgricEngInt: CIGR Journal*,14(3): 210-217
- Oluwalana, I.B.2014. Sensory and microbiological quality assessment of fried snacks produced from ripe and unripe plantain fruits (*Musa paradisiaca*) fortified with *Vignaunguiculata*(L.) Walp (cowpea). *International Journal of Biological and. Chemical. Sciences*, 8(1): 182-188.
- Oluwole, O.B., S.O. Awonorin, F.Henshaw, G.N. Elemo1, andO.A.T.Ebuehi.2013.Assessment of Microbial Changes and Nutritional Qualities of Extruded White Yam (*Dioscorearotundata*) and Bambara Groundnut (*Vigna subterranean*) Blends.*Food and Nutrition Science*, 4,100-107.Available at: <http://www.scirp.org/journal/fns>
- PHLSG. 2008. The Microbiological Quality of Ready-to-Eat Foods Sampled at the Point of Sale, (Public HealthLaboratoryServiceGuidelines). Brough Council, 2008.
- Ukpakure, J.1985. Fast foods-an alternative to Buka join: the punch daily newspaper 24th June, punch Newspaper Ltd.Lagos pg7.