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PROXIMATE, MINERAL COMPOSITION AND MICROBIAL COUNTS OF OVER-RIPE FRIED PLANTAIN (DODO-IKIRE) SOLD BY VENDORS IN IKIRE TOWN, NIGERIA

Kayode, R.M.O.[1] --- Ajiboye, A.T.[2] --- Babayeju, A.A[3] --- Kayode, B.I.[4] --- Oladoye, C.O.[5] --- Adu, K.T.[6]

[1,2,3]Division of Microbial Biotechnology, Department of Home Economics and Food Science, University of Ilorin, Nigeria

[4]Department of Food Science and Technology, College of Food Science and Human Ecology, Federal University of Agriculture, Abeokuta, Nigeria.

[5]Department of Science Laboratory Technology, Federal Polytechnic, Offa, Nigeria

[6]Department of Microbiology, University of Ibadan, Ibadan, Nigeria.

ABSTRACT

There are increasing reports of food poisoning due to methods used for processing certain food items in most parts of Africa especially in Nigeria. Also, very scanty information is available on the nutritional status and microbial counts of over-ripe fried plantain (Dodo-ikire) locally produced among the indigenes of Ikire Town and sold in some parts of Western States of Nigeria. This experiment reports the proximate, minerals and microbial counts of over-ripe fried plantain as affected by vendors in three different markets in Ikire Town, Osun State, Nigeria. Samples were obtained from four vendors each in three different markets namely: Total Station Market (TSM1-TSM4), Oja Ale Market (OAM1-OAM4) and Gbongan Garage Market (GGM1-GGM4). Among the samples obtained in TSM, the crude protein of sample TSM1 (4.16%) is not statistically different from the control (4.59%) but higher ($p<0.05$) than other treatments. The total ash of sample TSM2 (1.53%) and TSM3 (1.51%) were lower ($p<0.05$) compared with other samples. In the market coded OAM; the crude fat of sample OAM2 (15.4%) is significantly higher ($p<0.05$) compared to the value obtained for control and other samples, while total carbohydrate ranged from 66.81 to 76.64%. The results obtained for crude fibre ranged from 1.69% to 2.55%. The bacterial counts of dodo ikire purchased from four vendors in Total Station Market indicated that the samples coded TSM1 (8.0cfu/g) and TSM2 (9.0 cfu/g) had higher ($p<0.05$) bacterial counts compared with samples purchased from all the vendors in the selected market and the control sample. Samples TSM2 and TSM3 had the same level of fungal counts (3.0cfu/g) which differed significantly ($p<0.05$) from the values of sample TSM1 (4.0cfu/g). Among the samples obtained from vendors in Gbongan Garage Market, it is observed

that the crude protein of samples GGM1 (3.53%), GGM3 (3.54%) and GGM4 (3.94%) were not significantly ($p<0.05$) different but lower compared with the value (4.59%) of the control.

The range of values obtained for minerals were Sodium (21.089-44.437mg/kg), Potassium (16.345-17.432mg/kg), Calcium (3.567-5.005mg/kg), Magnesium (1.842-2.776mg/kg), Phosphorus (5.026-5.263mg/kg), Copper (0.000-0.004mg/kg), Iron (0.075-0.246mg/kg), Manganese (0.023-0.034mg/kg) and Zinc (0.002-0.004mg/kg). The sodium content (44.437mg/kg) of sample TSM is significantly ($p<0.05$) higher compared with samples from other markets and the control, while the values of potassium, phosphorus, manganese and zinc were not significantly ($p<0.05$) difference among the treatment samples from the markets and the control. The study concluded that the observable increase in fat, which results from the addition of palm oil; which is a major source of cholesterol to the over ripe plantain could pose deleterious effect on susceptible person consuming foods containing high cholesterol. The significantly higher values of microbial counts obtained in the samples purchased from some of the vendors compared with control sample which was prepared in the laboratory indicated poor hygiene practices by the vendors. From the result of microbial counts, it is suggested that improvement be made on preparation practices and that better choice of dodo ikire packaging material could also help to minimize microbial contamination. Finally, it was suggested that hawking in densely populated areas of the town should be discouraged to minimize microbial contamination of the final dodo ikire product during distribution and marketing.

Keywords: Dodo-ikire, Market location, Vendors, Proximate, Microbial count

INTRODUCTION

Plantain (*Musa spp. L*), is a major starchy staples in the sub-Saharan Africa both for rural and urban populace, providing more than 25% of the carbohydrates and 10% of the daily calorie intake for more than 70 million people in the continent (IITA, 2000) . Plantain cultivation is attractive to farmers due to low labour requirements for production compared with cassava, maize, rice and yam (Marriott and Lancaster, 1983). It therefore contributes significantly to food and income security of people engaged in its production and trade, particularly in developing countries.

Nigeria is known to be the world's largest producer and consumer of plantain (10.5 million tonnes annum^{-1}), accounting for approximately 10% of total global production (FAOSTAT, 2006).

Plantain being a climacteric fruit, when harvested at the pre-climacteric matured 'green' stage, the fruit undergoes various physicochemical changes such as composition, colour, texture, aroma and taste, pertaining to changes in metabolic rates and biochemical reactions like respiration, ripening and senescence in the climacteric phase (Adeyemi and Oladiji, 2009) . After harvest, fully mature plantains tend to ripen quite rapidly with an accelerated rate of change of starch into sugars (Simmonds, 2006). In the processing of foods derived from green plantains (normally used for cooking a variety of dishes, not as fresh fruit) it is of prime importance that the plantains are at the proper stage of development; fully mature but completely green. No changes in starch, total sugars, acidity and pH take place as the bunch matures on the plant. There seems to be s1ight tendency for reducing sugars values to increase with maturity (Sanchez *et al*., 1968).

Plantain has diversity of minerals; it is high in potassium, low in sodium (17 mg/100 g) and fat (0.1%) making it suitable to control blood pressure (Kanazawa and Sakakibara, 2000; Mohapatra *et al*., 2010). It is often recommended to be consumed by people who are intolerant to salt. Many nutritive minerals are essential to living organisms because they are use to activate hormone, enzymes, and other organic molecules that participate in the growth, function and maintenance of life processes (Aslam *et al*., 2005). Minerals cannot be synthesized and must be provided from plants, vegetables or mineral rich water (Adewusi *et al*., 1999). Minerals are the catalysts, which create a healthy environment in which the body is using vitamins, proteins, carbohydrates and fats. This is why a complete spectrum of minerals is necessary for exemplary health (Anwar and Bhanger, 2003). The consumption of plantain promote weight loss in obese individuals and caters to the calorific need of many developing countries (Kanazawa and Sakakibara, 2000; Mohapatra *et al*., 2010). Many products have been commercially produced from plantain fruits such as: chips, flour, beer and beverage drink (Casimir and Jayaraman, 1971). A typical staple snack produced in some Western States of Nigeria is called 'Dodo ikire' which originated from Ikire Town in Osun State, Nigeria. There is dearth of information on the proximate, mineral composition and microbial counts of 'Dodo ikire' (over ripe fried plantain). Thus the objectives of this study were to assess the proximate, mineral and microbial analysis of 'Dodo ikire' sold by vendors within Ikire Town, Nigeria.

MATERIALS AND METHODS

Source and Collection of Commercially Sold Dodo-Ikire Samples

Twelve samples of fried plantains were bought from four vendors each in three different markets in Ikire town, namely: Total Station Market, Oja Ale Market and Gbongan Garage Market. The samples were collected in sterilized glass containers, covered and were taken to the laboratory for analysis.

Source of Ingredients Used for Preparation of the Control Sample

The following ingredients: two bunches of matured ripe plantain fruits; palm oil (1litre), habanero pepper (15g), onions (100g) and salt were bought from Oja Tuntun Market in Ilorin. The preparation of laboratory 'Dodo ikire' (over ripe fried plantain) used as control sample was carried out in the food processing Laboratory of the Department of Home Economics and Food Science, University of Ilorin, Nigeria.

Preparation of Fried Plantain (Dodo Ikire)

Two kilogrammes of over ripe plantain was washed with clean water; the peel of the over ripe plantain was removed using stainless kitchen knife. 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 (1litre) 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 heated up slowly until it changes to golden brown before it was mould into cone shape using a stove funnel.

Microbial Counts and Chemical Analysis

Analyses carried out on the 'Dodo-ikire' samples include microbial count, proximate composition, and mineral analysis. All the experiments were carried out in triplicate, and the mean values taken. Fungal count was carried out by the method described by (Jonathan and Olowolafe, 2001). One gramme (1g) of each sample was suspended separately in 10 ml of sterile distilled water, and then later diluted to obtain a three-fold decimal dilution (10^{-3}). Zero point one (0.1) millilitre of each suspension was placed in 100mm diameter petri-dish containing sterile Potato Dextrose Agar (PDA) in which 0.05 mg of streptomycin has been added to suppress bacterial growth. Then 0.1ml of the 10^{-3} suspension was seeded into another petri-dish and overlaid with PDA. These were then incubated at 29±2^{0}C for 72h followed by the count of total numbers of colonies that developed using a colony counter (model). Protein was determined by the micro- Kjeldahl method and was obtained by multiplying Kjedahl nitrogen by the factor 6.25. Moisture content was obtained by heating 10.0 g of each sample to a constant weight in a hot air-circulating Gallenkamp oven at 105^{0}C for 24h Onyeike *et al.* (2008), Ash was determined by incineration in a pre-heated muffle furnace at 600^{0}C for 2h, fat content was carried out by soxhlet extraction, total carbohydrates was obtained by difference. Total dietary fibre content was determined by the enzymatic gravimetric method described by Prosky *et al.* (1985). Mineral analysis was performed according to the method described by AOAC (2000). The samples used for analyses were prepared by weighing 1g sample into a Pyrex conical flask to which 10ml of concentrated nitric acid was added using a pipette. Five millilitres (5ml) of perchloric acid was added and the mixture heated on an electro thermal heater for about 20 minutes until a clear digest was obtained (Aslam *et al.*, 2005).

The digest was allowed to cool at room temperature and then diluted to 50ml with distilled water and afterward filtered with 12cm whatman filter paper into a plastic vial for mineral analysis. Mineral analysis was carried out on the extracts using atomic absorption spectrophotometer (Model 210 VGP).

Statistical Analysis

Data was subjected to Statistical Analysis of Variance (ANOVA) at 5% level, and the means were separated using Duncan Multiple Range Test procedure as described in the SAS release 8.3 software. (SAS, 2002).

RESULTS

Tables 1 to 3 show the proximate composition of 'Dodo ikire' (over ripe fried plantain) purchased from four different vendors each in three major market locations in Ikire town namely: Total Station Market (TSM), Oja Ale Market (OAM) and Gbongan Garage Market (GGM) respectively. The range of results obtained for proximate analysis of the samples purchased from vendors in the market locations (TSM, OAM and GGM) were: moisture content (4.03-8.05%, 4.32-6.54% and 4.26-8.01%), crude protein (1.97-4.16%, 3.50-4.40% and 3.51-3.94%), crude fat (9.35-21.00%, 10.30-15.42% and 7.21-12.90%), total ash (1.51-5.50%, 1.34-5.52% and 4.20-8.59%), crude fibre (0.85-2.65%, 1.69-2.74% and 1.25-1.86%) and carbohydrate (66.51-72.19%, 66.53-76.63% and 63.48-75.15%) respectively. From Table 1, the result of crude protein of sample TSM1 (4.16%) is not statistically ($p<0.05$) different from control sample (4.59%) but higher than other treatments samples purchased from market location TSM. Total ash of the sample coded TSM2 (1.53%) and TSM3 (1.51%) were lower compared with other samples. The crude fat of sample TSM4 (21.00%) differed significantly ($p<0.05$) from the value obtained for control (13.9%) but similar to the value obtained for sample coded TSM3 (16.9%).

It is observed from Table 2 that the moisture content of samples coded OAM2 (6.54%), OAM3 (6.21%) and OAM4 (6.15%) were not significantly ($p<0.05$) different; although lower compared with the value of control sample (7.33%). The crude fat of sample OAM2 (15.42%) is significantly higher while total ash of sample OAM1 (1.34%) is significantly ($p<0.05$) lower compared with the results of other samples from Oja Ale Market.

From Table 3, it is indicated that the moisture content of samples coded GGM1 (4.26%) and GGM2 (4.49%) were significantly ($p<0.05$) lower than samples GGM3 (6.22%) and GGM4 (8.01%). The crude protein of samples GGM1 (3.51%), GGM2 (3.53%) and GGM3 (3.54%) were not significantly different ($p<0.05$). While, the carbohydrate of sample GGM1 (75.15%) was statistically ($p<0.05$) higher compared with the results of other treatments samples purchased from Gbongan Garage Market.

Microbial Count of the Dodo ikire Samples

Figure 1 shows the bacterial counts of dodo ikire purchased from four vendors in Total Station Market, it is obvious that the values of samples TSM1 (8.0cfu/g) and TSM2 (9.0 cfu/g) had the highest bacterial count and were significantly ($p<0.05$) higher compared with the value of other samples including the control.

Figure 2 indicates fungal count of sample purchased from four vendors in Total Station Market. The sample coded TSM2 and TSM3 had the same level of fungal counts (3.0cfu/g). All the

samples purchased from vendors in the market locations were higher compared with the control sample.

Figure 3 revealed the result of bacterial counts of dodo ikire purchased from Oja Ale Market. The result indicates that the sample coded OAM2 had total bacterial count of 2.0cfu/g which is observed to be significantly lower than other treatment but similar to the control. Figure 4 reveals the fungal counts of the samples purchased from Oja Ale Market in Ikire town. It is observed that sample coded OAM3 had fungal count of 3.0cfu/g while those coded OAM1, OAM2 and OAM4 had the same level of fungal counts (2.0cfu/g). The fungal counts of all samples from this market differed significantly ($p<0.05$) from the control. Figure 5 shows the bacterial counts of dodo ikire purchased from four vendors in Gbongan Garage Market in Ikire town. The value obtained for sample GGM1 (6.0cfu/g) is significantly higher than sample GGM3 and GGM4 which are of the same value (3.0cfu/g). The bacterial counts of all treatment samples were significantly ($p<0.05$) higher than the control sample.

Figure 6 indicates fungal counts of the samples purchased from the vendors in Gbongan Garage Market in Ikire town. The graph shows that sample GGM1 (3.0cfu/g) had the highest fungal count and, also significantly ($p<0.05$) higher compared with others and the control which had no growth at the dilution factors used for enumeration.

Mineral Composition of the Dodo Ikire

Table 4 shows the mean values of mineral compositions of Dodo-ikire samples purchased from the selected markets in Ikire Town and the laboratory prepared sample (control). The range of the mean values of minerals content of the treatment samples and control were: Sodium (21.089-44.437mg/kg), Potassium (16.345-17.432mg/kg), Calcium (3.567-5.005mg/kg), Magnesium (1.842-2.776mg/kg), Phosphorus (5.026-5.263mg/kg), Copper (0.000-0.004mg/kg), Iron (0.075-0.315mg/kg), Manganese (0.023-0.034mg/kg) and Zinc (0.002-0.004mg/kg), The sodium content (44.437mg/kg) of sample coded TSM is significantly ($p<0.05$) higher compared with other sample. While, iron (0.075mg/kg) content of sample OAM was significantly ($p<0.05$) lower compared with control and other treatment samples. There was no significant ($p<0.05$) difference among the treatment samples and control in the values recorded for the following minerals: potassium, phosphorus, manganese and zinc (Table 4).

DISCUSSION

Different factors can influence the nutritional composition of plantain which includes physical treatment, degree and method used for processing such as time, frying method and amount of heat or moisture used, co-ingestion of protein and fat (Collier *et al.*, 1984; Pi-sunyer, 2002). The low level (<10%) of moisture content recorded for most of the samples purchased from the

vendors in all the markets may be due to the effect of frying; since moisture could be loss during frying. Moisture from the samples could either have been evaporated or leach into the frying oil. It is observed from the results of analysis that the samples obtained from the vendors in the markets had increased crude fat which ranged from 7.21 to 21.00% (Table 1 to 3). This increased value in fat component may be due to the addition of palm oil to the over-ripe fried plantain during preparation and frying process.

Result of total ash, fibre and protein contents which increased slightly and the quantity of carbohydrate (ranged from 63.48 to 76.63%) as shown in Table 3 and 2 respectively compared with fresh plantain as shown by Adewole and Duruji (2010) may be attributed to loss of water in the final product of over-ripe fried plantain.

The values of bacterial counts (range from 2.0cfu/g to 9.0cfu/g) and the values of fungal counts (range from 2.0cfu/g to 3.0cfu/g) recorded for the samples purchased from the vendors in all the markets lie within acceptable range as stated in Nigeria by National Agency for Food and Drug Administration and Control (NAFDAC) for packaged snack, although this values were significantly higher than the values (1.0cfu/g) recorded for the control sample. This among other factors may be due to the unhygienic practises of the vendors, contamination due to population congestion in the market locations, use of unsuitable material for packaging and contamination of the final product during hawking. In conclusion, this study has shown the proximate composition and microbial counts of dodo ikire purchased from three different market in ikire town.

It is observed that increase in fat; which results from the addition of palm oil, a major source of cholesterol to the plantain could pose deleterious effect on susceptible persons to high cholesterol intake. Also, the significantly higher values of microbial counts obtained in the samples compared with control sample indicates poor hygiene practices by some of the vendors.

It is therefore recommended that the producer of dodo ikire should practise good hygiene during production and packaging. There should also be improvement on the type of packaging material used; which may improve on the storage life of the food product. Hawking of the food product should be discourage to minimize microbial contamination during marketing and lastly, an effective food safety programme could be put in place by the government(s) to seriously monitor the preparations of dodo ikire which may in turn guide against the possibilities of food borne infection or intoxication.

The variation of the values obtained for the mineral content of the samples and the control may be due the levels of minerals of the plantain ingredient and various additives such as palm oil, habanero pepper, onion and salt which were mixed together in the preparation of the samples. For instance, common salt is high in sodium content and its likely to be added to the samples

according to taste of the producers; the quantity of salt added during preparation varies and may likely affect the sodium content of the samples. Sodium is an important mineral from medicinal point of view; although too much consumption of sodium rich foods or substances used as food additives should be discouraged for people prone to have high blood pressure.

Potassium is important for reducing blood pressure and also increasing blood circulation, as well as preventive aid on general health of the heart (Rajurkar and Damame, 1998; Aslam *et al*., 2005). According to Aslam *et al.* (2005), Calcium helps in transporting of long chain fatty acid which helps in prevention of heart diseases, high blood pressure and other cardiovascular diseases. The authors also reported that magnesium works with calcium to transmit nerve impulse in the brain. Magnesium also has calming effect and works on the nervous system of the people with depression. Adewusi *et al.* (1999) estimated the mineral content in processed cassava products and reported that magnesium, iron, calcium and zinc were present in considerable amounts.

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Table-1. Proximate composition of over ripe fried plantain (Dodo ikire) purchased from four vendors in Total Station Market (TSM)

SAMPLES	MOISTURE CONTENT (%)	CRUDE PROTEIN (%)	CRUDE FAT (%)	TOTAL ASH (%)	CRUDE FIBRE (%)	CHO (%)
TSM 1	6.15^{c}	4.16^{a}	9.35^{d}	5.50^{a}	2.65^{a}	72.19^{a}
TSM 2	8.05^{a}	3.94^{b}	13.30^{c}	1.53^{c}	1.45^{b}	71.73^{a}
TSM 3	6.24^{c}	3.28^{bc}	16.90^{ab}	1.51^{c}	1.53^{b}	70.54^{b}
TSM 4	4.03^{d}	1.97^{c}	21.00^{a}	2.04^{b}	0.85^{c}	70.11^{b}
CONTROL	7.33^{b}	4.59^{a}	13.92^{b}	5.17^{a}	2.55^{a}	66.51^{c}

Values are means of three replicate determinations

CHO=Carbohydrate

abcd=means on the same column with different subscript are significantly different ($p<0.05$)

SEM= Standard Error of Mean

Key: TSM 1= First vendor of dodo ikire in Total Station Market

TSM 2= Second vendor of dodo ikire in Total Station Market

TSM 3=Third vendor of dodo ikire in Total Station Market

TSM 4= Fourth vendor of dodo ikire in Total Station Market

Table-2. Proximate composition of over ripe fried plantain (Dodo ikire) purchased from four vendors in Oja Ale Market (OAM)

Values are means of three replicate determinations

SAMPLES	MOISTURE CONTENT (%)	CRUDE PROTEIN (%)	CRUDE FAT (%)	TOTAL ASH (%)	CRUDE FIBRE (%)	CHO (%)
OAM 1	4.32^{c}	4.38^{a}	11.21^{cd}	1.34^{c}	2.12^{ab}	76.63^{a}
OAM 2	6.54^{b}	3.72^{b}	15.42^{a}	4.50^{b}	1.69^{b}	68.13^{b}
OAM 3	6.21^{b}	3.50^{b}	10.30^{d}	4.54^{b}	1.93^{b}	73.52^{ab}
OAM 4	6.15^{b}	4.40^{a}	14.43^{b}	5.52^{a}	2.74^{a}	66.78^{c}
CONTROL	7.33^{a}	4.59^{a}	13.90^{c}	5.17^{a}	2.55^{a}	66.53^{c}

CHO=Carbohydrate

abcd=means on the same column with different subscript are significantly different ($p<0.05$)

SEM= Standard Error of Mean

Key: OAM 1= First vendor of dodo ikire in Oja Ale Market

OAM 2= Second vendor of dodo ikire in Oja Ale Market

OAM 3=Third vendor of dodo ikire in Oja Ale Market

OAM 4= Fourth vendor of dodo ikire in Oja Ale Market

Table-3. Proximate composition of over ripe fried plantain (Dodo ikire) purchased from four vendors in Gbongan Garage Market (GGM)

SAMPLES	MOISTURE CONTENT (%)	CRUDE PROTEIN (%)	CRUDE FAT (%)	TOTAL ASH (%)	CRUDE FIBRE (%)	CHO (%)
GGM 1	4.26^{d}	3.51^{b}	11.30^{b}	4.53^{d}	1.25^{a}	75.15^{a}
GGM 2	4.49^{d}	3.53^{b}	12.10^{b}	8.59^{b}	1.70^{a}	69.59^{ab}
GGM3	6.22^{c}	3.54^{b}	12.90^{b}	12.00^{a}	1.86^{a}	63.48^{b}
GGM 4	8.01^{a}	3.94^{b}	7.21^{c}	4.20^{d}	1.29^{a}	71.35^{a}
CONTROL	7.33^{b}	4.59^{a}	13.9^{a}	5.17^{c}	1.55^{a}	67.53^{b}

Values are means of three replicate determinations

CHO=Carbohydrate

abcd=means on the same column with different subscript are significantly different ($p<0.05$)

SEM= Standard Error of Mean

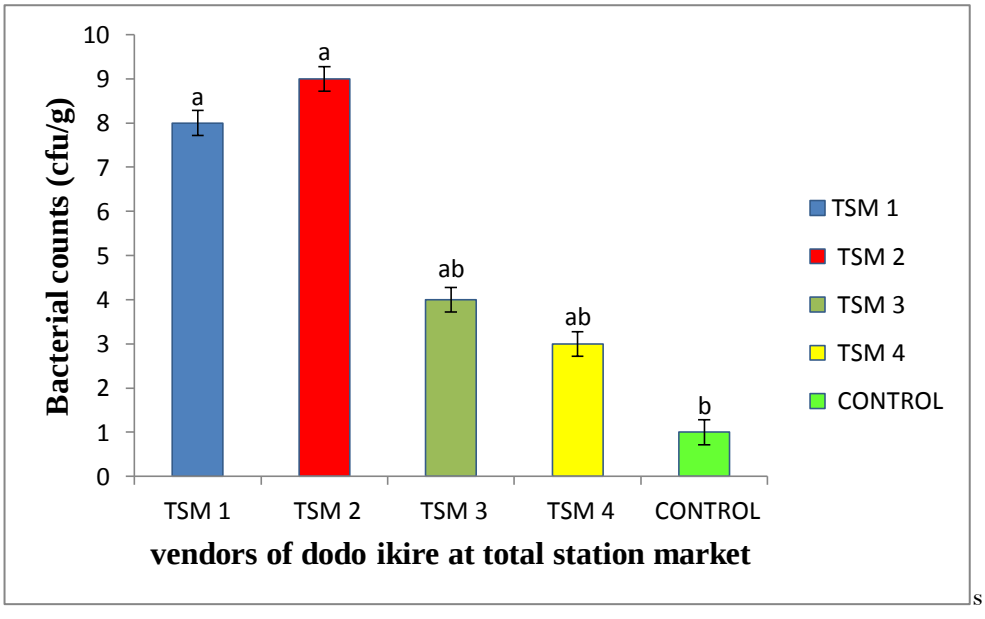
Key: GGM 1= First vendor of dodo ikire in Gbongan Garage Market

GGM 2= Second vendorof dodo ikire in Gbongan Garage Market

GGM 3=Third vendor of dodo ikire in Gbongan Garage Market

GGM 4= Fourth vendor of dodo ikire in Gbongan Garage Market

Figure-1. Total viable bacterial counts of dodo ikire purchased from Total Station Market



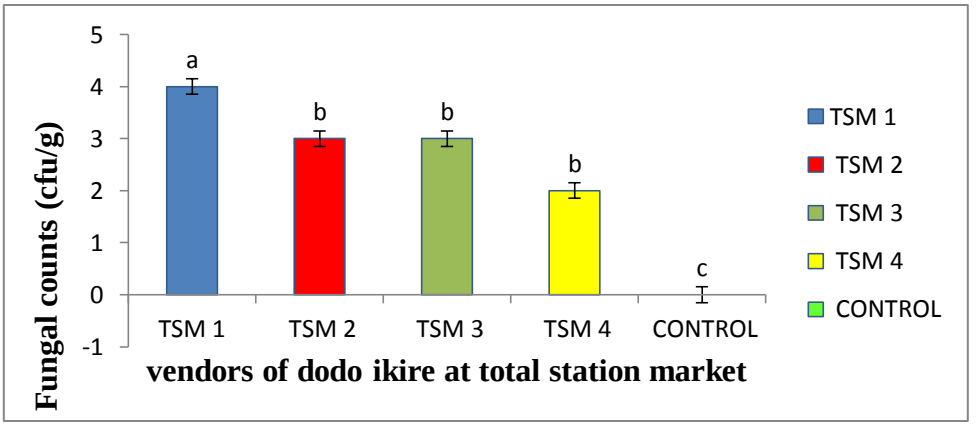
s

abcd= means on the same column with different subscript are significantly different ($p<0.05$)

Values are means of three replicate determinations

SEM= Standard Error of Mean

Figure-2: Total viable fungal counts of dodo ikire purchased from Total Station Market

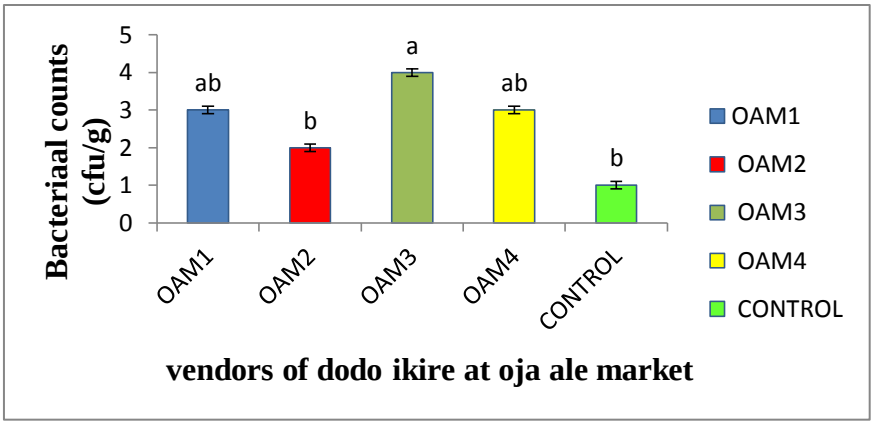


abcd=means on the same column with different subscript are significantly different ($p<0.05$)

Values are means of three replicate determinations

SEM= Standard Error of Mean

Figure-3. Total viable bacterial counts of dodo ikire purchased from Oja Ale Market

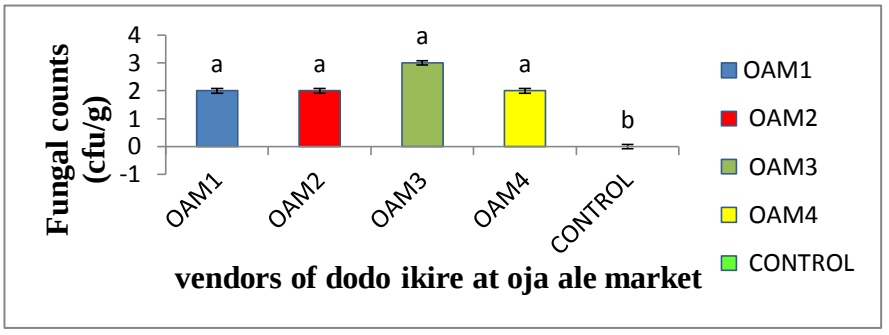


Abcd= means on the same column with different subscript are significantly different ($p<0.05$)

Values are means of three replicate determinations

SEM= Standard Error of Mean

Figure-4. Total viable fungal counts of dodo ikire purchased from Oja Ale Market

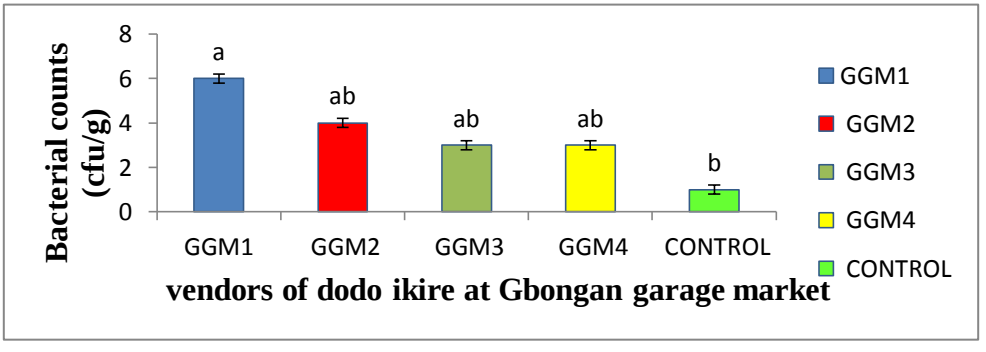


Abcd= means on the same column with different subscript are significantly different ($p<0.05$)

Values are means of three replicate determinations

SEM= Standard Error of Mean

Figure-5. Total viable bacterial counts of dodo ikire obtained from Gbongan Garage Market

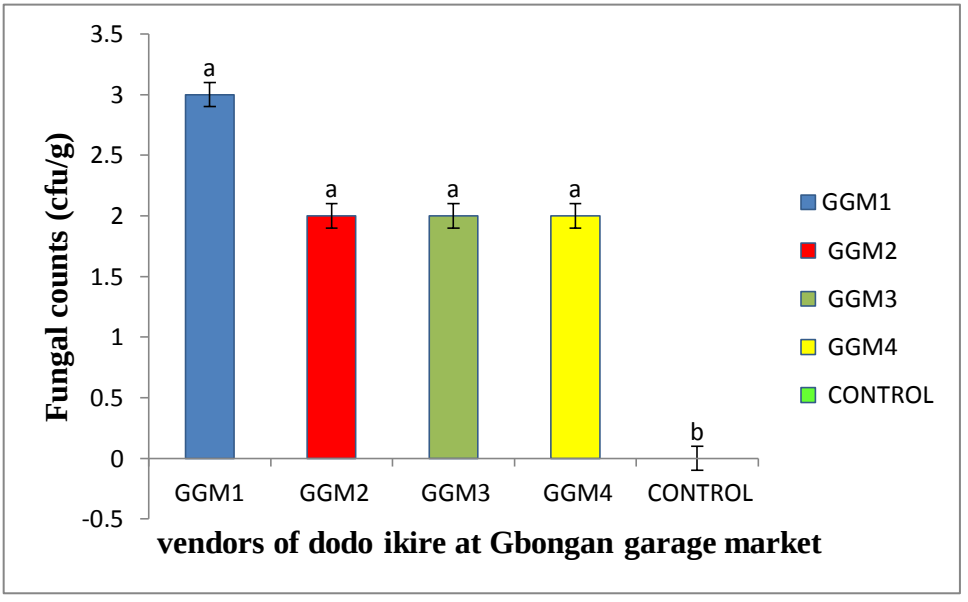


abcd means on the same column with different subscript are significantly different ($p<0.05$)

Values are means of three replicate determinations

SEM= Standard Error of Mean

Figure 6: Total viable fungal counts of dodo ikire purchased from Gbongan Garage Market



abcd= means on the same column with different subscript are significantly different ($p<0.05$)

Values are means of three replicate determinations

SEM= Standard Error of Mean

Table 4: Mineral compositions of Dodo-ikire purchased from selected markets in Ikire Town

	Markets Locations			
Mineral Composition (mg/100g)	TSM	OAM	GGM	Control
Sodium	44.437[a]	31.105[c]	40.265[b]	21.089[d]
Potassium	16.345[a]	17.432[a]	17.220[a]	16.563[a]
Calcium	4.976[a]	3.567[b]	5.005[a]	4.786[a]
Magnesium	2.776[a]	2.156[ab]	2.112[ab]	1.842[b]
Phosphorus	5.115[a]	5.026[a]	5.146[a]	5.263[a]
Copper	0.000[b]	0.004[a]	0.000[b]	0.000[b]
Iron	0.238[a]	0.075[b]	0.246[a]	0.315[a]
Manganese	0.034[a]	0.028[a]	0.023[a]	0.025[a]
Zinc	0.002[a]	0.004[a]	0.003[a]	0.003[a]

abc = means on the same column with different subscript are significantly different ($p<0.05$)

Values are means of three replicate determinations

SEM= Standard Error of Mean

Key: TSM = Sample Purchased from Total Station Market

OAM = Sample Purchased from Oja Ale Market

GGM= Sample Purchased from Gbongan Garage Market