

# The Preservative Effects of Two Local Nigerian Spices on the Shelf Life of fried Bean Cake Snacks

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## Abstract

Spices and herbs have been reported to be potent sources of natural antioxidants. Spices are known to impact flavour and improve overall organoleptic quality of foods. The use of naturally occurring materials like spices as preservatives has been proved to be a promising alternative to the use of chemicals. The effects of *Aframomum danielli* and *Zingiber officinale* crude extract on the storability of fried bean cake snacks were investigated. Proximate and sensory analyses of the snack were also assessed. The fried bean cakes were spiced with 0.2, 0.4, 0.6, 0.8 and 1% of both spices, the untreated sample was also prepared making a total of 11 samples. Proximate analyses revealed that moisture ranged from 0.85-1.05%, protein 80.00-78.70%, fat 2.09-1.08%, ash 1.50-1.30%, fibre 2.00-1.80%, carbohydrate 10.25-12.75% and dry matter 3.52-2.30%. Sensory evaluation shows that there was no significant difference ( $p < 0.5$ ) among the treated and untreated samples in terms of all the sensory attributes evaluated. Storage stability test also indicated the preservative effects of the incorporated extracts on spoilage micro-organisms at ambient temperature when compared to the control sample. There was, with respect to concentration of extract added, little significant difference in preservative effect between samples preserved with alligator pepper and ginger extracts. Conclusively, the fried bean cake snacks treated with 0.2% and 0.4% of both spices were more acceptable generally and stable than the ones treated with 0.6 and 0.8% of both spices. The fried bean cake snacks treated with 1% of both spices were unacceptable in terms of all the sensory attributes evaluated.

**Keywords:** Bean; Cakes; Ginger; Alligator pepper; Preservation

## Introduction

Cowpea (*Vigna unguiculata*) is the most common legumes consumed in Africa countries especially Nigeria, and it is an important source of plant protein and nutritious compound in human diet [1,2]. Beans cake is a deep fat fried products from cowpea which is produced following the process of Olapade et al. [3]. Beans cake is popular in Nigeria and other African countries because it is cheap, readily available and contains good quality protein that could be used for supplementation of cereals. It also serves as fast foods sold by the vendors on the streets, in the market places and at bus stations. The preparation of beans cake from fresh cowpea seed is labour intensive and time consuming with short shelf life which is just between 18-24 hrs according to Olapade and Adegoke et al. [3,4]. This pre-disposes the protein in the beans cake to putrefaction and the carbohydrate to fermentation and rottenness by *Bacillus subtilis* [5]. A new innovation with the commonly hawked fried beans cake in Ogbomosho is the reduction in the moisture content which imparts longer shelf life to the named food product. However, the product can only keep for four weeks before microbial spoilage sets in after absorption of moisture from the atmosphere. Longer storability of the beans cake from Ogbomosho therefore may be achieved probably with the introduction of antioxidant and antimicrobial agents coupled with high standard of hygiene during pre and post preparation handling.

Antioxidant properties of spices have been recognized about six decades ago when it was demonstrated that spices effectively increased the antioxidant capacity of foods and that their effects depended on food matrices [5]. Studies on culinary and medicinal herbs identified the superiority of spices in antioxidant capacity to berries, other fruits, vegetables and nuts [6]. The use of local spices to control the activities of micro-organisms in food has been reported by Akpomedaye and Ejechi, and Nwafor and Ogiehor [7,8]. Apart from antimicrobial activities, spices are believed to have medicinal value (especially in

African settings) and have desirable determinative influences on the overall organoleptic analysis when used.

*Aframomum danielli* (alligator pepper) is a parental crop with erect stems with about 50 species spread over West and some East Africa countries [9]. The antimicrobial activities of its crude extract against a number of micro-organisms have been established. A host of bacteria including *Salmonella enteritis*, *Pseudomonas fragi*, *Pseudomonas fluorescens*, *Proteus vulgans*, *Streptococcus pyogenes*, *Staphylococcus aureus* and molds *Aspergillus flavus* and *Aspergillus niger* has been reported inhibited by the extract [1,10]. Also, the nutritive status of *Aframomum danielli* has been reported by Fasoyiro et al. [1]. Adegoke et al. [11,12] reported the inhibition of some food spoilage yeasts (*Candida torulopsis*) at concentration of 100 to 200 ppm. The anti-oxidative activities of alligator pepper and the evaluation of its preservative action as a substitute for sorbic acid in treated bread has been discovered although the rheological properties such as loaf volume and texture were impaired [13]. *Aframomum danielli* was used to control ochratoxin A in kunun-zaki [14]. Adegoke et al. [12] reported that *Aframomum danielli* can be used in food processing and preservation.

*Zingiber officinale* is a tuber (rhizome) that is consumed whole as a delicacy medicine or spices. The characteristic odor and flavor

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of ginger is caused by a mixture of zingerone, shogaols and gingerols volatile oils that compose one to three percent of the weight of fresh ginger [15]. These contribute to its pungent taste. Ginger acts as a useful food preservative. Young ginger rhizomes are juicy and fleshy with a very mild taste. They can be stewed in boiling water to make ginger tea to which honey, sliced orange or lemon fruit may also be added. Mature ginger roots are used as a spice in Indian recipes and many South Asian cuisines for flavoring dishes such as sea food or goat meat and vegetarian cuisines. Powdered dry ginger root is typically used as a flavoring for recipes such as ginger bread, cookies, crackers and cake, ginger ale and ginger beer [6].

Therefore this research work therefore aimed at achieving the following objectives: to assess the effect of both *Aframomum danielli* and *Zingiber officinale* on the sensory and nutritional qualities of fried beans cake from Ogbomosho and to examine the preservative effects of both spices on the named food product.

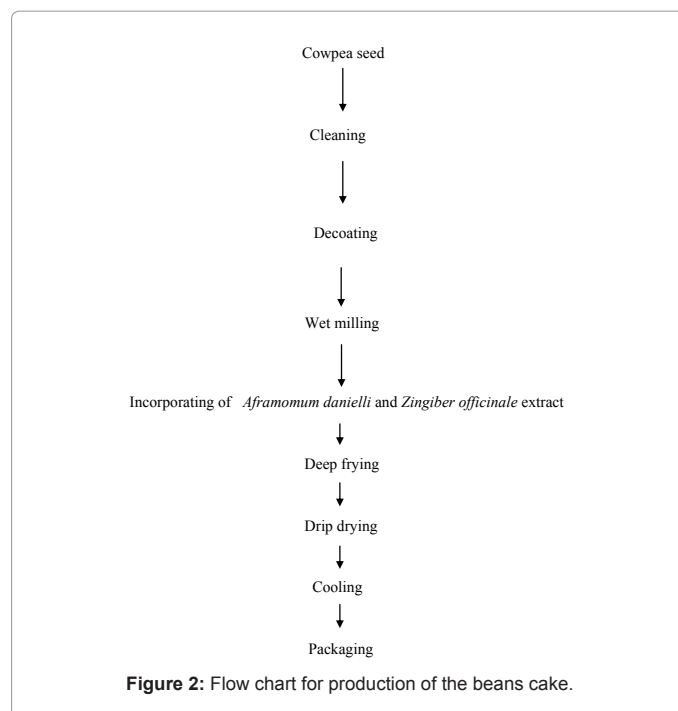
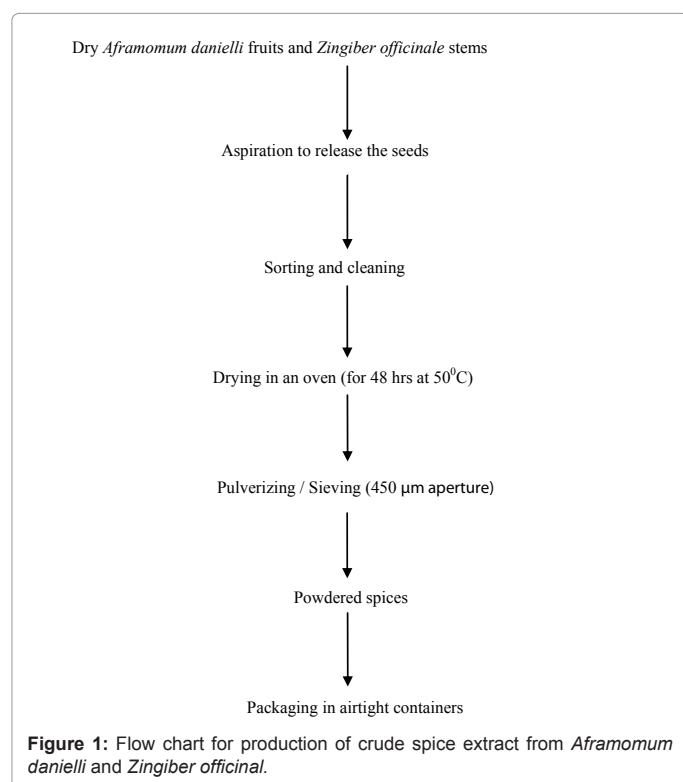
## Materials and Methods

### Sources of materials

*Aframomum danielli* dried fruits and *Zingiberofficinale* were obtained from Olu-ode market in Osogbo. Cowpea grains (Sokoto white), groundnuts oil, salt and onion were purchased from the same place. The chemicals, equipment and apparatus used all the experiment, storage tests and sensory evaluation were carried out at the Laboratory of Food Science and Technology Department, Osun State Polytechnic, Iree, Nigeria.

### Spices preparation

Ginger (*Zingiber officinale*) stems and alligator pepper (*Aframomum danielli*) seeds were removed from the pods, sorted and cleaned from all extraneous materials and adhering particles, The cleaned stems



and seeds were dried under the same condition for about 48 hrs to a moisture content of between 10-12%, air-skinned and winnowed. The dried samples were milled separately into flours using a coffee mill within few minutes' of extraction to prevent loss of flavour and sieved through 450 µm aperture sieve. The flour samples were packed in air tight containers and stored at refrigeration (5°C) until utilized. Figure 1 represents the flow diagram for preparation of the spices. The method described by Adegoke and Skura [10] was followed.

### Extraction of crude antioxidant extract from both Aframomum danielli and Zingiber officinale

20 g of the resulting powder was then weighed out and wrapped in five Whatman No.1 filter papers. Soxhlet extraction of the samples was accomplished and the products concentrated by evaporation over a monotherm at 65°C for 10 minutes and filtered. The crude extract was packed in amber bottles and stored at refrigeration temperature until it was used. The percentage yield of the extract was calculated.

### Production of beans cake from cowpea seeds

The methods described by Olapade et al. [3] except with reduced water content was adopted as shown in figure 2.

### Proximate composition of the fried beans cake samples

Moisture, fat, ash, crude fibre and crude protein of the beans cake treated with crude extract of both spices with the control were determined according to the method of AOAC [16].

### Microbiological analysis of the fried bean cake samples

Total viable counts and mould counts of spiced and unspiced samples were determined using the method adopted from Rosa [17].

### Sensory evaluation

A preference test was carried out to determine the most acceptable sample. The beans cake were coded and presented to ten semi-trained

panel of judges who were students and staff members of the department of Food Science and Technology. The samples were scored for the appearance, flavour, taste, texture and overall acceptability using a nine point hedonic scale where 9 indicated like extremely and 1 indicated dislike extremely. The scores were subjected to statistical analysis, Paired *t*-test was used to test the level of significance difference ( $p < 0.05$ ) in terms of attributes of fried bean cake samples [18].

### Storage stability test

The storage stability of the spiced and unspiced beans cakes were monitored by storing the sample at ambient conditions. The samples were sealed in high density polyethylene films of about 0.92 g/cm<sup>3</sup> of high resistance to moisture, heat and fat.

## Results and Discussions

### Proximate composition (%) of the spiced and unspiced beans cake

Ginger spiced samples had higher protein content than beverages spiced with alligator pepper. The protein content of ginger (12.60%) and alligator pepper (3.85%) has contributed significantly at ( $p < 0.05$ ) to the increase in protein content of beverage [19,20]. Control sample had a protein content of 78.70% while a range of 80.00-78.82% and 78.80-78.72% was recorded for samples containing ginger and alligator pepper extracts at varying concentrations, respectively. Although the sample is a good source of protein but addition of ginger or alligator pepper fried bean cake snacks resulted in significant ( $p < 0.05$ ) increase in their protein level. The observation shows a progressive significant decrease in the protein content with increasing ginger concentration in the sample. The same trend was observed for alligator spiced samples. This may be attributed to the heat process involved in the frying process which might have destroyed some amino acids with consequent reduction in total nitrogen content of the resulting beverage [21].

Ginger spiced samples had higher crude fat content than bean cakes spiced with alligator pepper. The lipid content of ginger (18.20%) and alligator pepper (11.0%) has contributed significantly at  $p < 0.05$  to the increase in fat content of the cakes and together with palm oil that was used for frying [19,20]. The control sample had a crude fat content of 1.80% while a range of 2.09-1.98% and 1.40 to 1.32% was recorded for samples containing ginger and alligator pepper extracts at varying concentrations, respectively. The addition of ginger or alligator pepper to the bean cake samples resulted in significant ( $p < 0.05$ ) increase in their fat content. The observation shows a progressive significant decrease in the fat content with increasing ginger concentration in the sample. The same trend was observed for alligator spiced samples (Table 1). This might be attributed to the effect of direct heat on fat soluble components of the beverage during the process of frying [22].

Ginger spiced samples had higher carbohydrate content than bean cakes spiced with alligator pepper. The carbohydrate content of ginger (15.09%) and alligator pepper (10.04%) has contributed significantly at  $p < 0.05$  to the increase in carbohydrate content of the cakes [19,20]. The control sample had a carbohydrate content of 12.75% while a range of 10.25-11.25% and 11.50-12.50% was recorded for samples containing ginger and alligator pepper extracts at varying concentrations, respectively. The addition of ginger or alligator pepper to the sample resulted in significant ( $p < 0.05$ ) increase in their fat content. The observation shows a progressive significant decrease in the fat content with increasing ginger concentration in the sample. The same trend was observed for alligator spiced samples. This might be attributed to the

effect of direct heat on the carbohydrate components of the beverage during the process of frying [22].

NSRL (2002) reported that, a diet low in fibre is undesirable as it could cause constipation and associated diseases like piles, appendicitis and colon cancer and several other digestive disorders. Fibre is reported to help in lowering the serum cholesterol, control blood sugar and increase bulk stool [23]. Ash content is an indication of mineral contents in food [22]. This observation suggests that the fried bean cake snack is a very good and nutritious food commodity. Ginger spiced samples had higher ash content than bean cakes spiced with alligator pepper. The control sample had an ash content of 1.30% while a range of 2.00-1.92% and 1.90-1.82% was recorded for samples containing ginger and alligator pepper extracts at varying concentrations, respectively. The addition of ginger or alligator pepper to the bean cake samples resulted in significant ( $p < 0.05$ ) increase in their fat content. The observation shows a progressive significant decrease in the fat content with increasing ginger concentration in the sample. The same trend was observed for alligator spiced samples.

The moisture content of the fried bean cake snack was found to be relatively low. This characteristic is advantageous in terms of shelf life. Ginger spiced samples had lower moisture content than bean cakes spiced with alligator pepper. The control sample had a moisture content of 1.05% while a range of 0.85-0.93% and 0.95-1.03% was recorded for samples containing ginger and alligator pepper extracts at varying concentrations, respectively.

### Storage stability of the bean cake samples

Tables 2 and 3 shows that the extracts of *A. Danielli* had similar inhibitory effect to *Z. officinale* on the bacterial and mould content of fried bean cake samples. The antibacterial effect increased with increase in the concentration of the extract. The result shows that there was reduced spoilage rate on the treated samples than the untreated sample at ambient temperature. Similar findings have been documented for related food items [24]. The microbial loads of the fresh samples were at the recommendation limit of (10<sup>3</sup> cfu/ml) for ready to consume food by International Commission on Microbiological specifications for foods

Sample	oisture	protein	fat	ash	fibre	CHO	dry matter
AA	0.85a	70.00k	12.09k	1.50k	2.00k	10.25a	3.52k
BB	0.87b	68.88j	12.06j	1.48j	1.98j	10.50b	3.50j
CC	0.89c	68.86i	12.03i	1.46i	1.96i	10.75c	2.48i
DD	0.91d	68.84h	12.01h	1.44h	1.94h	11.00d	2.46h
EE	0.93e	68.82g	11.98g	1.42g	1.92g	11.25e	2.44g
FF	0.95f	68.80f	11.95f	1.40f	1.90f	11.50f	2.40f
GG	0.97g	68.78e	11.92e	1.38e	1.88e	11.75g	2.38e
HH	0.99h	68.76d	11.89d	1.36d	1.86d	12.00h	2.36d
II	1.01i	68.74c	11.86c	1.34c	1.84c	12.25i	2.34c
JJ	1.03j	68.72b	11.83b	1.32b	1.82b	12.50j	2.32b
KK	1.05k	68.70a	11.80a	1.30a	1.80a	12.75k	2.30a

Keywords: AA rep 0.2% G.; BB rep 0.4% G.; CC rep 0.6%G.; DD rep 0.8% G.; EE rep 1%G; FF rep 0.2% A.P.; GG rep 0.4% A.P.; HH rep 0.6% A.P.; II rep 0.8%A.P.; JJ rep 1%A.P.; KK rep the control sample while G.rep *Ginger*; A.P.rep Alligator pepper

Values are means of 4 determinations

Values with the same letter along the column are not significantly different at  $p < 0.05$  by DMRT

Values with different letter along then same column are significantly different ( $p > 0.05$ ) by DMRT

**Table 1:** Proximate composition (%) of the spiced and unspiced beans cake.

Samples	Week 5	Week 6	Week 7	Week 8
AA	-	-	+	+
BB	-	-	+	+
CC	-	-	-	+
DD	-	-	-	+
EE	-	-	-	-
FF	-	-	+	+
GG	-	-	+	+
HH	-	-	-	+
II	-	-	-	+
JJ	-	-	-	-
KK	+	+	+	+

Keywords: AA rep0.2% G; BB rep0.4% G; CC rep0.6g% G; DD rep0.8% G; EE rep1% G.; FF rep0.2% A.P; GG rep0.4% A.P; HH rep0.6% A.P.; II rep0.8% A.P.; JJ rep 1.0% A.P.; KK rep the control sample while G.rep Ginger; A.P.rep Alligator pepper; - rep absence of growth; + rep presence of growth, Values are means of 4 determinations

Values with the same letter along the column are not significantly different at p <0.05 by DMRT

Values with different letter along then same column are significantly different (p>0.05) by DMRT

**Table 2:** Inhibitory effects of *Aframomum danielli* and *Zingiber officinale* on bacteria (cfu/ml).

Samples	Week 5	Week 6	Week 7	Week 8
AA	-	-	+	+
BB	-	-	+	+
CC	-	-	-	+
DD	-	-	-	+
EE	-	-	-	-
FF	-	-	+	+
GG	-	-	+	+
HH	-	-	-	+
II	-	-	-	+
JJ	-	-	-	-
KK	+	+	+	+

Keywords: AA rep0.2% G; BB rep0.4% G; CC rep0.6g% G; DD rep0.8% G; EE rep1% G.; FF rep0.2% A.P; GG rep0.4% A.P; HH rep0.6% A.P.; II rep0.8% A.P.; JJ rep 1.0% A.P.; KK rep the control sample while G.rep Ginger; A.P.rep Alligator pepper; - rep absence of growth; + rep presence of growth, Values are means of 4 determinations

Values with the same letter along the column are not significantly different at p <0.05 by DMRT

Values with different letter along then same column are significantly different (p>0.05) by DMRT

**Table 3:** Inhibitory effects of *Aframomum danielli* and *Zingiber officinale* on moulds (cfu/ml).

[25], for total bacteria and mould plate count. Drastic reductions in the total plate count of both bacteria and mould were observed with the treated sample when compared with the untreated ones indicating the effective inhibition of growth of micro-organisms by both spices. The microbial analysis of the fresh bean cake samples revealed that there was no coliform growth throughout the period of storage. This is an indication that the beverage was produced under hygienic conditions [26].

### Sensory attributes of the fried bean cake samples

Table 4 shows the fried bean cake samples with both spices in different concentrations ranging from 0.2-1% concentration were well acceptable by the panelists in terms of appearance, taste, texture, flavour and overall acceptability. Interestingly, the result of the sensory evaluation shows that there was no significant difference (p<0.5) among

the treated and untreated samples in terms of all the sensory attributes evaluated. The fried bean cakes with 0.2% and 0.4% of both spices had higher ratings than the ones spiced with 0.6 and 0.8% while the samples spiced with 1% were least appreciated as a result of higher concentration of the extracts which adversely affected the all the sensory attributes. The unspiced (control) samples had the least ratings in all the sensory attributes indicating the potential of the spices in producing acceptable food product. This supports the facts that spices are believed to have medicinal value (especially in African settings) and have desirable determinative influences on the overall organoleptic analysis when used [6]. Varying the concentration of both spices in the samples did not result in significant (p<0.05) changes in almost all the studied sensory attributes.

### Conclusion

The similarity between samples preserved with either of the two extracts can be traced to similarities in phytochemical constituents even though present in differing amounts. These phytochemicals include zingiberene, 6-gingerol, 6-paradol and shagaols. This means that preservation using alligator pepper and ginger extracts show similar effects. However, further research is necessary to investigate the possibility of a synergistic effect in preservation using a combination of the two extracts. Other spices are recommended to generate more data gather to assist in the commercial production of the product. Fresh spices could also be used instead of the dried ones used in this study. Moreover, further research work is necessary on the effect of the above extracts on the organoleptic quality of the fried bean cakes.

Treatment of the fried bean cake with *A. danielli* and *Z. officinale* extract at 0.2 and 0.4% concentrations showed effectiveness in extending the shelf life of the fried bean cake from spoilage and microbial changes. Also, the fried bean cake snacks produced at 0.6 and 0.8% were still organoleptically acceptable; therefore the spices have the potentials of being used as preservatives for fried bean cake snacks.

Coliform and total viable counts were found to be nil in the freshly prepared samples. The anti-microbial activities of the spices were established with the microbial profile of the spiced beverages during storage. The result of this study reveals that nutritious and relatively shelf stable food products could be produced from cowpea (*Vigna unguiculata*) and local spices without the use of chemical preservatives.

Sample	Colour	Flavour	Taste	Mouth feel	Overall acceptability
AA	9.00a	9.00a	9.07	9.00a	9.12a
BB	9.08a	9.12ab	9.10ab	9.07ab	9.12b
CC	8.67ab	8.17ab	8.60ab	8.46abc	8.87ab
DD	8.50b	8.13bc	8.08abc	8.19ab	8.52abc
EE	8.50ab	8.12bcd	8.03cd	8.07abc	8.23ac
FF	8.47bc	8.00cd	8.80bcd	8.06cde	8.03abc
GG	8.40ab	8.00bcd	8.80bcd	8.03abcd	8.01cde
HH	7.33c	6.50cde	6.60bc	6.80acd	7.40bc
II	7.17c	6.50cde	6.50bcd	6.33bcd	7.33bc
JJ	7.00c	6.17e	6.05d	6.13d	7.03c
KK	6.80ac	6.01ce	6.00bc	6.02ac	7.00bd

Keywords: AA rep 0.2%G.; BB rep 0.4% G.; CC rep 0.6% G.; DD rep 0.8% G.; EE rep 1% G.; FF rep 0.2% A.P.; GG rep 0.4% A.P.; HH rep 0.6% A.P.; II rep 0.8% A.P.; JJ rep 1% A.P.; KK rep the control sample while G.rep Ginger; A.P.rep Alligator pepper Values are means of 4 determinations. Values with the same letter along the column are not significantly different at p <0.05 by DMRT

Values with different letter along then same column are significantly different (p>0.05) by DMRT

**Table 4:** Organoleptic attributes of the fried bean cake samples.



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