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Storage Stability and Sensory Qualities of 'Kango' Prepared from Maize Supplemented with kidney Bean Flour and Alligator Pepper.

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Abstract:
Background: Kango is a traditional snack made from maize and consumed by all ages in western part of Nigeria, the shelf life of the snack is short so also is the Maize snack s lacking in Lysine and tryptophan an important amino acid. Hence the need to supplement the snack with kidney bean that contains about 20-30% protein on dry basis. Alligator pepper is a spice that is needed in small quantity in the diet, it is used traditionally to cure measles and excessive bleeding after child birth.
Materials and Methods: Composite Maize flour, kidney bean and alligator pepper flour were mixed with water and soaked for 20 minutes. Other ingredients such as onion and salt were added to the mixture. it was fried at temp of 140^{o}C. Kango is consumed by people of all ages (excluding infants). Kango is fried at 140^{o}C with other ingredients such as pepper, salt and onion for a period of 5-7 minutes.
Results: The study indicates that addition of kidney bean in maize snacks (kango) improved the sensory qualities, hence the acceptability while the added alligator pepper reduces the microbial load of the kango snacks.
Conclusion: The total viable count decreases with increase in the addition of alligator pepper in all the snacks which may be due to the addition of alligator pepper which has strong antimicrobial effect hence a better storage life.
Key Word: Kidney bean, Maize, Alligator pepper, Snacks, Nutritional composition, kango.

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I. Introduction

Kango is a Nigerian local snack made from corn just like akara is made from cowpea, but *Kango* is much cheaper in price to make (just because corn is cheaper than beans). Maize snacks do not provide adequate nutritional qualities needed by the body because they are deficient in some essential amino acids especially lysine (Adelakun, Adejuytan, Olajide & Alabi, 2005). Some deficiencies may be due to their composition, or in many instances due to losses during processing. Amino acids lacking can be supplied to the food by complimenting the maize with legumes such as peanuts, pulses which are better sources of the sulphur amino acids (Okaka, 2005). Maize substituted with kidney bean is expected to be highly nutritious as the kidney bean contributes protein and other nutrients to the diet. Acceptable maize products can be made with as much as 10% legume seed with 90% maize flour. In order to enhance the nutritional value of the snack, addition of vegetable protein could be a way of doing so by introducing new protein into it. Several studies have been conducted to improve the protein quality of maize products by fortification with plant proteins such as soybean, which is less expensive and this is evident in the report of Kaur and Sharma, (1999) on the study of high-protein cookies using soy flour and pulse flours. 89

Kidney bean (*Phaseolus vulgaris L*) is the most widely produced and consumed food legume in Africa, India and Latin America (FAO, 1999). Kidney bean usually contains 20-30% protein on a dry basis (Sathe*et al.*, 1982). The storage proteins of kidney bean have recently attracted much attention, due to their superior functionalities such as protein solubility, emulsifying properties and ability to form heat-induced gels (Sathe*et al.*, 1982). Kidney beans have numerous health benefits among which is their ability to reduce heart and renal disease risks, lower glycemic index for persons with diabetes and prevent cancer.

Alligator pepper is a West African spice which corresponds to the seeds and seed pods of *Aframomumdanielli*, *A.citratum* or *A. escapum.* It is a close relative of grains of paradise, obtained from the closely related species of *Aframomummelegueta* (Menotti, Kromhout & Blackburn2009). Alligator pepper is a spice used as worm expellants and also used sparingly because of its strong flavour. It is a popular ingredient in

the famous pepper soup which is a great delight in Africa, and is useful in the treatment of measles and controlling excessive bleeding after child birth (Inegbenebor, 2009). The presence of alkaloids, tannins and saponin in alligator pepper supports the use of this plant as antimicrobial agent (Doherty, Wang, Ross, Stanton, Fitzgeralld, & Brodkorb, 2010). Therefore, the objective this work is to determine the nutritional quality and acceptability of 'kango' fortified with kidney beans and alligator pepper.

II. Material And Methods

Materials

Three varieties of maize were obtained from the Institute of Agricultural Research and Training at Ibadan (IAR & T), Moore Plantation.

i. ART-98-SW06-W(Agricultural Research Training, South West, White)
ii. BR 9943-DMR-SR-W(Boral Resistance Downey Mildew Research Streek Resistance –White)
iii. SUWAN-1-SR-Y(Suwan-1-Streak Resistance, Yellow)

Mature kidney been seeds (*Phaseolus Vulgaris*), Alligator pepper, salt, pepper, vegetable oil, onion were obtained at a local market in Akure, Ondo State

Methods

Production of maize flour

Maize grains were washed, drained, dried at a temperature of 60 °C for 5hours, it was milled into fine powder using hammer mill. The flour was sieved using a 250µm sieve. The flour was kept in a clean airtight container which was used for further analysis. The flow chart of the production of maize flour is shown in figure 1

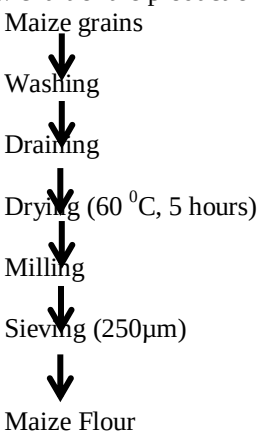

Figure 1 : Flow chart for the production of maize flour
(Source: Otunola *et al.*, 2012)

Production of alligator pepper flour

Alligator pepper seeds were removed from the pod, picked, washed and dried at 60 °C for 3 hours, the dried seeds were milled into four using hammer mill, it was sieved using 250µm sieve.

Production of kidney bean flour

The kidney bean was picked, washed and soaked in water for 6hours, the soaked kidney beans was dehulled and drained, the dehulled kidney beans was dried in the oven 65 ^{0}C for 6 hours. The dried beans was milled using the hammer mill, sieved with a 250µm sieve and kept in an airtight container for further analysis.

Production of *kango*

Composite Maize flour, kidney bean and alligator pepper flour was mixed with water and soaked for 20 minutes. Other ingredients such as onion and salt were added to the mixture. it was fried at temp of 140^{o}C. *Kango* is consumed by people of all ages (excluding infants). However, compared to other maize based snacks, *kango* has a short shelf-life of between 12-24hours. Major challenges of *Kango* is the aspect of Preservation, that is it has short shelf-life. *Kango* is fried at 140^{o}C with other ingredients such as pepper, salt and onion for a period of 5-7 minutes. When well fried, *kango* is expected to have good taste, good aroma, brown colour and fluffy texture. Good preservative and better packaging can be employed in the production and sales of *kango*, it will increase the shelf-life, improve the sales and encourage mass production of the product, some of which can be exported to neighboring countries.

Plate 1: *Kango* snack

Storage of *kango*

Effect of storage time and condition on peroxide value (POV) of kango (meq/kg)

Table 1 shows the peroxide values of *kango* samples kept at different conditions (ambient, refrigerator and freezer) for one week. The samples had peroxide values in the range of 7.15 to 9.08 on day one of the storage at ambient temperature, sample SUWAN1 had the highest value of 9.08 while samples ART2 and BR3 both had the least values of 7.15.

Table 1: ***Effect of storage time and condition on peroxide value of kango (meq/kg)***

Days	ART1	ART2	ART3	ART4	BR1	BR2	BR3	BR4	SUWAN1	SUWAN2	SUWAN3	SUWAN4
Day 0	8.6	7.35	8.15	7.15	8.75	7.15	8.45	7.35	9.08	8.75	8.55	7.55
Day3 Ambient	12.61	11.15	10.7	10.5	13.6	12.5	12.3	12.2	15.24	13.55	13.35	13.35
Day3 Fridge	10.68	10.21	10.5	10.2	11.5	11.3	11.2	11.1	12.15	11.45	11.25	11.25
Day 3Freezer	10.93	10.45	10.3	10.3	11.5	11.3	10.6	10.5	11.37	10.85	10.65	10.65
Day 5 Ambient	42.7	37.96	37.2	37.8	40.3	38.8	38.1	38	44.43	38.35	38.15	38.15
Day5 Fridge	15.51	11.15	11.1	11	15.9	12.1	11.2	11.2	16.39	11.55	11.35	11.46
Day5 freezer	11.28	10.45	10.2	10.3	11.9	11.3	10.6	10.5	11.39	10.85	10.65	10.65

Key

ART-1= Sample prepared from 100% 'ART-98-SW06-W' maize;
ART-2= Sample prepared from 82.7% 'ART-98-SW06-W' maize, 15.7% kidney bean and 1.6% alligator pepper;
ART-3= Sample prepared from 75.9% 'ART-98-SW06-W' maize, 23.6% kidney bean and 0.5% alligator pepper;
ART-4= Sample prepared from 72% 'ART-98-SW06-W' maize, 26% kidney bean and 2% alligator pepper;
BR-1= Sample prepared from 100% 'Br-W9943-DMR-SR-W' maize;
BR-2= Sample prepared from 82.7% 'Br-W9943-DMR-SR-W' maize, 15.7% kidney bean and 1.6% alligator pepper;
BR-3= Sample prepared from 75.9% 'Br-W9943-DMR-SR-W' maize, 23.6% kidney bean and 0.5% alligator pepper;
BR-4= Sample prepared from 72% 'Br-W9943-DMR-SR-W' maize, 26% kidney bean and 2% alligator pepper;
SUWAN-1= Sample prepared from 100% 'SUWAN-1-SR-Y' maize;
SUWAN-2= Sample prepared from 82.7% 'SUWAN-1-SR-Y' maize, 15.7% kidney bean and 1.6% alligator pepper;
SUWAN-3= Sample prepared from 75.9% 'SUWAN-1-SR-Y' maize, 23.6% kidney bean and 0.5% alligator pepper; and
SUWAN-4= Sample prepared from 72% 'SUWAN-1-SR-Y' maize, 26% kidney bean and 2% alligator pepper.

The peroxide values (POV) for the ambient temperature at day three were within the range of 10.45 to 15.24 and the *kango* sample SUWAN1 had the highest value of 15.24 and sample ART2 had the least value of 10.45. *Kango* samples at day five were greatly affected by the oxidation of lipids as the peroxide values of the samples were very high as compared to day one and day three. The range of the PV was from 38.05 to 44.44 and sample SUWAN1 had the highest value of 44.44 and sample BR2 had the least value of 38.05. The PV for the refrigerated *kango* samples at day three were in the range of 10.15 to 12.15 and sample SUWAN1 had the highest value of 12.15 while sample ART2 had the least value of 10.15. Refrigerated *kango* samples, at day five had its PV in the range of 11.00 to 16.39, sample SUWAN1 had the highest value of 16.39 and sample ART3 had the least value of 11.00. The *kango* samples in the freezer at day three had peroxide values in the range of 10.25 to 11.46 and samples ART2 and ART3 had the least value of 10.25 while sample BR1 had the highest value of 11.46. Day five of *kango* samples from the freezer was in the range of 10.2 to 11.90 and sample BR1 had the highest value of 11.90 while samples ART3 had the lowest value of 10.2. The storage time and condition has effect on the peroxide value of the stored kango snacks as there were increase in the peroxide values as the storage days increase and at different temperatures. The peroxide value of the stored snacks were higher than 10 meq/kg regarded as been appropriate for fatty products and when the product is been considered fresh. this implies that the kango samples cannot be kept for a long period of time, due to the fact that it can be easily affected by lipid oxidation especially when kept at ambient temperature and high percentage of oil used for the frying may equally predispose *kango* to oxidation and rancidity during storage, this is in accord with the report of Berk, (1991).

Effect of storage time and condition on Free fatty acid of *kango* (mg/KOH/g)

The effect of storage time and condition on free fatty acid of stored *kango* samples were as presented in Table 2. The recorded range for the free fatty acid of the *kango* samples at the day zero was from 3.20 to 5.75 and the highest was recorded for SUWAN1 with FFA value 5.75 while the least value was recorded for sample

Table 2: Effect of storage time and condition on Free fatty acid of *kango* (mg/KOH/g)

	ART1	ART2	ART3	ART4	BR1	BR2	BR3	BR4	S1	S2	SN3	S4
Day 0	3.7	3.2	3.1	3.1	4.75	4.6	4.6	4.2	5.75	5.2	4.9	4.5
Day 3 Ambient	7.44	6.37	5.27	5.27	7.43	6.7	6.8	6.4	8.49	7.37	7.07	8.17
Day 3 Fridge	5.39	4.16	4.01	4.09	5.38	5.6	5.6	5.2	7.3	6.2	5.9	6.9
Day 3 Freezer	4.25	3.14	3.23	3.14	5.3	4.6	4.6	4.2	6.3	5.2	4.94	6.04
Day 5 Ambient	13.46	11.2	11.32	11.1	13.4	12.7	13	12	15.35	13.27	12.97	14.07
Day 5 Fridge	8.5	4.21	4.12	4.2	8.5	5.7	5.7	5.2	8.27	6.3	5.99	7.09
Day 5 Freezer	4.44	3.15	3.2	3.15	5.3	4.54	4.7	4.3	6.3	5.3	4.95	6.05

Key
ART-1= Sample prepared from 100% 'ART-98-SW06-W' maize;
ART-2= Sample prepared from 82.7% 'ART-98-SW06-W' maize, 15.7% kidney bean and 1.6% alligator pepper;
ART-3= Sample prepared from 75.9% 'ART-98-SW06-W' maize, 23.6% kidney bean and 0.5% alligator pepper;
ART-4= Sample prepared from 72% 'ART-98-SW06-W' maize, 26% kidney bean and 2% alligator pepper;
BR-1= Sample prepared from 100% 'Br-W9943-DMR-SR-W' maize;
BR-2= Sample prepared from 82.7% 'Br-W9943-DMR-SR-W' maize, 15.7% kidney bean and 1.6% alligator pepper;
BR-3= Sample prepared from 75.9% 'Br-W9943-DMR-SR-W' maize, 23.6% kidney bean and 0.5% alligator pepper;
BR-4= Sample prepared from 72% 'Br-W9943-DMR-SR-W' maize, 26% kidney bean and 2% alligator pepper;
SUWAN-1= Sample prepared from 100% 'SUWAN-1-SR-Y' maize;
SUWAN-2= Sample prepared from 82.7% 'SUWAN-1-SR-Y' maize, 15.7% kidney bean and 1.6% alligator pepper;
SUWAN-3= Sample prepared from 75.9% 'SUWAN-1-SR-Y' maize, 23.6% kidney bean and 0.5% alligator pepper; and
SUWAN-4= Sample prepared from 72% 'SUWAN-1-SR-Y' maize, 26% kidney bean and

2% alligator pepper.

ART3 and ART4 with FFA value 3.10. The value of FFA at day three at ambient temperature was in the range of 5.27 to 8.49 while the FFA increased at ambient temperature at day 5 to 11.10 to 15.35. The highest for both days was recorded for ART1 with 7.44 and SUWAN1 with 15.35 at day 5, while the least FFA value was recorded in sample BR2 for day three with 5.27. Large increase was recorded in the FFA values of samples at day five which range from 11.10 to 15.35. It was observed that there was a slight increase in the FFA at day five. The FFA values at day three ranged from 4.01 to 7.30 FFA at day five ranged from 4.20 to 8.5. The highest FFA value was found in sample ART1 at day five. The effect of free fatty acid was observed more in the *kango* products stored at ambient temperature. The increase in the FFA of the stored snacks may be as a result of the presence of some colonies of mould (< 5 cfu/g), which might have favoured some limited hydrolytic reaction responsible for the cleavage of the free fatty acids. This in line with the report of Kumar, (2004) that hydrolytic reaction occurring during storage causes fat cleavage which results in liberation of free fatty acids.

Effect of storage time and condition on thiobarbituric acid (TBA) number during storage of kango

Table 3 shows the TBA number of *kango* stored for five days. The TBA of the samples ranges between 0.62 to 0.91 at day zero of the stored *kango* samples. The sample with highest TBA at day zero was BR1. There was an increase in TBA of *kango* samples kept at ambient temperature, ART1, BR1 and SUWAN1 at day 3. The levels further increased in day5 at samples kept at ambient temperature while sample stored in the refrigerator and freezer had minimal level of TBA. The effect of TBA was observed more in kango products stored at ambient temperature.

Table 3: ***Effect of storage time and condition on thiobarbituric acid (TBA) number during storage of kango*** **(mgmda/g)**

	ART1	ART2	ART3	ART4	BR1	BR2	BR3	BR4	SUWAN1	SUWAN2	SUWAN3	SUWAN4
Day 0	0.83	0.62	0.65	0.71	0.91	0.64	0.7	0.8	0.82	0.7	0.75	0.8
Day 3 Ambient	1.95	1.64	1.49	1.55	1.71	1.48	1.54	1.64	1.92	1.54	1.59	1.64
Day 3fridge	0.89	0.7	0.72	0.79	0.96	0.72	0.77	0.87	0.99	0.78	0.83	0.88
Day3 Freezer	0.88	0.63	0.66	0.72	0.86	0.65	0.71	0.81	0.96	0.72	0.76	0.82
Day5 Ambient	3.44	2.52	2.54	2.1	3.56	2.54	2.59	2.69	3.53	2.6	2.65	2.7
Day5 Fridge	1.32	0.71	0.73	0.83	0.42	0.73	0.78	0.88	0.95	0.78	0.83	0.89
Day5 Freezer	0.99	0.64	0.66	0.73	0.96	0.66	0.72	0.81	1.05	0.72	0.77	0.82

Key

ART-1= Sample prepared from 100% 'ART-98-SW06-W' maize;
ART-2= Sample prepared from 82.7% 'ART-98-SW06-W' maize, 15.7% kidney bean and 1.6% alligator pepper;
ART-3= Sample prepared from 75.9% 'ART-98-SW06-W' maize, 23.6% kidney bean and 0.5% alligator pepper;
ART-4= Sample prepared from 72% 'ART-98-SW06-W' maize, 26% kidney bean and 2% alligator pepper;
BR-1= Sample prepared from 100% 'Br-W9943-DMR-SR-W' maize;
BR-2= Sample prepared from 82.7% 'Br-W9943-DMR-SR-W' maize, 15.7% kidney bean and 1.6% alligator pepper;
BR-3= Sample prepared from 75.9% 'Br-W9943-DMR-SR-W' maize, 23.6% kidney bean and 0.5% alligator pepper;
BR-4= Sample prepared from 72% 'Br-W9943-DMR-SR-W' maize, 26% kidney bean and 2% alligator pepper;
SUWAN-1= Sample prepared from 100% 'SUWAN-1-SR-Y' maize;
SUWAN-2= Sample prepared from 82.7% 'SUWAN-1-SR-Y' maize, 15.7% kidney bean and 1.6% alligator pepper;
SUWAN-3= Sample prepared from 75.9% 'SUWAN-1-SR-Y' maize, 23.6% kidney bean and 0.5% alligator pepper; and
SUWAN-4= Sample prepared from 72% 'SUWAN-1-SR-Y' maize, 26% kidney bean and 2% alligator pepper.

Microbial qualities of *kango* snacks

Table 4 reveals the microbial load of the *kango* samples which was carried out 12h after the production. The total viable count decreases with increase in the addition of alligator pepper in all the snacks. This may be

due to the addition of alligator pepper which has strong antimicrobial effect. There was no coliform count in the products which shows there is no feacal contamination. The microbial analysis of the *kango* products indicates that the products are good for consumption and not hazardous to the body. The total viable count was found to be minimal in the entire sample. In *kango*, there was no coliform counts in all the products and also the mould count which was minimally found in samples ART2 (0.2), BR2 (0.3), SUWAN2 (0.4) and SUWAN3 (0.1). The minimal microorganisms found in the products can be attributed to the presence of the alligator pepper added to the flour. The values obtained were than the 1 x 10^4 CFU/g recommended by the International Commission of Microbiological specification for food (IMSF, 1974).

Table 4: Microbial load of *kango* (CFU/g)

Samples	Total viable count	Total coliform count	Mould count
ART1	1.4×10^1	Nil	Nil
ART2	1.4×10^1	Nil	0.2
ART3	1.0×10^2	Nil	Nil
ART4	1.1×10^1	Nil	Nil
BR1	1.2×10^2	Nil	Nil
BR2	1.8×10^1	Nil	0.3
BR3	1.7×10^1	Nil	Nil
BR4	1.1×10^1	Nil	Nil
SUWAN1	1.2×10^1	Nil	Nil
SUWAN2	1.5×10^1	Nil	0.4
SUWAN3	1.4×10^1	Nil	0.1
SUWAN4	1.6×10^1	Nil	Nil

Key
ART-1= Sample prepared from 100% 'ART-98-SW06-W' maize;
ART-2= Sample prepared from 82.7% 'ART-98-SW06-W' maize, 15.7% kidney bean and 1.6% alligator pepper;
ART-3= Sample prepared from 75.9% 'ART-98-SW06-W' maize, 23.6% kidney bean and 0.5% alligator pepper;
ART-4= Sample prepared from 72% 'ART-98-SW06-W' maize, 26% kidney bean and 2% alligator pepper;
BR-1= Sample prepared from 100% 'Br-W9943-DMR-SR-W' maize;
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SUWAN-4= Sample prepared from 72% 'SUWAN-1-SR-Y' maize, 26% kidney bean and 2% alligator pepper.

Sensory evaluation of kango snacks

The result of the sensory evaluation for ***kango*** is shown in Table 5. From the result, it was observed thatthe best texture as indicated by the panelist were from samples ART2 (76% maize, 24% kidney and 5% alligator pepper), BR2 (76% maize, 24% kidney and 5% alligator pepper), and SUWAN2 (76% maize, 24% kidney and 5% alligator pepper), having a mean value of 8.40, 8.20 and 7.70 respectively, though there was no significant difference ($p \leq 0.05$) between them. The Taste result showed that samples ART2, BR2 and SUWAN2 also had the highest mean score of 7.90, 7.40 and 7.60 respectively and there was no significant difference ($p \leq 0.05$) between them. This result has proved that these three samples were equally accepted in terms of the taste of the *kango* samples and they are samples with added kidney bean, better taste than the samples with 100% maize. Samples ART2, BR2and SUWAN2 also had the highest mean value for the colour with 7.80, 7.70 and 7.50, which translates to like moderately in the hedonic scale and there was no significant ($p \leq 0.05$) difference between them. Food flavour according to Ihekoronye and Ngoddy (1985) arises from a subtle

interaction of taste and aroma, which imparts a pleasing and displeasing sensory experience to a consumer. It is the flavour of a food that ultimately determines its acceptance or rejection, even though its appearance evokes the initial response.There was no significant ($p \leq 0.05$) difference between the samples with the highest mean score for the flavor of *kango*, samples ART2, BR2and SUWAN2 respectively with 7.70, 7.70 and 7.50 and the least mean score 3.00 was found in sample SUWAN3 (82,6% maize, 15.7% kidney and 1.6% alligator pepper).There was significant difference ($p \leq 0.05$) in the overall acceptability of the kango. Samples ART2 (75.9% maize, 23.6% kidney and 0.5% alligator pepper), BR2 (75.9% maize, 23.6% kidney and 0.5% alligator pepper) and SUWAN2 (75.9% maize, 23.6% kidney and 0.5% alligator pepper) had the highest score of 7.80, 7.80 and 7.70 while the least value was recorded in sample SUWAN3 (83% maize, 16% kidney and 16% alligator pepper) with 3.30. The *kango* made with composite flour were much preferred than the *kango* made with 100% maize flour.

Table 5 :Sensory properties of *Kango*

Parameters	Texture	Taste	Colour	Flavour	G.Accept
ART1	4.40±1.71bc	4.50±1.08b	4.20±1.32bc	4.40±1.78bc	4.40±1.26b
ART2	3.40±0.84bc	3.50±0.97b	3.00±1.15c	3.20±1.03c	3.40±0.84b
ART3	8.40±0.70a	7.90±0.57a	7.80±0.63a	7.60±1.07a	7.80±0.42a
ART4	5.00±2.11b	4.60±2.37b	5.10±2.42a	5.30±2.21b	4.90±2.02b
BR1	4.50±1.90bc	4.10±1.29b	4.00±1.63bc	4.20±1.99bc	4.70±1.77b
BR2	3.40±1.07bc	3.40±1.17b	3.20±1.40c	3.80±1.14bc	3.50±1.08b
BR3	8.20±0.79a	7.40±0.97a	7.70±1.34a	7.70±0.82a	7.80±0.79a
BR4	4.00±2.49bc	4.20±2.25b	4.00±1.89bc	3.70±2.67bc	4.10±2.64b
SUWAN1	4.60±1.96b	4.50±1.43b	3.90±1.66bc	4.00±2.11bc	4.80±1.69b
SUWAN2	2.90±1.20c	3.30±1.16b	3.30±1.77c	3.00±1.25c	3.30±1.25b
SUWAN3	7.70±1.57a	7.60±2.07a	7.50±2.01a	7.50±1.35a	7.70±1.49a
SUWAN4	4.20±1.99bc	4.20±2.30b	3.40±1.07c	4.30±2.41bc	3.90±2.38b

Values are means of triplicates samples. Values followed by different alphabets along the same column are significantly different at $p \leq 0.05$.

Key

ART-1= Sample prepared from 100% 'ART-98-SW06-W' maize;
ART-2= Sample prepared from 82.7% 'ART-98-SW06-W' maize, 15.7% kidney bean and 1.6% alligator pepper;
ART-3= Sample prepared from 75.9% 'ART-98-SW06-W' maize, 23.6% kidney bean and 0.5% alligator pepper;
ART-4= Sample prepared from 72% 'ART-98-SW06-W' maize, 26% kidney bean and 2% alligator pepper;
BR-1= Sample prepared from 100% 'Br-W9943-DMR-SR-W' maize;
BR-2= Sample prepared from 82.7% 'Br-W9943-DMR-SR-W' maize, 15.7% kidney bean and 1.6% alligator pepper;
BR-3= Sample prepared from 75.9% 'Br-W9943-DMR-SR-W' maize, 23.6% kidney bean and 0.5% alligator pepper;
BR-4= Sample prepared from 72% 'Br-W9943-DMR-SR-W' maize, 26% kidney bean and 2% alligator pepper;
SUWAN-1= Sample prepared from 100% 'SUWAN-1-SR-Y' maize;
SUWAN-2= Sample prepared from 82.7% 'SUWAN-1-SR-Y' maize, 15.7% kidney bean and 1.6% alligator pepper;

SUWAN-3= Sample prepared from 75.9% 'SUWAN-1-SR-Y' maize, 23.6% kidney bean and 0.5% alligator pepper; and

SUWAN-4= Sample prepared from 72% 'SUWAN-1-SR-Y' maize, 26% kidney bean and 2% alligator pepper.

III. Conclusion

The total viable count decreases with increase in the addition of alligator pepper in all the snacks which may be due to the addition of alligator pepper which has strong antimicrobial effect hence a better storage life.

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