

Nutritional and Shelflife of Moi-Moi in Biodegradable Material Treated with Natural Spice (Garlic)

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ABSTRACT

Moi-Moi is a steamed gel from cowpea with a short shelf life. This study was based on the use of biodegradable packaging material pre-coated with garlic paste as antimicrobial agents to extend the shelflife of Moi-Moi. The Moi-Moi was prepared from cowpea by steeped method. 50ml paste was dispensed in tin can, steamed in a pressure cooker for 15 min. The Moi-Moi was removed and cooled. Garlic used as antimicrobial agent was cleaned and mashed into paste. The garlic extract 0 g, 40g, and 80 g were applied in a thin layer on saviet (50 mm²), dried(35°C±2) and used as inner lining of the packaging material. The packaged samples were kept on shelf at ambient (33°C±2). The nutrient composition were carried out at 0 and 24h. The shelflife of the products were studied through physical examination and microbial assessment. Some of the nutritional composition of Moi-Moi decreased significantly ($p>0.05$) during the storage between 0 and 24 h. The crude protein 0 g treated sample showed slight increase (9.92 – 10.06 %) while 40 and 80 g treated samples showed decrease from 0 to 24 h.. The colony growth (cfu/g) increased with storage time. The colony count was low in 80g treated sample followed by 40g and control respectively. The physical examination showed that till 72h, the 80g treated sample was found edible considering the characteristics. Beyond 48h, 40g treated sample was not edible while beyond 24h, the control (0g) was not edible. Garlic showed potential to increase shelflife of Moi-Moi but the extension is limited.

KEYWORDS: Moi-Moi, Shelf-life, Biodegradable material, Garlic, Antimicrobial agent

1.0 INTRODUCTION

Moi-Moi or moin-moin is a popular ready to eat steamed gel produced from cowpea paste in Nigeria and West Africa [1]. It is produced by wet milling dehulled beans or cowpea flour and mixed with water, vegetable oil and seasonings into a homogenous slurry or paste, wrapped or packaged in leaf pouches or other packaging materials like aluminum containers and steamed. During steaming, the paste solidifies into irreversible gel between due to hydration of complex carbohydrate, protein gelation and curdling of complex carbohydrate.

However, this freshly prepared Moi-Moi product has short shelf life of about a day at ambient temperature. The perishability could be as a result of high moisture content and nutritional components of Moi-Moi which might have been good source of nutrients to microorganisms that cause spoilage [2]. The current trend of craving for convenient foods that can easily be gotten on shelf in the supermarket necessitate improving on processing and preservation of Moi-Moi for prospective consumers of the product.

In the quest for healthy foods, more and more consumers are shunning foods laden with chemical additives and preservatives in favour of what they perceive to be cleaner and greener foods. It has been reported that chemicals which are used as preservatives have side effects. The reaction of preservatives and packaging materials could be very mild to life-threatening [3,4]. Canning of Moi-Moi has been reported but this is a sophisticated technology of packaging cooked beans in cans. The packaged beans are usually in brine, sugar or tomato purees [2,5]. The technology is considered expensive with standard of living of an average Nigerian.

The prevention of the growth of spoilage microorganisms that is responsible for the deterioration of the product using natural antimicrobial agents has been reported. Studies had confirmed that the growth of both gram-positive and gram-negative food borne bacteria, yeast and mold can be inhibited by garlic, onion, cinnamon, cloves, thyme, sage, and other spices [6,7]

Based on convention, these antimicrobial agents are usually incorporated directly into the food. This method has many disadvantages as a result of concerns about their side effects (safety). Another major reason is that since food spoilage occurs primarily on the surface, incorporation of relatively large quantities of the agents in the bulk

of the food is not justified and lastly some of the agents possess a distinct flavour that may be rendered to the food flavor when in excess [6].

However, since food spoilage occurs primarily on the surface, packaging materials in which the antimicrobial agent is added as protective barrier or coated on the internal surface of the packaging material can increase the shelf-life of packaged product by extending the lag phase and reducing the growth rate of spoilage microorganisms. The main objective of this research is to improve the shelf life stability of Moi-Moi using biodegradable packaging materials treated with natural spices.

2.0 MATERIALS AND METHODS

2.1. Materials

Cowpea (a local variety “Kanannado Brown”) for the preparation of *Moi-Moi* was obtained from Central market in Gashua, Yobe State. Other materials such as soviect, biodegradable material, garlic vegetable oil (Turley brand™), and pepper were also purchased from Gashua. The reagents for microbial and proximate analysis were analar grade from Microbiology Laboratory, Federal University Gashua.

2.2 Design of the experiment

Moi-Moi was produced as described by [1] from wet milled cowpea. Garlic used as antimicrobial agent was washed, drained, and mashed into paste. The garlic extract 0 g, 40 g, and 80 g were applied in a thin layer on the saviet (50 mm²), dried in oven at ambient 35°C±2 and used as inner lining of the packaging material to test the potency of the garlic extract against invasion of spoilage microorganisms. The sensory and nutrient evaluation were conducted in 0 and 24 h on the samples. The shelflife of the products were studied through physical observations and microbial assessment.

2.3 Preparation of Moi-Moi

Moi-Moi was preparation as described by [8] with little modification in the recipe. Cowpea variety local variety “Kanannado Brown” (500 g) was steeped in water for 5 min and dehulled. Other ingredients: dried pepper (50 g), onion (50 g), salt (2 g) and 100 ml of groundnut oil (Turkey brand™) were cleaned wet milled with the dehulled cowpea to form a smooth paste. The paste is thoroughly mixed for uniformity and 50 ml of the paste were dispensed in tin of the same volume and steamed for 15 min to form pudding. The *Moi-Moi* was allowed to cool at room temperature before packaging in antimicrobial treated packaging material.

Preparation of the natural preservatives and packaging material

The garlic is sorted and the bran was removed manually. A wooden mortar and pestle was used for crushing the garlic into a smooth paste. The extracts was applied in a thin layer on the saviet which was used as inner lining of the packaging material at different levels of concentrations (0 g, 40 g and 80 g to 20 mm²) and dried in oven at 35°C±2. The packaging material without garlic paste coating was used as control. *Moi-Moi* were packaged and kept on shelf at ambient. The proximate analysis was done at 0 and 24 h, this could not be continued due to spoilage of control sample (0g). Physical examination and microbial analysis were carried out up to 72h when the *Moi-Moi* still have good sensory quality.

Nutrient composition of Moi-Moi

Determination of proximate composition; moisture, crude fat, crude protein, ash and crude fibre were determined using standard methods as described by [9]. The total carbohydrate was obtained by difference.

Physical examination and microbial analysis

Changes in physical sensory parameters such as colour, texture, growth were used to monitor rate of spoilage. The microbial profiles of the cowpea product were monitored at every 24 h after production as described by [10]. The microbial analysis i.e total plate and fungi were monitored on daily basis until the products deteriorate. Colony characterisation was done using Macconkey agar, eosyn methyl blue agar, brilliant green agar and potato dextrose gar.

Statistical analysis

Data were subjected to variance test at 5% significance 5 % and lack of fit test.

RESULTS AND DISCUSSION

Nutrient composition of *Moi-Moi* (bean pudding)

The results of proximate composition of *Moi-Moi* determined at 0 and 24 hours are provided in Table 1 and 2 respectively. The moisture content of the *MOI-MOI* varied significantly ($p < 0.05$) with levels of garlic extracts

substitution. The moisture in 0 g treated *Moi-Moi* increased from 54.20 - 62.60 % within 24h while other revealed reductions from 55.87 – 54.41 %, and 52.98 – 53.72 % at 40 g and 80 g treatments respectively. The moisture content can be used as a pointer to the rate at which deterioration occurs in *Moi-Moi* samples resulting in the early decomposition. Reduction in moisture from 0 to 24h could be attributed to the absorbent characteristics of packaging material [11]. The recipes for the preparation could cause the variation. High moisture content increases water activity and spoilage of food. The crude protein 0 g treated sample showed slight increase (9.92 – 10.06 %) while 40 and 80 g treated samples revealed steadily decrease from 0 to 24 h. The invasion of microbe might contribute to protein recorded in control (0g). Processing methods and variety of cowpea used might contribute to the variation. The average protein recorded in this research is related to reports of [1,11].

Ash is a representation of general mineral composition of food. Ash increased significantly at 0, 40 and 80 g treatments. The result of the ash content revealed that there was a significant differences at $p < 0.05$. These results are in agreement with the findings of [12].

The crude fibre and lipid contents decreased from 0 to 24h of storage for all the levels of treatments. The vegetable oil used in the preparation was high and this reflected in the results. According to [13], the fat content of most legumes ranged from 0.6 to 5.0 %. The reason for variation might be because of method of production and variety of cowpea.

Table 1: Result of proximate composition in *Moi-Moi* with varying preservative (g/100g) with 12 hours

Sample (g)	Moisture, %	Ash, %	Crude fibre, %	Crude protein, %	Crude lipid, %	NFE, %
0	54.20±0.13 ^b	2.13±0.02 ^b	1.39±0.01 ^b	09.92±0.06 ^b	05.46±0.10 ^a	26.90±0.12 ^b
40	55.87±0.60 ^a	2.50±0.07 ^a	1.73±0.14 ^a	10.82±0.23 ^a	04.20±0.37 ^b	24.88±0.97 ^c
80	52.98±0.22 ^c	2.18±0.11 ^b	1.58±0.13 ^{ab}	09.62±0.14 ^c	04.76±0.52 ^{ab}	28.88±0.08 ^a

Mean ± SD with the same superscript are not significant different ($P > 0.05$)

Table 2: Result of proximate composition in *Moi-Moi* with varying preservative (g/100g) with 24 hours

Sample (g)	Moisture %	Ash, %	Crude fibre, %	Crude protein, %	Crude lipid, %	NFE, %
0	52.60±0.05 ^b	2.30±0.09 ^b	1.20±0.01 ^c	10.06±0.01 ^c	04.97±0.03 ^a	23.47±0.07 ^a
40	54.41±0.22 ^a	2.59±0.02 ^a	1.54±0.04 ^a	10.56±0.06 ^a	03.68±0.09 ^c	27.90±0.28 ^c
80	53.72±0.64 ^c	2.14±0.05 ^b	1.32±0.02 ^b	09.31±0.28 ^b	04.61±0.17 ^b	28.90±0.82 ^b

Mean ± SD with the same superscript are not significant different ($P > 0.05$)

Keyword: Nitrogen Free Energy

Antimicrobial effect of garlic treated packaging material on bacterial growth in moi-moi

The result of bacterial count in the treated samples at 24 and 48 hours are presented in Table 3. It was observed that sample with 80 g of treatment has the lowest growth compare to 40 g and control (0g). The sample without treatment which serves as the control had the highest growth. Bacterial invasion is responsible for spoilage of food. The analysis was discontinued after 48 h because of deterioration in the control and 40 g treated samples. The observation revealed the higher the treatment, the more the microbial growth retardation. Deterioration of food quality occurs during processing and storage. Spices are recognized to stabilize foods from microbial deterioration [14].

Table 3: Bacteria colony count at 24 and 4 h of storage

Treatments	CFU/g at 24 h	CFU/g at 48 h
0g	2.7 x 10 ⁷	1.25 x 10 ⁹
40g	77.02 x 10 ³	2.18 x 10 ⁴
80g	0.15 x 10 ¹	1.47 x 10 ²

The colony characterizations of the samples were conducted. The results for 12 h and 24 h are presented in Table 4 and 5. *Staphylococcus* specie, *E. Coli*, and *Aspergillus* were found in the control (0g) and *Staphylococcus* specie and *Aspergillus* were found in 40g treated samples at 12 h of storage on shelf while non was found in 80g.

After storing the sample at room temperature for 24 h, *Escherichia coli*/ *Aspergillus* specie was confirmed in 0g. *Staphylococcus* and *Aspergillus* were suspected in 40 and 80g has non 24 h. The physical observation during the storage showed that sample treated with 80 g of garlic paste had good appearance without any physical growth and non-slimy for 84 h. The reduction in microbial growth and physical observation has shown that garlic as a spice can elongate the shelflife of *Moi-Moi*.

From the study findings, garlic was found to be more effective in preventing food spoilage. This is in tandem with findings by [15], garlic was found to exhibit a wide spectrum of antibacterial activity against Gram-negative and

Gram-positive bacteria including species of Escherichia, Salmonella, Staphylococcus, Streptococcus, Klebsiella, Proteus, Bacillus and Clostridium. All this is due to allicin properties of garlic. The antimicrobial effect of allicin is due to its chemical reaction with thiol groups of various enzymes [15].

Table 4: Colonies characterization at 12 hour

Sample (g)	MCA	EMB	BGA	PDA	Suspected organism
0g	Non lactose fermenting colonies, opaque with smooth surface and smooth edge. Pink mucoid colonies with rough edge	Green metallic sheen	Pink smooth colonies	Greenish hairy colonies with branches	Staphylococcus specie/Aspergillus specie/E. coli
40g	Non lactose fermenting colonies, opaque with smooth surface and smooth edge	No growth observed	No growth observed	Black hairy-like colonies with branches	Staphylococcus specie/Aspergillus specie
80g	Rough edge and surface	No growth observed	No growth observed	No growth observed	Nil

Keywords: MCA; Macconkey Agar EMB; Eosyn methyl blue agar BGA; Brilliant green agar PDA; Potato dextrose gar

Table 5: Colonies characterization at 24 hour

Sample (g)	MCA	EMB	BGA	PDA	Suspected organism
0g	Pink lactose fermenting colonies, opaque with smooth surface and smooth edge	Green metallic sheen	Deep pink colonies with rough surface and rough edge	Greenish hairy colonies with branches	Escherichia coli specie/Aspergillus specie
40g	Non lactose fermenting colonies, opaque with smooth surface and smooth edge	No growth observed	No growth observed	Black hairy-like colonies with branches	Staphylococcus specie/Aspergillus specie
80g	Rough edge and surface	No growth observed	No growth observed	No growth observed	Nil

Keywords: MCA; Macconkey Agar EMB; Eosyn methyl blue agar BGA; Brilliant green agar PDA; Potato dextrose gar

Table 6: Physical examination of control (0g) treated packaging material

Sample: 0 gram

Storage	Appearance	Odor	Texture
0-24h	Orange yellow and smooth,	Typical fresh Slightly	Firm to touch
24-48h	Slimy with whitish growth	Repugnant Offensive	Slightly fresh
48-72h	Covered with growths and slimy	Offensive	Marshy
72-96h	Completely covered with whitish growth		Marshy

Table 7: Physical examination of 40g treated packaging material

Sample: 40gram

Storage	Color	Odor	Texture
0-24h	Orange yellow and smooth	Typical fresh	Firm to touch
24-48h	Orange yellow with moisture	Slightly fresh	Slightly firm
48-72h	Covered with growths and slimy	Repugnant	Soft
72-96h	Covered with growths and slimy	Offensive	Marshy

Table 8: Physical examination of 80g treated packaging material

Storage	Appearance	Acceptance	Odor	Texture
0-24h	Orange yellow and smooth	Edible	Typical fresh	Firm to touch
24-48h	Orange yellow and smooth	Edible	Typical fresh	Firm to touch
48-72h	Orange yellow with moisture Slightly slimy with completely covered whitish growth	Edible	Fresh	Slightly soft
72-96h		Completely not edible	Repugnant and offensive	Marshy

The physical examination showed that till 72h, the 80g treated sample was still found edible considering the characteristics. Beyond 48h, 40g treated sample was not edible while beyond 24h, the control (0g) was not edible.

CONCLUSION

The nutritional and shelflife stability of moi-moi packaged in biodegradable packaging materials was affected by the levels of garlic treatment. The colony growth (cfu/g) increased with storage time. However, the colony count was low in 80g treated sample followed by 40g and control respectively. The physical examination showed that till 72h, the 80g treated sample was still found edible considering the characteristics. Beyond 48h, 40g treated sample was not edible while beyond 24h, the control (0g) was not edible. This research work revealed that the treated biodegradable packaging material had impact on the moi-moi by increasing the shelf life. *Moi-Moi* packaging material treat with 80g can extend the shelflife for more than three days compare to control that could not be edible after 24h.

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