Research Journal of Food and Nutrition
Volume 4, Issue 2, 2020, PP 13-19
ISSN 2637-5583

Proximate, Mineral and Sensory Attributes of Moi-Moi and "Epiti" Wrapped with Different Local Leaves in Nigeria

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ABSTRACT

The study assessed the proximate, mineral and sensory attributes of moi-moi and epiti wrapped with different leaves. Moi-moi and epiti were prepared and wrapped with three different leaves – uma or etere (Thaumatococcus danielli), plantain (Musa paradisiaca) and banana (Musa, sapientum). Standard methods of analysis were used to determine the proximate, mineral and sensory characteristics of the moi-moi and epiti samples wrapped with these leaves. The results showed that moi-moi samples were not significantly different (P<0.05) in their moisture (70.24-72.26%), ash (2.42-2.44%), fat (5.44-6.39%), protein (4.08 - 4.39%) and carbohydrate (13.28-14.50%) contents. Crude fibre differed significantly (P>0.05) and ranged from 2.08% to 2.61%. Epiti samples differed significantly (P>0.05) in moisture (49.02-62.70%), ash (1.60-2.23%), fat (6.98 - 9.28%), and protein (2.81–4.15%) while crude fibre (1.32-1.54%) and carbohydrate (25.58-33.02%) were not significantly different (P<0.05). The mineral content differed significantly in moi-moi and epiti samples for all the elements assessed. Moi-moi wrapped with plantain leave had the highest content of calcium (147.2mg) and iron (58.90mg) while moi-moi wrapped with banana leave had the highest content of potassium (734.53mg), magnesium (82.83mg), sodium (1623.90mg) and phosphorus (0.80mg). Epiti wrapped with plantain leave had the highest calcium (304.63mg) content while epiti wrapped with banana leave had the highest content of potassium (1746.82mg), magnesium (324.40mg), sodium (2088.30mg), Iron (3.05mg) and phosphorus (1.50mg). The sensory scores showed no significant difference (P<0.05) in all attributes assessed for the moi-moi and epiti samples. The differences in the mineral content of the moi-moi and epiti samples infer that the different leaves had varying effect on the mineral content of the samples. Plantain and banana leaves wrapped moi-moi and epiti had higher content of most of the minerals assessed than uma leave.

Keywords: *Nutrient, leaves, wrapping, moi-moi, epiti.*

INTRODUCTION

Food packaging materials are basically intended to provide covering and protection for food products. Trends in the food industry have shown that packaging materials and packaging plays an important role in the food production process. Besides the physical protection of the food product, packaging materials minimizes risk of damage during transportation, eases convenience during distribution, handling, and sales (Kabuo, *et al*, 2015b). Packaging materials are often used as a tool for preservation and extension of shelf life by preventing or reducing water loss in fresh produce (Opara and Mditshwa, 2013) and sometimes for advertisement (Adejumo and Ola, 2008). Packaging materials are also an important factor that affects consumers' choice of food products and marketers target consumers with dynamic packaging materials designed specifically to promote consumer purchases of their branded food products (Mensah *et al.*, 2012).

Packaging materials have evolved over the years beginning with the use of a variety of plant materials such as leaves and other natural containers to the use of synthetic and more sophisticated materials such as polyethylene, plastics, paper, glass and metals. The development and use of synthetic packaging materials reduce the growth of microorganisms and protects foods from external microbial contamination (Raheem, 2012). With the developments of these sophisticated packaging materials, the use of leaves as packaging materials ought to be of little or no appeal particularly to consumers of packaged food products. However the use of leaves as packaging material continues to be a common phenomenon in the traditional food industry in Nigeria and other African countries. Dainelli *et al*, (2008) reported that the use of

leaves to package cornmeal products in Ghana has enjoyed continuing marketing success without changes.

Leaves play a vital role in the traditional packaging of food products as different leaves are used for wrapping several foods particularly ready-to-eat food products (Kabuo *et al.,* 2015b). Leave packaged foods are not only available in rural areas alone as they are commonly found in large restaurants in the urban areas as well. These foods have gained widespread acceptance among the elites who not only consider it as exotic but also as flavour enhancing (Thorn, 2004).

The type of leaves used depends on location or locality and availability but generally, the leaves used all have large surface areas (Ojekale *et al.,* 2007). Leaves commonly used for wrapping food include those of *Thaumatococcus danielli* (etere or uma), *Musa paradisiaca* (plantain), *Musa, sapientum* (banana). Others are *Xanthosoma sagittifolium* (cocoyam), *Tectona grandis*, *Thespesia populnea*, *Cola nitida* and sheaths of *Zea mays* (maize). These leaves are used to either wrap the food prior to cooking or just after cooking until they are consumed. Foods such as "moi-moi" (beans pudding) and "epiti" (steamed maize-plantain pudding) are among the foods that are commonly wrapped with different leaves in Nigeria.

Moi-moi and "epiti" are ready-to-eat street foods consumed by people of all ages and socio-economic groups. Recently, there seem to be an increased consumer preference for the consumption of moi-moi and "epiti" wrapped with different leaves as observed in most cities in Nigeria particularly in the Niger Delta region. This may not be unconnected with the recent consumer awareness on the adverse effects of consuming polyethylene packaged foods and attendant effect of heat. Leaves wrapped moi-moi and "epiti" are not only consumed as street foods but also an item on the menu in most restaurants and at various functions. There is little or no information on the effect of locally available wrapping material on the nutrient composition of foods. Therefore, the study is aimed at assessing the proximate, mineral and sensory attributes of moi-moi and "epiti" wrapped with three different leaves.

MATERIALS AND METHODS

Materials

Cowpea, maize, overripe plantain, palm oil, groundnut oil, dried pepper, stock cubes, onions, salt and fresh uma (*Thaumatococcus danielli)* leaves were purchased from Mile 3 market in Diobu, Port Harcourt, Rivers State. Plantain (*Musa paradisiaca)* and banana (*Musa, sapientum)* leaves were obtained from Rivers State University Research Farm, Port Harcourt, Rivers State.

Chemicals

All chemicals used were of analytical grade and were obtained from the analytical laboratory, Department of Food Science and Technology, Rivers State University, Port Harcourt, Rivers State, Nigeria.

Methods

Preparation of Moi-moi

The method described by Akusu and Kiin-Kabari (2012) was modified and used for the preparation of moi-moi. Cowpea seeds were soaked in water to soften the seed coat. They were manually dehulled and wet milled into a smooth paste using a kitchen blender. Other ingredients were added, whipped thoroughly and wrapped separately in previously washed and blanched leaves and steamed for an hour. They were allowed to cool at room temperature before analyses.

Table1. *Recipe for Moi-moi*

Ingredients	Quantity
Cowpea	300g
Dried pepper (ground)	30g
Onions	60g
Stock cube	5g
Salt	2g
Groundnut oil	140mls

Preparation of Epiti

The method of Barber *et al.,* (2010) was used for the preparation of Epiti. Over-ripe plantain was blended at maximum speed with 500ml of water to obtain slurry. Maize flour and other ingredients were added to the slurry and mixed properly. The batter obtained was wrapped separately in previously washed and blanched leaves and steamed for an hour and allowed to cool at room temperature before analyses.

Table2. *Recipe for Epiti*

Ingredients	Quantity
Maize flour	240g
Over-ripe plantain	300g
Dried pepper (ground)	4g
Onions	50g
Salt	1g
Palm oil	100ml
Water	500ml

Proximate Composition

The moisture, ash, fat crude protein and crude fiber were determined using standard methods as described by Association of Official Analytical Chemist (2012). Fat was determined by Soxhlet extraction method using petroleum spirit as solvent. Crude protein was determined by the micro-Kjeldhal method while total available carbohydrate was calculated by difference.

Mineral Analysis

Mineral analysis was done according to the method described by Onwuka (2005) using an atomic absorption spectrophotometer.

Sensory Evaluation

Moi-moi and "Epiti" samples were coded and presented to twenty man panelists who were used to the products and were neither sick nor allergic to any of the raw materials under review. They consisted of staff and students from Food Science and Technology Department, Rivers State University, Nkpolu, Port Harcourt. A 9-point hedonic scale was used to evaluate the samples with (1) representing dislike extremely and (9) like extremely (Iwe, 2002). The attributes evaluated were colour, aroma, taste and texture. Overall acceptability was calculated as the mean responses of all the other attributes. Water was given to the panelists to rinse their mouth in between tasting to avoid after taste.

Statistical Analysis

Means of the data obtained for all determinations were subjected to Analysis if variance (ANOVA). Duncan's Multiple Range Test was used to identify significant difference among treatment means at ($p<0.05$) using Statistical Package for Social Sciences (SPSS) version 20.0.

RESULTS

Table 3 and 4 shows the result of the proximate composition of moi-moi and epiti wrapped with different leaves. Moisture content ranged from 70.24% to 72.45% in moi-moi and 49.78% to 62.70% in the epiti samples. Moi-moi and epiti wrapped with uma leaves had the highest moisture content while moi-moi wrapped with plantain leaves and epiti wrapped with banana leaves were the least. Ash content ranged from 2.42% in moi-moi wrapped with plantain leaves to 2.44% in moi-moi wrapped with uma and banana leaves and from 1.60% in epiti wrapped with uma and plantain leaves to 2.23% in epiti wrapped with banana leaves. The fat content ranged from 5.44% in moi-moi wrapped with uma leaves to 6.39% in moi-moi wrapped with plantain leaves and 6.98% in epiti wrapped with uma leaves to 9.28% in epiti wrapped with banana leaves. Protein content was highest in moi-moi wrapped with plantain leaves (4.39%) and epiti wrapped banana leaves (4.15%) while moi-moi (4.08%) and epiti (2.81%) wrapped with uma leaves had the lowest. Crude fibre ranged from 2.08% to 2.36% in moi-moi wrapped with banana leaves and uma leaves respectively and 1.32% in epiti wrapped with uma leaves to 1.54% in epiti wrapped with banana leaves. The carbohydrate content of the samples ranged from 13.28% to 14.50% in moi-moi wrapped with uma and banana leaves respectively and from 25.58% to 33.02% in epiti wrapped with uma and banana leaves respectively.

Table3. *Proximate composition of Moi-moi wrapped with different leaves (% Wet basis)*

Samples	Moisture	Ash	Fat	Protein	Crude Fibre	Carbohydrate
MU	72.45±1.26^{a}	2.44±0.01^{a}	5.44±0.04^{a}	4.08±0.27^{a}	2.36±0.05^{a}	13.28±0.57^{a}
MP	70.24±1.74^{a}	2.42±0.08^{a}	6.39±0.76^{a}	4.39±0.50^{a}	2.61±0.14^{a}	13.95±0.23^{a}
MB	70.74±1.53^{a}	2.44±0.01^{a}	5.98±0.04^{a}	4.26±0.23^{a}	2.08±0.02^{b}	14.50±1.22^{a}

Values are means of duplicate determinations. Means with different superscript on the same column are significantly different (P< 0.05).

Key: *MU = Uma leaves wrapped moi-moi, MP= Plantain leaves wrapped moi- moi, MB= Banana leaves wrapped moi-moi*

Table4. *Proximate composition of "Epiti" wrapped with different leaves (% Wet basis)*

Samples	Moisture	Ash	Fat	Protein	Crude Fibre	Carbohydrate
EU	62.70±2.50^{a}	1.60±0.21^{b}	6.98±0.62^{b}	2.81±0.19^{b}	1.32±0.01^{a}	25.58±1.49^{a}
EP	59.38±0.07^{a}	1.60±0.03^{b}	7.98±0.25^{b}	3.74±0.06^{b}	1.33±0.40^{a}	25.97±0.66^{a}
EB	49.78±0.24^{b}	2.23±0.05^{a}	9.28±0.03^{a}	4.15±0.13^{a}	1.54±0.20^{a}	33.02±0.17^{a}

Values are means of duplicate determinations. Means with different superscript on the same column are significantly different (P< 0.05).

Key: *EU = Uma leaves wrapped epiti, EP= Plantain leaves wrapped epiti, EB= Banana leaves wrapped epiti*

Tables 5 and 6 shows the result of the mineral content of moi-moi and epiti wrapped with different leaves. Calcium ranged from 81.44mg to 147.24mg in banana leaves wrapped moi-moi and plantain leaves wrapped moi-moi respectively and from 62.54mg to 304.63mg in banana leaves wrapped epiti and plantain wrapped epiti respectively. Potassium ranged from 404.70mg and 562.90mg in plantain wrapped moi-moi and epiti respectively to 734.53mg and 1746.8mg in banana wrapped moi-moi and epiti respectively. Magnesium ranged from 22.65mg to 82.83mg in moi-moi wrapped with plantain leaves and banana leaves respectively and from 148.84mg to 324.40mg in epiti wrapped with uma leaves and banana leaves respectively. Sodium ranged from 954.72mg and 890.74mg in plantain leaves wrapped moi-moi and epiti respectively to 1623.90mg and 2088.30mg in banana leaves wrapped moi-moi and epiti respectively.

Iron ranged from 53.51mg in banana leaves wrapped moi-moi to 58.90mg in plantain leaves wrapped moi-moi and from 2.30mg in uma leaves wrapped epiti to 3.05mg in banana leaves wrapped epiti. Phosphorus ranged from 0.71mg to 0.80mg in moi-moi wrapped with uma leaves and banana leaves respectively and from 0.80mg to 1.50mg in epiti wrapped with plantain leaves and banana leaves respectively.

Table5. *Mineral content of Moi-moi wrapped with different leaves*

Samples	Calcium	Potassium	Magnesium	Sodium	Iron	Phosphorus
MU	105.80^{b}	705.74^{a}	50.10^{b}	1286.83^{b}	54.02^{b}	0.71^{c}
MP	147.2^{a}	404.70^{c}	22.65^{c}	954.72^{c}	58.90^{a}	0.94^{a}
MB	81.44^{c}	734.53^{a}	82.83^{a}	1623.90^{a}	53.51^{b}	0.80^{b}

Values are means of duplicate determinations. Means with different superscript on the same column are significantly different (P< 0.05).

Key: *MU = Uma leaves wrapped moi-moi, MP= Plantain leaves wrapped moi- moi, MB= Banana leaves wrapped moi-moi*

Table6. *Mineral content of "Epiti" wrapped with different leaves*

Samples	Calcium	Potassium	Magnesium	Sodium	Iron	Phosphorus
EU	139.51^{b}	765.40^{b}	148.84^{b}	950.52^{b}	2.30^{b}	0.83^{b}
EP	304.63^{a}	562.90^{c}	177.33^{b}	890.74^{c}	2.82^{b}	0.80^{b}
EB	62.54^{c}	1746.82^{a}	324.40^{a}	2088.30^{a}	3.05^{a}	1.50^{a}

Values are means of duplicate determinations. Means with different superscript on the same column are significantly different (P< 0.05).

Key: *EU = Uma leaves wrapped epiti, EP= Plantain leaves wrapped epiti, EB= Banana leaves wrapped epiti*

Tables 7 and 8 shows the mean sensory scores for moi-moi and epiti wrapped with different leaves. Colour ranged from 7.80 for moi-moi wrapped with plantain leaves to 8.15 for moi-moi wrapped with uma leaves and from 8.20 for epiti wrapped with uma leaves to 8.60 for epiti wrapped with banana leaves. Aroma ranged from 7.80 and 8.30 in moi-moi and epiti wrapped with plantain leaves respectively to 8.15 and 8.50 in uma leaves wrapped moi-moi and banana leaves wrapped epiti respectively. Taste ranged from 7.80 and 8.45 in moi-moi wrapped with banana leaves and epiti wrapped with uma leaves to 7.90 and 8.60 in moi-moi wrapped with plantain leaves and epiti wrapped with banana leaves. Texture ranged from 7.70 and 8.25 in moi-moi wrapped with plantain leaves and epiti wrapped with uma leaves to 7.85 and 8.60 in moi-moi and epiti wrapped with banana leaves respectively. The overall acceptability ranged from 7.80 and 8.31 in moi-moi wrapped with plantain leave and epiti wrapped with uma leaves to 7.98 and 8.58 in moi-moi wrapped with uma leaves and epiti wrapped with banana leaves.

Table7. *Mean sensory scores of Moi-moi wrapped with different leaves*

Samples	Colour	Aroma	Taste	Texture	Overall Acceptability
MU	8.15^{a}	8.15^{a}	7.85^{a}	7.75^{a}	7.98^{a}
MP	7.80^{a}	7.80^{a}	7.90^{a}	7.70^{a}	7.80^{a}
MB	8.10^{a}	8.10^{a}	7.80^{a}	7.85^{a}	7.96^{a}

Values are means of panelists' scores. Means with different superscript on the same column are significantly different (P< 0.05).

Key: *MU = Uma leaves wrapped moi-moi, MP= Plantain leaves wrapped moi- moi, MB= Banana leaves wrapped moi-moi*

Table8. *Mean sensory scores of "Epiti" wrapped with different leaves*

Samples	Colour	Aroma	Taste	Texture	Overall Acceptability
EU	8.20[a]	8.35[a]	8.45[a]	8.25[a]	8.31[a]
EP	8.50[a]	8.30[a]	8.55[a]	8.40[a]	8.44[a]
EB	8.60[a]	8.50[a]	8.60[a]	8.60[a]	8.58[a]

Values are means of panelists' scores. Means with different superscript on the same column are significantly different (P< 0.05).

Key: *EU = Uma leaves wrapped epiti, EP= Plantain leaves wrapped epiti, EB= Banana leaves wrapped epiti*

DISCUSSION

Results of proximate composition of moi-moi and epiti samples wrapped with the different leaves revealed that there was no significant difference (P>0.05) in the moisture, ash, fat, protein and carbohydrate content of the moi-moi samples with significant difference observed for the crude fibre content of the moi-moi samples. The similarities in the moisture content of all the moi-moi samples could be linked to the permeability properties of the leaves. Okwunodulu *et al* (2019) reported no significant differences in moisture content of moi-moi wrapped with uma and banana and leaves; the values are however lower than that of the present study. The epiti samples differed significantly (P<0.05) for all other parameters except for fibre and carbohydrate content. The differences in the moisture content of the epiti samples could be as a result of the method of wrapping which may have created openings that allowed moisture to sip into the food during steaming. The values obtained for moisture content of the epiti samples in this study are lower than that reported by Oranusi *et al.* (2014).

The ash content of the moi-moi samples were not significantly different but was higher in moi-moi wrapped with uma and banana leaves. Ash content differed significantly in the epiti samples with epiti wrapped with banana leave having the highest value. The higher ash content of the epiti sample wrapped with banana leave implies that it has higher mineral content as ash is an indication of the mineral content in a food product. The result obtained in this study is in agreement with the findings of Kabuo, *et al.*, (2015a) who reported higher ash content in "Ogiri" (fermented *Citrullus vulgaris*) wrapped with banana leave than the sample wrapped with uma leave.

There was no significant difference (P>0.05) in the fat content of the moi-moi samples but the epiti samples differed significantly (P<0.05) with epiti wrapped in banana leave having the highest fat content. The values obtained for both moi-moi and epiti samples are higher than those reported by Okwunodulu *et al* (2019). The differences in the fat content of the epiti samples could be linked to the differences in their moisture content which might have affected the soluble components of the epiti samples.

Protein content of the moi-moi samples did not differ significantly (P>0.05) however significant difference (P<0.05) was observed in the epiti samples with the sample wrapped with banana leave having the highest protein content. The protein content of the moi-moi samples in this study is in agreement with the work of Okwunodulu *et al* (2019) who reported a protein content of 4.91 to 4.98 for moi-moi wrapped with banana and etere leaves.

The moi-moi samples differed significantly (P<0.05) in crude fibre content with the sample wrapped with plantain leave having the highest fibre content. There was no significant difference (P>0.05) in the fibre content of the epiti samples. The results obtained in this study for moi-moi and epiti are higher than previous studies. Obueh *et al*, (2017) reported fibre content of 0.78 in moi-moi while Oranusi *et al*, (2014) reported fibre content of 0.07 in epiti.

Carbohydrate content of the moi-moi and epiti samples were not significantly different (P>0.05). However moi-moi and epiti samples wrapped with banana leave had the highest carbohydrate content. The carbohydrate content of the moi-moi samples are lower than that of the findings of Okwunodulu *et al* (2019) who reported carbohydrate content 36.79 and 38.20% in moi-moi wrapped with banana and etere leaves respectively.

There were significant differences (P<0.05) in the mineral content of the moi-moi and epiti samples wrapped with different leaves for all the mineral elements assessed. Calcium was highest in moi-moi and epiti wrapped with plantain leave and were significantly different from the other samples. The differences could be as a result of differences in the mineral content of the various leaves which may have leached into the moi-moi and epiti samples. Plantain leaf has been reported

to contain high amount of calcium (Okareh, *et al*., 2015). This further provides another source of obtaining calcium in food as well as value addition for plantain leave.

The highest content of potassium, magnesium and sodium were obtained in moi-moi and epiti wrapped with banana leave and were significantly different ($P<0.05$) from other samples. The higher content of these minerals in epiti wrapped with banana leave is expected as banana is known to be a good source of potassium, while magnesium and sodium are components of the electrolyte which in synergy help to maintain the body cells and regulation. Mineral result of the present study corroborates the high ash content of the sample; with the low moisture content of the sample contributing to the high amount of these minerals in the sample. Previous studies by Ayo-Omogie *et al.*, 2010 and Mohapatra *et al.*, 2010) had reported that minerals such as potassium, magnesium and phosphorus constitute a greater percentage of the total mineral contribution in banana and plantain. The findings of this study are at variance with that of Aniebet and Olanrewaju (2018) who reported higher content of potassium, magnesium and sodium in uma leave wrapped moi-moi than in banana leave.

The iron content of the moi-moi and epiti samples differed significantly ($P<0.05$). Iron was highest in plantain leave wrapped moi-moi and banana leave wrapped epiti. The iron content of the moi-moi samples were higher than previous studies. Aniebet and Olanrewaju (2018) reported an iron content of 18.30mg in moi-moi wrapped with banana leave which was higher than that of moi-moi wrapped with uma leave.

There was no significant difference ($P>0.05$) in the mean sensory scores of the moi-moi and epiti wrapped with the different leaves for all the attributes assessed. This implies that none of the leaves used had a distinct or unique effect on the sensory attributes of the samples that would have affected consumers' preference. Hence the preference for all the samples wrapped with the different leaves by the consumers. Consumers acceptability of all the leaves used could be the reason why these leaves are still used widely for packaging several food products as reported by Peter-Ikechukwu *et al.* (2014). The preference for all the food samples wrapped with the different leaves could also be attributed to their perception of the additional health benefits they might obtain by consuming leaves packaged foods. Ojekale *et al* (2007) reported that people who consume foods wrapped with leaves affirm that there is a particular flavour associated with foods wrapped with leaves.

CONCLUSION

The different leaves used as wrapping material for moi-moi and epiti had similar effect on the proximate composition of the food products. However the high moisture content of the samples would affect their keeping quality and shelf life and therefore the need for immediate consumption. The variations in the mineral content of the food products suggest that the different leaves may have impacted on the mineral content of the samples. The preference for all the samples indicates the acceptance of leave packaged moi-moi and epiti by the consumers. Therefore use of locally available and consumable leaves should be encouraged.

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Citation: *Beleya, E. A and Eke-Ejiofor, J, "Proximate, Mineral and Sensory Attributes of Moi-Moi and "Epiti" Wrapped with Different Local Leaves in Nigeria", Research Journal of Food and Nutrition, 4(2), 2020, pp. 13-19.*