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PROXIMATE AND SENSORY PROPERTIES OF MOI-MOI DEVELOPED FROM COWPEA AND AVOCADO PEAR SEED FLOUR BLENDS

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ABSTRACT

Moi-moi is a steamed cowpea based gel that is popular in Nigeria. The proximate composition and sensory properties of moi-moi produced from cowpea and avocado pear seed flour blends was investigated. Moi-moi was prepared by varying the proportion of cowpea to avocado pear seed flour in the ratios of 100:0, 90:10, 80:20, 70:30, 60:40 and 50:50. The result of proximate analysis of the moi-moi samples revealed a significant decrease in the ash (1.73-1.17%), fat (2.15-0.71%), crude protein (12.33-7.18%) and carbohydrate (52.06-49.27%) contents while an increase in moisture (30.38-39.52%) and crude fibre (1.35-2.15%) contents was observed as substitution of cowpea with avocado pear seed flour increased in the blends. The control sample without avocado pear seed flour substitution was significantly different from all others except for ash in which the blend with 10 and 20% avocado pear seed flour substitution was not significantly different ($p<0.05$) with control sample. Results of the sensory analysis also revealed that there was a significant difference ($p<0.05$) between the 100% cowpea moi-moi and all the other samples except for texture of the 10%, 20% and 30% avocado pear seed flour substitution (with mean value of 5.95, 5.85 and 5.35 respectively) and sogginess of 10% avocado pear seed flour moi-moi blends (with mean value of 5.95). This study therefore suggests that the blend of 10% avocado pear seed flour with cowpea can be used for the production of moi-moi with desirable sensory quality thereby providing an alternative way of utilizing avocado pear seed.

Contribution/Originality: This study documents the possibilities of making moi-moi from the partial substitution of cowpea with Avocado pear seed flour. The acceptable level of Avocado pear seed flour to cowpea flour for moi-moi production was also established.

1. INTRODUCTION

Cowpea (*Vigna unguiculata*) is an important leguminous crop which is widely cultivated in tropical and sub-tropical countries (Kebede & Bekeko, 2020). It is a drought tolerant crop and considered second most important food grain legume constituting an inexpensive source of protein for humans and animals (Karunasena, 2001). Nutritionally, cowpea seeds contain 20-25% protein, 1.5-4% crude fiber, 1-2% fat, 3-4% ash and 55-68% carbohydrate in addition to vitamins and beneficial phytochemicals (Frank-Peterside, Dosumu, & Njoku, 2002). Cowpea seeds can be cooked in its dried form, sprouted or ground into flour. They can also be boiled with condiments and eaten singly with stew or combined with cereals (Otunola & Afolayan, 2018). In Nigeria, they are used in the preparation of bean pudding locally called "akara" (fried cowpea paste) or steamed cowpea paste locally called "moi-moi". Moi-moi (Cowpea puddy) is a gel which is made by steaming cowpea paste containing vegetable

oil, spices and other condiments. Agbara, Haruna, Chibuzo, and Agbara (2018). It is a well cherished food popularly consumed in Nigerian homes where it is taken with pap, eaten lone or combined with rice (Nwosu, 2011).

Avocado (*Persea Americana*) is an edible fruit belonging to the family *Lauraceae*. It is native to Mexico, Central America and South America but now being cultivated in the subtropical and tropical areas such as East and West Africa (Adeyemi, Okpo, & Ogunti, 2002; Leite et al., 2009). The skin of the avocado fruit is yellow-green to purple containing a single seed which is 5-15 cm long and ovate to spherical (Nonso, Ikechukwu, Moses, & Emmanuel, 2018; Nwaokobia, Oguntokun, Okolie, Ogboru, & Idugboe, 2018). The fruits of avocado are edible and reported to be rich in minerals such as sodium, potassium, magnesium, phosphorus and calcium and fatty acids such as lioleic, oleic, palmitic, stearic, Capric, linolenic, and myristic acids (Nonso et al., 2018; Nwaokobia et al., 2018). Avocado pear fruit is a major tropical and energetic fruit shown to contain appreciable quantities of protein and fat soluble vitamins such as vitamin A, C and E (Talabi, Osukoya, Ajayi, & Adegoke, 2016). The fruits have also been proven to be of immense health benefits as it aids in the reduction of saturated fat (Nwaokobia et al., 2018).

Avocado fruit pulp is prepared in different forms. In Nigeria, it is eaten with bread while in northern South America, Central America and Mexico; it is consumed as puree salads and also used in the preparation of other dishes (Koller, 1992). The seed is high in carbohydrate 49.03g, lipid 17.90g, protein 15.5g, moisture, 15.10g and ash 2.26g (Nonso et al., 2018). The avocado pear seed could serve as a good dietary fibre source and perhaps fibre health benefits (Anthony, Immaculate, Chimaraoke, & Nancy, 2018). Nonso et al. (2018) also reported that avocado pear seeds contains substantial nutrients that could meet the needs and requirement of the body, thus it is good for human consumption.The formulation of moi-moi from different blends of raw materials such as cowpea/maize (Akusu & Kiin-Kabari, 2012) cowpea/African yam bean (Nwosu., Onuegbu, Ogueke, Kabuo, & Omeire, 2014) cowpea/water yam (Otunola & Afolayan, 2018) has been reported by several authors. These studies were developed with the intent of producing moi-moi from locally available raw materials apart from cowpea that will be more nutritious and acceptable to the Nigerian consumers. The avocado pear seed represents 13-18% of the fruit and is a by-product generally not utilized by avocado processors (Nonso et al., 2018). According to Nonso et al. (2018) the seeds are often discarded during processing of the fruit while it is consumed in some countries such as Niger Republic. The waste from this seed may represent a human contaminant affecting the health of humans. This menace may be reduced by finding a better use for Avocado seed as plant seeds are known to contain basic nutrients in adequate amounts. Avocado pear seed has been reported to be a rich source of dietary fibre and bioactive compounds such as fatty acids. It is also shown to possess some antioxidant properties (Ramos et al., 2004). Cowpeas on the other hand are valuable as a good source of proteins, rich in amino acids such as lysine and limiting in sulphur containing amino acids such as methionine and cysteine (Otunola & Afolayan, 2018). The incorporation of avocado pear seed with cowpea for the production of moi-moi will therefore bring about an improvement in its nutritional quality and acceptability. It is on this view that this study was conducted to evaluate the proximate and sensory properties of moi-moi made from cowpea and avocado pear seed composite flours towards increasing the utilization of avocado pear seed for culinary purposes and reducing environmental waste burden for avocado processors.

2. MATERIALS AND METHODS

2.1. Collection of Materials

The following materials: Cowpea (*Vigna unguiculata*), avocado pear (*Persea americana*), vegetable oil, Tatashe pepper, onions, salt and magi cubes were purchased from Mile 1 market, Port-Harcourt, Nigeria. All chemicals and reagents used in this study were obtained from the Department of Food Science and Technology, Rivers State University, Port Harcourt and were of analytical reagent grade.

2.2. Processing of Cowpea flour

The method of Nwosu. et al. (2014) was used for the processing of cowpea seeds into flour as shown in Figure 1. Five kilograms (5 kg) of cowpea seeds were cleaned, weighed and sorted. The sorted seeds were soaked in portable water for 10-15 min and then the seed coats removed manually. The seeds were further rinsed in water until they were clean and free from impurities. Thereafter, they were dried in an air oven at 50-60°C for 5 h and milled using a hammer mill. The flour was kept in a dry, air-tight plastic container for further use.
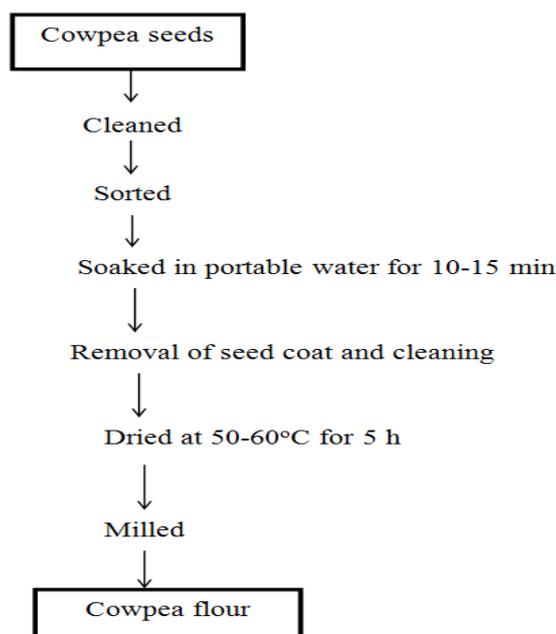
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┌─────────────────┐
│  Cowpea seeds   │
└─────────────────┘
         │
      Cleaned
         │
       Sorted
         │
Soaked in portable water for 10-15 min
         │
Removal of seed coat and cleaning
         │
  Dried at 50-60°C for 5 h
         │
       Milled
┌─────────────────┐
│  Cowpea flour   │
└─────────────────┘
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Figure-1. Preparation of Cowpea flour.

2.3. Preparation of Avocado Pear Seed Flour

The flow chart for preparation of Avocado pear seed flour is shown in Figure 2. The seeds of Avocado fruits (*Persia Americana* Mill) were separated from the pulp by removing the fleshy cover. The seeds were thereafter washed with distilled water, milled into smaller pieces with the aid of a kitchen knife and oven dried to a constant weight at 50°C. The dried seeds were then milled using a hammer mill and then stored in an air tight container.
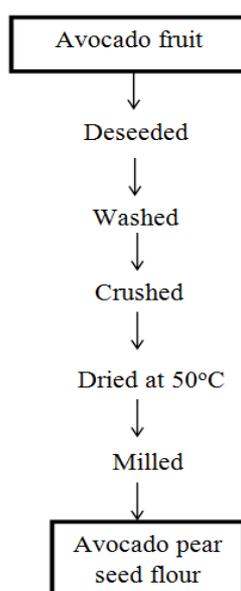
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┌─────────────────┐
│  Avocado fruit  │
└─────────────────┘
         │
      Deseeded
         │
       Washed
         │
       Crushed
         │
   Dried at 50°C
         │
       Milled
┌─────────────────┐
│  Avocado pear   │
│   seed flour    │
└─────────────────┘
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Figure-2. Preparation of avocado pear seed flour.

2.4. Preparation of Moi-Moi

Moi-moi was prepared from blends of cowpea and avocado pear seed flour blends using the method of Akusu and Kiin-Kabari (2012). Cowpea flour was partially replaced with 0% of avocado pear seed flour (Control), 10% (sample B), 20% (sample C), 30% (sample D), 40% (sample E) and 50% (sample F) avocado pear seed flour (AVF). The flour mixtures were mixed gradually in a bowl using a wooden spatula. Three hundred grams (300g) of the blended cowpea/avocado pear seed flour was mixed with tatashe pepper, onions, salt, magi cube and vegetable oil Table 1. Warm water at 70ᵒC (900 ml) was added in the bowl containing the flour mixtures and mixed using a wooden handle until a smooth paste was formed. The paste formed was allowed to stand for 3 min and mixed thoroughly. The paste was dispensed into aluminum foil packaged and steamed for 1 h. The moi-moi samples were cooled, evaluated for sensory properties and stored for further analysis.

Table-1. Recipe for moi-moi preparation.

Sample	Cowpea flour (g)	Avocado pear seed flour (g)	Tatashe pepper (ground) (g)	Onions (g)	Salt (g)	Hot water (70ᵒC) (ml)	Maggi cube (g)	Vegetable oil (ml)
A	100	0	60	60	40	900	10	140
B	90	10	60	60	40	900	10	140
C	80	20	60	60	40	900	10	140
D	70	30	60	60	40	900	10	140
E	60	40	60	60	40	900	10	140
F	50	50	60	60	40	900	10	140

2.5. Sensory Analysis

The method of Ngoddy, Enwere, and Onuorah (1986) was used for sensory evaluation of the moi-moi samples. This involved a panel of twenty members consisting of students in the Department of Food Science and Technology, Rivers State University, Port Harcourt, Nigeria who were familiar and regular consumers of cowpea based moi-moi. Moi-moi produced from each flour blend, along with the control sample were presented in coded form on white disposable plates and presented randomly to the panelists. The assessors were also provided with portable water for rinsing the mouth between evaluations. The quality attributes (colour, sogginess, texture, flavor and overall acceptability) of the moi-moi were evaluated and rated by the panelists on a 9-point hedonic scale of 1 to 9 with 1 as disliked extremely while 9 as liked extremely using the sensory scale.

2.6. Proximate Analysis

Standard methods of the AOAC (2012) were used in determining the moisture, ash, protein, fat and crude fibre of moi-moi samples while carbohydrate content was determined by the difference using the formula:

$$100\% - (\% \text{ MC} + \% \text{ Ash} + \% \text{ Crude protein} + \% \text{ Fat} + \% \text{ Crude fibre})$$

2.7. Statistical Analysis

Proximate analysis was carried out in duplicate while data from the analysis were subjected to analysis of variance (ANOVA) using the SPSS version 23 (SPSS, IBM, Chicago USA). The means were calculated and separated using the Duncan Multiple Range Test (DMRT) where significant differences existed at $p=0.05$.

3. RESULTS AND DISCUSSION

3.1. Proximate Composition

Table 2 shows the proximate composition of moi-moi produced from cowpea and avocado pear seed flour blends. Results revealed that the moisture content of the moi-moi ranged between 30.38-39.52% with sample F (50% cowpea: 50% avocado pear seed flour moi-moi) recording the highest while sample A (100% cowpea flour moi-moi) was lowest. Moisture content of 100% cowpea flour blends was significantly ($p<0.05$) different from all others

while moi-moi from flour blends showed no significant difference (p>0.05) amongst one another. Increase in the substitution of cowpea flour with avocado pear seed flour resulted to an increase in the moisture content of the moi-moi samples. Moisture content in a food sample gives an indication of the water content and its total solid content. The high moisture content of moi-moi made from cowpea/avocado pear seed flour blends implies low shelf life, storability and stability of product however, moisture is needed to aid easier mastication, swallowing, refreshing and hydration of the moi-moi samples. Moisture content of moi-moi obtained from this study is lower when compared with 52.06-55.06% for moi-moi made from cowpea-Asparagus bean flours (Nwosu, 2011). It is also lower than that reported by Ogundele, Ojubanire, and Bamidele (2015) for cowpea/soybean moi-moi (48.36-53.93%). The moisture content of moi-moi from this study is within the range of 36.80-44.23% obtained for cowpea/maize moi-moi (Akusu & Kiin-Kabari, 2012). Protein content of the moi-moi samples ranged between 7.18-12.33% with sample A recording the highest while sample F (50% cowpea: 50% avocado pear seed flour moi-moi) as lowest. There was a significant difference (p<0.05) in the protein content of the moi-moi samples with 100% cowpea flour moi-moi significantly higher (p<0.05) than others. A decrease in the protein content of the moi-moi was observed as substitution of cowpea flour with avocado pear seed flour increased. The decrease in protein content could be attributed to the low protein content of avocado pear seed flour (7.04%) as compared with cowpea (20-25%) as reported (Frank-Peterside et al., 2002). Lower protein values obtained from the moi-moi samples could also be attributed to the high moisture content of the moi-moi samples. Protein is needed in the diet as it essential for growth, development and survival of human beings. It also works in synergy with minerals to enhance growth, provide energy, repair, and regulate body processes (Okwunodulu., Peter, & Okwunodulu, 2019). Protein content obtained from this study compares well with the study of Ogundele et al. (2015) who reported protein content of 4.40-11.60% for moi-moi made from cowpea and soybean flour blends. It is also close to the study of Agbara et al. (2018) who reported 4.72-10.32% for differently processed moi-moi samples.

Ash content of the moi-moi samples ranged between 1.20-1.73% with sample A showing the highest while sample E (60% cowpea: 40% avocado pear seed flour moi-moi) as lowest. Ash content of samples A, B and C showed no significant difference (p>0.05) and were significantly higher (p<0.05) than other samples. A slight decrease in the ash content was also observed as substitution of cowpea with avocado pear seed flour increased. The decrease is due to the substitution with avocado pear seed flour as cowpea flour contains higher mineral content than avocado pear seed flour. Cowpea seeds contain 3-4% ash while that of avocado pear seed flour is 2.12% (Frank-Peterside et al., 2002). Ash content in a food gives an indication of minerals present. It could be said that moi-moi made from cowpea with 10% and 20% avocado pear seed flour still contains appreciable ash content as those with cowpea normally used by most consumers. Ash content from this study correlates well with 1.39-1.90% for cowpea/maize flour moi-moi reported by Akusu and Kiin-Kabari (2012). It is higher than 0.67-0.91% for cowpea and Asparagus flour moi-moi reported by Nwosu (2011). Fat content ranged between 0.71-2.15% with sample A recording the highest and sample F as lowest. Fat content of sample A was significantly higher (p<0.05) than moi-moi from cowpea/avocado pear seed flour blends while moi-moi from 30, 40 and 50% avocado pear seed flour substitution showed no significant difference (p<0.05). A decrease in the fat content was also observed as substitution of cowpea with avocado pear seed flour increased. Frank-Peterside et al. (2002) reported that cowpea seeds contain 2% fat while that of avocado pear seed flour is 1.03%. Higher fat value of sample A (100% cowpea) over others may mean that cowpea had more fat than cowpea and the inclusion of avocado pear seed flour in the blends reduced the fat content. Fat content of moi-moi obtained from this study is higher than 16.50-21.81% for moi-moi produced from cowpea and maize flour blends (Akusu & Kiin-Kabari, 2012). Ogundele et al. (2015) reported 1.91-4.06% for cowpea/soybean flour moi-moi formulations. These differences could be due to the variation in recipes used. According to Wardlaw (2004) the presence of fat in diet shows that such diets is a source for fat soluble vitamins such as vitamins A, D, E and K. Crude fibre content of the moi-moi samples ranged between 1.35-2.15% with sample F showing the highest and sample A as lowest. There was no significant difference in the crude fibre content

of moi-moi produced from blends of cowpea and avocado pear seed flour, however these values were significantly higher (p<0.05) than the control moi-moi sample. An increase in the crude fibre content was observed as substitution of cowpea with avocado pear seed flour increased. Okwunodulu et al. (2019) also reported an increase in crude fibre content of moi-moi from cowpea/Bambara groundnut flour blends (1.25-2.00%) as the substitution with Bambara groundnut flour increased. Crude fibre content obtained from this study is higher than 0.75-0.83% for cowpea/Asparagus bean flour moi-moi reported by Nwosu (2011). It also compares well with 1.38-1.65% for cowpea/maize flour moi-moi reported by Akusu and Kiin-Kabari (2012). The increase in fibre content of the moi-moi samples is desirable as fibre is needed for easy passage of waste by expanding the inside walls of the colon. It also helps to reduce the problem of constipation and lowers blood cholesterol level (Wardlaw & Kessel, 2002). This indicates that the cowpea/avocado pear seed flour moi-moi blends when consumed will help to reduce the health problems associated with low fibre. Carbohydrate content of the moi-moi samples ranged between 47.72-52.06% with sample A recording the highest and sample D (90% cowpea: 10% avocado pear seed flour moi-moi) was lowest. Carbohydrate content of sample A was significantly higher (p<0.05) than other samples while no significant difference (p>0.05) was observed among the blends. A decrease in the carbohydrate content was also observed as substitution of cowpea with avocado pear seed flour increased. Carbohydrate content of moi-moi obtained from this study is higher than 15.87-34.72% reported by Akusu and Kiin-Kabari (2012) for cowpea/maize flour moi-moi. It is slightly lower than 54.71-59.37% reported by Nwosu. et al. (2014) for African yam bean and cowpea flour blend moi-moi. These differences could also be due to the variation in recipes used. High carbohydrate in diets is of advantage as it provides the energy needed to do work (Ijeh, Ejike, Nkwonta, & Njoku, 2010). However, low carbohydrate content diets are also of advantage for diabetic patients that need very low carbohydrate content in their diets.

Table-2. Proximate composition of moi-moi produced from Cowpea and Avocado pear seed flour blends.

Samples	Moisture (%)	Protein (%)	Ash (%)	Fat (%)	Crude fibre (%)	CHO (%)
A	30.38±0.22[a]	12.33±0.30[a]	1.73±0.04[a]	2.15±0.20[a]	1.35±0.01[b]	52.06±1.00[a]
B	37.58±1.05[b]	9.63±0.20[b]	1.49±0.00[a]	1.10±0.14[b]	1.66±0.33[ab]	48.54±0.01[b]
C	38.13±0.01[b]	9.37±0.23[b]	1.43±0.30[a]	1.04±0.00[b]	1.76±0.29[ab]	48.27±1.41[b]
D	39.06±1.20[b]	9.07±0.09[c]	1.22±0.29[b]	0.93±0.00[bc]	2.00±0.00[a]	47.72±0.15[b]
E	39.11±0.00[b]	7.78±0.00[d]	1.20±0.00[b]	0.85±0.10[bc]	2.10±0.01[a]	48.96±0.03[b]
F	39.52±0.98[b]	7.18±0.11[d]	1.17±0.00[b]	0.71±0.00[c]	2.15±0.20[a]	49.27±0.00[b]

Note: Values are expressed as mean ± standard deviation of duplicate determination. Means with the same letters along the same column are not significantly different (p>0.05).
Keys:
A= 100% Cowpea flour moi-moi.
B= 90% Cowpea: 10% Avocado pear seed flour.
C= 80% Cowpea: 20% Avocado pear seed flour.
D= 70% Cowpea: 30% Avocado pear seed flour.
E= 60% Cowpea: 40% Avocado pear seed flour.
F= 50% Cowpea: 50% Avocado pear seed flour.

3.2. Sensory Properties of Moi-Moi Produced from Cowpea and Avocado Pear Seed Flour Blends

The mean sensory scores of moi-moi produced from cowpea and avocado pear seed flour blends is shown in Table 3. From the results, it was observed that there was a significant difference (p<0.05) between the 100% cowpea moi-moi and all the other samples except for texture of the 10%, 20% and 30% avocado pear seed flour substitution (with mean value of 5.95, 5.85 and 5.35 respectively) and sogginess of 10% avocado pear seed flour moi-moi blends (with mean value of 5.95). Among all the samples, sample A (100% cowpea moi-moi) was rated highest in all the sensory parameters examined. This could be due to the source of the sample which is 100% cowpea which the judges were used to. This was followed closely by sample B (90% cowpea: 10% avocado pear seed flour moi-moi) and sample C (80% Cowpea: 20% avocado pear seed flour moi-moi). This may be due to the level of substitution of avocado pear seed flour into cowpea. The least accepted sample by the panelist was sample F (50% Cowpea: 50% Avocado pear seed flour moi-moi). The results from this study is in line with studies of Ogundele et al. (2015) who reported a decrease in sensory scores of moi-moi made from cowpea and soybean as substitution of cowpea with

soybean increased. They also reported that substitution of soybean in cowpea at 10% was mostly accepted. Based on the sensory results, avocado pear seed flour can be used to partially substitute cowpea in moi-moi preparation as there was an acceptable product for sogginess and texture up to 10% substitution.

Table-3. Mean sensory scores of moi-moi produced from cowpea and avocado pear seed flour blends.

Sample	Colour	Texture	Sogginess	Flavour	Overall Acceptability
A	6.75[a]	6.40[a]	6.95[a]	7.50[a]	7.00[a]
B	5.00[b]	5.95[ab]	5.95[ab]	5.85[b]	5.75[b]
C	5.15[b]	5.85[ab]	5.45[b]	4.65[c]	5.45[bc]
D	5.30[b]	5.35[abc]	5.45[b]	4.40[c]	5.20[bc]
E	4.55[b]	4.70[bc]	5.10[b]	3.90[c]	4.60[cd]
F	3.80[c]	4.30[c]	3.95[c]	3.45[c]	3.95[d]

Note: Means with the same letters along the same column are not significantly different (p>0.05).
Keys:
A= 100% Cowpea flour moi-moi.
B= 90% Cowpea: 10% Avocado pear seed flour.
C= 80% Cowpea: 20% Avocado pear seed flour.
D= 70% Cowpea: 30% Avocado pear seed flour.
E= 60% Cowpea: 40% Avocado pear seed flour.
F= 50% Cowpea: 50% Avocado pear seed flour.

4. CONCLUSION

The study has showed that Avocado pear seed flour can be used to partially substitute cowpea in moi-moi preparation. There was a decrease in the ash, fat, crude protein and carbohydrate content of the moi-moi with a corresponding increase in crude fibre and moisture content as substitution of cowpea with Avocado pear seed flour increased in the blends; however, the blend with 10% and 20% avocado pear seed flour showed no significant difference with reference sample in the ash content. There was also an acceptable product compared with the reference sample for texture at up to 30% and sogginess up to 10% avocado pear seed flour substitution while moi-moi with 10% Avocado pear seed flour were rated most preferred among the moi-moi blends, although the control sample was significantly higher for all sensory parameters. This study therefore suggests that the blend of 10% avocado pear seed flour with cowpea can be used for the production of moi-moi. The use of avocado pear seed flour for the development and incorporation into existing products should be encouraged. The partial replacement of cowpea flour with avocado pear seed flour for the production of moi-moi will go a long way in the utilization of avocado pear seed flour; however, further studies should be focused on seeking ways of improving the nutritional quality of the cowpea/avocado pear seed flour moi-moi blends.

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