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Research Article
Effect of Mung Bean and Watermelon Rind Flour Supplementation on the Proximate Composition and Storage Condition of Wheat Bread

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Abstract
Objective: This study was carried out to evaluate the proximate composition and microbial assessment of bread produced from composite flours of wheat, mung bean and watermelon rind. **Materials and Methods:** The wheat, mung bean and watermelon rind were blended in the ratios of 90:5:5, 80:10:10, 70:15:15, 60:20:20 and 50:25:25 used for the production of bread while 100% wheat bread was made and use as a control. The proximate and storage condition of bread samples were determined using standard methods. **Results:** Based on the proximate composition it was observed that the samples increased from 8.11-8.61%, the moisture content increased from 2.18-2.69%, ash content increased from 3.37-4.19%, crude fibre increased from 3.60-4.43% and fat increased from 9.18-18.42%, respectively with increased substitution of mung bean and watermelon rind flours, while carbohydrate and energy content decreased. The control (100% wheat bread) had the highest carbohydrate (73.57%) and energy (363.98 KJ/100 g). There was a rise in total viable count from 0.62-1.80 cfu/g along with no increase in coliform and fungal. **Conclusion:** The proximate contents of bread could be enhanced by substituting wheat flour with malted mung bean and watermelon rind flour at different graded levels in the production of breads.

Key words: Bread, flour, mung bean, watermelon, watermelon rind, wheat bread, wheat flour

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INTRODUCTION

Background of the study: Mung bean (*Vigna radiata* L.) is a legume that is widely cultivated for its nutritional and health benefits. It is rich in bioactive compounds such as polyphenols, polysaccharides and peptides[1,2]. Vitexin and isovitexin are the major flavonoids found in mung bean seeds, particularly in the seed coat[1]. These compounds contribute to the antioxidant activity of mung bean and have potential health benefits[3]. Mung bean proteins and peptides, including albumins and globulins, have been isolated and characterized[2]. These proteins have nutritional and functional properties that make them valuable in food applications. Mung bean also has potential health benefits. Studies have shown that mung bean consumption can have hypolipidemic and hypoglycemic effects, making it beneficial for managing lipid and glucose levels[4]. The high fiber content of mung bean, particularly in the seed coat, has been shown to modulate gut microbiota and improve serum glucose and lipid profiles[5]. Mung bean coat, which is rich in polyphenols and dietary fiber, is considered responsible for many of the health benefits associated with mung bean consumption[5].

Watermelon rind refers to the firm outer layer of a watermelon, usually green on the exterior, transitioning to a pale white interior before reaching the red to pink flesh of the fruit. Surprisingly, the rind is edible and harbors a wealth of nutrients found in the juicy fruit itself. It boasts low-calorie content but is rich in essential nutrients like vitamin C, vitamin A, vitamin B6, potassium, zinc, lycopene, amino acids, flavonoids and phenolic compounds[6]. The utilization of watermelon rind in combination with wheat and malted mung bean flour for bread production remains a novel approach. Mung bean flour, recognized for its protein content, can be further enhanced nutritionally through the malting process. Malted mung bean flour is notable for its high protein and low-fat content[7]. Studies have explored the use of watermelon rind powder in food products such as wet yellow noodles[8]. Watermelon rind powder has been found to contribute to the physicochemical, textural and sensory properties of these products. Additionally, watermelon rind is a rich source of dietary fiber and bioactive compounds, making it suitable for the development of functional foods like cookies[9].

Bread is a staple food consumed worldwide, providing essential nutrients such as proteins, lipids and carbohydrates[10]. However, bread can also be a source of concern for individuals with specific dietary needs or health conditions. Fortunately, research has explored various aspects of bread production and ingredients to address these concerns. One area of research focuses on the use of sourdough as a leavening agent in bread making. Sourdough-based biotechnologies have been found to have the capacity to degrade toxic epitopes during food processing, making them suitable for the production of gluten-free bread[11]. This is particularly beneficial for individuals with gluten sensitivities or celiac disease. Inflammatory bowel disease (IBD) is another health condition that has been studied in relation to bread. The bread-making process, specifically the use of sourdough, has been found to have a prebiotic effect on the microbiome of individuals with IBD. Lactobacillus sanfranciscensis and Saccharomyces cerevisiae were the dominant microorganisms found in sourdough and bread doughs, which may contribute to the beneficial effects on the gut microbiota[12]. Fortification of bread with whole green banana flour has also been investigated. This study found that fortifying bread with this flour improved its physicochemical and nutritional properties. Additionally, the *in vitro* digestibility of the bread was enhanced, potentially leading to improved nutrient absorption[10]. Other ingredients, such as red bell pepper and coconut and chestnut flour, have also been studied for their potential benefits in bread production. Red bell pepper has been found to contribute to the physical, nutritional, bioactive and sensory characteristics of bread[13]. Coconut and chestnut flour supplementation in wheat-based bread has been shown to affect texture, nutritional properties and sensory attributes[14].

Wheat is a major grain in the human diet and is extensively cultivated worldwide[15,16]. It is an important staple food in many countries[16]. Wheat production involves various factors such as genetics, agronomy and quality[17,18]. Distinctiveness, uniformity and stability are prerequisites for a new wheat variety to obtain a release permit[18]. The nutritional value of wheat is influenced by its phytochemical profiles, total phenolic and carotenoid contents and total antioxidant activities[15]. Wheat is a rich source of starch, protein, minerals and dietary fiber, which contribute to its nutritional value[19]. The rheological characteristics of wheat play a role in the evaluation of wheat-based products[20]. There are different varieties of wheat, each with its own characteristics and qualities. The physicochemical and functional properties of wheat bran, for example, have been studied extensively[16,21]. The color of wheat grains is an important characteristic that can be analyzed to understand the formation and expression of correlated genes[19]. The nutritional value of wheat and its by-products, such as distiller's dried grains with solubles (DDGS), has also been investigated[22-25]. The digestibility and digestible contents of energy, amino acids and phosphorus in wheat and DDGS have been studied in relation to animal nutrition[22-25]. The quality of wheat is also influenced by environmental conditions and genetic factors[26-28]. The effects of thermal stabilization on the physicochemical parameters and functional properties of wheat bran have been examined[21]. The use of color sorting machines has been shown to improve the food safety parameters of wheat[29]. The role of farmers in shaping agricultural technologies, including the development of wheat varieties, has been explored[30].

Incorporating malted mung bean flour and watermelon rind into wheat flour for bread-making offers potential benefits. This includes improving the nutritional profile of the products and modifying the functionality of the flours and the final bread[31]. Furthermore, such an approach lessens the reliance on imported wheat flour, addresses issues related to protein-energy malnutrition and micronutrient deficiencies and caters to health-conscious consumers in Nigeria and other developing countries.

One of the major challenges facing many developing countries, like Nigeria, is the inadequate intake of both the quality and quantity of nutrients, resulting in protein-energy malnutrition and micronutrient deficiencies. Therefore, supplementing bread with flours from less common legumes like mung beans and fruits like watermelon rind offers a potential solution to mitigate these nutritional issues. The formulation of cost-effective bread enriched with these ingredients enhances the protein, fiber and micronutrient content of the product. Additionally, incorporating malted mung bean and watermelon rind flours into wheat-based bread production helps boost the utilization of these nutrient-rich local ingredients and reduces the overreliance on imported wheat flour.

MATERIALS AND METHODS

Procurement of raw materials: Mung bean seeds and watermelon fruits (*Citrullus Lanatus*), used for the study were bought from New Market Enugu, Enugu State, Nigeria. The wheat flour and other ingredients such as bakery fat, sugar, yeast, salt and flavour for the production of bread were purchased from the same market.

Preparation of mung bean seed flour: The malted mung bean flour was prepared according to the method described by Adegunwa *et al.*[32]. One kilogramme (1 kg) of mung bean seeds were cleaned to remove dirt and other extraneous materials. The cleaned seeds were soaked in 4 litres of potable water in a plastic bowl at room temperature (30+2°C) for 20 hrs with a change of water at every 5 hrs to prevent fermentation. After soaking, the grains were drained, rinsed and immersed in 2% Sodium hypochlorite solution for 10 min to disinfect the seeds. The seeds were rinsed for five consecutive times with excess water and cast on a moistened jute bag, covered with polyethylene bag and left for 24 hrs to fasten sprouting. The seeds were then spread carefully on the jute bag and allowed to germinate in the germinating chamber at room temperature (30+2°C) and relative humidity of 95% for 96 hrs. During this period, the grains were sprinkled with water at intervals of 12 hrs to facilitate germination. Non-germinated seeds were discarded and the germinated seeds were collected, spread on the trays and dried in a tray dryer (Model EU850D, UK) at 60°C for 18 hrs with occasional stirring of the seeds at intervals of 30 min to ensure uniform drying. After drying, the radicles and plumules of the malted mung bean seeds were removed by rubbing them in-between palms. The malted mung bean seeds were milled in the attrition mill and sieved through a 500-micron mesh sieve. The flour produced was packaged in an air tight plastic container, labelled and stored in a refrigeration until when needed for further use.

Preparation of watermelon rind flour: The watermelon rind flour was prepared according to the method described by Choudhary *et al.*[33]. The water melon rinds were manually separated from washed watermelon fresh fruits with a sterile kitchen knife. The cleaned watermelon rinds were sliced into smaller slices of 5 mm in diameter using a stainless-steel knife. The slices were dried in a tray dryer (Model EU850D, UK) at 50°C for 18 hrs to obtain dried chips. The chips were milled in the attrition mill and sieved through a 500-micron mesh sieve to obtain the flour. The flour produced was packaged in an air tight plastic container, labelled and stored in a refrigerator until needed for further use.

Formulation of flour blends: The wheat, mung bean and watermelon rind flour were blended in the ratios of 100:0:0, 90:5:5, 80:10:10, 70:15:15, 60:20:20 and 50:25:25 in a Ken Wood mixer (Model Philips, type HR, 1500/ A, Holland) to obtain homogenous samples of composite flour. Thereafter, the flour blends were individually packaged in air tight plastic containers, labelled and kept in a refrigerator until needed for further use. The flour blends used for the production of bread loaves are given in Table 1.

Preparation of bread samples: The bread loaves were prepared according to the method described by Mitiku *et al.*[34]. The recipe used for the preparation of breads contained 100%

Table 1: Flour blends used for bread production

Samples	Wheat flour	Mung bean flour	Watermelon rind flour
A	100	0	0
B	90	5	5
C	80	10	10
D	70	15	15
E	60	20	20
F	50	25	25

flour, 60% sugar, 20% fat, 2% yeast, 2.5 mL vanilla flavour, 5% milk, 0.25% salt. All the raw materials were thoroughly mixed together manually to obtain homogeneous mixtures and kneaded properly on a dusty table (to avoid sticky) to incorporate air into the dough. The mixed kneaded dough was milled thoroughly using milling machine on till the gluten content in the dough is stretched to an extent that the gluten content in the dough can trap CO_2 released by yeast during fermentation that leads to elasticity and increase in dough volume. The milled dough was weighed to obtain accurate and uniform measurement; therefore, the weighed dough was increase in size. During fermentation CO_2 and ethanol (C_2H_6O) are released by yeast and the stretched gluten in the dough holds the air bubbles released so as to increase the size of the dough. If the rising dough exceed its rising limit during fermentation, the rising dough will collapse and alcohol smell will be released and perceived. The fermented dough was baked in a convention oven (Mac Adams Rotary Oven, South Africa) at 170°C for 20 min. After baking the loaves were removed from oven and allowed to cool at ambient temperature (30±2°C). The cooled breads were de-panned, packaged and labelled and kept in a refrigerator until needed for analysis. The pictures of the bread samples are given in Plates 2.1 and 2.2, respectively.

Proximate composition of the bread samples

Determination of moisture content: The moisture content of each sample was determined by the air oven drying method of AOAC[35] Five grams (5 g) of each sample was weighed into a petri-dish (W_2) and dried in a hot air oven at 105°C for 3 hrs. Drying was stopped after obtaining a constant weight. After that, the sample was cooled in a desiccator and weighed (W_3). The weight loss obtained as the percentage of moisture content was calculated using the following formula:

$$\text{Moisture}(\%) = \frac{W_2 - W_3}{W_2 - W_1} \times \frac{100}{1}$$

Where,

W_1 : Initial weight of empty petri dish

W_2 : Weight of empty petri dish+sample before drying

W_3 : Final weight of empty petri dish+sample after drying

Determination of ash content: The ash was determined using the AOAC[35] method. Crucibles were washed, dried in an oven at 60°C for 20 mins, cooled in dessicator and weighed. Five grams (5 g) of each bread sample weighed into the crucible and the weight taken. The crucible containing the samples was placed into the muffle furnace and ignited at 500°C for 6 hrs. The muffle furnace was allowed to cool in a desiccator and weighed.

The ash content of each sample was calculated using the following formula.

$$\text{Ash}(\%) = \frac{W_2 - W_3}{W_2 - W_1} \times \frac{100}{1}$$

W_1 : Weight of empty crucible

W_2 : Weight of the sample+crucible

W_3 : Weight of crucible+ash

Determination of fat content: The soxhlet method of AOAC[35] was used for determination of the fat content of each bread sample. Five grams (5 g) of each sample was weighed and wrapped in a filter paper and placed in to a thimble. Normal hexane was poured into the extraction flask to about three quarter of the volume of the flask. The flask with the reflux flask condenser was connected to the soxhlet apparatus and heat was applied under reflux for 3 hrs. After, the extraction, the extraction flask was removed and solvent was recovered. The oil collected was dried in an oven at a temperature of 105°C for 20 min, cooled in a desiccator and weighed. The percentage fat content of each sample was calculated using the following formula.

$$\text{Fat content }(\%) = \frac{C - B}{A} \times \frac{100}{1}$$

Where:

A : Weight of sample

B : Weight of empty flask

C : Weight of flask+oil after drying

Determination of crude fibre content: The crude fibre content of each sample was determined according to AOAC[35] method. Five grams (5 g) of each of the samples were weighed in to a 50 mL volumetric flask. Fourty milliliter of 0.3N sulphuric acid and 0.2 Sodium hydroxide solution was added to the flask. The mixture was heated and refluxed for one hour using air condenser. After that, the flask was removed from the heater and filtered. The residue obtained after filtration was continuously washed with distilled water and then transferred into a crucible. The crucible containing the residue was placed into the oven and dried at 105°C for 18 hrs after drying, the crucible with sample was placed in the muffle furnace and ashed at 500°C until a light grey ash was obtained. After ashing, the crucible containing the sample was removed from furnace, cooled in a desiccator and weighed. The percentage crude fibre content of the sample was calculated using the following formula:

$$\text{Crude fibre content (\%)} = \frac{W_2 - W_3}{W_2} \times \frac{100}{1}$$

W_1 : Weight of the sample
W_2 : Weight of crucible+sample before ashing
W_3 : Weight of crucible+sample after ashing

Determination of crude protein content: The crude protein of each sample was determined according to the modified Micro-kjeldahl method of AOAC[35]. Five gram of each sample was weighed and introduced into the digestion flask. Then, one gram of Copper sulphate was added to the flask as catalyst. In addition, 5 pinches of Selenium powder and 10 mL of concentrated Sulphuric acid were added. The flask was thoroughly shaken and placed on the digestion rack and the content of the flask was digested by heating in a fume chamber with occasional swirling until blacking occurred. The temperature was increased and the sample was allowed to boil for 90 min until a clear solution was obtained. After that, the digest obtained was transferred into 100 mL volumetric flask and then made up to the mark with distilled water. The mixture was thoroughly shaken and 100 mL of the digest solution was pipetted and transferred into Kjeldahl distillation flask followed by the addition of 5 mL of 40% Sodium hydroxide solution. Thereafter, the flask was fixed immediately to the splash lead of the distillation apparatus, 5 mL of 2% boric acid solution and 2 drops of methyl red indicator were placed into the 100 mL receiving conical flask and kept under the condenser of the distillation apparatus in such a way that the top of the delivery tube was on the surface of the conical flask containing the boric acid solution. After that, the mixture was heated and the ammonia liberated from the sample was condensed into the receiving conical flask containing boric acid solution and methyl red indicator until bluish-green distillate was obtained. Then, the distillate was titrated with 0.1N Hydrochloric acid until the end point of pink colouration was obtained. The titre value was taken and recorded immediately. Also, the blank experiment was performed without the sample and its titre value was similarly recorded. The percentage crude protein content of each sample was calculated from the formula using 6.25 as the factor for the conversion of percentage nitrogen to percentage crude protein of each sample.

$$\text{Crude protein content (\%)} \frac{0.0001401 \times T \times 6.25 \times 5}{\text{Weight of sample}} \times 100$$

Where:
T : Titre value
W : Weight of sample dried

Determination of carbohydrate content: The carbohydrate content of the bread samples was determined by difference[35]:

Carbohydrate (%) = 100-% (Protein+Fat+Fibre+Ash+Moisture) contents of each sample

Determination of energy content: The energy content of the bread samples was calculated by multiplying the percentage contents of crude protein, fat and carbohydrate of each sample using the Atwater factors of 4, 9 and 4, respectively[35].

RESULTS AND DISCUSSION

Proximate composition of the bread samples: The proximate composition of breads produced from wheat, malted mung bean and watermelon rind composite flours are presented in Table 2. The moisture content of the samples ranged from 8.11-8.61%. The substituted with 25% malted mung bean and 25% watermelon rind flours had the highest value (8.61%), while the control sample (100% wheat bread) had the least (8.11%) moisture content. It was observed that there were significant ($p<0.05$) differences among the samples. Moisture content is an indicator of shelf life and stability hence, the high content of the samples. A similar increase in moisture content was reported by Chiranthika *et al.*[36] for wheat, acha and mung bean composite breads. The moisture content of all the samples were below 10% moisture level recommended as the normal moisture content for the shelf stability of breads with proper packaging and storage[37].

The ash content of the samples ranged from 2.18-2.69%. The sample supplemented with 25% malted mung bean and 25% watermelon rind flours had the highest value (2.69%),

Table 2: Proximate composition (%) of bread samples (WF:MMBF:WRF)

Samples	Substitution (%)	Moisture	Ash	Crude fibre	Fat	Protein	Carbohydrate	Energy (KJ/100 g)
A	100:0:0	8.11±0.01^{f}	2.18±0.01^{f}	3.37±0.01^{e}	3.60±0.01^{e}	9.18±0.01^{f}	73.57±0.03^{a}	363.98±0.47^{a}
B	90:5:5	8.17±0.01^{e}	2.25±0.01^{e}	3.53±0.01^{d}	3.74±0.01^{d}	10.28±0.01^{e}	72.06±0.04^{b}	362.94±0.05^{b}
C	80:10:10	8.25±0.01^{d}	2.37±0.01^{d}	3.65±0.01^{-c}	3.85±0.01^{-c}	12.48±0.01^{d}	69.42±0.00^{c}	360.19±0.04^{c}
D	70:15:15	8.36±0.01^{c}	2.29±0.01^{c}	3.88±0.01^{b}	4.03±0.01^{c}	14.35±0.01^{c}	66.92±0.01^{d}	356.27±0.07^{d}
E	60:20:20	8.48±0.01^{b}	2.56±0.01^{b}	4.02±0.01^{b}	4.19±0.01^{b}	16.15±0.01^{b}	64.64±0.00^{e}	352.75±0.01^{e}
F	50:25:25	8.61±0.01^{a}	2.69±0.01^{a}	4.19±0.01^{a}	4.43±0.01^{a}	18.42±0.01^{a}	61.67±0.00^{f}	350.21±0.09^{f}

Data are mean±standard deviation of duplicate determinations, Means in the same column bearing different superscripts differed significantly ($p<0.05$) from each other, A bread made from 100% wheat flour, B: bread made from 90% wheat flour: 5% malted mung bean flour: 5% watermelon rind flour, C: bread made from 80% wheat flour: 10% malted mung bean flour: 10% watermelon rind flour, D: Bread made from 70% wheat flour: 15% malted mung bean flour: 15% watermelon rind flour, E: bread made from 60% wheat flour: 20% malted mung bean flour: 20% watermelon rind flour, F: bread made from 50% wheat flour: 25% malted mung bean flour: 25% watermelon rind flour, WF: Wheat flour, MPPF: Malted mung bean flour and WRF: Watermelon rind flour

while the 100% wheat bread sample had the least (2.18%). It was observed that there were significant ($p<0.05$) differences among the samples, the difference could be due to variation of the proportion of the raw materials used for the preparation of the breads. The results showed that the sample supplemented with higher levels of malted mung bean and watermelon rind flours had the highest ash content compared to the control sample and this is an indication that mung bean and watermelon rind are rich in sources of minerals[31]. The values (2.18-2.69%) obtained were higher than the ash content (2.10-2.62%) reported by Chiranthika *et al.*[36] for bread produced from wheat, acha and mung bean composite flours.

The crude fibre of the bread samples ranged from 3.37-4.19%. The sample substituted with 25% malted mung bean and 25% watermelon rind flours had the highest value (4.19%), while the 100% wheat bread sample had the least value (3.37%). There were significant ($p<0.05$) differences among the samples and the differences could be a result of variation in the proportion of raw materials used for the preparation of bread samples. The results showed that the crude fibre content of the samples increased significantly ($p<0.05$) with increase in the addition of malted mung bean and watermelon rind flours in the products. This was an indication that mung bean and watermelon rind are rich sources of crude fibre. A similar increase in crude fibre content of the bread samples was reported by Imoisi *et al.*[31] for breads produced from wheat and watermelon rind composite flours.

The fat content of the samples ranged from 3.60-4.43%. The sample substituted with 25% malted and 25% watermelon rind flour, had the highest value (4.43%), while the 100% wheat bread sample had the least value (3.60%). There were significant ($p<0.05$) differences among the samples the differences could be attributed to variation in the proportions of raw materials used for the preparation of the products. Fat improves flavor and increase the mouth feel of foods and it is a significant factor in the formulation of food products especially the baked food products[36].

The protein content of the bread samples ranged from 9.18-18.42%. The sample substituted with 25% malted mung bean and 25% watermelon rind flours had the highest value (18.42%), while the 100% wheat bread sample had the least value (9.18%). There were significant ($p<0.05$) differences among the samples as a result of raw material differences in proportion. Several researchers had also reported that increase in the substitution of mung bean, increases the protein content of the products[38].

The carbohydrate content of bread ranged from 73.57-61.67%. The 100% wheat bread had the highest value (73.57%) because wheat is more of carbohydrate based while the sample substituted with 25% malted mung bean and 25% watermelon rind flour had the least value (6.67%) because increase in substitution of mung bean and watermelon rind flour degrade the carbohydrate content and led to increase in protein content and micronutrients. This decrease in carbohydrate may be due to increase in fibre content of mung bean and watermelon rind flour incorporated based on the ratio as reported by Umezuruike *et al.*[37].

The energy content of bread samples ranged from 365.98-350.21 KJ/100 g. The control sample had the highest value (365.98 KJ/100 g) due to the wheat-based bread that is rich in carbohydrate and no mung bean and watermelon rind flour added while the sample substituted with 25% malted mung bean and 25% watermelon rind flour had the least value (350.21 KJ/100 g). There were significant ($p<0.05$) differences among the samples as a result of raw material differences in proportion. The energy decreased as a result of increase in substitution ratio of mung bean and watermelon rind flour. The same is reported by Chiranthika *et al.*[36].

Microbial qualities of the bread samples: The microbial content (total viable count) of the samples ranged from $0.62\times12.\ 10^{4}$ to $1.80\times20.\ 10^{4}$ cfu/g (Table 3). The sample substituted with 25% malted mung bean and 25% watermelon rind flours had the highest value

Table 3: Microbial qualities (cfu/g) of the bread samples

Samples	Substitution (%) WF:MMBF:WRF	Total viable count	Coliform	Fungi count
A	100:0:0	$0.62\times12.10^{4}\pm0.01$	Nil	Nil
B	90:5:5	$0.67\times11.10^{4}\pm0.01$	Nil	Nil
C	80:10:10	$1.10\times13.10^{4}\pm0.01$	Nil	Nil
D	70:15:15	$1.40\times15.10^{4}\pm0.01$	Nil	Nil
E	60:20:20	$1.60\times17.10^{4}\pm0.01$	Nil	Nil
F	50:25:25	$1.80\times20.10^{4}\pm0.01$	Nil	Nil

Data are mean±standard deviation of duplicate determinations, Means in the same column bearing different superscripts differed significantly ($p<0.05$) from each other, A bread made from 100% wheat flour, B: bread made from 90% wheat flour :5% malted mung bean flour: 5% watermelon rind flour, C: bread made from 80% wheat flour: 10% malted mung bean flour: 10% watermelon rind flour, D: bread made from 70% wheat flour: 15% malted mung bean flour: 15% watermelon rind flour, E: bread made from 60% wheat flour: 20% malted mung bean flour: 20% watermelon rind flour, F: bread made from 50% wheat flour: 25% malted mung bean flour: 25% watermelon rind flour, WF: Wheat flour, MPPF:Malted mung bean flour and WRF: Watermelon rind flour

(1.80×20.10^{4} cfu/g), while the control (100% wheat bread) had the least value (0.62×12.10^{4} cfu/g) which are within the acceptable microbial load of $<10^{4}$ cfu/g . The increase was observed in total viable count of all the samples of composite bread samples and this could be attributed to increase in the addition of malted mung bean and watermelon rind flour in the samples. The increase was due to increase in nutrient and moisture content of each sample. Nutrient and moisture content increases the activities of microbial growth as reported by Dudley[39]. Fungi were not detected in the baked products from the control sample through the composite samples. Coliform were not detected in any of the samples analyzed. The results showed ($p<0.05$) significant differences among the bread samples.

CONCLUSION

The study showed that the substitution of wheat flour with mung bean and watermelon rind in bread production improve the nutrient content of the product. From the findings of the study, it was observed that the composite bread had high protein, fat, crude fibre and ash contents with increased in the substitution of mung bean and watermelon rind flours compare to the control (100% wheat bread). The control sample had the highest carbohydrate (73.57%) and energy (363.98 KJ/100 g) contents, respectively. The total viable count of the bread samples showed increase as the substitution ratio increased while coliform, fungal count showed non.

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