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Evaluation of Potentials of some selected seeds' flours as partial Substitute for Wheat in Cookies production

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Abstract: Increase in the consumption of fruit pulp usually result into seeds referred to as waste meanwhile these seeds could be of value.Main objective of this study was to determine qualities of cookies from wheat partially substituted with some selected seeds' flours. Pawpaw, benoil, golden melon and water melon seeds' flours were substituted with wheat flour at ratios 50:50. Functional properties of the flour blends were determined. Cookies were produced from the blends using standard method. Nutrient composition, physical, sensory properties and microbiological stability of the resulting cookies were determined. All these results were subjected to statistical analysis (SPSS 17.0) and means separated. Incorporation of different seeds' flours resulted into high oil absorption capacity and least gelation capacity but there was no significant ($p \geq 0.05$) difference in bulk density. Incorporation of each seeds' flours into wheat flour for cookies production improved its fibre, ash, protein and virtually all the minerals examined. The increase was mostly significant in cookies made with goldenmelon and watermelon flours incorporation. Phytochemical such as flavonoid, alkaloid and tannin were high in cookies from the blends which show that incorporation of these seeds' flours in cookie making could help prevent some diseases. Cookies made with watermelon and golden melon was accepted next to cookies from wheat flour whereas cookie from pawpaw was least accepted. This study confirmed that great potential exist for these seeds.

Keywords: Cookies, Flour blends, Functional properties, Potentials, Phytochemical, Seed's flour, Watermelon seeds

INTRODUCTION

Baking industry is considered as one of the major segments of food processing in the present days and baked products are gaining popularity because of their availability, ready to eat convenience and reasonably good shelf life.
Cookies are a form of confectionery product dried to low moisture content [38]. They are consumed extensively all over the world as a snack food and on a large scale in developing countries where protein and caloric malnutrition are prevalent [13].
Cookies hold an important position in snack food industry due to variety in taste, crispness and digestibility. They are ideal for nutrient availability, palatability, compactness and convenience. Wheat (*Triticumaestivum* L.) is one of the important cereal grains because of its use for the preparation of many baked products. Unfortunately, lysine is the first limiting amino acid in wheat flour and more than 10% of it is being destroyed during baking. Most of these foods are however, poor sources of protein with nutritional quality. Enrichment of cereal based foods with other protein sources such as oil seeds has received considerable attention because oil seed are high in lysine, an essential limiting amino acid in most cereals [40].
Traditionally, cookies are made from wheat flour but could be produced from cassava flour and other composites [15], [44]. The fact that Nigeria does not grow wheat and relies heavily on importation of the commodity justifies the continued search for flour composite for local use.
Composite flour can be described as a mixture of several flours obtained from roots and tubers, cereals, legumes etc. with or without the addition of wheat flour [5]. It can also be a mixture of different flours from cereals, legumes or root crops that is created to satisfy specific functional characteristics and nutrient composition.
The increased advocacy on the consumption of functional foods by world nutrition bodies due to different health problems related with food consumption such as Celia disease (Life-long intolerance to wheat gluten, characterized by inflammation of the proximal small intestine), diabetes and coronary heart diseases, led to the recent WHO recommendations to reduce the overall consumption of sugars and foods that promote high glucose responses [54].
[30] stated that Benoil (*Moringaoleifera*) seeds contain more vitamin A than carrots, more calcium than milk, more vitamin C than oranges, and more potassium than bananas, 4 times the fibre in Oats, 9 times the iron in Spinach, and that the protein quality rivals that of milk and eggs. Also, watermelon seed has been reported to be high in protein with excellent functional properties and has also been found to be effective in baking [20], [35].
Pawpaw seeds are high in fat, protein and a good source of calcium, magnesium and phosphorus. It also contains phenolic and flavonoid compounds that have antioxidant properties. The seeds of pawpaw irrespective of its fruit maturity stages have bacteriostatic activity on gram positive and negative organisms which could be useful in treating chronic skin ulcer [32]. There is increasing interest in the pawpaw seed due to its medicinal value. The seed has been shown to be a good source of oil. (25.6%) that may be useful for medicinal, biofuel, and industrial purposes [6].
Golden melon seeds are high in fat and good source of vitamin C. Golden melon indicates the presence of

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carotenoids called zeaxanthin, potassium, folic acid, vitamin B_6 which is responsible for the maintenance of a healthy immune system.

Golden melon seed (often discarded as agro waste) can be utilized for other food applications such as preservative, and also in animal fed and oil extraction, contributory to less waste disposal and value-addition. The uses of golden melon seeds as potential sources of oils have been reviewed [29]. Seeds often will be discarded as waste since it is not currently utilized for commercial purpose [7] but are promising source of useful compounds because of their favourable technological or nutritional properties [48]. To meet the requirement for dietary fibre, the development of cookies with a higher dietary fibre content will be another alternative to increase the fibre intake. Reports made on some individual lesser known seeds and fruits indicated that theycould be good sources of nutrient for both man andlivestock [19],[4]

Chemical, phytochemical and functional properties of pawpaw seeds, benoil (*Moringaoleifera*), melon, watermelon and pear seeds' flours have been reported [41] which revealed they could be harness for consumption and possible industrial usage. However, in order to create more report on the importance of usually discarded seeds and since cookies can serve as vehicle for delivery of important nutrients if made readily available to the population [13], there is a need to produce cookies with these seeds and investigate the resulting cookie's qualities. Therefore,

1.1 Main Objective

The main objective of this study is to investigate the qualities of cookies produced from wheat/selected seeds flours

1.2 Specific Objectives

- To determine the functional and pasting properties of wheat flours substituted with seeds' flours
- To determine the physical properties of the resulting cookies from wheat flours substituted with seeds' flours.
- To determine the proximate of the resulting cookies
- To determine the phytochemicals and anti-nutritional factors on the cookies
- To determine the microbiological and sensory properties of the cookies

2 METHODOLOGY

2.1 Source of Materials

Watermelon, pawpaw and golden melon fruits were purchased from "Lafenwa" market. The benoil pods from a local farm in Oke-Ata while other materials such as eggs, baking powder, margarine and wheat flour were purchased from "Omida" open market. All were gotten from Abeokuta, Ogun State, Nigeria.

2.2 Raw Materials Preparation

The fresh ripe fruits of watermelon, golden melon and pawpaw were washed, cut into two longitudinal halves and seeds were removed by hand. The testae of the seeds were removed by squeezing between two fingers. The seeds were collected separately and washed with water. They were then sun dried and grinded with hammer mill to obtain their flours. The flours passed through a 2mm sieve and were stored in polythene bags for further analysis. Benoil seeds were removed from its pod, sundried and milled into flour. After milling, oil was extracted from the seed flour with the use of soxhlet extractor using N-hexane as the solvent. The seeds' cake was re-milled and spread in the open air for the n-hexane to escape.

2.2. Composite Flour Formation

The blends were prepared by mixing wheat flour with each seeds' flours in the ratio 50:50, i.e. 50 wheatflour:50 seeds' flour (Benoil, Golden melon, Pawpaw and Watermelon seeds' flours)

2.3 Preparation of Cookies

Fat and sugar were mixed using an electric mixer at medium speed for 1hr. after the mixture has turned creamy, eggs were mixed and added to the creamy mixture where they were mixed together to form a dough. The dough was rolled and cut into star shapes of 5cm diameter. Baking was carried out at temperature of 180^0c for 20±5 minutes. Cookies samples were cooled and stored in airtight containers until needed. Cookies were made from wheat to serve as a control [39].

2.4 Analysis of Samples

2.4.1 Determination of Functional Properties

The Water absorption capacity was determined accordingto the method of [15]. The result was expressed as a percentage of water absorbed by the blends on % g/g basis.

(Density of water was assumed to be 1 g/ml). The method described by [33] was used to determine the swelling capacity while the solubility was calculated after the determination of swelling capacity as per 100g of starch on dry basis. 5 ml of aliquot of the supernatant was dried to a constant weight at 120^oC. The residue obtained after drying represents the amount of starch solubilized in water using the method of [33]. The procedure of [8] was used to determine packed and loosed bulk density (PBD & LBD). The Least gelation concentration was determined using the method of [16]. It was taken as the least concentration when the sample from the inverted test tube did not fall or slip.

2.4.3 Determination of Pasting Properties of Flours

Pasting properties of the samples were determined with Rapid ViscoAnalyser (RVA). Sample moisture content was determined. 3g (on 100% dry matter basis) of the sample was weighed into canister and dissolve with 25ml distilled water. The slurry was heated uniformly from 25 to 95^{0}C, held for 15 minutes and cooled at the same rate to 50^{0}C. Cooked paste viscosity of the slurry was determined. The precise linear ramped heating and cooling abilities of the RVA along with steady state temperature control of cooking environment whilst changes in viscosity were continuously recorded [42].

2.4.4 Physical Evaluation of Cookies

The diameter (D) and thickness (T) of the cookies were measured to calculate the spread factor (SF) according to AACC method to 10-50D, [1]. The diameter and thickness were determined using the micrometer screw gauge. The weight was determined using a weighing balance and the length, breadth and height were determined using a calculated according to the following formula.

SF = ($^D/_T$ x CF x 10)-----------------------------[1]

Where, CF is the correction factor, at constant atmospheric pressure (1.0 in the present study).

The texture profile of cookies was determined using testmetric universal machine. M500 – 25KN

2.4.5 Proximate Analysis of Cookies

2.4.5.1 Determination of Moisture content

A dried deems plat dish made of silica (or any other suitable material) was placed in an oven for one hour, after which the plat dish is transferred into a desiccators to cool. The weight of the cooled plate empty dish is recorded (W_1).

Cookies weight 2gm was spread on the plat dish and weighed (W_2), the dish was transferred with its content into the air oven set at 105^{o}C to dry the content for 3 hours. After which the plat dish and its content were transferred into the desiccators to cool, then the new weight of the plat dish was accurately weighed with the cookies contained in it. It was then returned into the air over for 1 hour and dried to constant weight (W_3) [11].

Calculation:

$$\% \text{ Moisture} = \frac{W_2 - W_3}{W_2 - W_1} \times 100$$ ---------------[2]

2.4.5.2 Determination of Ash Content

The weight of platinum or silica dish was weighed (W_1) 5gm of cookies was weighed into the dish and weighed (W_2). The dried sample was charred over a Bunsen plane in a fume until no soot was given off. The dish was transferred using a pair of tongs into a muffle furnace set at 550^{o}C. Ashing was assumed completed when the charred sample was completely white in colour. The dish and its content were transferred into the desicator to cool, with the aid of a pair of tongs and weighed W_3.

Calculation:

$$\% \text{ Ash} = \frac{W_3 - W_2}{W_2 - W_1} \times 100$$ [11] ………[3]

2.4.5.3 Determination of Fat using Soxhlet Method

An appropriate weight of 3gm of cookies was weighed into the extraction thimble (W_1). The samples were covered with a thin film of defatted cotton wool, then it was attached to the thimble adaptors. The weight of the extraction cup with boiling chips was recorded W_2. 50ml of hexane was added into the extraction cups containing the boiling chips and then the thimble was attached to the extraction units. It was then boiled at 120^{o}C for 15min, before rinsing with the solvent for about 30min, then the solvent were collected. The air valves were opened and vacuum applied to remove traces of the solvent. The extraction cup containing the fats, oil and chips were removed and dried for 30min at 100^{o}C. Coded in a desicator and weighed (W_3) [11].

Calculation:

$$\% \text{ Fat} = \frac{W_3 - W_2}{W_1} \times 100$$ ----------------------[4]

2.4.5.4 Determination of Protein

An appropriate weight of 1gm of cookies was placed in the digestion tube, and two kjeltabs (3.5g K_2SO_4 and 3mg Se) were added. 12ml of concentrated H_2SO_4 was added and gently shake to wet the sample with the acid. The exhaust system was attached to the digestion tubes in the rack and the aspirator was set to full effect. The digestion blocks was heated to 420^{o}C and after 5 minutes the water aspirator was turned down to allow the acid to fume. The digestion was continued unto sample turned green solution, after which the sample was cooled for 20mintues. Then 80ml of deionised water was added, the steam value was opened on the Kjectel 1002 and distilled for 4 minutes and then the steam value was dosed. The distilled was then titrated with standardized HCl until end point was achieved and volume of acid was noted.

Calculation of result

$$\% N = \frac{(T - B) \times N \times 14.007}{\text{Weight of Sample (mg)}} \times 100$$

% Protein = N x F-------------------[5]

T = Titration volume for sample (ml)

B = Titration volume for blank (ml)

N = Normality of acid

F = Conversion factor for Nitrogen to protein

14.007 = Molecule weight of Nitrogen

[11]

2.4.5.5 Determination of Crude Fiber

An appropriate weight of 1gm of cookies was weighed into the crucible (W_1), then 3g celite was added to the crucible to simplify filtration. After a set of crucibles was loaded with the cookies powder, the stand on the front of the hot extraction unit was hooked, then the crucible holder was fixed to the crucibles and transferred to the unit. 150mls of hot 0.128m sulphric acid was added through the value, then preheated reagent was poured from the reagent bottle into the column. The tap water was opened for cooling of the condensers, then 2 drops of Odenol was added to prevent foaming and it was heated to boil and left for 30minutes.

The crucibles are then removed and transferred to a crucible stand, and left at room temperature in a ventilated chamber, until nearly all acetone was gone. Then, the crucibles were dried at 100°C overnight cooled to room temperature in a dessicator and weighed (W_2).

The sample was ashed in the crucible at 500°C for 3hours and cooled down to below 25°C, before removing them from the furnace. The cruciblESwere then cooled slowly to room temperature in a dessicator and weighed (W_3).

Calculation

$$\% \text{ Crude Fibre} = \frac{W_2 - W_3}{W_1} \times 100 \quad \text{-------------[6]} \quad [11]$$

2.4.5.6 Carbohydrate

Carbohydrate was determined by difference by subtracting ash content, moisture content, crude fibre, crude protein, and fat from 100.

2.4.6 Determination of Minerals

Minerals such as calcium, sodium, zinc, iron, potassium and magnesium were determined using digestion procedure by [17],[36].

0.20g of cookies was poured into a 50ml digestion tube. Pour 2.5ml of the H_2SO_4 mixture to each tube. Aluminum block was placed on a hotplate and heated at approximately 200°C until the sample fumed. The tube was removed and cooled for 10minutes. 1ml of 30% H_2O_2 was added to samples and after reaction subsided additional 2ml H_2O_2 was added [36].

It was replaced on hotplate and heavy 15ml glass vial was placed on top of each tube and heated to 330°C, the hotplate was left to clear. The yellow tint of the samples disappeared as the digestion was completed, then the samples were allowed to cool and made up to required, before mixing thoroughly and samples were transferred into vials for analysis using [11]

2.4.7 Determination of Anti-nutrients and phytochemical analysis

The method of [51] was used for the determination of tannin contents at the differently substituted flours. Alkaloid was done by the alkaline precipitation gravimetric method described by [24]. Phytateaccording to the method of [37], flavonoid according to the method of [24], saponinaccording to the method of [47] while oxalates determination by Titration method. This determination involves three methods; digestion, precipitation and permanganate titration. This was adopted by [37]

2.4.8 Microbiological Analysis

Each cookies sample was prepared for microbiological examination according to [26]. The standard dilute plate method was used for the isolation of bacteria and fungi. Samples were examined for different types of fungi and bacteria present in the sample.

2.4.9 Sensory Evaluation

The cookies quality was assessed by a test panel of 25judges. Each product was evaluated by the panel of judges on a 7-point hedonic scale where 7 represented like extremely while 1 represented dislike extremely. The cookies were evaluated for quality characteristics such as colour, taste, texture, aroma, crispness and overall acceptability. The scores were subjected to analysis of one way (ANOVA) and the treatment means and standard variation separated suing Duncan's multiple range tests [27].

2.5 Statistical Analysis

Analysis was done in triplicates and the mean value determined in each case. Data obtained were subjected to appropriate statistical analysis (SPSS 17.0) and the means were separated by Duncan Multiple Range Test where significant difference occurs.

3 RESULT AND DISCUSSION

3.1 The Result and Discussion on Functional Properties of Flour Blends

The result of the functional properties on flour blends is as shown in table 1.The bulk density of the flour blends ranges from 0.99 to 1.00 g/ml. There was no significant difference among the samples ($p \geq 0.05$). Bulk density gives an indication of the relative volume of packaging material required and high bulk density is a good physical attribute when determining the mixing quality of a particular matter. Swelling capacity has been reported as part of the criteria for a good quality product [2]. The Swelling index of the samples ranged from 118.18 to 142.96 %. There was significant difference ($p \leq 0.05$) among the samples examined. Wheat flour had the highest swelling capacity at different degree Celsius. The oil absorption capacity suggests the lipophilic nature of the flour constituents. Wheat/pawpaw flour blends had the highest of about 200.00% while wheat/ben oil seed flour blends had the lowest oil absorption capacity. High oil absorption may also be attributed to the presence hydrophobic protein which shows superior binding of lipids [31].

Emulsion capacity of the flour blends ranged from 22.88 to 25.33 %. There was significant difference between the samples ($p \leq 0.05$). High emulsion capacity is an indication that the flour samples could be an excellent emulsifier in various foods [52]. Wheat/Ben oil seed flour blends had the highest while wheat/watermelon flour had the lowest emulsion capacity. The emulsion capacity recorded for watermelon seed flour and wheat flour is higher than the one recorded in [52]

Emulsion stability of the samples ranged between 23.44 and 26.47%. Wheat flour had the highest, while wheat/watermelon had the lowest. There was significant difference among the sample ($p<0.05$). The result recorded was higher than the value recorded in [52]

The result of the foaming range from 8 to15%, wheat flour had the highest, while wheat/ golden melon flour had the lowest. The result recorded for wheat flour is higher than the value recorded in [52]. There was significant difference among the blends $p<0.05$. The foaming stability of the samples ranged from 8 to 19%. Good foam capacity and stability are desirable attributes for flours intended for the production of variety of baked products such as angel cakes, muffins, cookies etc. and also act as functional agent variation could be due to climate, water and cultural practice adopted during planting [50].

3.2 Result and Discussion on Pasting Properties of Flour Blends

The result of the pasting properties is shown in table 2. The peak viscosity, trough, breakdown, find viscosity, set back value, peak time and temperature values of flour samples ranges from 291.00 to 2089.00RVU, 206.00 to 1285.00RVU, 85.00 to 804.50RVU, 474.00 to 2624.50RVU, 27.00 to 1339.50RVU, 1.00 to 5.30 min, 88.00 to 95.10°C respectively. The peak viscosity which is the maximum viscosity developed during or soon after the heating portion. The peak viscosity of wheat flour is 2089.50RVU at a temperature of 85°C in 6.38min. The seed flour blend had lower values in the range of 291.00 – 577.50RVU. This suggests that the presence and interaction of components like fats and protein with starch lowers its peak viscosity [18]. The apparent gelatinization temperature of wheat flour was 88°C while those seed flour blend varied from 92.15°C – 95.10°C. This may be due to the buffering effect of fat on starch which interferes with the gelatinization process [18]. The breakdown viscosity of wheat flour is 804.50RVU. The seed flour blend had lower values in the range of 85 – 234.50RVU. [3], recorded that the higher breakdown in viscosity, the lower the ability of the sample to withstand heating and shear stress during cooking. The final viscosity of the flour blends ranged from 474 to 946RVU. The wheat flour had the highest (2624.50RVU) final viscosity, while golden melon seed flour blend had the lowest. [49] reported that final viscosity is used to indicate the ability of starch to form various paste or gel after cooling and that less stability of starch paste is commonly accompanied with high value of breakdown. Wheat flour had the highest value (1339.50RVU), then watermelon seed flour blend (607RVU), while pawpaw seed flour blend had the lowest (37RVU). The increase in the setback value in seed flour blend maybe due to increased hydrogen bonding during cooling and the high amylase content of the starch [10].

3.3 The Result and Discussion on Physical Properties of Cookies

The physical Properties of Cookies prepared from selected seed flours and 100% wheat flour is as shown in table 3. The length and breadth of the cookies ranged from 3.89 to 4.77 and 3.05 to 5.79cm respectively. Significant difference ($p \leq 0.05$) was observed among the length of the cookies while there was no significant difference ($p \geq 0.05$) between the breadth of the cookies, although cookies from 100% wheat flour had the lowest breadth.

The height ranged from 0.31 to 1.12cm of which one of the composite cookies (wheat/pawpaw) had the lowest height.

The thickness and diameter ranged from 1.55 to 1.92cm and 3.74 to 4.77cm respectively. There was no significant ($p \leq 0.05$) difference in diameter and thickness between composite cookies and 100% wheat cookies increased compared to that of the composite cookies. Addition of the selected seed flour to the wheat flour slightly increased the weight and decreased thickness of the wheat cookies which is in contrast with the work of [13] who stated that addition of defatted sesame flour to unripe plantain flour slightly increased the thickness and the weight of composite cookies. The increase in weight of composite cookies due to addition of the selected seed flour could be attributed to high bulk density of those seed flour than wheat flour.

The spread factor of composite cookies was higher when compared to that of the whole wheat cookies. Cookies from wheat/ben oil seed's flour blends were recorded to be the highest (26.46)

The result of the texture profile is as shown in table 4. The width ranged from 25.00 to 40.00mm from which composite cookies (wheat/Ben oil seed flour) had the highest width. The force at peak for at peak, force at yield ranged from 7.17 to 33.33N, 0.00 to 3.23N and 1.07 to 33.05N respectively. There was significant difference ($p \leq 0.05$) among samples. The wheat cookies had the highest force yield while the composite cookies had the lowest.

The deformation at peak and deformation at break ranged from 0.86 to 3.98mm and 1.24 to 7.36mm and 0.27 to 0.89mm respectively. There were significant differences ($p \leq 0.05$) among samples. The composite cookies (wheat/Ben oil seed flour) had the lowest deformation yield while the wheat cookies had the highest.

The bending strength at peak, bending strength break, strength yield and bending modulus ranged from 0.01 to 0.50N/mm², 0.00 to 0.05N/mm², 0.00 to 0.50N/mm² and 0.02 to 8.75N/mm² respectively. There were significant differences ($p \leq 0.05$). The composite cookies (wheat/Ben oil seed flour) had the lowest bending strength at peak while the wheat cookies had the highest. The composite cookies with Ben oil seed flour and pawpaw had the lowest bending strength break. The energy to peak and energy break had no significant difference. The energy to break ranged from 0.01 to 0.02g.

3.4 The Result and Discussion on Proximate Composition of Cookies

The result of the proximate composition of cookies is as shown in table 5. Moisture content of any food material is a measure of the life span of the food. It indicates how long a food material can be stored without becoming mouldy [23]. [25]reported that the moisture level of a food influence the texture and the more ordered the endosperm structure, the lower the rate of moisture content. Cookies made with wheat/ ben oil, wheat/golden melon, wheat/watermelon seeds' flours were found to be nutritionally superior (have higher proximate value for moisture, ash and crude fibre) to wheat. Cookies except wheat/pawpaw seeds' flours and wheat flour that was low in moisture and low in protein. The moisture content is higher in wheat/ golden melon seeds' flour cookies, wheat/ben oil seeds' flour cookies and wheat/ watermelon seeds' flour cookies ranging from 8.96 to 9.6% than wheat cookies. High moisture content has been associated with short shelf life to spoilage [22], [21]. Protein content increased with substitution of flours except wheat/watermelon seeds' flour (8.92 to 12.90 %). Wheat/ben oil had the highest protein content than whole wheat cookies. Protein is needed as building blocks for the body, necessary for growth and for the repair of worn out tissue [53].

The fat content also increased with substitution of flours. Wheat/pawpaw seed flour had the highest fat content. While wheat/watermelon seed flour cookies had the lowest. However, the high oil content of the cookies will affect the shelf stability [45]. Fat is essential component of tissue and a veritable source for fat soluble, vitamin A, D, E and K. It is able to supply thrice the amount of energy required by the body [53]

The ash content also increased with substitution of seed flours. Wheat/pawpaw had the highest ash content while refined wheat cookies had the highest ash content, while wheat cookies had the lowest (1.48%). Ash is an indication of mineral content of foods and has been shown by [9] to be high in pawpaw.

Crude fibre content also increased with substitution of seeds' flours. Wheat/watermelon flour cookies had the highest, while wheat flour cookies had the lowest (7.94%). However, the high crude fibre most likely come from the bran of the whole-wheat flour and the hull of seeds represents variables fraction of dietary fibre and includes mostly the lignin, cellulose etc. [34]

Wheat cookies had the highest carbohydrate (56.77%) while wheat/golden melon defatted seed flour cookies had the lowest (37.25%). However, increased fibre and lower carbohydrate content of cookies have several health benefits, as it will aid digestion and reduce constipation [20], [21]. High energy foods tend to have a protective effect in the optimal utilization of other nutrients [53]

3.5 The Result and Discussion of Antinutrient and Phytochemicals of Cookies

The result of the antinutrient composition is as shown in table 7. The oxalate and cyanide content are relatively low. High oxalate diet can increase the risk of renal calcium absorption and has been implicated as a source of kidney stone. Wheat cookies have the lowest oxalate content of about 1.26% while wheat/pawpaw flour cookies had the highest of 1.62%. Cyanide content ranges from 0.30 to 0.39%. Whole wheat cookies had the lowest while wheat/pawpaw seed's flour cookies had the highest. This shows that the level of the acid in the cookies sample is within the range for human consumption. Consumption of high levels of cyanide is associated with a serious health problem, a neurological disease known as Tropical AtaxisNeurophathy (TAN) was linked to consumption of high level of cyanide in cassava based diet.

Phytochemicals are important chemicals found virtually in plants and their different parts and at different concentrations. Table 7 shows the presence of saponins and other phytochemical constituents some of the general characteristics of saponins include formation of foams in aqueous solution, haemolytic activity and cholesterol binding properties. Wheat/golden melon defatted flour cookies had the highest saponin content of about 11.05% while whole wheat cookies had the lowest 9.94 [12]. Alkaloids are important the therapeutically significantly plant secondary metabolites isolated pure form of alkaloids and their synthetic derivatives are used as basic medicinal agents for their analgesic and bactericidal effect. Wheat/ben oil seed's flour cookies had the highest alkaloid content, while wheat/pawpaw defatted flour cookies had the lowest which ranges from 17.54 to 27.02% There was significant different among the sample ($p<0.05$). Phytic acid levels ranges between 1.28 to 3.18%. Wheat/golden melon seed's flour cookies had the highest while wheat/ben oil flour cookies had the lowest. There was significant difference among the sample ($p<0.05$). Phytic acid had strong binding capacity and forms insoluble complexes with multivalent cations including Ca, Mg, Fe and Zn and renders them biological unavailable [43]

Flavonoid content ranges between 11.24 to 23.14%. Wheat cookies had the lowest while cookies from wheat/golden melon seed's flour had the highest. Flavonoids are potent soluble super antioxidants and free radical scavengers. They prevent oxidative cell damage, have strong anticancer activity are protect against all stages of carcinogenesis. Flavonoids which are high could be behind anti-inflammatory, anti-cancer and anti-hypertensive [12]. Tanin content ranges from 0.03 to 0.22%, wheat/moringa seed's flour cookies had the highest while wheat/pawpaw flour cookies had the lowest. There was significant difference $p<0.05$ among samples evaluated. Tannin inhibits activity of digestive enzymes. The lower values obtained for tannin is very important because tannin acid because about 10% of totally dry weight affects overall nutritional potential of food material. Importantly, tannin can be used in treatment of skin eruption, due to the astringent properties.

3.6 The Result of Bacterial Load and fungal count on Cookies

The result obtained for total bacterial variable count is as shown in table 8. The result obtained shows that bacterial count is high in all cookies (wheat flour/pawpaw flour) has the highest bacterial count, the high fibre and oil content must have been responsible. The oil and fibre content are critical to the survival of bacterial and will ultimately affect the shelf stability and sensory quality of the cookies samples [22]. Cookies produced from wheat flour had the lowest bacterial count with the week 1 having no count. Low moisture content may be responsible for this, because wheat flour has a low moisture content of about 9.76% moisture. This could be due to the dry nature of the cookies samples [22]. Micro-organism can be found in dust, air, water etc. human and animals are the primary reservoir. Food handlers are usually the main source of food contamination.

Result obtained for total fungal count is shown in table 9. Cookies produced from wheat/pawpaw flour have the highest number of fungal growth. The high oil content in the seed flour may be responsible. The oil and fibre content are critical to the survival of micro-organism and will ultimately affect the shelf stability/sensory quality of the cookies samples [22]. There was no observable fungi growth in (whole wheat flour) for two weeks. This eliminates the possibility of faecal contamination in the different cookies samples, which is pointer to good production and handling practice. This could be due to the dry and nature of the cookies samples (22].

3.8 Result of Sensory Evaluation of Cookies

The result of the sensory evaluation of the cookies sample is as shown in table 10. Color is an important sensory attribute of any food because of its influence on acceptability. The old adage says that the eye accepts the food before the mouth is very true. The brown color resulting from Millard reaction is always associated with baked food [28]. There is significant different among the cookies sample, the colour of sample with 100% wheat and wheat to golden melon seed flour cookies was superior to all other samples followed by sample with wheat to watermelon seed flour cookies and sample with wheat to ben oil seed flour cookies while sample with wheat to pawpaw was the least preferred sample in terms of colour. Aroma is another attributes that influence the acceptance of baked good even before they are tasted. In terms of aroma, the sample are significantly different ($p<0.05$) where sample with 100% wheat is the most preferred follow by sample with wheat golden melon seed flour cookies and sample with wheat to pawpaw seed flour cookies was the least preferred sample in terms of aroma. Crispness is a desirable quality of cookies. Crispness scores were significantly different ($p<0.05$) superior in cookies is sample with 100% wheat cookies followed by sample with wheat to golden melon seed flour cookies while sample with wheat to watermelon seed flour cookies and wheat to pawpaw seed flour cookies have equal acceptability while sample with wheat to ben oil seed flour cookies is the least preferred in terms of crispness. The effect of fat on cookies texture and other baked food is well known. Cookies produced with wheat flour and wheat/golden melon seed's flour had the best texture score. There was significant difference ($p<0.05$) in the texture of the cookies sample and the remaining sample was liked equally. The taste of sample produce with wheat flour was most preferred by the judges followed by sample with wheat to golden melon then sample with wheat to watermelon seed's flour cookies. Sample with wheat to pawpaw and wheat to ben oil seed's flour cookies was least preferred in terms of taste. The cookies produced with wheat flour were the best in overall acceptability followed by sample with wheat to golden melon seed flour cookies. The result confirmed that the quality of colour, aroma, crispness, texture and taste indeed influence the overall acceptability of the cookies. Wheat flour could therefore be supplement with golden melon seed flour in cookies production without affecting the sensory qualities.

4Conclusions

The result from this study shows that cookies produced from combination of wheat/ watermelon seed flour and wheat/golden melon seed flour has a high level of phytochemicals, minerals and low level of anti-nutrient content. The result for proximate analysis shows that ben oil seed flour/wheat had the highest value in terms of protein while pawpaw seed flour/wheat had the highest in fat content. Also, wheat/watermelon seed flour had the highest in crude fiber and ash content while wheat cookies had the highest carbohydrate content and low moisture content which gives the cookies a longer shelf life. The result also shows that the cookies are safe for human consumption considering their low microbial content of less than 10^{10}.

Seeds from the selected fruits have been previously overlooked but now the production of cookies with improved nutritional and sensory quality with less effect on the physical characteristics reveals their potentials for industrial use instead of discarding them after consuming the fruit.

5 Recommendation

This report have clearly established the potentials of these selected seeds for industrial use, it is therefore recommended that similar work should be carried out on their utilization for some other food products

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7 Appendix

Table 1: Result of Functional Properties on Flour Blends

		% Swelling at								
Sample	Bulk Density (g/ml)	65°C	75°C	85°C	% Foaming capacity	% of Foaming Stability	% Oil Absorption	% Gelation Capacity	% Emulsion Capacity	% Emulsion Stability
A	0.99 ± 0.00	1.42 ± 0.03a	136.98 ± 0.03a	131.66 ± 0.03a	15.00 ± 2.65a	19.00 ± 2.65a	60.00 ± 2.65d	4.00 ± 2.65	24.56 ± 0.03c	26.47 ± 0.03a
B	1.00 ± 0.03	126.02± 0.03d	121.83± 0.03d	119.47 ± 0.03c	8.00 ± 2.65b	12.00 ± 2.65bc	140.00 ± 2.65c	6.00 ± 2.65	23.98 ± 0.03d	25.34 ± 0.03c
C	0.99 ± 0.00	124.70 ± 0.26e	118.18 ± 0.03e	112.35 ± 0.03e	13.00 ± 2.65ab	17.00 ± 2.65ab	40.00 ± 2.65e	8.00 ± 2.65	25.33 ± 0.03a	26.04 ± 0.03b
D	0.99 ± 0.00	129.86± 0.03b	122.54 ± 0.03c	116.52 ± 0.03d	12.00 ± 2.65ab	8.00 ± 2.65c	200.00 ± 2.65a	6.00 ± 2.65	24.64 ± 0.03b	24.98 ± 0.03d
E	0.99 ± 0.00	127.93 ± 0.03e	122.89± 0.03b	126.40 ± 0.03b	11.00 ± 2.65ab	15.00 ± 2.65a	980.00 ± 2.65b	6.00 ± 2.65	22.88 ± 0.03e	23.44 ± 0.03e

Values are mean and standard deviation of three determinations
Values followed by different superscript in a column are significantly ($p \leq 0.05$) different from each other.

Table 2: Result of Pasting Properties of Flour Blends

Samples	Peak (RVU)	Trough (RVU)	Breakdown (RVU)	Final Viscosity (RVU)	Set Back (RVU)	Peak Time (mins)	Pasting Temperature (°C)
A	2089.50± 10.61^{a}	1285.00±18.38^{a}	804.50 ± 7.78^{a}	2624.50 ± 13.44^{a}	1339.50 ± 31.82^{a}	6.23 ± 0.05^{b}	88.00 ± 0.07^{e}
B	291.00 ± 9.90^{e}	206.00 ± 2.83^{d}	85.00 ± 7.07^{d}	537.00 ± 14.14^{d}	331.00 ±11.31^{d}	5.33 ± 0.09^{d}	93.68 ± 0.03^{c}
C	344.00 ± 4.24^{d}	221.50 ± 4.95^{d}	122.50 ± 0.71^{c}	624.50 ± 16.26^{c}	403.00 ± 11.31^{c}	5.60 ± 0.09^{c}	95.10 ± 0.21^{a}
D	530.50 ± 3.54^{c}	437.00 ± 1.41^{b}	93.50 ± 4.95^{d}	474.00 ± 5.66^{e}	37.00 ± 4.24^{e}	7.00 ± 0.00^{a}	94.52 ± 0.03^{b}
E	573.50 ± 3.54^{b}	339.00 ± 2.83^{c}	234.50 ± 6.36^{b}	946.00 ± 9.90^{b}	607.00 ± 7.07^{b}	5.30 ± 0.05^{d}	92.15 ± 0.00^{d}

Values are mean and standard deviation of two determinations
Values followed by different superscript in a column are significantly ($p \leq 0.05$) different from each other.

Key

A - Wheat flour cookies
B - Wheat/Golden melon seed's flour cookies
C - Wheat/Ben oil seed's flour cookies
D - Wheat/Pawpaw seed's flour cookies
E - Wheat/Watermelon seed's flour cookies

Table 3: The Result of Physical Properties of Cookies

Samples	Length (cm)	Breadth (cm)	Height (cm)	Thickness (cm)	Diameter (cm)	Weight (cm)	Spread Factor
A	3.89 ± 0.0^{e}	3.05 ± 0.01^{a}	0.82 ± 0.01^{c}	1.92 ± 0.01^{a}	3.74 ± 0.01^{e}	4.11 ± 0.01^{c}	19.38 ± 0.01^{e}
B	4.45 ± 0.01^{c}	3.54 ± 0.01^{a}	0.96 ± 0.01^{b}	1.75 ± 0.01^{b}	4.07 ± 0.01^{c}	4.09 ± 0.01^{d}	23.13 ± 0.01^{d}
C	4.77 ± 0.01^{a}	5.79 ± 0.00^{a}	0.77 ± 0.01^{d}	1.61 ± 0.01^{c}	4.22 ± 0.01^{b}	5.35 ± 0.01^{b}	26.46 ± 0.01^{b}
D	4.72 ± 0.01^{b}	3.83 ± 0.01^{a}	1.12 ± 0.01^{a}	1.91 ± 0.01^{a}	5.08 ± 0.01^{a}	5.37 ± 0.01^{a}	26.46 ± 0.01^{a}
E	4.37 ± 0.01^{d}	3.73 ± 0.01^{a}	0.31 ± 0.01^{e}	1.55 ± 0.01^{d}	3.95 ± 0.01^{d}	2.75 ± 0.01^{e}	25.13 ± 0.01^{c}

Values are mean and standard deviation of analysis
Values followed by different superscript in a column are significantly ($p \leq 0.05$) different from each other
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Table 4: The Result of Texture Profile

SAMPLE	Width (mm)	Force @ Peak (N)	Force @ Peak (N)	Force @ Yield (N)	Deformation @ Peak (mm)	Deformation @ Break (mm)	Deformation @ Yield (mm)
A	25.00 ± 0.00[a]	33.33 ± 8.33[a]	1.10 ± 0.96[b]	33.50 ± 8.41[a]	0.89 ± 0.32[b]	1.35 ± 0.32[c]	0.89 ± 0.32[a]
B	25.00 ± 0.00[a]	7.17 ± 2.86[c]	1.50 ± 1.30[ab]	4.47 ± 4.02[c]	1.31 ± 0.06[b]	2.57 ± 0.32[b]	0.68 ± 0.71[a]
C	40.00 ± 0.00[b]	3.97 ± 2.14[c]	0.80 ± 1.39[b]	1.07 ± 0.95[c]	3.98 ± 1.46[a]	7.36 ± 0.91[a]	0.27 ± 0.25[a]
D	25.00 ± 0.00[a]	29.13 ± 3.57[a]	0.00 ± 0.00[b]	29.13 ± 3.57[a]	0.86 ± 0.10[b]	1.24 ± 0.22[c]	0.86 ± 0.10[a]
E	25.00 ± 0.00[a]	19.23 ± 3.24[b]	3.23 ± 0.93[a]	17.00 ± 6.85[b]	1.01 ± 0.24[b]	1.67 ± 0.39[c]	0.77 ± 0.26[a]

Sample	Bending Strength @ Peak (Nmm^2)	Bending Strength @ Break (Nmm^2)	Bending Strength @ Yield (Nmm^2)	Bending Modulous (Nmm^2)	Energy to Peak (J)	Energy to Break (J)
A	0.50 ± 0.13[a]	0.02 ± 0.01[b]	0.50 ± 0.13[a]	8.75 ± 3.49[a]	0.01 ± 0.00[a]	0.01 ± 0.00[a]
B	0.11 ± 0.04[c]	0.02 ± 0.02[b]	0.07 ± 0.06[c]	0.56 ± 0.25[b]	0.01 ± 0.00[a]	0.01 ± 0.00[a]
C	0.01 ± 0.01[c]	0.00 ± 0.00[b]	0.00 ± 0.00[c]	0.02 ± 0.01[b]	0.01 ± 0.01[a]	0.02 ± 0.12[a]
D	0.43 ± 0.05[a]	0.00 ± 0.00[b]	0.43 ± 0.05[a]	7.39 ± 0.87[a]	0.01 ± 0.00[a]	0.01 ± 0.00[a]
E	0.28 ± 0.05[b]	0.05 ± 0.01[a]	0.25 ± 0.10[b]	2.57 ± 1.19[b]	0.01 ± 0.00[a]	0.02 ± 0.00[a]

Values are mean and standard deviation of triplicate determinations
Values followed by different superscript to a column are significantly ($p \leq 0.05$) different from each other

Keys:
A - Wheat flour cookies
B - Wheat/Golden melon seed's flour cookies
C - Wheat/Ben oil seed's flour cookies
D - Wheat/Pawpaw seed's flour cookies
E - Wheat/Watermelon seed's flour cookies

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Table 5: Result and Discussion on Proximate Composition of Cookies

SAMPLE	% Moisture	% Ash	% C. Fibre	% Protein	% Fat	% CHO
A	8.39 ± 0.06[d]	1.48 ± 0.03[d]	7.94 ± 0.04[e]	10.84 ± 0.03[c]	14.56 ± 0.03[d]	56.79 ± 0.03[a]
B	9.11 ± 0.05[b]	1.97 ± 0.03[b]	20.39 ± 0.03[b]	10.55 ± 0.04[d]	20.73 ± 0.03[b]	37.25 ± 0.03[e]
C	9.60 ± 0.06[a]	1.68 ± 0.03[c]	17.16 ± 0.06[d]	12.90 ± 0.14[a]	18.45 ± 0.03[c]	40.21 ± 0.03[d]
D	6.54 ± 0.04[e]	4.12 ± 0.03[a]	17.39 ± 0.03[c]	12.35 ± 0.03[b]	21.69 ± 0.03[a]	40.91 ± 0.03[c]
E	8.96 ± 0.04[c]	1.99 ± 0.03[b]	20.52 ± 0.03[a]	8.92 ± 0.03[e]	13.00 ± 0.03[e]	46.61 ± 0.03[b]

Table 6: Result of Mineral Composition of Cookies

SAMPLE	% Ca	% K	% Zn	% Mg	% Na	% Fe
A	0.10 ± 0.00[c]	0.22 ± 0.00[d]	9.50 ± 0.03[d]	0.11 ± 0.00[e]	0.43 ± 0.00[b]	37.00 ± 0.00[d]
B	0.11 ± 0.00[c]	0.32 ± 0.00[c]	23.00 ± 0.03[a]	0.22 ± 0.00[c]	0.43 ± 0.00[b]	30.50 ± 0.03[e]
C	0.10 ± 0.00[c]	0.19 ± 0.00[e]	8.50 ± 0.03[e]	0.12 ± 0.00[d]	0.26 ± 0.00[c]	43.00 ± 0.03[b]
D	0.39 ± 0.00[a]	0.78 ± 0.00[a]	21.50 ± 0.03[c]	0.24 ± 0.00[b]	0.45 ± 0.00[a]	39.00 ± 0.03[c]
E	0.12 ± 0.00[b]	0.39 ± 0.00[b]	22.50 ± 0.00[b]	1.19 ± 0.00[a]	0.43 ± 0.00[b]	46.00 ± 0.03[a]

Values are mean and standard deviation of triplicate determinations
Values followed by different superscript to a column are significantly ($p \leq 0.05$) different from each other
A - Wheat flour cookies
B - Wheat/Golden melon seed's flour cookies
C - Wheat/Ben oil seed's flour cookies
D - Wheat/Pawpaw seed's flour cookies
E - Wheat/Watermelon seed's flour cookies

Table 7: Result of Anti-nutrient and Phytochemicals

Sample	Oxalate (mg/g)	Cyanide (mg/g)	Saponin (mg/g)	Alkaloid (mg/g)	Phytic Acid (mg/g)	Flavonoid (mg/g)	Tannin (mg/g)
A	1.26 ± 0.03[d]	0.30 ± 0.00[d]	9.94 ± 0.03[e]	17.84 ± 0.03[d]	1.99 ± 0.03[c]	11.24 ± 0.03[e]	0.09 ± 0.00[d]
B	1.44 ± 0.03[b]	0.31 ± 0.00[c]	11.05 ± 0.03[a]	26.32 ± 0.03[b]	3.81 ± 0.03[a]	23.74 ± 0.03[a]	0.16 ± 0.00[c]
C	1.17 ± 0.03[e]	0.31 ± 0.00[c]	10.33 ± 0.03[d]	27.02 ± 0.03[a]	1.28 ± 0.03[e]	16.02 ± 0.03[d]	0.22 ± 0.00[a]
D	1.62 ± 0.03[a]	0.39 ± 0.00[a]	10.56 ± 0.03[c]	17.54 ± 0.03[e]	1.36 ± 0.03[d]	17.12 ± 0.03[e]	0.03 ± 0.00[e]
E	1.35 ± 0.23[c]	0.32 ± 0.00[b]	10.41 ± 0.03[b]	22.10 ± 0.03[c]	2.41 ± 0.03[b]	22.46 ± 0.03[b]	0.17 ± 0.00[b]

Values are mean and standard deviation of triplicate determinations
Values followed by different superscript to a column are significantly ($p \leq 0.05$) different from each other

Table 8: Result of Bacterial Load of Cookies (cfu/g)

Sample	WK 1	WK 2	WK 3	WK 4
A	Nil	0.65×10^5	1.25×10^6	1.8×10^6
B	1.31×10^5	2.74×10^5	1.95×10^6	4.49×10^6
C	2×10^5	3.12×10^5	2.79×10^6	1.28×10^6
D	4.12×10^5	5.88×10^5	4.12×10^6	6.18×10^6
E	0.43×10^5	1.28×10^5	2.10×10^6	3.15×10^6

A - Wheat Flour Cookies
B - Wheat/ golden melon seed's flour cookies
C - Wheat/ben oil seed's flour cookies
D - Wheat/ pawpaw seed's flour cookies
E - Wheat/watermelon seed's flour cookies

Table 9: Result of Fungal Count (cfu/g)

Sample	WK 1	WK 2	WK 3	WK 4
A	Nil	Nil	0.3×10^3	1.0×10^3
B	0.23×10^3	1.2×10^3	1.8×10^3	2.18×10^3
C	2.84×10^3	1.52×10^3	0.9×10^3	5.4×10^3
D	0.12×10^3	0.43×10^3	2.5×10^3	4.1×10^3
E	0.43×10^3	1.56×10^3	3.12×10^3	3.20×10^3

Table 10: Result of Sensory Evaluation of Cookies

Sample	Colour	Taste	Aroma	Crispness	Texture	Overall Acceptability
E	3.72±1.67[b]	4.04±1.19[c]	3.68±1.73[c]	4.28±1.70[c]	3.96±1.40[b]	3.84±1.40[c]
D	2.60±1.76[c]	3.60±1.68[d]	2.72±1.40[d]	4.40±1.47[c]	3.44±1.73[b]	3.20±1.66[cd]
C	4.20±1.12[b]	2.96±1.51[d]	3.56±1.66[c]	2.84±1.52[d]	3.44±1.76[b]	3.16±1.54[d]
B	6.00±0.96[a]	5.84±0.94[b]	5.60±1.29[b]	5.52±1.00[b]	5.88±0.93[a]	5.76±1.05[b]
A	6.60±0.58[a]	6.80±0.41[a]	6.52±0.59[a]	6.36±1.04[a]	6.52±0.59[a]	6.68±0.48[a]

Mean values in the same column with different superscripts are significantly different ($p<0.05$)

Sample
E = Wheat/watermelon seed flour cookies (50:50)
D = Wheat/pawpaw seed flour cookies (50:50)
C = Wheat/ben oil seed flour cookies (50:50)
B= Wheat/golden melon seed flour cookies (50:50)
A = Wheat flour (100:0)

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