Original Research Article

EFFECT OF CARROT POWDER ADDITION ON THE QUALITY ATTRIBUTES COOKIES PRODUCED FROM WHEAT AND SOY FLOUR BLENDS

Abstract

Aim: to evaluate effect of carrot powder addition on the quality attributes cookies produced from wheat and soy flour blends.

Study Design: Cookies were produced from wheat flour, soy flour and carrot powder composite blends. Functional (bulk density, foam capacity, oil absorption capacity, water absorption capacity and swelling index) properties, Proximate (crude protein, ash, moisture, crude fibre, crude fat, carbohydrate and energy value) composition, Physical (weight, diameter, thickness and spread ratio) and sensory (appearance, flavour, taste, texture and overall acceptability) attributes were determined.

Results: The functional properties showed that Bulk Density ranged from 0.82 – 0.92, Foam capacity ranged 3.92 – 5.00, Oil Absorption Capacity ranged from 0.60 – 0.97%, Water Absorption Capacity ranged from 1.05 – 1.45% and Swelling Index ranged from 2.37 – 2.75. Results of percentage proximate composition showed that moisture content ranged from 4.70 – 7.57, protein content ranged from 10.61 – 21.60, fat content ranged from 8.89 – 15.85, fibre content ranged from 1.39 – 4.30, ash content ranged from 0.70 – 1.23 and carbohydrate content ranged from 52.34 – 70.84. The physical properties showed that weight of the cookies ranged from 17.85 – 21.60, diameter ranged from 57.50 – 60.50, thickness ranged from 20.50 – 24.00 and spread ratio ranged from 2.40 – 2.91. The sensory attribute showed that cookies produced from wheat flour, soy flour and carrot powder compared well with cookies produced with wheat flour. The wheat flour cookie sample (A) was most preferred by the panellist.

Conclusion

The functional properties of the composite flour produced from wheat, soybean and carrot powder show potential quality that when properly harnessed could be used for the production of baked product like biscuits, pastry etc. The proximate composition shows that the composite flour cookies were the most preferred sample to the 100% wheat flour cookies. This is due to its high protein, fat, ash and fibre content to that of thee 100% wheat cookies. However, in terms of proximate composition, the composite cookies were most acceptable. The physical property of the cookies indicates that the composite flour cookies were most preferred to the 100% wheat cookie. This could be seen from the high values it's had in weight, diameter and spread ratio. However, the sensory score of the overall acceptability shows that the 100% wheat cookies were most acceptable. Though, the composite flour cookies compete very closely with 100% wheat cookies

Keywords: wheat, Soy flour, carrot powder and cookie

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Sevindik M, Akgul H, Pehlivan M, Selamoglu Z (2017). Determination of therapeutic potential of Mentha longifolia ssp. longifolia. Fresen Environ Bull. 26: 4757-4763.

INTRODUCTION

Cookies are consumed all over the world as a snack food. In developing countries where protein and calories malnutrition are prevalent particularly, cookies are consumed on a large scale amongst women and children (Chinma and Gernah, 2007). Cookies and other bakery products have now become cherished fast food products for every age-group, because they are easy to carry about, tasty to eat, cholesterol-free, contains digestive and dietary principles of vital importance and reasonably cheap (Peter *et al,* 2017). With the increased advocacy on the consumption of functional foods by World nutrition bodies due to different health problems related with food consumption, the food industries are therefore faced with the challenges of producing food products containing functional ingredients in order to meet the nutritional requirements of consumers (Chinma and Gernah, 2007 ;Yusuf and Akhigbe, 2014; Sevindik et al, 2017). Cookies can be made from hard dough, hard sweet dough or soft dough. Cookies are characterized by their high sugar and shortening content but low in water. They differ from other baked foods like bread and cakes because they have low moisture content, making them comparatively free from microbial spoilage and having long shelf (Hanan, 2013). The main ingredients of cookies are wheat flour, fat (margarine), sugar and water, while other ingredients such as milk, salt, aerating agent, emulsifier, flavor and colour can be included. They can also be enriched or fortified with other ingredients in order to meet specific nutritional or therapeutic needs of consumers. Flour used in making cookies is basically from wheat or composite flour which forms the basic ingredients of bakery products (Peter *et al,* 2017). In Nigeria, reliance on wheat flour in the pastry and bakery industries has over the years restricted the use of other cereals and tuber crops available to domestic use.

In recent years, government has through intensive collaboration with research institutes encouraged the use of composite flours in the production of bread and related food products such as biscuit. This initiative has enhanced the use of flours from cassava, sweet potato, bread-fruit, plantains and other under-utilized crops that are good sources of flour. The adoption of these locally produced flours in the bakery industry will increase the utilization of indigenous crops cultivated in Nigeria and also lower the cost of bakery products (Racheal *et al*, 2016). Fruits such as carrots, orange etc are mostly known and accepted as an excellent source of nutrients such as minerals, vitamins and also contain carbohydrates in form of soluble sugar, cellulose and starch. Fruits form a vital portion of an adequate diet and also serve as food supplement and appetizer. Carrot (Daucus carota) is one of the important nutritious root vegetables grown throughout the world. It is usually orange in colour, though purple, red, white and yellow varieties exist. It is an excellent source of phytonutrients such as phonols, polyacetylenes and carotenoids. Carotenoids are potential antioxidants which help to neutralize the effect of free radicals. Reports have shown that they have inhibitory mutagenesis activity thus, contributing to decrease risk of some cancer. They are grown in different part of Nigeria. Due to postharvest losses, it is very important to process carrot into powder and use as blends in food (Dias, 2012a).

Wheat is a good source of calories and other nutrient but it has low protein content compared to milk, soybean and pea-nut as it is deficient in essential amino acids such as lysine and threonine (Jideani and Onwubali, 2009). The enrichment of baked products and other cereals based confections with legume flours particularly in regions where protein utilization is inadequate has long been recognized. This is because legumes are nutritionally rich in proteins and high in minerals, vitamin B and lysine which are an essential limiting amino acid in most cereal (Jideani and Onwubali, 2009). Soybean is one of the most important oil and protein crops of the world. It contains 30 to 45% protein with a good source of amino acids. It is also rich in calcium, phosphorus and vitamin A, B, C and D (Islam, 2007 and Serrem, 2011). The use of wheat, soy flour and carrot powder blends in the production of cookies was to enhance its protein and vitamin content. The over dependence and high cost of wheat flour in the production of bakery products tends to drain the foreign exchange of countries that don't cultivate wheat thus, production of cookies from composite flour of wheat, soy flour and carrot powder will help to reduce excess importation of wheat flour. The objective of this study therefore was to evaluate the effect of carrot powder addition on the quality characteristics of cookies produced from wheat and soy flour composite blends.

MATERIALS AND METHODS

Wheat flour (Golden Penny, flourmill of Nigeria Ltd) and other raw materials such as soybeans, Carrots, milk powder, eggs and Margarine were purchased from *Wadata* market, Makurdi in Benue State, Nigeria.

Preparation of soybean into flour

Soy flour was prepared according to the method described by Bolarinwa *et al,* (2015) as shown in fig 1. The soybeans were thoroughly cleaned to remove unwanted and extraneous materials. It was then washed and blanched in hot water at100^{0}C for 15 mins. The water was drained and the soybean dehulled by hand washing to remove chaff and then sun dried. After drying, soybeans were toasted in the oven at 120^{0}C for 10 mins. The toasted soybean was milled and sieved through a 250 µm, packaged and stored at 10 ^{0}C.

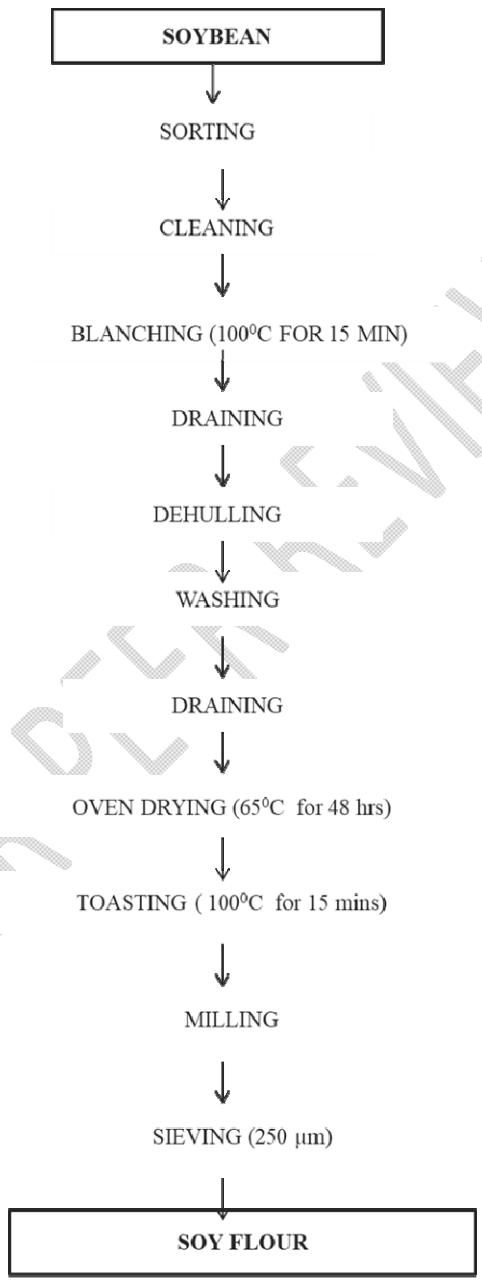

Fig 1: Flow chart for the production of soy flour
Source: Modified Bolarinwa *et al*, (2015)

Preparation of carrots into powder

The method as described by Marvin, (2009) as shown in fig 2 was used to produced carrot powder. The carrots were washed in water, scraped and sliced into 56mm thickness. The sliced carrots were subsequently blanched in hot water containing 2% sodium metabisulphite for 2 mins to prevent decolouration. The blanched carrots were then oven dried at 65^0C for 48 hrs. The dried carrots were then milled into powder, packaged and stored at 10^0C.

Production of cookies

Different samples of cookies were produced using the blend formulation and recipe as presented in tables 1 and 2 respectively. The flowchart for cookies is shown in fig 3.

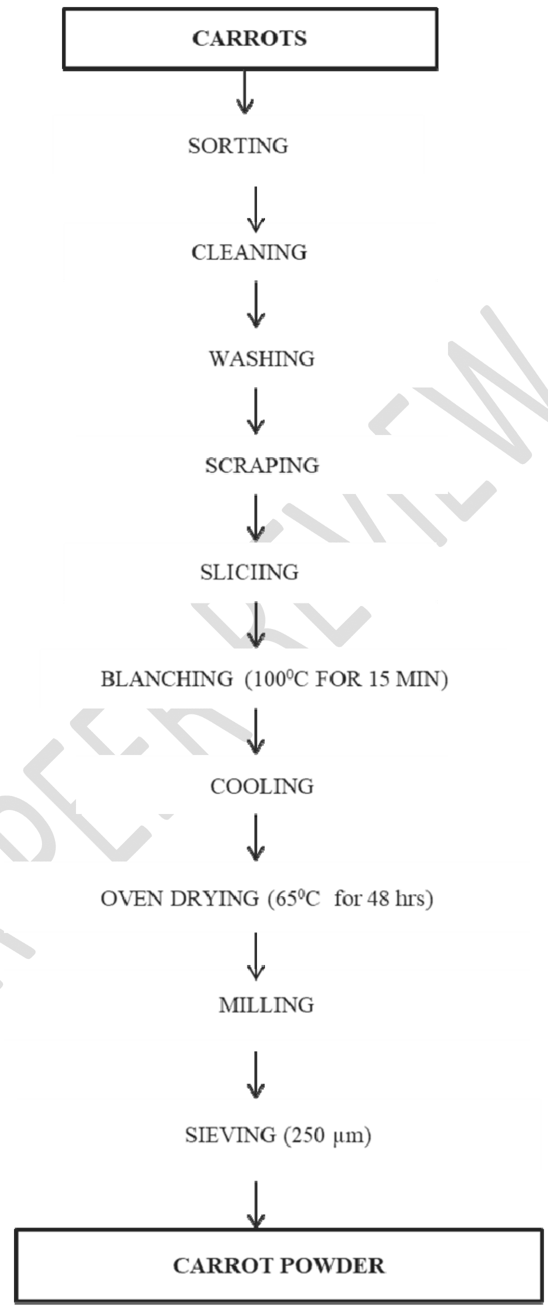

Fig 2: Flow chart for the production Carrot powder
Source: Modified method of Marvin, (2009)

Table 1: Blend formulation

Sample code	Wheat Flour	Soy Flour	Carrot Powder
A	100	0	0
B	80	10	10
C	70	20	10
D	60	30	10
E	50	40	10

Table 2: Recipe formulation for cookies production

Ingredient (%)	A	B	C	D	E
Wheat flour (g)	100	80	70	60	50
Soy flour (g)	0	10	20	30	40
Carrot powder (g)	0	10	10	10	10
Salt (g)	0.4	0.4	0.4	0.4	0.4
Sugar (g)	40	40	40	40	40
Butter (g)	50	50	50	50	50
Egg	9.1	9.1	9.1	9.1	9.1
Baking Powder (g)	2	2	2	2	2

Source: Modified Islam *et al*, (2011)

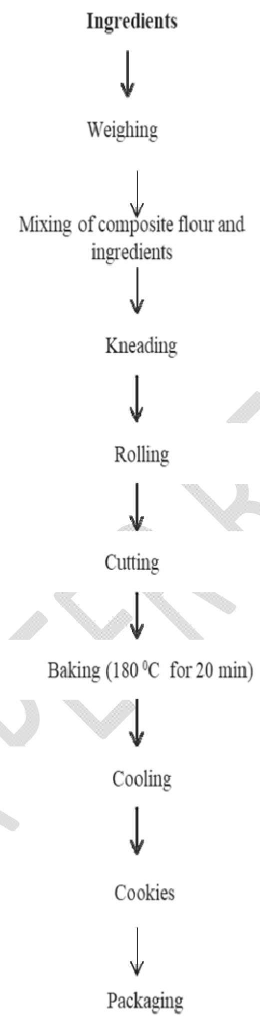

Fig 3: Flow chart for the production cookies
Source: Modified Marvin, (2009)

Determination of Moisture Content

Moisture content was determined by the air-oven method as described by Dendegh *et al, (*2019). Two grams of the sample was weighed in duplicate into Petri dishes of know weight and covered immediately. These were transferred into oven, uncovered and heated at 105°C ± 2 for 5 hours. The samples were then removed from the oven and placed in the desiccators to cool for 15 minutes before weighing. The process was repeated until constant weights were recorded. The loss in weight from the original weight was reported as the moisture content.

$$\%\,Moisture\ Content = \frac{\mathrm{W2} - \mathrm{W3}}{\mathrm{W2} - \mathrm{W1}}\ \mathrm{X}\ 100$$

Determination of Crude Protein Content

Crude protein of the cookies was determined using the Kjedahl method according to Dendegh *et al, (*2019). One gram of the sample was introduced into the digestion flask. Kjedahl catalyst (Selenium Tablets) was added to the sample. 20 **ml** mL of concentrated tetraoxosulphate (vi) acid was added to the sample and fixed to the digester for eight hours until a clear solution was obtained. The cooled digest was transferred into 100 **ml** mL volumetric flask and made up to the mark with distilled water. The distillation apparatus was set and rinsed for ten minutes after boiling. 20 **ml** mL of 4% boric acid were pipetted into conical flask. Five drops of methyl red was added to the flask as indicator and the sample was diluted with 75 **ml** mL distilled water. Ten mils of the digest was made alkaline with 20 **ml** Ml of NaOH (20%) and distilled. The steam exit of the distillatory was closed and the change of color of boric acid solution to green was timed. The mixture was distilled for fifteen minutes. The filtrate was then titrated against 0.1 N HCL. The percentage total was calculated:

$$\%\,Nitrogen = \frac{(\mathrm{titre} - blank)x\ 0.04\ x\ \%\ Normality}{\mathrm{Weight}}\ \mathrm{X}\ 100$$

$$\%\,protein = 6.25\ \mathrm{X}\ \%\ \mathrm{Nitrogen}$$

Determination of crude fat content

The fat content of the flour samples were determined using solvent extraction in a soxhlet apparatus as described by Dendegh *et al,* (2019). Two grams of each of the flour samples were wrapped in a filter paper and placed in a soxhlet reflux flask which is connected to a condenser on the upper side and to a weighed oil extraction flask full with 200 ml petroleum ether. The ether was brought to its boiling point, the vapour condensed into the reflux flask immersing the samples completely for extraction to take place on filling up the reflux flask siphons over carrying the oil extract back to the boiling solvent in the flask. The process of boiling, condensation, and reflux was allowed to process for 4 hr before the defatted samples were removed. The oil extract in the flux was dried in the oven at 60˚C for 30 min and then weighed.

$$\%\,Fat\ Content = \frac{\mathrm{W4} - \mathrm{W3}}{\mathrm{W2} - \mathrm{W1}}\ X\ 100$$

Determination of Crude Fibre content

The crude fibres of the cookies were determined according to the method described by Dendegh *et al,* (2019). Two grams of each of the samples were boiled under reflux for thirty minutes with 200 **ml** mL of solution containing 1.25 g of H_2SO_4 per 100 ml of solution. The solution was filtered through linen on a flaunted funnel and washed with water until the washing is no longer acidic. The residue was then transferred to a beaker and boiled for thirty minutes with **100ml** 100mL of solution. The final residue was filtered through a thin—but—closer pad of washed and ignited asbestos in a Gosh crucible. The residue was then dried in an electric oven and weighed; the residue was incinerated, cooled, and weighed.

$$\% \, Crude \, Fibre = \frac{\mathrm{W2} - \mathrm{W3}}{\mathrm{W1}} \, X \, 100$$

Determination of Ash Content

The ash content was determined using the method as described by Dendegh *et al*, (2019). Porcelain crucible were dried and cooled in desiccators before weighing. Two grams of the sample flours were weighed into the crucible and the weight taken. The crucible containing the samples were placed into the muffle furnace and ignited at 550˚C. This temperature was maintained for three hours. The muffle furnace was then allowed to cool; the crucibles were then brought out, cooled and weighed. The ash content was calculated as follows:

$$\% \, Ash \, Content = \frac{\mathrm{W2} - \mathrm{W1}}{\mathrm{Weight \; of \; sample}} \, \mathrm{X} \, 100$$

Carbohydrate Content Determination

Carbohydrate content of the flour samples was determined using the formula described by Ihekoronye and Ngoddy, (1985).

% carbohydrate =100 −%(protein + fat + fibre + ash +moisture content.)

FUNCTIONAL PROPERTIES

Swelling index

One gram of the sample was weighed into a conical flask. It was hydrated with 15 **ml** mL distilled water, shaken for 5 min with mechanical shaker at low speed. Heating was done for 40 min at 80-85°C with constant stirring in a water bath. The content was transferred into a clean, dried and pre-weighed centrifuge tube. Distilled water of 7.5 **mil** mL was added and centrifuged at 2200 rpm for 20 min. The supernatant was decanted into a pre-weighed can and dried at 100 °C to a constant weight. The sediment was weighed in the centrifuge. Swelling power and solubility were calculated viz:

$$Sweling \, Index = \frac{\mathrm{Weight \; of \; sediment}}{\mathrm{Weight \; of \; flour} - \mathrm{Weight \; of \; dried \; supernatant}}$$

Bulk density

Fifty gram flour sample was put into a 100 **ml** mL measuring cylinder. The cylinder was tapped several times on a laboratory bench to a contant volume. The volume of sample was recorded.

$$\mathrm{Bulk \; density \; (g/cm\,)} = \frac{\mathrm{weight \; of \; sample \; (g)}}{\mathrm{Volume \; of \; sample \; after \; tapping}}$$

Water absorption capacity

Fifteen millitres of distilled water was added to 1 g of the flour in a weighed 25 **ml** mL centrifuge tube. The tube was agitated on a vortex mixer for 2 min. It was centrifuged at 4000 rpm for 20 min. The clear supernatant was decanted and discarded **and reweighed**and reweighed. Water absorption capacity was expressed as the weight of water bound by 100 g dried flour.

$$Water\ Absorption\ Capacity\ g/ml = \frac{\text{Weight of wet sediment}}{\text{Dry weight of flour}}$$

Oil absorption capacity

Ten millitre refined corn oil was added to 1 g of the flour in a weighed 25 or 80 **ml** mL centrifuge tube. The tube was agitated on a vertex mixer for 2 min. It was centrifuged at 4000 rpm for 20 min. The volume of free oil was recorded and decanted. oil absorption capacity is expressed as value of oil bound by 100 g dried flour.

$$Oil\ Absorption\ Capacity \frac{g}{ml} = \frac{\text{Weight of wet sediment}}{\text{Dry weight of flour}}$$

Foam Capacity

This was carried out as described by Dendegh *et al, (*2019). One gram of flour sample was added to 50 **ml** mL distilled water at 30^0C in a graduated cylinder. The suspension was mixed and shaken for 5 min to foam. The volume of foam at 30 sec after whipping was expressed as foam capacity using the formula.

$$Foam\ Capacity = \frac{\text{Volume after whipping} - \text{Volume before x 100}}{\text{Volume before whipping}}$$

Sensory Evaluation

Sensory evaluation was conducted by 20 trained panellists Department of Food Science and Technology, University of Agriculture, Makurdi who were familiar with cookies. The panellists were trained in ten sessions until the panellists' were familiar with the range of characteristic intensities required for the study. They were provided with clean water to rinse their mouth after tasting each sample. Assessment was by 9 - point hedonic scale for appearance, flavour, taste, texture and general acceptability where 9 represent like extremely and 1 represents dislike extremely

Statistical Analyses

All analyses were carried out in triplicate unless otherwise stated. Statistical significance was established using one-way analysis of variance (ANOVA), and data were reported as the mean ± standard deviation. Mean comparison and separation was done using Fisher's Least Significant Difference test (LSD) at ($P< 0.05$). Statistical analysis was carried out using the SPSS 21 statistical package.

Results

Table 3: Functional Properties of Cookies Produced from Wheat, Soy flour and Carrot Powder

Samples	Bulk Density (g/ml)	Foam capacity (ml)	Oil Absorption Capacity (%)	Water Absorption Capacity (%)	Swelling Index
A	0.92 ± 0.02^{a}	5.00 ± 1.41^{a}	0.88 ± 0.06^{a}	1.25 ± 0.07^{b}	2.75 ± 0.11^{a}
B	0.86 ± 0.01^{b}	3.92 ± 0.00^{a}	0.60 ± 0.02^{b}	1.05 ± 0.07^{c}	2.37 ± 0.10^{ab}
C	0.82 ± 0.01^{b}	4.00 ± 0.00^{a}	0.60 ± 0.02^{c}	1.35 ± 0.07^{a}	2.50 ± 0.09^{b}
D	0.83 ± 0.01^{b}	4.90 ± 1.39^{a}	0.79 ± 0.06^{c}	1.45 ± 0.07^{a}	2.55 ± 0.10^{ab}
E	0.84 ± 0.01^{b}	5.00 ± 1.41^{a}	0.97 ± 0.06^{a}	1.45 ± 0.07^{a}	2.75 ± 0.11^{a}

Values with different superscript within the same column are significantly ($p<0.05$) different.

Key:

A = 100 % wheat flour

B = 80% wheat flour, 10% soy flour and 10% carrot powder

C = 70% wheat flour, 20% soy flour and 10% carrot powder

D = 60% wheat flour, 30% soy flour and 10% carrot powder

E = 50% wheat flour, 40% soy flour and 10% carrot powder

Table 4: Proximate Composition of Cookies Produced From Wheat, Soy Flours and Carrot Powder.

	Parameters					
Samples	**Moisture**	**Protein**	**Fat**	**Fibre**	**Ash**	**Carbohydrate**
A	7.57 ± 0.01^{a}	10.61 ± 0.01^{a}	8.89 ± 0.01^{e}	1.39 ± 0.01^{e}	0.70 ± 0.01^{e}	70.84 ± 0.01^{a}
B	6.87 ± 0.01^{b}	11.84 ± 0.01^{d}	9.86 ± 0.02^{d}	1.54 ± 0.0^{d}	0.97 ± 0.01^{d}	68.93 ± 0.01^{b}
C	6.23 ± 0.02^{c}	13.34 ± 0.02^{c}	10.31 ± 0.03^{c}	1.71 ± 0.03^{c}	1.04 ± 0.02^{c}	67.39 ± 0.02^{c}
D	5.76 ± 0.04^{d}	18.32 ± 0.03^{b}	13.38 ± 0.10^{b}	2.24 ± 0.02^{b}	1.12 ± 0.02^{b}	59.79 ± 0.03^{d}
E	5.70 ± 0.01^{e}	21.60 ± 0.02^{a}	15.85 ± 0.01^{a}	2.40 ± 0.01^{a}	1.23 ± 0.01^{a}	54.44 ± 0.02^{e}

Values with different superscript within the same column are significantly ($p<0.05$) different.

Key:

A = 100 % wheat flour

B = 80% wheat flour, 10% soy flour and 10% carrot powder

C = 70% wheat flour, 20% soy flour and 10% carrot powder

D = 60% wheat flour, 30% soy flour and 10% carrot powder

E = 50% wheat flour, 40% soy flour and 10% carrot powder

Table 5: Physical Properties of Cookies Produced from Wheat, Soy flour and Carrot Powder

	Parameters			
Samples	**Weight (g)**	**Diameter (mm)**	**Thickness (mm)**	**Spread Ratio**
A	17.85±0.642^{b}	57.50±2.12^{b}	24.00±0.00^{a}	2.40±0.09^{b}
B	20.55±1.91^{ab}	61.50±0.71^{a}	22.50±0.71^{abc}	2.74±0.12ab^{c}
C	21.20±1.41^{ab}	60.50±0.71^{ab}	23.00±1.41^{ab}	2.64±0.19^{ab}
D	20.55±1.34^{ab}	60.50±2.12^{ab}	21.50±0.71^{bc}	2.82±0.19^{a}
E	21.60±0.57^{a}	59.5001.71^{ab}	20.50±0.71^{c}	2.91±0.06^{a}

Values with different superscript within the same column are significantly ($p<0.05$) different.

Key:

A = 100 % wheat flour B = 80% wheat flour, 10% soy flour and 10% carrot powder

C = 70% wheat flour, 20% soy flour and 10% carrot powder

D = 60% wheat flour, 30% soy flour and 10% carrot powder

E = 50% wheat flour, 40% soy flour and 10% carrot powder

Table 6: Sensory Scores of cookies produced from wheat, soy flours and carrot powder.

Samples	Appearance	Flavour	Taste	Texture	General acceptability
A	8.47^{a}	8.20^{a}	8.27^{a}	7.73^{a}	8.47^{a}
B	7.33^{b}	7.27^{b}	7.00^{b}	7.33^{ab}	7.47^{b}
C	6.87^{b}	6.47^{b}	6.20^{c}	6.60^{bc}	6.87^{bc}
D	7.00^{b}	6.80^{b}	6.67^{bc}	6.47^{c}	6.60^{bc}
E	$6.i47^{b}$	6.53^{b}	6.00^{c}	6.20^{c}	6.20^{c}

Values with different superscript within the same column are significantly ($p<0.05$) different.

Key: A = 100 % wheat flour B = 80% wheat flour, 10% soy flour and 10% carrot powder

C = 70% wheat flour, 20% soy flour and 10% carrot powder

D = 60% wheat flour, 30% soy flour and 10% carrot powder

E = 50% wheat flour, 40% soy flour and 10% carrot powder

DISCUSSION

Functional Properties of Wheat Flour, Soy Flour and Carrot Powder Blends

Bulk density

Table 3 shows the functional properties of wheat flour; soy flour and carrot powder composite blends. The bulk density of the composite flour ranges from 0.82 (sample C) to 0.92 (sample A). The bulk densities of the blends tend to decrease with increase in substitution level of soy flour and carrot powder. The 100% wheat flour had the highest bulk density 0.92 while sample C had the lowest 0.82. The result of the study agrees with those presented by Abayomi *et al,* (2013).

Foaming capacity

The foaming capacity increased as the percentage soy flour and carrot powder increased. This increase in foam capacity could be associated with the starch and protein content respectively of the flour. 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, fudges, *akara* and also act as functional agents in other food formulations (El-Adawy, 2001).

Oil Absorption Capacity

The oil absorption capacity values for the samples as presented in table 3 increased from 0.60 in samples B and C to 0.97 in sample E. This shows that the increase in addition of Carrot powder to wheat may have possibly increased the oil absorption capacity of the flours. The possible reason for increase in the OAC of composite flours after incorporation of the other flours is the variations in the presence of non-polar side chain, which might bind the hydrocarbon side chain of the oil among the flours. Similar findings were observed by (Dendegh *et al,* 2019). However, the flours in the present study are potentially useful in structural interaction in food especially in flavour retention, improvement of palatability and extension of shelf life particularly in bakery or meat products where fat absorption is desired (Dendegh *et al,* 2019). There were significant ($P \leq 0.05$) differences amongst the samples. It could be attributed that the higher the oil absorption capacity of a flour sample, the better the cooking quality. Absorption of oil by food products improves mouth feel and flavour retention. Oil retention also improves the quality of cookies because oil contributes to the soft texture of cookies (Peter *et al,* 2017)

Water Absorption Capacity

The water absorption capacity of the composite flours is given in Table 3. The WAC ranged between 1.05 in composite sample B to 1.45 in composite flour sample C and D. The WAC was observed highest in C and D (1.45) and lowest in B (1.05). The result suggests that addition of soy flour and carrot powder to wheat flour increased the amount of water absorption. The increase in water absorption values observed and substitution with increased soy flour and carrot powder could be due to the high protein content of the soy flour. Madu (2007) stated that water absorption capacity enables bakers to add more water to dough and so improve handling characteristics and maintain freshness of the baked products. Also water absorption capacity is the ability of protein in a product to associate and retain water which increases water absorption capacity with increased protein content (Peter *et al*, 2017). The addition of soy flour to whole wheat flour increased the protein content and significantly increased the water absorption capacity of the different flour ratios used in this work, thereby making the dough handling very difficult. There were significant ($P \leq 0.05$) differences in water absorption capacity values of the flour blends. High WAC of composite flours suggests that the flours can be used in formulation of some foods such as sausage, dough and bakery products. The increase in the WAC has always been associated with increase in the amylose leaching and solubility, and loss of starch crystalline structure. The flour with high water absorption may have more hydrophilic constituents such as polysaccharides. Protein has both hydrophilic and hydrophobic nature and therefore they can interact with water in foods.

Swelling Index

The swelling capacity of samples ranged between 2.37 (sample C) to 2.75 (sample A and E). The swelling capacity of flours depends on size of particles, types of variety and types of processing methods and/or unit operations. Suresh et al., (2015) reported that the flour of parboiled rice has more swelling capacity as compared to raw rice. They also reported that the Swelling capacity of composite flours increased with increase in the level of incorporation and decreased with level of wheat flour addition. It is explicit that the swelling capacity of composite flours is highly affected by the level of soy flour and carrot powder, because soy flour is rich in protein and starch content.

Proximate Composite of Cookies Produced from Wheat flour, Soy Flour and Carrot Powder

The results for the proximate composition of cookies produced from wheat flour, soy flour and carrot powder are shown in Table 4. The value shows that the moisture content of the cookies ranged from 4.70 – 7.57% with sample E (4.70%) having the least moisture as compared to sample A (7.57%). The composite cookie were significantly ($p<0.05$) different amongst itself and also with the 100% wheat flour cookie. Though, the percentage moisture content decreases as the percentage of soy flour increases. There were significant ($P \leq 0.05$) difference in the moisture contents of all the cookies. The percentage protein content increased from (10.61 – 21.60%) with increase in soy flour addition. The increase in protein was as a result of the increased soy flour addition in the composite flour blends. Proteins are building blocks of the body and foods that are rich in protein are known to reduce protein energy malnutrition. The protein content shows significant ($p<0.05$) difference in all the samples and increase with increase in soy flour addition. The fat content of the samples was found to range from 8.89 to 15.85% with sample E (15.85%) having the highest significant ($P<0.05$) value than others. This is as a result of the high soy (50%) flour content in the sample. Sample A and B with low Fat content could be as a result of low amount of soy flour addition. The crude fibre content of the composite cookies tends to be higher than the 100% wheat. Crude fibre content of the composite cookies increased as a result of carrot powder inclusion which may have had a pronounced effect on dough properties, yielding higher water absorption, mixing tolerance and tenacity, small extensibility in comparison with those obtained without fibre addition (Elluech *et al*, 2011)]. An increase in the fibre content of cookies has some beneficial effect on the muscles of the large and small intestines. The Ash content of the composite cookies was higher than the 100% wheat. The increase in ash content could be due to increase in soy flour and carrot powder as reported by Eduardo, (2015). Ash content is an indication of mineral content; hence samples with higher ash content are expected to have a relatively higher mineral content. The values of ash content recorded for the wheat and cassava fours were in line with the values reported by Olapade and Adeyemo, (2010). Carbohydrate content of the samples was found to range from 52.34 to 70.84% with sample A having the highest significance ($P<0.05$) value. The high value of carbohydrate in sample A could be as a result of wheat flour. Carbohydrate is required in infant diet for energy during growth. The results in table 4 show that carbohydrate decreases as the amount of soy flour increased. This could be attributed to the diluting ability of the soy flour on the starch content of wheat flour.

Physical Properties of Cookies Produced from Wheat, Soy Flours and Carrot Powder

Weight

There were significant ($p<0.05$) difference in terms of weight between cookies produced from 100% (A) wheat flour and composite (B, C, D and E). This could be attributed to increased soy flour and carrot powder addition. It was also observed that composite flour cookies produced were not significantly ($p<0.05$) different in weight. However, an increase in weight was observed amongst the composite cookies produced than 100% wheat cookie. The result obtain from this study tends to agree with those reported by Chinma and Gernah, (2007)

Diameter

The diameter of the cookies ranged between 57.50 to 61.50 mm. The diameter of sample A was significantly ($P<0.05$) different from those of the composite (B, C, D and E) cookies. The diameter of cookies obtained from soy flour and carrot powder incorporation decreased from 61.50 mm in sample B to 59.50 mm in sample E. The result agrees with those reported by (Peter *et al*, 2017).

Thickness

The cookies thickness ranged from 20.50 mm to 24.00 mm. The 100% wheat cookies has the highest thickness and the least thickness was recorded in composite cookie sample E. The less thin the cookies the lesser its ability to withstand stress.

Spread Ratio

The result of the spread ratio shows that, sample E and D had the highest value while the 100% wheat cookie had the least. The result agrees with Olapade and Adeyemo, (2014) and Peter *et al,* (2017) who reported that, the Spread ratio is an indication of ability of the cookie to raise, hence the lower the value the better the ability. It has been suggested that cookie spread (diameter and height) is affected by the competition of ingredients for available water (Yusuf and Akhigbe, 2014). The results obtained from this study were similar to the findings reported by Mridula *et al.,* (2007) for wheat/sorghum composite biscuits. Peter *et al,* (2017) and Handa *et al.,* (2012) also reported that Cookie spread represents a ratio of diameter to thickness. Cookies having higher spread ratio are considered most desirable. Also, larger cookie diameter and higher spread ratio are considered as the desirable quality attributes in cookies. Spread ratios of cookies prepared with soy flour and carrot powder were observed to increase (Peter *et al,* 2017).

Sensory Scores of Cookies Produced from Wheat Flour, Soy Flour and Carrot Powder

The mean sensory scores of cookies produced from wheat flour, soy flour and carrot powder are presented in Table 6. The brown appearance resulting from Maillard reaction is always associated with baked goods. The composite flour cookies were significantly ($p<0.05$) different in terms of appearance. The appearance of the whole wheat cookie was superior to those of the composite flour cookies. In terms of Appearance, sample A was most preferred sample.

Flavour is important attribute in sensory evaluation due its ability to put off or bring customers to buy such products. The scores for flavour in the study show that sample A (100% wheat flour) was most preferred to the composite flour cookie. The score for sample A was 8.27 which was higher than that scored by the composite cookies samples.

Taste is an important sensory attribute of any food because of its influence on acceptability of any product which has the highest impact as far as market success of product is concerned. The preferences for taste of the samples also showed a decrease in increasing substitution of soybean (Olapade and Adeyemo, 2014) and (Abayomi *et al,* 2013). The taste scores of cookies produced ranged from 6.00 to 8.27. Except for the cookies from sample A, there were no significant ($p>0.05$) differences among the cookie samples produced from composite flour. Sample A sensory score shows the highest (8.27) for taste, followed by cookies from sample B (7.00). Sample A was most preferred in terms of Taste.

There were significant ($p<0.05$) differences in the texture among the samples. An increase in the substitution levels of soy flour and carrot powder resulted in a decrease in texture scores. Cookie produced from composite flour scored least in terms of texture while whole wheat cookies had the highest score of 7.73. The scores for texture decreased with increase in the amount of soy flour and carrot powder blend which may be attributed to the high fat absorption capacity of soy flour. The texture sensory scores show that sample A was most preferred sample. The observations in the present study were agreement with the findings of Olapade and Adeyemo, (2014), who studied the effect of soy flour on the functional properties and the potential of soybean and cassava flour blends in cookie production. Cookie from sample A was significantly ($p<0.05$) different from the composite flour cookies in overall acceptability and was most preferred sample to the composite flour cookies. This was followed by sample B of the composite cookie.

Conclusion

The functional properties of the composite flour produced from wheat, soybean and carrot powder show potential quality that when properly harness could be used for the production of baked product like biscuits, pastry etc. The proximate composition shows that the composite flour cookies were the most preferred sample to the 100% wheat flour cookies. This is due to its high protein, fat, ash and fibre content to that of thee 100% wheat cookies. The physical property of the cookies indicates that the composite flour cookies were most preferred to the 100% wheat cookie. This could be seen from the high values it's had in weight, diameter and spread ratio. However, the sensory score of the overall acceptability shows that the 100% wheat cookies were most acceptable. Though, the composite flour cookies compete very closely with 100% wheat cookies

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