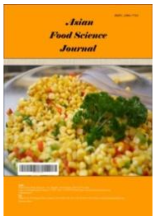

Asian Food Science Journal

20(2): 1-11, 2021; Article no.AFSJ.65273
ISSN: 2581-7752

Physical Characteristics and Mineral Composition of Bread Produced from Blends of Wheat and Defatted/Undefatted Cashew Kernel Flours

Barber, Lucretia Ifeoma[1*], Emelike, Nkechi Juliet T.[1] and Deebom Maureen Dumlebabari[1]

[1]Department of Food Science and Technology, Rivers State University, Nkpolu Oroworukwo, Port Harcourt, Rivers State, Nigeria.

Authors' contributions

This work was carried out in collaboration among all authors. Authors BLI and ENJT designed the study. Author ENJT performed the statistical analysis and wrote the protocol. Author BLI wrote the first draft of the manuscript. Author DMD managed the analyses of the study and the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AFSJ/2021/v20i230259
Editor(s):
(1) Dr. Vijaya Khader, Acharya N. G. Ranga Agricultural University, India.
Reviewers:
(1) Manisha Mathur, Post Graduate Institute Veterinary Education Research, India.
(2) Peter Chikezie Ayogu, Enugu State University of Science and Technology, Nigeria.
Complete Peer review History: http://www.sdiarticle4.com/review-history/65273

Original Research Article

Received 01 December 2020
Accepted 05 February 2021
Published 24 February 2021

ABSTRACT

The present study was aimed at assessing the physical characteristics and mineral composition of breads produced from blends of wheat-defatted/undefatted cashew kernel flours. Cashew kernel was processed into flour and thereafter divided into two portions. One portion was left undefatted while the other portion was defatted using a hydraulic press. Bread was prepared from the blends of wheat and defatted/undefatted cashew kernel flours using 90:10, 80:20, 70:30, of wheat flour to defatted cashew kernel flour (DCF) and wheat flour to undefatted cashew kernel flour (UCF), respectively and 100% wheat flour as control. Mineral composition and physical characteristics of the composite breads was determined using standard methods. The study revealed a significant ($p<0.05$) increase in the calcium (12.21-24.60 mg/100 g), iron (1.08-5.13 mg/100 g), potassium (4.13-19.63 mg/100 g), sodium (0.27-0.55 mg/100 g), zinc (0.05-2.25 mg/100 g) and magnesium (4.29-23.72mg/100g) contents as the proportion of defatted and undefatted cashew kernel flour increased. Defatting resulted to a significantly ($p<0.05$) higher increase in the mineral contents of

*Corresponding author: Email: barber.lucretia@ust.edu.ng;

the bread samples. Physical characteristics of the composite bread showed a decrease in the height (8.00-5.20 cm), length (12.30-11.25 cm), width (8.00-7.45 cm), loaf volume (682.50-505.00 cm^3) and specific volume (2.62-2.08 g/cm^3) as amounts of defatted and undefatted cashew kernel flour substitution increased. Weight of the bread increased as substitution with 10% defatted and undefatted cashew kernel flour. Beyond the 10% level, a decrease in bread weight was observed. The findings of the present study therefore showed that wheat flour bread supplemented with 10% UCF cashew kernel flour produced bread of higher mineral content than 100% wheat flour bread and this level of UCF substitution did not have adverse effect on the bread's physical characteristics.

Keywords: Bread; defatted; undefatted; cashew kernel; mineral; physical; characteristics.

1. INTRODUCTION

Bread is an important staple food which has gained wide acceptance throughout the world. Its consumption is globally increasing in Nigeria due to its taste, good eating quality and convenience it offers to consumers [1]. Bread is generally made from wheat flour, water and yeast followed by a series of operations which includes mixing, kneading, proofing, shaping and baking [2]. Wheat flour which is a major ingredient in bread production is primarily used because of its high gluten content. However, wheat grain is mostly adapted to temperate climates [3]. Wheat production in Nigeria is limited which demands importation in order to meet local flour needs for bakery products. Several studies on the incorporation of different proportions of flours from cereals, legumes and nuts for the production of bread have been extensively carried out in developing countries [4,5,6]. These researches were carried out so as to reduce the demand for imported wheat flour and to produce protein enriched bread.

Cashew (*Anarcadium occidentale*) Linn is a tropical evergreen tree belonging to the *Anacardiaceae* family [7]. It is valuable cash crop cultivated and grown in India, Brazil, East Africa and Vietnam [8]. The cashew fruit comprises of cashew apple, cashew nut shell and cashew nut kernel. The kernels are highly nutritive and have been reported to contain 19.8% protein, 47.1% fat, 5.7% moisture and 9% iron [9]. Emelike et a*l*. [9] also reported the defatted cashew kernel flour to be richer in crude protein, crude fiber and ash than the undefatted flour. The kernel contains an average of 48% oil which are oleic (73.73%), linoleic (13.60%) and stearic (10.20%) acids in the ratio of 1:2:1 which can be used to lower blood serum cholesterol [10]. The kernels finds wide application in the confectionary industry where it is used as a dessert nut such as cakes, pastries, candies and chocolates, enriching their taste and appearance [11]. They can also be eaten in the roasted form, fried and sometimes salted, sweetened or coated with different spices such as garlic, ginger, and chili pepper. They can be milled into flour and be used for the preparation of cereal bars, cookies, candies and chocolates [12]. The production of plant milk from cashew kernels has also been reported by Emelike and Akusu [13]. Recently, consumers' consciousness on the need to eat high quality and healthy foods has been on the rise. This necessitates the need to produce specialty breads from whole grain wheat flour and other nutrient rich crops such as cashew kernel. Bread containing cashew kernel flour which is rich in minerals would offer great potential to speed up the body's metabolic processes, improve growth and development, thereby improving the wellbeing of consumers [14]. However, for bread to be acceptable to consumers, it has to be of good quality. There is therefore, a need to assess the quality of such breads. The quality of breads depends on the properties of the raw materials and the baking process. The most frequently accessed physical parameters of breads are weight, volume and specific volume [15]. Differences in protein content of the flour used, dough extensibility and flour strength can results to differences in the physical qualities of bread [16]. Thus, the objective of this study was to evaluate the mineral composition and physical characteristics of bread prepared from blends of wheat and defatted/undefatted cashew kernel flours.

2. MATERIALS AND METHODS

2.1 Source of Materials

The cashew kernel was collected from Uturu, Abia State, Nigeria. Wheat flour (Golden penny) and other ingredients such as sugar, margarine, baker's yeast (*Saccharomyces cerevisiae*), salt and milk were purchased from Mile 1 market, Port Harcourt, Rivers State.

2.2 Preparation of Cashew Kernel

The Cashew kernels were roasted in a hot air oven at 180°C for 40 minutes, cooled slightly and the testa manually removed. The covering testa were removed by squeezing and then winnowed to obtain cream colour nuts.

2.3 Preparation of Defatted and Undefatted Cashew Kernel Flour

The cream coloured nuts were milled into flour using a cleaned manual blender and divided into two portions. One portion of the obtained flour was dried in a hot air oven at 60°C for 12 hours, sieved and left at that stage as the undefatted cashew kernel flour (UCF). The second portion was defatted flour after drying in the oven at same temperature and time to reduce the moisture and to condition the fat molecules of the flour. The oil was extracted by a hydraulic press (using muslin cloth). The flour produced was sieved, packaged and stored for further analysis (Fig. 1).

2.4 Composite Flour Formulation

The composite flours composed of wheat and undefatted or defatted cashew kernel flours were obtained by substituting wheat flour with undefatted cashew kernel flour (UCF) or defatted cashew kernel flour (DCF) in the following ratios 0:100, 10:90, 20:80 and 30:70% cashew kernel/wheat flour respectively. The 100% wheat served as the control as seen in Table 1.

2.5 Recipe for Preparation of Wheat/ Cashew Kernel Bread

The recipe used in the bread making process was that described by Owuno et al. [17] with some modifications. The detailed recipe is shown in Table 2. The 100% wheat bread served as the control. Enough water was added to each formulation to obtain kneadable dough.

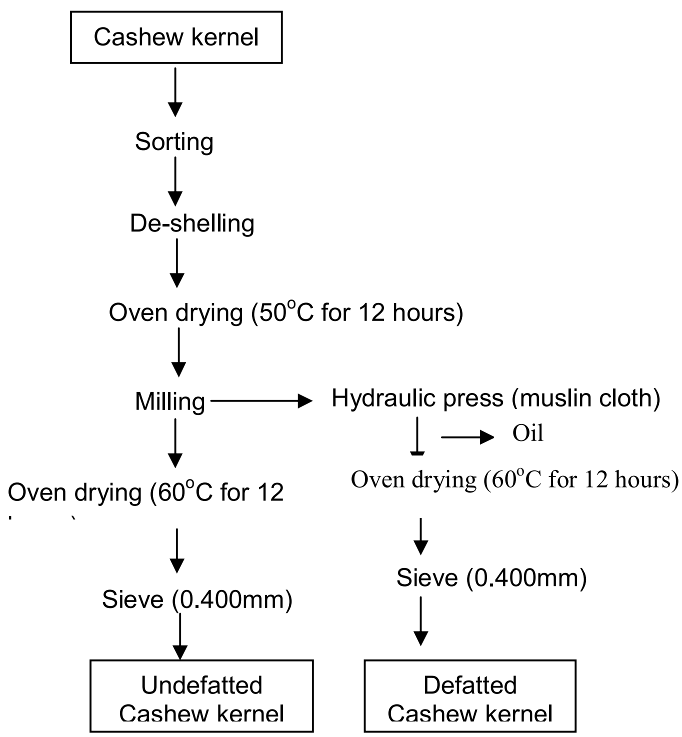

Fig. 1. Processing of undefatted and defatted Cashew Kernel Flours
Source: Emelike et al. [14]

Table 1. Formulation of wheat/cashew kernel flour composites

Sample code	WF	UCF	DCF
WF_{100}	100	0	0
UCF_{10}	90	10	0
UCF_{20}	80	20	0
UCF_{30}	70	30	0
DCF_{10}	90	0	10
DCF_{20}	80	0	20
DCF_{30}	70	0	30

Key: WF =Wheat Flour; UCF = Undefatted Cashew Kernel Flour; DCF = Defatted Cashew Kernel Flour

Table 2. Recipe for production of wheat/cashew kernel flour (g)

Code	Level of substitution	WF	UCF	DCF	Fat	Salt	Sugar	Yeast
WF_{100}	100:0	300	0	0	21	1.5	30	10
UCF_{10}	90:10	270	30	0	21	1.5	30	10
UCF_{20}	80:20	240	60	0	21	1.5	30	10
UCF_{30}	70:30	210	90	0	21	1.5	30	10
DCF_{10}	90:10	270	0	30	21	1.5	30	10
DCF_{20}	80:20	240	0	60	21	1.5	30	10
DCF_{30}	70:30	210	0	90	21	1.5	30	10

Source: Owuno et al. [17]

2.6 Preparation of Cashew Kernel/ Wheat Bread

The method reported by Owuno et al. [17] was used with some modifications for production of wheat / cashew kernel bread as shown below. All the bread samples contain 10% sugar, 7% margarine, 3% yeast, 0.5% salt, 60% water of the weight of the composite flour. Flour, sugar, margarine and salt were mixed together manually for 3-5 min to get a creamy dough. The other ingredients, except water, were then incorporated. All ingredients were mixed in a Kenwood mixer (Model HM430) for 5 minutes until a firm dough was obtained. The dough was proof for 30min, and then a second kneading was done for 10 minutes. The dough was moulded and transferred into an already greased aluminium loaf pan. The pan was covered with transparent film and allowed to proof for 1 hour. The dough was baked at 180°C for about 35 - 45 minutes in an oven. The bread samples were left at room temperature to cool.

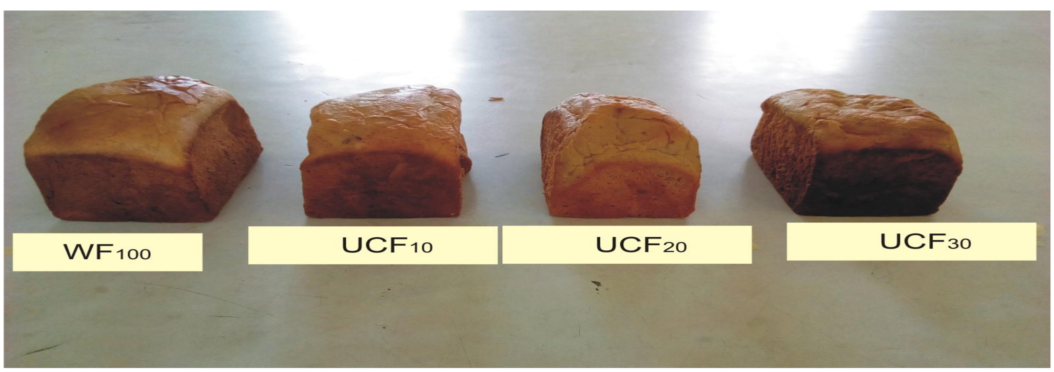

Plate 1. Wheat/undefatted cashew kernel composite bread

KEY: WF = 100% Wheat Flour; UCF_{10} = 90% Wheat/10% Undefatted Cashew Kernel Flour; UCF_{20} = 80% Wheat/20% Undefatted Cashew Kernel Flour; UCF_{30} = 70% Wheat/30% Undefatted Cashew Kernel Flour

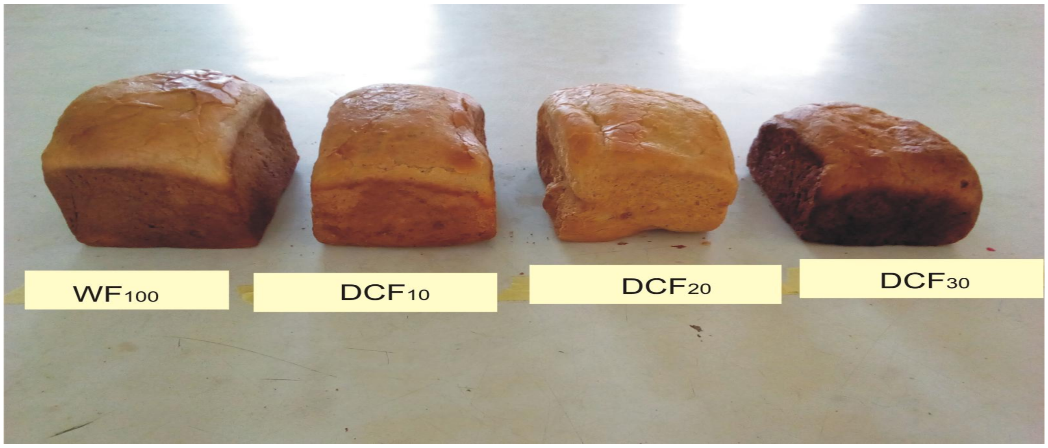

Plate 2. Wheat/defatted cashew kernel composite bread

KEY: WF = 100% Wheat Flour; DCF_{10} = 90% Wheat/10% Defatted Cashew Kernel Flour; DCF_{20} = 80% Wheat/20% Defatted Cashew Kernel Flour; DCF_{30} = 70% Wheat/30% Defatted Cashew Kernel Flour

2.7 Mineral Composition

The bread samples were analyzed for iron, calcium, magnesium, zinc, sodium, and potassium using an Atomic Absorption Spectrophotometer, AAS (Model 372, Perkin-Elmer, Beaconsfield, U.K.) according to AOAC [18] methods.

2.8 Analysis of Physical Parameters of Bread

Weight of bread was determined with weighing balance. Height, length and width of bread were measured using meter rule as described by Akubor and Obiegbuna [19]. Loaf density was calculated as weight/volume.

2.8.1 Loaf volume

Loaf volume was measured by small seeds displacement method used by Greene and Bovell-Benjamin [20]. A container was used to measure the volume using *Guinea corn seeds* (in place of rapeseeds) were poured into a container of known volume until the bottom was covered. The loaf was placed inside the container which was filled to the top with more seeds. The extra seeds, which equal the loaf volume, were measured in a graduated cylinder.

Loaf volume = volume of the spilled over guinea corn seeds

2.8.2 Specific volume determination

Specific volume of bread was determined using the formula described by Akubor and Obiegbuna [19].

Specific volume (g/cm^3) = Weight of loaf sample / Volume of loaf sample

2.9 Statistical Analysis

A completely randomized 2x4 factorial design was applied. Data collected were subjected to analysis of variance (One-Way ANOVA) using the SPSS (version 21.0) software and results presented as Mean ± SD from duplicate determinations and significant variation between the means were separated using Duncan's Multiple Range Test according to the method described by Wahua [21]. All statistical tests were performed at 5% significance difference.

3. RESULTS AND DISCUSSION

3.1 Mineral Composition of Bread Produced from Wheat/Defatted and Wheat/ Undefatted Cashew Kernel Composite Flour

The mineral composition of the wheat/defatted and wheat/undefatted cashew kernel flour bread samples is presented in Table 3. Supplementation of wheat flour with 10-30% UCF and DCF resulted in significant ($p<0.05$) increases in calcium, iron, potassium, magnesium, sodium and zinc contents of the bread samples. The iron content of the bread samples ranged from 1.08-5.13mg/100g. Sample DCF_{30} (30% defatted cashew kernel flour substitution) had the highest iron content (5.13 mg/100 g) while sample WF (100% wheat flour bread) had the lowest iron content (1.08 mg/100 g). The iron content of wheat/UCF breads reported in this study (1.13-2.67 mg/100 g) was similar to the values (1.06-1.36 mg/100 g) reported for breads produced from wheat, African yam bean, cowpea, pigeon pea, plantain and water yam flour blends [22] while the iron content of wheat/DCF breads (2.64-5.13 mg/100 g) were higher than the range (1.30-2.46 mg/100 g) for breads fortified with *Pleurotus ostreatus* mushroom [1]. The iron content in the wheat/DCF breads compared to the wheat/UCF breads indicates that wheat/DCF breads could help in addressing the problem of iron deficiency in diets of low income earners in developing countries. The US recommended dietary allowance (RDA) for iron (ferrous) is 10-15mg per day [23]. The level of iron in sample DCF_{30} breads suggests that a 100g portion of this product could provide about 50% of the RDA.

Sample DCF_{30} had the highest magnesium content (23.72 mg/100 g) while sample WF (100% wheat flour bread) had the least magnesium content (4.29 mg/100 g). The high magnesium content of the breads supplemented with cashew kernel flours could be due to the high magnesium content of cashew kernel (220 mg/100 g and 190 mg/100 g respectively for defatted and undefatted cashew kernel flours as reported by Emelike et al. [9]. The magnesium content (18.85-23.72 mg/100 g) of samples DCF_{10}-DCF_{30} obtained in this study was higher than the magnesium content (8.28-9.96 mg/100 g) of breads made from wheat-anchote-soybean flour blends [24]. The magnesium content of samples UCF_{10}-UCF_{30} from this study (8.63-19.30mg/100g) was lower when compared to the values (37.15-168.88 mg/100 g) obtained by Malomo et al. [25] for wheat/breadfruit flour bread. Magnesium is one of the essential elements required for proper metabolism and bone mineral density. It is a cofactor in many enzymatic reactions in key metabolic pathways of the body. Low intake and impaired absorption of magnesium have been reported to be associated with the development of osteoporosis [26].

The most abundant minerals present in the bread samples was calcium which ranged from 12.21-24.60 mg/100 g. The trend showed that there was a significant ($p<0.05$) increase in the calcium content of the breads as the proportion of cashew kernel flour increased. This increase was higher in samples substituted with deffated cashew kernel flour than for samples substituted with undefatted cashew kernel flour. This may be attributed to higher concentration of calcium in the defatted cashew kernel flour used for supplementation with wheat flour [9]. The calcium content of the breads substituted with defatted cashew kernel flour (18.69-24.60 mg/100 g) compares well with the values of 22.20-24.20 mg/100 g obtained by Onoja et al. [22] for breads supplemented with African yam bean, pigeon pea, cowpea, plantain and water yam flours [22]. The calcium content of samples UCF_{10}-UCF_{30} (15.25-20.54 mg/100 g) is also similar to the calcium content (11.82-38.55 mg/100 g) of breads fortified with mushrooms [1]. Calcium is important in the development and health of bone and teeth. The high calcium content of wheat-defatted/undefatted cashew kernel flour composite breads could help in promoting a healthier cardiovascular system and bone development in consumers.

Potassium content of the composite breads increased significantly ($p<0.05$) with increase of undeffated and defatted cashew kernel flours in the blends and ranged from 4.13-19.63 mg/100 g.–Sample WF (100% wheat flour bread) had the lowest value while sample DCF_{30} had the highest potassium content. It was observed from the study that breads substituted with defatted cashew kernel flour contained significantly ($p<0.05$) higher potassium content than breads substituted with undefatted cashew kernel flour. This may be attributed to the defatting of the cashew kernels. Defatting had been reported to significantly increase the potassium content of cashew kernels from 6.8mg/100g to 52.80 mg/100 g [9]. The potassium contents of the breads obtained from this study are lower than values (173.00-176.20 mg/100 g) reported for breads supplemented with African yam bean, pigeon pea, cowpea, plantain and water yam [22]. According to Androgue and Madias [27], potassium intake is required in relatively large amounts in the body because it functions as an important electrolyte in the nervous system.

Sodium content of the bread samples ranged from 0.27mg/100g in WF to 0.55mg/100g in Sample DCF_{30}. This represents significant ($p<0.05$) increases in the sodium content of the bread samples with increase in undefatted and defatted cashew kernel flours. This could also be attributed to the high sodium content of cashew kernels (7.8 mg/100 g and 5.0 mg/100 g for defatted and undefatted flours, respectively) as reported by Emelike et al. [9]. The value obtained for sodium from this study is lower than 33.50-72.60 mg/100 g reported for bread fortified with mushroom [1]. The high potassium and low sodium contents of the breads makes them suitable for use by hypertensive individuals.

Zinc content of the breads ranged from 0.05-2.25mg/100g with sample WF having the lowest and sample DCF_{30} the highest. The value obtained from this study (0.05-2.25 mg/100 g) was comparable with the zinc content (0.61-0.68 mg/100 g) of bread supplemented with African yam, pigeon pea, cowpea, plantain and water yam flours [22]. It is also similar with the zinc content (0.95-0.88 mg/100 g) of breads fortified with mushroom [1]. Since zinc is important for normal growth and health, consumers of the wheat-defatted/undefatted cashew kernel flour composite breads will benefit from its zinc content.

3.2 Physical Characteristics of Bread Produced from Wheat-defatted/Undefatted Cashew Kernel Composite Flour

The mean physical parameters of breads from wheat flour and undefatted/defatted cashew kernel flour blends are shown in Table 4. Increased levels of cashew kernel flour substitution led to a significant ($p<0.05$) decrease in the height (8.00-5.20 cm), length (12.30-11.25 cm) and width (8.00-7.45 cm) of the composite breads. Addition of defatted cashew kernel flours resulted in significantly ($p<0.05$) higher decrease in these parameters than the undefatted samples. The decrease in the height and length of the breads on substitution with defatted and undefatted cashew kernel flours may be due to high water absorption capacity of cashew kernel flour. In addition, the low level of gluten in the composite flour may have affected the height and length of the breads due to the inability of the composite blends to expand and retain carbon dioxide necessary for leavening. Similar observation was also reported by Onoja et al. [22] for breads supplemented with African yam, cowpea, plantain, cocoyam, water yam and pigeon pea flours.

The loaf weight of the composite bread samples ranged from 240.02 g in sample DCF_{30} to 280.63g in sample DCF_{10}. The loaf weights of the composite breads substituted with 10% defatted and undefatted cashew kernel flours were significantly ($p<0.05$) higher than the 100% wheat flour bread; however, as the level of cashew kernel flour substitution increased, a decrease in the weight of the breads was observed. Loaf weight reduction during baking is an undesirable quality attribute as consumers are often attracted to bread with high weight and volume believing that it has more substance for the same price [25].

Loaf volume of the composite breads ranged from 682.50 cm^3 in the control sample to 505.00 cm3 in sample DCF_{30}. Increase in the levels of cashew kernel flour substitution resulted to a significant ($p<0.05$) decrease in the loaf volume of the breads. Similarly, defatting resulted to a significantly ($p<0.05$) higher decrease in the loaf volume than the undefatted sample. The decrease in loaf volume on substitution with cashew kernel flour may be due to dilution of wheat flour which resulted in low glutted content. Flours with high gluten content have the ability to extend and trap carbon dioxide produced during fermentation. Similar finding was also reported by Ni et al. [28] who stated that weakened gluten network during dough formation can hinder rising of the bread which results in decreased loaf volume. Based on the findings of this study, a limit of 10% undefatted cashew kernel flour with wheat flour in bread making is necessary to produce bread with weight and volume characteristics comparable to 100% wheat bread.

The specific volume is the most important parameter in bread making, which indicates final gas retention in the bread and affects consumer preference [29]. The control bread had the greatest specific volume (2.62 g/cm^3) while the bread substituted with 30% defatted cashew kernel flour had the least (2.08 g/cm^3). The specific volumes of the breads substituted with defatted and defatted cashew kernel flours were significantly ($p<0.05$) lower compared to the control.

Table 3. Mineral composition of bread produced from wheat-defatted/undefatted cashew kernel composite flour

Samples	Calcium	Iron	Potassium	Magnesium	Sodium	Zinc
WF_{100}	12.21±0.08^{f}	1.08±0.04^{e}	4.13±0.18^{g}	4.29±0.01^{f}	0.27±0.01^{d}	0.05±0.01^{e}
UCF_{10}	15.25±0.28^{e}	1.13±0.03^{e}	6.54±0.23^{f}	8.63±0.10^{e}	0.28±0.03^{d}	0.07±0.00^{e}
UCF_{20}	18.05±0.07^{d}	1.60±0.28^{d}	8.55±0.07^{e}	12.88±0.27^{d}	0.32±0.04^{c}	0.32±0.04^{d}
UCF_{30}	20.54±0.06^{b}	2.67±0.02^{c}	13.61±0.24^{d}	19.30±0.04^{c}	0.35±0.00^{bc}	0.55±0.07^{c}
DCF_{10}	18.69±0.27^{c}	2.64±0.13^{c}	14.36±0.04^{c}	18.85±0.04^{c}	0.31±0.01^{c}	0.13±0.04^{e}
DCF_{20}	20.48±0.13^{b}	3.20±0.07^{b}	16.52±0.04^{b}	20.61±0.16^{b}	0.38±0.04^{bc}	1.32±0.03^{b}
DCF_{30}	24.60±0.14^{a}	5.13±0.21^{a}	19.63±0.18^{a}	23.72±0.40^{a}	0.55±0.01^{a}	2.25±0.07^{a}

Values are means of triplicate determinations. Values within a column with different superscripts are significantly different at (p <0.05); Key: WF_{100} = 100% Wheat flour; UCF_{10} = 90% wheat/10% Undefatted Cashew Kernel Flour blends; UCF_{20}= 80% wheat/20% Undefatted Cashew Kernel Flour; UCF_{30}= 70% wheat/ 30% Undefatted Cashew Kernel Flour; DCF_{10}= 90% wheat / 10% defatted Cashew Kernel Flour blends; DCF_{20}= 80% wheat flour / 20% defatted Cashew Kernel Flour blends; DCF_{30}= 70% wheat flour / 30% defatted Cashew Kernel Flour blends.

Table 4: Physical properties of bread produced from wheat-defatted/undefatted cashew kernel composite flour

Samples	Height (cm)	Length (cm)	Width (cm)	Weight (g)	Volume (cm^3)	Specific Volume (g/cm^3)
WF_{100}	8.00±0.00^{a}	12.30±0.07^{a}	8.00±0.14^{a}	260.70±0.00^{c}	682.50±3.54^{a}	2.62±0.00^{a}
UCF_{10}	7.40±0.14^{ab}	11.65±0.00^{b}	7.65±0.21^{b}	266.77±0.00^{b}	667.50±3.54^{b}	2.50±0.00^{b}
UCF_{20}	7.40±0.57^{ab}	11.50±0.07^{bc}	7.50±0.00^{c}	253.72±0.02^{d}	637.50±3.54^{c}	2.51±0.00^{b}
UCF_{30}	6.45±0.64^{c}	11.45±0.07^{bc}	6.50±0.00^{d}	247.22±0.02^{e}	570.00±0.00^{d}	2.31±0.00^{c}
DCF_{10}	6.95±0.07^{bc}	12.25±0.07^{a}	7.60±0.00^{b}	280.63±0.00^{a}	645.00±7.07^{c}	2.30±0.01^{c}
DCF_{20}	6.50±0.00^{c}	11.50±0.00^{bc}	7.50±0.00^{c}	240.02±0.03^{g}	545.00±7.07^{e}	2.27±0.01^{c}

Values are means of triplicate determinations. Values within a column with different superscripts are significantly different at (p <0.05); Key: WF_{100} = 100% Wheat flour; UCF_{10} = 90% wheat/10% Undefatted Cashew Kernel Flour blends;UCF_{20}= 80% wheat/20% Undefatted Cashew Kernel Flour; UCF_{30}= 70% wheat/ 30% Undefatted Cashew Kernel Flour; DCF_{10}= 90% wheat / 10% defatted Cashew Kernel Flour blends;DCF_{20}= 80% wheat flour / 20% defatted Cashew Kernel Flour blends; DCF_{30}= 70% wheat flour / 30% defatted Cashew Kernel Flour blends.

This loss of volume can be attributed to the dilution of gluten content and the increase in fibre content of cashew kernel flour. According to Awika [30] and Hemdane et al. [31], fibre particles can impede proper gluten developments by cutting through gluten strands, thus inhibiting the formation of a viscoelastic network which results in weakening of the dough. Similar decrease in specific volumes was also reported by Porcel et al. [32] for wheat bread substituted with okara flour. Kiin-Kabari [6] also reported a decrease in specific volume of wheat/plantain composite bread as levels of plantain flour substitution increased. The result from this study therefore suggests that substituting 10-20% of undefatted cashew kernel flour in the bread formula would not interfere with bread specific volume.

4. CONCLUSION

The study showed that substitution of wheat flour with defatted and undefatted cashew kernel flours for the production of bread improved the mineral content of the breads. Increased substitution level of cashew kernel flour resulted to a decrease in the height, length, width, loaf volume and specific volume of the breads. Weight of the bread increased at 10% defatted and undefatted cashew kernel flour substitution. The study therefore indicates that undefatted cashew kernel flour could be used to replace up to 10% of the wheat flour without adversely impacting on the physical characteristics of the bread.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Oyetayo VO, Oyedeji RR. Proximate and mineral composition of bread fortified with mushroom (*Pleurotusostreaus*) and *Calocybeindica*. Microbiology Research Journal International. 2017;19(4):1-9.
2. Dewttinck K, Van Bockstaele F, Kunhne B, Van de Walle, Courtens T, Gellynck X. Nutritional value of bread: Influence of processing, food interaction and consumer perception. Rev. J. Cereal Sci. 2008;48:243-257.
3. Masamba K, Jinazali H. Effect of cassava flour processing methods and substitution level on proximate composition, sensory characteristics and overall acceptability of bread made from wheat-cassava flour blends. African Journal of Food, Agriculture, Nutrition and Development. 2014;14(6):9390-9403.
4. Mepba HD, Eboh L, Nwaojigwa SU. Chemical composition, functional and baking properties of wheat-plantain composite flours. African Journal of Food, Agriculture, Nutrition and Development. 2007;14(2):129-142.
5. Makinde FM, Akinoso R. Physical, nutritional and sensory qualities of bread samples made with wheat and black (*Sesamum indicum Linn*) flours. International Food Research International. 2014; 21(4):1635-1640.
6. Kiin-Kabari DB. Physico-chemical and sensory properties of bread prepared from wheat and unripe plantain composite flours fortified with Bambara groundnut protein concentrate. International Journal of Nutrition and Food Sciences. 2015;4(5):594-599.
7. Muniz CR, Borges MDF, Freire FDCO. Tropical and Subtropical Fruit Fermented Beverages. In: Microbial, Biotechnology and Horticulture, Ray RC, Ward OP. (editors). Science Publishers, Enfield, NH., USA. 2006;2.
8. Omosuli VS, Ibrahim AT, Oloye D, Agbaje R, Jude-Ojei B. Proximate and mineral composition of roasted and defatted cashew nut (*Anarcadium occidentale*) flour. Pakistan Journal of Nutrition. 2009;8:1649-1651.
9. Emelike NJT, Barber LI, Ebere CO. Proximate, mineral and functional properties of defatted and undefatted cashew (*Anacardium occidentale* Linn.) kernel flour. European Journal of Food Science and Technology, 2015; 3(4):11-19.
10. Emelike NJT, Barber LI. Effect of cashew kernel and soya bean oils on blood serum cholesterol and triglyceride of albino rats (Rattus rattus). Asian Food Science Journal. 2018;1(2):1-6.
11. Araujo MC, Ferraz ACO. Efeito da umidificação, tratamentotérmico e deformaçãosobre a decorticação da castanha de caju 'CCP-76' pormeio de impactoúnico e direcionado.

EngenhariaAgrícola. 2006;26(2):590-599.
12. Gadani BC, Miléski KML, Peixoto LS, Agostini JS. Physical and chemical characteristics of cashew nut flour stored and packaged with different packages. Food Sci. Technol, Campinas. 2017;37(4):657-662.
13. Emelike NJT, Akusu MO. Physicochemical, mineral and sensory characteristics of cashew nut milk. International Journal of Food Science and Biotechnology. 2019;4(1):1-6.
14. Emelike NJT, Barber LI, Deebom MD. Nutrient composition and sensory properties of wheat bread substituted with defatted and undefatted cashew kernel (*Anacardium occidentale* Linn.) flours. European Journal of Nutrition and Food Safety. 2020;12(12):28-39. DOI:https://doi.org/10.9734/ejnfs/2020/v12i1230332.
15. Okpala LC, Akpu MN. Effect of orange peel flour on the quality characteristics of bread. Current Journal of Applied Science and Technology. 2014;4(5):823-830.
16. Akubor PI. Chemical composition, physical and sensory properties of bread incopoarted with raw and boiled African fan palm (*Borassus aethiopum*) root flours. International Journal of Agricultural and Veterinary Sciences. 2016;2(3):125-136.
17. Owuno F, Eke-Ejiofor J, Wordu G. Effects of ciscus (*Ciscus populnea*) gum on dough rheoogy and quantity of wheat-cassava composite bread. Journal of Food, Agriculture and Environment. 2012;10(2):80-84.
18. AOAC. Official methods of analysis of the association of official analytical chemists, 20thed; 2012.
19. Akubor PI, Obiegbuna JE. Effect of processing methods on the quality of flour and bread from African breadfruit kernel flour. Food Science and Quality Management. 2014;24:32-41.
20. Greene JL, Bovell-Benjamin AC. Macroscopic and sensory evaluation of bread supplemented with sweet potato flour. J. Food Sci. 2004;69:167-173.
21. Wahua TAT. Applied Statistics for Scientific Studies. African Link Press, Aba, Nigeria; 1999.
22. Onoja US, Dibua UME, Eze JI, Odo GE. Physico-chemical properties, energy, mineral, vitamin and sensory evaluation of wheat-based bread supplemented with legume, root, tuber and plantain flour. Global Journal of Pure and Applied Sciences. 2011;17(3):319-327.
23. Wardlaw HM, Hampin JJ. Perspectives in nutrition. 7th Edn. New York. McGraw Hill; 2007.
24. Haile A, Bekele T, Desalego T. Proximate compositions, anti-nutritional factors and minerals content of composite flours and bread from blends of wheat-anchote-soyabean flours. Advances in Nutrition and Food Science. 2018;3(1):1-9.
25. Malomo SA, Eleyinmi AF, Fashakin JB. Chemical composition, rheological properties and bread making potentials of composite flours from breadfruit, breadnut and wheat. African Journal of Food Science. 2011;5(7):400-410.
26. Bolarinwa IF, Aruna TE, Adejuyitan JA, Akintayo OA, Lawal OK. Development and quality evaluation of soy-walnut milk drinks. International Food Research Journal. 2018;25(5):2033-2041.
27. Androgue MD, Madias NE. Sodium and potassium in the pathogenesis of hypertension. New England Journal of Medicine. 2007;356:1966-1978.
28. Ni Q, Ranawana V, Hayes HE, Hayaward NJ, Stead D, Raikos V. Addition of broad bean hull to wheat flour for the development of high-fiber bread. Effects on Physical and Nutritional properties. Foods. 2020;9:1192. DOI:10.3390/foods9091192.
29. Onimawo IA, Akubor PI. Food chemistry (Integrated Approach with Biochemical background). 2ndEdn. joytal printing press, Agbowo, Ibadan, Nigeria; 2012.
30. Awika JM. Effect of bioactive components on dough rheology, baking and extrusion. In fruit and cereal bioactives: Sources, chemistry and applications; Tokusoglu O, Hall CA, III, Eds.; CRC press: New York, NY,USA. 2011;337–344.
31. Hemdane S, Jacobs PJ, Dornez E, Verspreet J, Delcour JA, Courtin CM. Wheat (*Triticumaestivum*L.) Bran in bread making: A critical review. Compr. Rev. Food Sci. Food Saf. 2016;15:28–42.

32. Porcel MVO, Camderros E, Rinaldoni AN. Effect of okara flour addition on the physical and sensory quality of wheat bread. MOJ Food Processing and Technology. 2017;4(6): 184-190.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/65273