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EFFECT OF DATE FLOUR AS SUGAR SUBSTITUTE ON THE TEXTURAL, PASTING PROPERTIES AND QUALITY CHARACTERISTICS OF CHINCHIN

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ABSTRACT

This paper studied the textural and quality characteristics of Chinchin produced from wheat with date flour substituted at varying proportion as sugar replacer(FTB (100%), BYT (90:10), BGD (80:20), FYB (70:30), MOA (60:40) and BOT (50:50). These were deep fried at 180ºC for 8min. Pasting, Functional properties, mineral content, colour and consumer acceptability were also evaluated. The result revealed that significant difference (P<0.05) exited between values obtained for pasting, functional and textural properties. The values of cohesiveness, gumminess, resilience and springiness ranged from 0.11-0.30, 2788-6920, 0.09-3.34 and 0.27-1.38, respectively. There was significant impact (P<0.05) of Date fruits on the mineral content and particularly the colour of the composite flour and the chinchin. The organoleptic attributes significantly decreased with increase in the inclusion of date flour. The possibility of Chinchin produced with moderate date fruits flour inclusion as sugar substitute was established.

1.Introduction

Snacks as part of human diet has a reputation of contributing tremendously to global and national food security and economy (Thakur and Saxena, 2000; Lasekan and Akintola, 2002; Abegunde et al. 2014). Snack is a portion of food, often smaller than a regular meal and most times eaten between meals. The demand for snacks is often connected with population growth and urbanization of both developed and developing countries. Snacks are usually prepared from ingredients commonly available in the home (Opara et al, 2013; Adegunwa et al., 2014). They are typically designed to be portable, quick, and satisfying (Thakur and Saxena, 2000) and Chinchin is one of these important products usually produced from wheat flour (Opara et al, 2013; Adegunwa et al., 2014). Chinchin is sweet to taste and slightly hard. This depends on the materials used (Adegunwa et al., 2014; Adeyeye et al., 2020).

Dates are abundant sources of carbohydrates, with sucrose, maltose, glucose and fructose which constitute more than 80% of its dry matter. According to Maqsood et al. (2019), compositions and sugar content of date fruits differ with variety and fruit maturation. Dates have been described as a good source of essential amino acids. Histidine and arginine have been reported necessary in the proper physiological functioning of the human body (Al-Farsi et al., 2005;Idowu et al., 2019). About twenty-three different amino acids were detected in date fruits compared with some notable fruits (Al-Farsi et al., 2005; Idowu et al., 2019). The carbohydrates in dates are mainly simple sugars and are a mixture of sucrose, glucose and fructose, with small amounts of polysaccharides such as cellulose and starch while Mannose and maltose are present in the seeds (Manickavasagan et al., 2013). It has been reported that significant quantities of potassium, calcium, sodium, phosphorus, magnesium, iron, zinc, copper and manganese were discovered in the date fruits along side significant quantities of water-soluble and oil-soluble vitamins (Manickavasagan et al., 2013). Apart from date fruits providing essential nutrients when consumed, it has also reported to be a good source of dietary fibre (Manickavasagan et al., 2013; Al-Farsi et al, 2007). Dietary fibre is considered good for health and is claimed to have a preventative effect against many diseases such as diabetes, obesity, hyperlipidaemia, coronary heart disease, hypertension, intestinal disorders, prostate cancers, and colorectal cancer (Vyawahare et al, 2009). The texture of dates depends on interaction between water and other components such as protein, carbohydrate, lipids and salts.

In the recent years there has been a lot of concern about the excessive consumption of sugar, and its effect on health (National Heart Lung and Blood Institute 2004; Hutchinson et al., 2018;Lustig et al., 2012; Hutchinson et al., 2018).The World Health Organization recommends limiting added sugar intake to less than 10% of total energy (World Health Organization, 2015). Date fruit contains more than 70% sugar mainly glucose and fructose and therefore are high energy food sources (Dada et al., 2012), thus making it an ideal replacement for sugar (sucrose) in the confectionery recipe, which is also of great nutritional benefit to diabetics and other metabolic health related patients (Dada et al., 2012; Bolaji et al., 2022).

2.Materials and Methodology

The wheat flour, date fruit, egg, nutmeg, salt, milk, pineapple, baking powder, vegetable oil and butter used in this study were purchased from Sabo Market, Ikorodu. The production of the Chinchin was carried out in the Food Processing Laboratory of the Department of Food Technology and biotechnology, Lagos state University of Science and Technology. The method of Platat *et al.* (2015) with little modification was used in the preparation of the date fruit powder. The date was rinsed with water to remove adhering dirt. Seeds were removed the pulp with pericarp was oven dried at 75^0C for 8h and subsequently milled using blender and sieved through a 0.35 µm mesh sieve to obtain fine homogenized particles. The date fruit flour was packaged for further analysis. The flow chart to produce date fruit is as shown in Figure 1. Whole wheat flour was obtained by cleaning to remove dirts, stone and other extraneous material, milled into powder and sieving through a sieve to obtain fine homogenised flour (Figure 1). The composite flour of wheat-date flour blend was formed in the varying proportion (FTB (100%), BYT (90:10), BGD (80:20), FYB (70:30), MOA(60:40) and BOT(50:50)

2.1. Preparation of Chinchin

The production of Chinchin was inline with method reported by Adeyeye *et al.* (2020) as shown in Figure 1, column 3. Flour, salt and nutmeg were first sieved into a bowl and margarine (125/500g) was mixed together with blended flour wheat and date flour evenly. Egg (3/500g) and other ingredients: baking powdered (2 table spoon/500g), about 42.325g of Milk/500g), Nutmeg(10g/500g) and water 100 mL/500g flour) were added to make fairly stiff dough. The stiff dough was rolled tightly to 1cm thickness on a board and cut into cubes. The cut dough was fried in deep hot vegetable oil at 180^oC for 8min. The chin-chin was then drained, cooled and packaged in an air tight container.

2.2. Proximate analysis

The moisture content, ash content, protein and crude fibre of the chinchin samples were determined according to the standard method of AOAC (2010). The carbohydrate content of the samples was determined by difference.

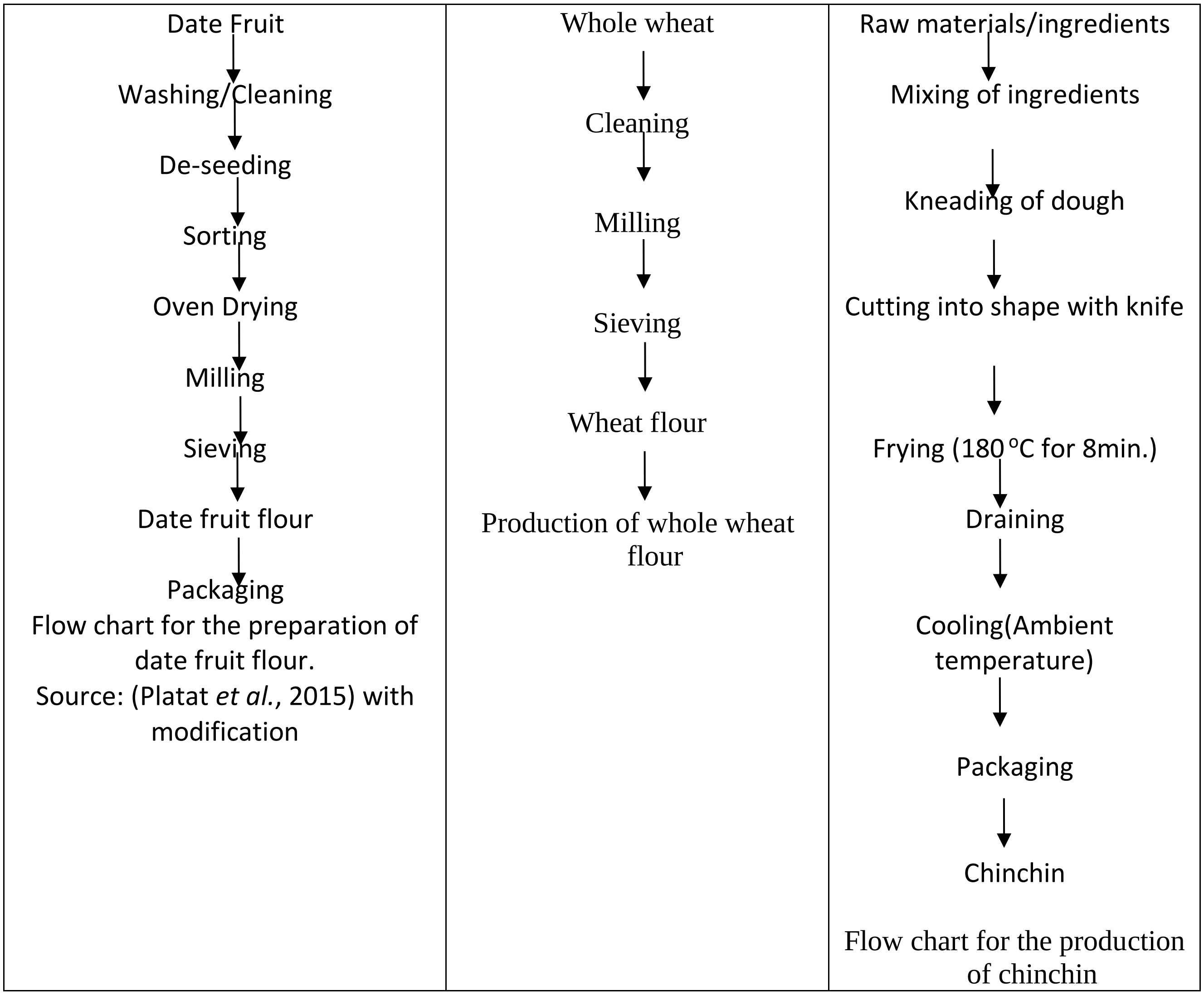

Figure 1. Flow chart for the production of date flour, wheat flour and Chinchin

2.3. Determination of Functional Properties of the Flour

The bulk density, Swelling Power and Solubility of the flour samples were determined using the method described by Nwosu, (2011), Water/Oil Absorption Capacity were determined following methods of Horsfall *et al.* (2007).

2.4.Determination of Mineral Content of the Flour

The mineral content of the flour samples was determined using the method described by AOAC (2005).

2.5. Pasting Properties of the Flour

The pasting properties of the flour samples were determined using the rapid visco analyzer (RVA) as described by Bolaji *et al.* (2011).

2.6.Determination of Colour Attributes

The colour intensity of the samples was measured using a Konica Minolta Colour Measuring System (Chroma Meter CR-410, Minolta LTD Japan).The lightness (L*), redness or greenness (a* or –a*), and yellowness or blueness (b* or –b*) values were obtained after calibrating the instrument using a white tile. Three replicate readings were taken for each samples and the average value were reported. The results were expressed in accordance with the CIE lab system where L* is known as the lightness (L = 0 (black), L = 100 (white), a* (-a = greenness, +a = redness) andb* (-b = blueness, +b = yellowness)

2.7.Textural Analysis of the Chinchin

Texture of the Chinchin samples was determined with the aid of texture analyser (Model CT310K Texture Analyzer, USA).Texture profile analysis was performed on central Chinchin cubes by TPA test with a 3mm cylindrical stainless steel (TA 44 probe).Downward speed was 0.5mm/s and upward speed 0.5mm/s with a trigger load of 4.0g. The relevant textural properties were recorded

2.8.Sensory Evaluation

Sensory evaluation of the chinchin was carried out using a 9-point Hedonic scale. Samples were rated alongside the control sample (100% wheat flour chinchin). All analysis were performed in triplicate.

2.9.Statistical Analysis

The analysis of variance (ANOVA) was performed to examine the significant level in all parameters measured and where this exited, dumcan multiple range test (DMRT) was used to separate means.

3. Results and Discussion

3.1.Pasting Properties of Wheat and Date Flour

The pasting properties of the flour are shown in Table 1. There was significant influence ($p<0.05$) in the pasting properties of samples of flours with increase in the inclusion of date flour. The addition of date flour as natural sugar replacer caused significant reduction in the peak, trough, breakdown, final and setback viscosities, including the cooking time. However, there was increase significant increase in the pasting temperature with increase in the inclusion date flour. The peak viscosity was within the range of values reported for wheat, breadfruit, and cassava starch(Bolarinwa *et al.*, 2015). Trough viscosity is the ability of the phase to withstand breakdown during cooling (Awolu and Oseyemi, 2016). The reduced trough viscosity with increased date flour suggested that the flour blends may not find good application in the food system where high paste stability during cooling is required (Adegunwa *et al.*, 2015; Awolu and Oseyemi, 2016). The values of trough viscosity in this study were higher compared with values reported by Offia-Olua (2014) who worked on chemical, functional and pasting properties of wheat and walnut flour. Trough and breakdown measure how long a food item can withstand high temperatures without experiencing any disruptions (Adebowale et al., 2011; Bolaji et al., 2022). According to Adebowale et al. (2011), Breakdown viscosity of a food material is the capacity to tolerate heat and shear stress during cooking. Shimels *et al.* (2006) reported that final viscosity gives an idea of the ability of a material to gel after cooking. The final viscosities in this study was higher when compared with the values reported by Anosike *et al.* (2020). The Setback values have been reported to correlate with ability of starches to gel into semi solid pastes. This stage involves re-association, retrogradation or re-ordering of starch molecules (Michiyo *et al.*, 2004). The Peak time is a measure of the cooking time. The value of peak time ranged from 5.84-6.84min. The peak time values in this study were similar to that reported for flours made from wheat and okra by Akoja and Coker (2018). Pasting temperature gives an indication of the energy cost for preparing a product (Punia *et al.*, 2019;Abegunde et al., 2014). However did not follow the pattern reported by Bolaji et al. (2022). This decreased with increase in the Date flour inclusion.

3.2. Textural Properties of the Chinchin Produced from Wheat and Date Flour

Textural properties play a significant role in the perception and acceptability of any processed food product (Serdaroglu *et al.*, 2005). The textural properties of the chinchin are as shown in Table 2. The peak force varies from 17770-28398.5g. Obomeghei and Ebabhamiegbebho, (2020) reported range of lower values of peak force for chinchin from orange fleshed sweet potato and red bambara groundnut. According to reports, adhesiveness indicates the first bite's negative force area as well as the effort needed to resist the attraction forces between a food's surface and the surfaces of other objects it comes into touch with (Kasapis, 2009). The values of adhesiveness in this study was lower compared with values reported by Obomeghei and Ebabhamiegbebho, (2020). A product with high cohesive force is more resistant to packaging, production and transportation stresses and so can be delivered to the consumers in the intended state (Texture Technologies, 2016). Gumminess, according to Dar and Light (2014), is the amount of energy needed to break up a semisolid meal into pieces that are ready to swallow. The value of gumminess ranged from 2788-6920. Springiness depends on different agents such as heat treatment, protein interaction, elasticity, and degree of unfolding of protein (Delikanli and Ozcan, 2017). High springiness suggest that more mastication energy will be needed in the mouth when chewing (Rahman and Al-Mahrouqi, 2009). The value of stickiness in this study was higher than (-1.6) – (-3.1) reported by Thara and Nazni (2021) for foxtail millet and semolina incorporated ready to cook upma mix. Stickiness is the important factor that affects the texture of products due to the presence of the soluble fibre content as reported by (Aisoni et al., 2018).

3.3. Functional Properties of Wheat and Date Flour

Table 3 displays the flour's functional attributes. Packed bulk density (PBD) and loose bulk density (LBD) were found to range between 0.54 and 0.69 g/ml and 0.76 and 0.85 g/ml, respectively. Bulk density has important applications in raw material handling, packing, and transportation. It is often influenced by the density and particle size of the flour blend (Adegunwa et al., 2015; Bolaji et al., 2022). However, the low bulk density of the flour blends observed in this study would be of an advantage in the formulation of complementary food (Bolaji et al., 2022). The value of water absorption capacity (WAC) and oil absorption capacity (OAC) ranged from 71.80-114.23 and 41.23-67.33, respectively. Water absorption capacity is the ability of flour to take up water and swell for improved consistency in food. This is usually useful in confectionary products that need hydration to improve handling features (Adegunwa *et al.*, 2014; Oppong *et al.*, 2015; Adeyeye *et al.*, 2020). The water absorption capacity was significantly reduced as the level of date flour substitution increased. Thus, this implies that the addition of date flour may be reduced the reconstitution ability of the composite flour. Folorunsho *et al.* (2018) reported the value (137.63-161.29%) for wheat-date palm fruit flour. These values were higher when compared to this present study. The oil absorption capacity significantly($p<0.05$) reduced as the level of date flour substitution increased. Oil absorption capacity tends to cause an increase in the functionality of product by retaining flavour and improvement on the mouth feel (Akinwale *et al.*, 2017). The value of water absorption and oil absorption capacity in this work were lower when compared with values reported by Abioye *et al.* (2020) who worked on chinchin produced from composite flours of wheat and germinated finger millet flour.

3.4. Proximate Composition of Chinchin Produced from Wheat and Date Flour

The proximate composition of the chinchin is as shown in Table 4. The moisture content varies from 3.29-7.82%. The moisture content observed in this study are within range of values reported by some researchers for snacks from composite flour (Adebayo-Oyetoro *et al.*, 2017; Deedam *et al.*, 2020) however, lower compared with values reported by Bolaji et al. (2022).

Table 1. Pasting properties of Chinchin produced from wheat and date flour

Sample	Peak (cP)	Trough (cP)	Breakdown (cP)	final viscosity (cP)	Setback (cP)	Peak time (min)	Pasting temperature (^{o}C)
FBT	1853.50±149.19^{a}	1541.50±150.61^{a}	312.00±1.41^{a}	1893.00±151.32^{a}	351.50±0.71^{a}	6.84±0.05^{a}	69.03±3.14^{b}
BYT	1405.50±7.78^{b}	1139.50±2.12^{b}	267.00±7.07^{b}	1499.00±8.49 ^{b}	359.50±6.36^{a}	6.73±0.00^{a}	89.08±0.04^{a}
BOD	1101.00±18.38^{c}	869.00±21.21^{c}	232.00±2.82^{c}	1202.50±16.26 ^{c}	333.50±4.955^{b}	6.44±0.05^{b}	89.83±0.04^{a}
FYB	794.00±18.38^{d}	613.00±14.14^{d}	181.00±4.24^{d}	885.00±22.63^{d}	272.00±8.49^{c}	6.27±0.09^{c}	91.20±0.00^{a}
MAO	579.50±27.58^{e}	430.50±21.92^{e}	149.00±5.66^{e}	657.50±30.41^{e}	227.00±8.48^{d}	6.04±0.05^{d}	91.25±0.07^{a}
BOT	337.00±4.24^{f}	243.50±3.54^{f}	93.50±0.71^{f}	386.00±1.41^{f}	142.50±4.95^{e}	5.84±0.05^{e}	90.90±0.28^{a}

*Mean ± standard deviation with same superscripts along the column are not significantly different at (p>0.05)

Table 2. Textural properties of the Chinchin produced from wheat and date flour

Sample	PF	Height	Weight	Adhesiveness	area	Chewiness	Cohesiveness	CF	Gumminess	Resilience	Springiness	Stickiness	Stringiness
FBT	22133.5	13.02	1.50	1.18	77489.29	1135	0.24	22059.5	5380	0.11	0.22	-8.00	2.05
BYT	17770	13.01	0.00	0.58	56331.12	766.50	0.19	17750.5	3593	0.09	0.21	-3.00	0.88
BOD	24731	12.54	0.50	1.60	78123.38	3387	0.11	14622	2788	3.34	1.38	-8.50	1.65
FYB	28398.5	10.76	1.50	4.35	83161.89	3127.50	0.18	21382	5015.5	0.56	0.61	-4.50	1.87
MAO	18680	11.42	11.42	0.47	40272.16	1170	0.30	16995	5548.	0.32	0.27	-4.00	0.41
BOT	21294.5	13.92	0.50	4.84	48486.79	1859	0.32	20198.5	6920	0.34	0.30	-5.00	2.16

KEY: FTB (100%), BYT (90:10), BOD (80:20),FYB (70:30), MOA(60:40) and BOT(50:50)

Table 3. Functional properties of Chinchin produced from wheat and date flour

Sample	LBD (g/mL)	PBD (g/mL)	WAC (%)	OAC ((%)
FBT	0.54±0.00[a]	0.84±0.00[b]	114.23±0.48[a]	67.33±0.04[a]
BYT	0.60±0.00[a]	0.85±0.00[a]	93.75±0.50[b]	63.29±0.01[b]
BOD	0.60±0.00[a]	0.83±0.00[b]	76.00±0.03[d]	58.62±0.16[c]
FYB	0.69±0.00[a]	0.80±0.00[c]	81.20±0.01[c]	53.66±0.01[d]
MAO	0.63±0.00[a]	0.76±0.01[d]	75.69±0.01[d]	51.95±0.07[e]
BOT	0.69±0.19[a]	0.83±0.01[b]	71.80±0.31[e]	41.23±0.35[f]

*Mean ± standard deviation with same superscripts along the column are not significantly different at (p>0.05)

Table 4. Proximate composition of Chinchin produced from wheat and date flour

Sample	MOISTURE (%)	PROTEIN (%)	FAT (%)	FIBER (%)	ASH (%)	CHO (%)
FBT	5.88±0.06[b]	3.42±0.01[f]	24.12±0.03[b]	0.01±0.00[b]	2.94±0.08[ab]	63.65±0.13[b]
BYT	5.81±0.02[b]	3.48±0.03[e]	24.08±0.02[b]	0.01±0.00[b]	3.54±0.62[a]	63.10±0.64[bc]
BOD	7.82±0.44[a]	3.55±0.01[d]	17.58±0.03[c]	0.01±0.00[b]	2.73±0.08[b]	68.33±0.37[a]
FYB	5.87±0.05[b]	3.81±0.01[b]	18.51±0.04[c]	0.49±0.01[a]	2.59±0.01[b]	68.75±0.16[a]
MAO	3.29±0.04[c]	3.92±0.01[a]	27.59±0.01[a]	0.25±0.35[ab]	2.62±0.08[b]	62.34±0.40[c]
BOT	6.20±0.01[b]	3.71±0.01[c]	27.58±0.03[a]	0.01±0.00[b]	2.72±0.01[b]	59.76±0.06[d]

*Mean ± standard deviation with same superscripts along the column are not significantly different at (p>0.05)

KEY: FTB (100%), BYT (90:10), BOD (80:20),FYB (70:30), MOA(60:40) and BOT(50:50)

The relative low moisture content of product below 13% may aid longer shelf-life, if stored under low relative humidity. There was significant difference (P<0.05) in the value of protein. The result showed that the addition of date flour aided an increase in the protein content of the samples and this suggested that the chinchin produced from wheat and date blend could provide additional protein to consumers in developing countries where many can hardly afford costly sources.

The values of protein in this study was lower when compared with values reported by Deedam *et al.* (2020) for chinchin developed from wheat and African walnut flour blends. However still relevant compared with the recommended daily allowance (RDA) for adults, adolescents and children which is 0.8, 1.0 and 1.5 g protein/kg, respectively (Kafatos and Hatzis, 2008).

The findings in this work revealed that the consumption of about 100g of the Chinchin produced from wheat-date flour blend in this study will provide adequate amount of daily protein needed in the body. The value of fat varies from 17.58-27.59%. There was significant difference (p<0.05) among the samples. The values of fat in this study are comparable with the value reported by Adebayo-Oyetoro *et al.* (2017) for chinchin from wheat-tigernut flour blends. While the crude fibre were significantly influenced by date flour inclusion. The crude fibre values obtained in this work were within the range of recommendation -5% (Ndife *et al.*, 2020). The value of ash obtained ranged from 2.59-3.54%. Value recorded for sample FYB was significantly different (p<0.05) from other samples and however all higher than values reported by Baljeet *et al.* (2014).The carbohydrate contents of the chinchin samples from composite flours of varying wheat-date flour blends were within values reported by some researchers (Adegunwa *et al.*, 2014; Adebayo-Oyetoro, 2017; Adeyeye *et al.*, 2020)

3.5.Mineral Composition of Chinchin Produced from Wheat and Date Flour

Table 5 presents the mineral makeup of the chinchin. A noteworthy variation ($p<0.05$) was seen in the mineral makeup of the chinchin samples. Fasogbon et al. (2017) found that chinchin made with wheat encriched with leftover veggies had a greater calcium content. The presence of egg, milk, and margarine among other preparation-related components may have contributed to the high magnesium content of chinchin. The recommended dietary allowance of magnesium for an adult and children are 350 and 170 mg/day, respectively (Akindele *et al.*, 2017). The values of iron were within 5.21 and 6.55 mg/100g. According to Mason (2008), the recommended dietary allowance of iron for men and postmenopausal women was 8 mg/day, while 11, 15 and 30 mg/day were recommended for adolescents, premenopausal women and pregnant women, respectively. This present study showed that these chinchin can supply the daily recommended iron in the diet, most especially when about 200g of the product is consumed daily. The value of sodium ranged from 117.50-138 mg/100g. The results showed that chinchin produced from composite flour of wheat and date flour had higher value of sodium when compared to the control. The value of zinc (0.02-0.05 mg/100g) revealed that these chinchin samples can be consumed without exceeding the maximum Zinc limit daily intake level, since the upper level of Zinc intake according to FAO/WHO is 60 mg/day (Sarikurkcu *et al.*, 2015). The results revealed that the addition of date flour contributes to the increase in phosphate content. Hence, the chinchin produced could be a good source of phosphate.

Table 5. Mineral composition of Chinchin produced from wheat and date flour

SAMPLE	CALCIUM (mg/100g)	MAGNESIUM (mg/100g)	IRON (mg/100g)	SODIUM (mg/100g)	ZINC (mg/100g)	PHOSPHATE (mg/100g)
FBT	117.25±0.35^{a}	36.01±0.01^{a}	6.55±0.07^{a}	117.50±3.54^{c}	0.02±0.01^{c}	42.50±3.54^{b}
BYT	115.49±1.00^{ab}	35.01±0.01^{ab}	5.88±0.03^{b}	130.50±0.71^{ab}	0.03±0.01^{bc}	52.50±3.54^{ab}
BOD	114.69±1.69^{b}	33.50±0.00^{b}	5.63±0.04^{c}	122.50±3.54^{bc}	0.02±0.00^{bc}	52.50±3.54^{ab}
FYB	114.94±0.06^{b}	34.72±1.44^{ab}	5.76±0.08^{bc}	122.50±3.54^{bc}	0.03±0.00^{b}	60.00±7.07^{a}
MAO	109.35±0.64^{c}	33.77±0.01^{b}	5.68±0.11^{c}	126.00±5.66^{bc}	0.05±0.01^{a}	55.00±0.00^{a}
BOT	105.23±0.32^{d}	35.00±0.00^{ab}	5.21±0.01^{d}	138.50±2.12^{a}	0.05±0.01^{a}	52.50±3.54^{ab}

*Mean ± standard deviation with same superscripts along the column are not significantly different at ($P>0.05$)

3.6. Colour Properties of Chinchin Produced from Wheat and Date Flour

Table 6 indicates the chinchin's colour characteristics. The range of the L* value was 18.38–38.19.

A statistically significant ($P<0.05$) variation was seen in the reported values for the samples. As the ratio of date flour grew, the value of L* decreased.

This demonstrated that the samples' inclination to become lighter was greatly diminished by the addition of date flour.

A* has a value between 0.63 and 1.95. As the date flour replacement level grew, so did the a (redness) values.

The range of values for b* was 5.91 to 16.46. As the date flour replacement level increased, the b (yellowness) values declined.

This work revealed colour which is one of the first property that consumers considers in accessing and assessing for will be critical in the chinchin produced from these samples (Kumar *et al.*, 2012).

Table 6. Colour properties of Chinchin produced from wheat and date flour

Sample	L*	a*	b*	ΔE
FBT	$38.19{\pm}0.14^{a}$	$0.63{\pm}0.23^{d}$	$16.46{\pm}0.32^{a}$	$42.95{\pm}0.14^{a}$
BYT	$32.14{\pm}0.18^{b}$	$1.06{\pm}0.02^{c}$	$13.51{\pm}0.35^{b}$	$32.46{\pm}0.83^{b}$
BOD	$29.67{\pm}0.08^{c}$	$1.27{\pm}0.04^{bc}$	$10.42{\pm}0.21^{c}$	$26.93{\pm}0.63^{c}$
FYB	$26.66{\pm}0.74^{d}$	$1.41{\pm}0.12^{b}$	$7.58{\pm}0.34^{d}$	$17.92{\pm}0.04^{d}$
MAO	$23.55{\pm}0.47^{e}$	$1.71{\pm}0.02^{a}$	$6.52{\pm}0.66^{e}$	$15.32{\pm}0.46^{e}$
BOT	$18.38{\pm}1.07^{f}$	$1.95{\pm}0.06^{a}$	$5.91{\pm}0.02^{f}$	$11.97{\pm}1.34^{f}$

*Mean ± standard deviation with same superscripts along the column are not significantly different at ($P>0.05$)

Table 7. Sensory scores of chinchin produced from wheat and date flour

Sample	Taste	Appearance	Flavour	Colour	Overall Acceptability
FBT	$7.50{\pm}1.27^{a}$	$6.80{\pm}0.79^{a}$	$7.90{\pm}1.29^{a}$	$8.80{\pm}1.03^{a}$	$8.00{\pm}0.82^{a}$
BYT	$6.91{\pm}1.68^{b}$	$6.78{\pm}1.54^{a}$	$6.75{\pm}1.21^{b}$	$6.55{\pm}1.82^{b}$	$7.88{\pm}1.45^{b}$
BOD	$6.75{\pm}1.38^{bc}$	$6.65{\pm}1.23^{b}$	$6.58{\pm}1.42^{c}$	$6.25{\pm}1.52^{bc}$	$7.20{\pm}1.49^{bc}$
FYB	$6.69{\pm}1.66^{c}$	$6.55{\pm}1.61^{b}$	$6.60{\pm}1.47^{c}$	$6.20{\pm}1.67^{bc}$	$6.65{\pm}1.23^{bc}$
MAO	$5.61{\pm}1.43^{d}$	$6.00{\pm}1.14^{c}$	$6.42{\pm}1.09^{d}$	$6.45{\pm}1.39^{b}$	$5.86{\pm}1.63^{c}$
BOT	$4.55{\pm}1.27^{e}$	$4.85{\pm}1.04^{d}$	$4.86{\pm}1.63^{e}$	$4.15{\pm}1.73^{d}$	$4.65{\pm}1.26^{d}$

*Mean ± standard deviation with same superscripts along the column are not significantly different at ($p>0.05$)

3.7. Sensory evaluation of Chinchin Produced from Wheat and Date Flour

All sensory parameters examined showed a significant change ($P<0.05$). Table 7 presents the sensory properties of the chinchin. The more date flour added, the worse the panelists' scores were for flavor and color. Sample BOT was ranked lower than all the other samples, with a taste that varied from 4.55-7.50. This was due to the effect that a larger amount of date fruit flour had on the appearance. The results of this study demonstrated that, with the exception of sample BOT, which had its color affected by the significant amount of date flour employed, most of the samples were favored by the panelists.

4.Conclusion

The study showed that utilization and possibility of date flour in preparation of chinchin improved the quality attributes of the product in terms of protein, fibre, and mineral contents. The pasting properties, textural characteristics, water absorption capacity, oil absorption capacity, bulk density, were all affected by the increased in the substitution of date flour. The scores for organoleptic attributes: taste, colour, flavour, appearance and overall acceptability were generally acceptable. The appearance and colour of the chinchin were impacted by the level of date flour inclusion. Chinchin produced from wheat flour substituted with date, sample FYB (90% Wheat flour; 10% Date Flour) compared favourably well with chinchin produced from 100% wheat flour in all sensory attributes.

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Authors' contributions

Dr. Bolaji Olusola Timothy: initiated ideas, concept and research design, project planning and execution, finance, statistical analysis, manuscript draft, editing and review the final manuscript for publication; Akeju Mary Tomisin: finance, experimental analysis, data/evidence collection, data curation and research report; Apotiola Zaccheaus Olasupo: project planning, validation, prepared the draft research report.