FUNCTIONAL AND SENSORY QUALITIES OF COOKIES AND CHINCHIN PRODUCED FROM WHEAT-DATE FRUIT FLOUR BLENDS

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Abstract
Date fruit contains more than 70% sugar mainly glucose and fructose and therefore making it an ideal replacement for sugar (sucrose) in the confectionery recipe. The study investigated the sensory qualities of cookies and chinchin produced from wheat-date fruit flour blends. 30g and 40g of date palm fruit flour were separately blended with 100g of wheat flour while 30g of refined sugar was blended with 100g of wheat flour and serves as control sample. The functional properties of flour blends were analysed while sensory properties of cookie and chinchin produced from flour blends were assessed using standard methods. The data showed that functional properties of flour blends were significantly different which ranged for water absorption capacity (137.63 – 161.29%), oil absorption capacity (131.68 – 170.33%), bulk density (0.55 – 0.65g/ml), foaming capacity (13.86 – 16.31%), foaming stability (45.51 – 50.66%), emulsification activity index (12.35 – 16.53%), gelatinization (70.25 – 72.91 ^{O}C), pH (5.43 – 6.54) and swelling index (10.80 -13.54%). Also, the values of sensory properties ranged from 6.83 – 8.33, 6.43 – 7.70, 6.60 – 8.00, 6.27 – 7.70 and 6.80 – 8.20 for colour, flavour, taste, texture and overall acceptability respectively. The cookies produced from 100g wheat flour and 30g date palm fruit flour blend was most acceptable in terms of colour while chinchin produced from 100g wheat flour and 40g date palm fruit flour blend was most acceptable in term of flavour, taste and overall acceptability. The study showed that date palm fruit flour improved bulk density, foaming capacity, foaming stability, emulsification activity index and gelatinization temperature of the flour blends and acceptable cookie and chinchin could be produce from wheat-date palm fruit flour blends especially when blending 100g of wheat flour with 30g or 40g of date palm fruit flour.

Keywords: Functional Properties, flour blends, Sensory qualities, date palm fruit, snack

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1. INTRODUCTION

The date palm (*Phoenix dactylifera l*) fruit is a drupe in which an outer fleshy part consists of pericarp and pulp surrounding a shell of hard endocarp with a seed inside (Farheena et al., 2015). They are mainly consumed fresh or dried. Dry or soft dates are eaten out of hand, or may be pitted and stuffed with fillings such as almonds, walnuts, pecans, candied orange and lemon peel, tahini, marzipan or cream cheese. Date palm fruit is locally called "debino" in Hausa language, from the family of Arecaceae (Al-daihan & Bhat, 2012). Sugar is an important ingredient in the preparation of enumerable sweets. It has many functional properties in foods such as bulking agent, preservative, texturizer, humectant, dispersing agent, stabilizer, fermentation substrate, flavour carrier, browning agent and decorative agent (Pai, 2006). In the recent years there has been a lot of concern about the excessive consumption of sugar, and its effect on health. Scientific evidence demonstrates that excessive added sugar increases the risk of overweight, obesity, cardiovascular diseases, dyslipidemia, high blood pressure, tooth decay, nutrient deficiencies, and may cause hyperglycaemia and hyperactivity in children and in sensitive people (Lustig et al. 2012). The World Health Organization recommends limiting added sugar intake to <10% of total energy (World Health Organization, 2003). The food guide from the United States Department of Agriculture (USDA) recommends consumption of added sugar in the range of 6 to 10% of total energy.

To minimize the intake of added sugar, and enjoy the delicious sweet taste, many sugar substitutes are available for use in baking especially in a situation where low-calorie alternative may affect positively a medical condition such as diabetes where sugar consumption is severely limited. 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. Dates provide a wide range of essential nutrients, and are very good source of dietary potassium (Al farsi and Lee, 2008b; Besbes et al., 2010; Nehdi et al., 2010). The remainder consists of protein, fibre, and trace elements including boron, cobalt, copper, iron fluorine, magnesium, manganese, selenium, and zinc (Al-shahib &Marshall, 2003; Dada et al., 2012; Farheena et al., 2015). Fruits are an important supplement to the human diet as they provide carbohydrate, essential minerals, vitamins, fibre (roughage) and phytochemicals etc. required for maintaining health and are therefore, referred to as protective foods (Srivastava & Kumar, 2002). Since excessive consumption of confectionery sweetened with refined sugar has been found to cause a lot of health hazards like obesity, type 2 diabetes and tooth decay. When refined sugar are taken it immediately goes into the blood stream and as a result of this, it elevate the blood sugar level which directly increase insulin production that can lead to many health related problems like hyperglycemia (Mcwilliam, 2006). Some natural alternatives to white sugar for bakery products namely raw honey, maple syrup, molasses, corn syrup, stervia, xylitol, agava nectar, brown rice syrup, evaporated cane juice, black strap molasses, date sugar and organic sugar have been reported by Anon (2010) and Khan (2010). Khan (2010) reported that one cup of date sugar is equivalent to one cup of granulated or brown sugar. Date palm fruit has been found to contain dietary fibre (Hamza et al., 2014) (8g in 100g of date) (USDA nutrient data base) which lower the absorption of sugar into the blood and as a result of this, prevent any health hazard that could be caused by sugar. Dates fruits play an important role in the diet and treatment of obesity (Al shahib & Marshall, 2003b). The proteins in dates contain 23 types of amino acids, some of which are not present in the most popular fruits such as oranges, apples and bananas. Dates contain six vitamins including small amounts vitamin A, vitamin C, thiamine, riboflavin, nicotinic acid (niacin) which is an excellent cure for intestinal disturbance. (Al shahib & Marshall, 2003a). Regular consumption of date has been found to check the growth of pathological organisms and help in the growth of friendly bacteria in the intestine. Due to the amount of dietary fibre present in date it can be used as a laxative for those suffering from constipation (Al shahib & Marshall, 2002). Researches have also revealed selenium and other element present in date fruit is effective in preventing abdominal cancer and important in immune functions. Date also contains elemental fluorine that is useful in protecting teeth against decay (Al shahib & Marshall, 2003). It should be noted that date palm fruits is nutritious and excessive consumption of refined sugar has been linked with several health hazards. Since date palm fruit is nutritious and contained natural sugar, date palm fruit flour could serves as alternative and substitute for refined sugar in the production of snacks. The study is aimed to blend date palm fruit flour with wheat flour and assess the sensory acceptability of the snacks (cookie and chinchin) produced from the blends.

2. MATERIALS AND METHODS

2.1 Materials Sources

The date palm fruit was procured from Iwo, Osun state. Other ingredients for chin-chin and doughnut such as flour, margarine, eggs, salt, vegetable oil and baking powder were procured at new market in Ile-Ife, Osun state.

2.2 Production of Date fruit flour (Date sugar)

The date fruits was sorted out and washed to remove dirt and unwanted materials. Afterward, the date fruits was deseeded (de pitting) manually and cut into small pieces with the aid of knife, cleaned and weighed. The pulp with the pericarp was then dried in hot air oven at 60°C for 72hours and was subsequently milled into flour with a blender and sieved through a 0.35mm mesh sieve to obtain flour (Figure 1). The date palm flour was sealed in an airtight container and stored at room temperature.

2.3 Blending of wheat flour with date flour

The date flour was mixed with the wheat flour using standard recipe for sugar-flour in production of chinchin and cookies. The sample was mixed in ratio 100g (wheat flour: 30g (date flour), 100g (wheat flour): 40g (date flour) and 100g (wheat flour): 30g (refined sugar) which was their control.

2.4. Preparation of chinchin and cookies with date flour blends

The method described by Ballesteros and Enrique (2012) with minor modification was used for the preparations of chin-chin while the method described by Lai & Lin (2006) with minor modification was used for the preparation of cookies.

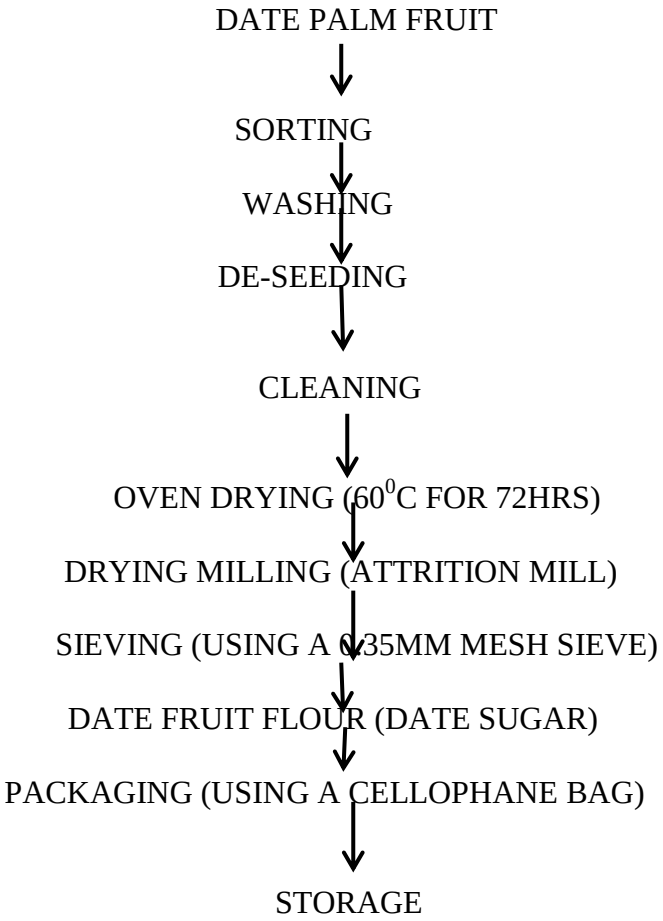

Fig. 1: Flow chart for production of date fruit flour

Source: Manickavasagan (2012)

Recipe for the preparation of standard chinchin

Ingredients used for the production of chinchin are 100g flour, 30g refined sugar, baking powder, 2 eggs, 1 teaspoon vanilla, ½ cup milk, ½ cup margarine and ½ tea spoon salt.

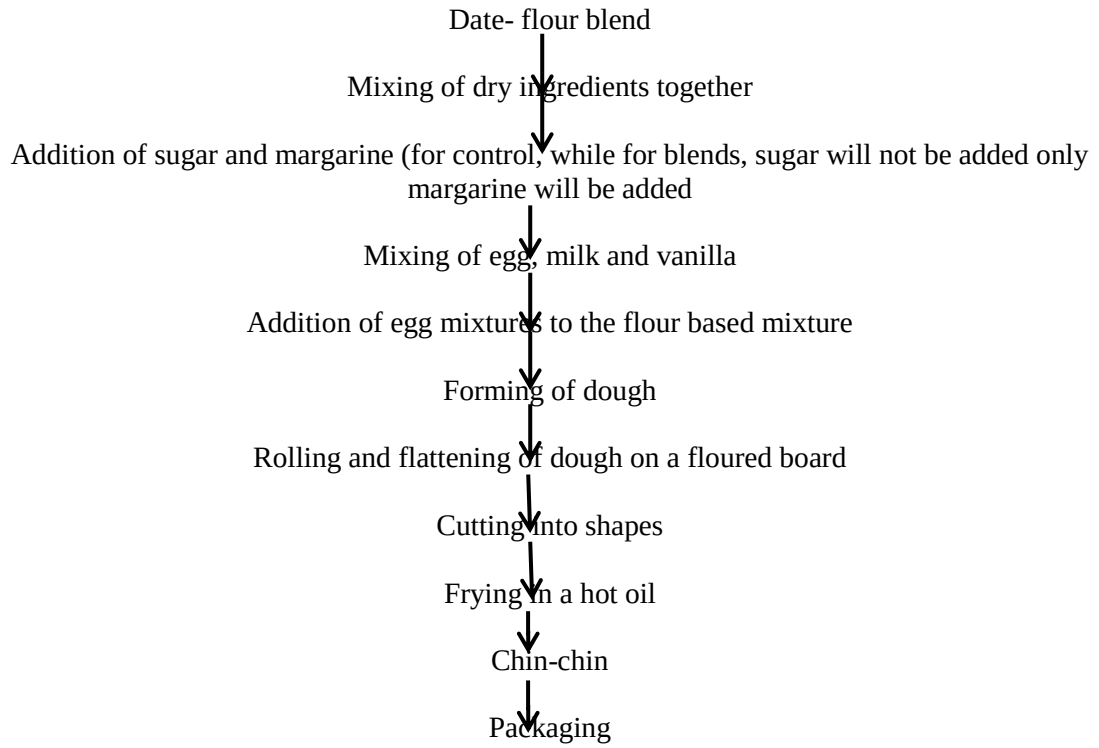

Fig. 2: Flow chart for production of chinchin

Source: Ballesteros and Enrique (2012) with minor modification

Recipe for preparation of standard cookies. Standard ingredients to be used for the cookies are 100g flour, 2g salt, 40g margarine, 2g baking powder, 70g eggs, ½milk, 30g sugar and ½ cup of water.

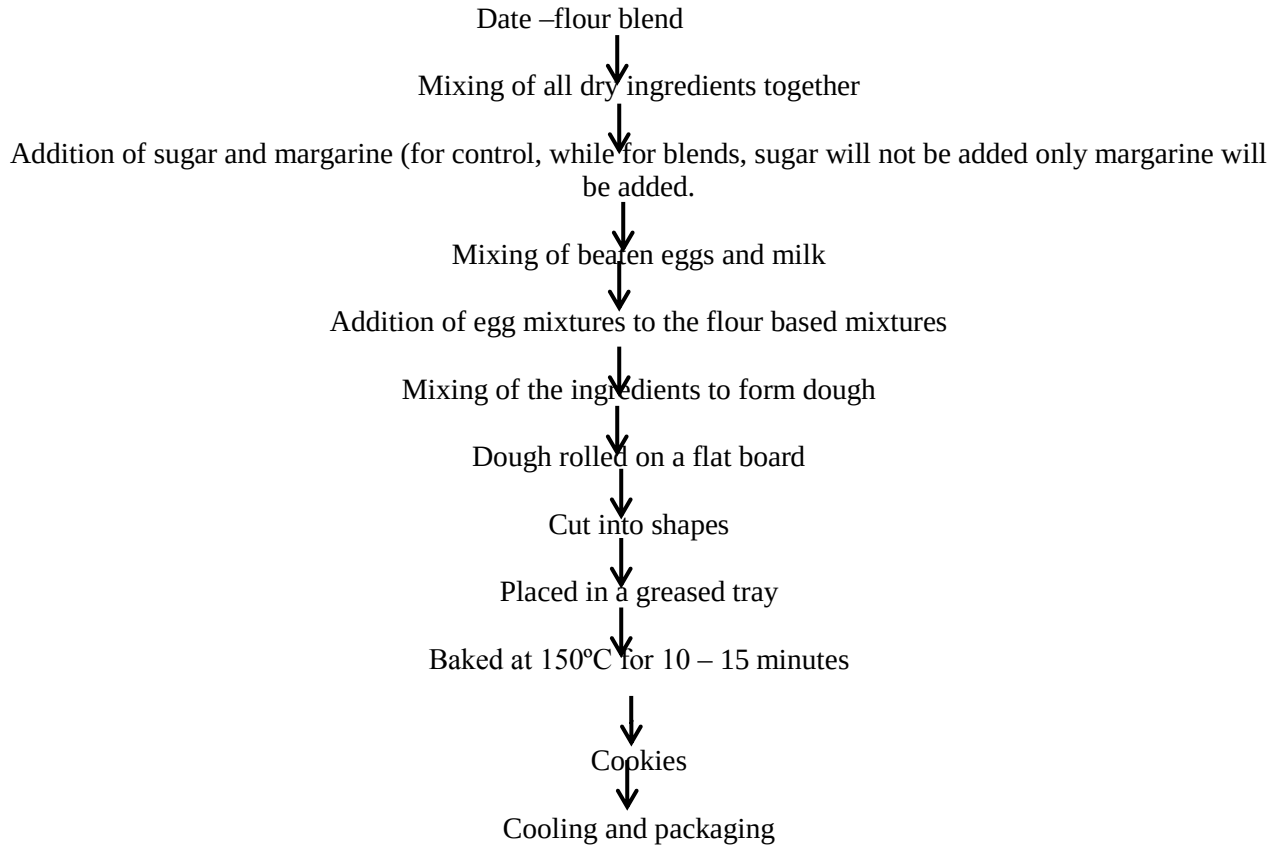

Fig. 3: Flow chart for the production of cookies

Source: Lai and Lin (2006) with minor modification

2.5 Determination of functional properties of date flour blends

The methods described by AOAC (2006) were used to determined water absorption capacity, oil absorption capacity, emulsification capacity, foaming capacity and stability. The methods described by Matthew et al. (2015) were used to determined pH and Gelatinization temperature while bulk density and Swelling index was determined by method described by Nwosu (2013) and Ukpabi and Ndimele (2000) respectively.

2.6 Sensory Evaluation Test

Sensory evaluations of the samples were carried out in the Food and Nutrition Laboratory, Department of Family Nutrition and Consumer Sciences. The six different samples were evaluated by using a 9-point hedonic scale described by Iwe (2002). The samples were presented to a 50-member panelists who was regular eaters of chin-chin and cookie in campus of Obafemi Awolowo University, Ile Ife to rate the sample on the hedonic scale where 9 was maximum and 1 was minimum. The samples were scored for the colour, flavour, taste, texture and overall acceptability. The panelists were instructed to rinse their mouth thoroughly with water after testing the sample before the next sample, to prevent the taste of sample from affecting one another.

2.7. Statistical Analysis

The data generated from the study were analyzed by analysis of variance (ANOVA) to find out whether there is any significant difference among the samples. Means were separated by fishers less significant difference (LSD) and the comparison *was* carried out using Tukey's test.

3.0 RESULT AND DISCUSSIONS

3.1 Functional properties of wheat-sugar flour blend and wheat-date palm fruit flour blends

Table 1 shows the functional properties of wheat-sugar flour blend and wheat-date palm fruit flour blends. The functional properties of flour blends were significantly different which ranged for water absorption capacity (137.63 – 161.29%), oil absorption capacity (131.68 – 170.33%), bulk density (0.55 – 0.65g/ml), foaming capacity (13.86 – 16.31%), foaming stability (45.51 – 50.66%), emulsification activity index (12.35 – 16.53%), gelatinization (70.25 – 72.91 ^{O}C), pH (5.43 – 6.54) and swelling index (10.80 -13.54%). The higher the date palm flour in the blends led to decreases in the water absorption capacity, oil absorption capacity and swelling index while it led to increases in bulk density, foam capacity, foam stability, emulsification activity index and gelatinization. Water absorption capacity decreased with increased date palm fruit flour. That it, it decreased from 161.29% (wheat-refined sugar blends) to 137.63% (100g wheat flour-40g date palm fruit flour). The significant differences ((P<0.05)) in water absorption capacity values of the flour blends could be attributed to the quantity of the date palm fruit flour in each sample. The reduction in water absorption capacity values could be due to the low protein content of the date palm (2.3 to 5.6%) as reported by Abdel Moneim et al. (2012). Madu (2007) reported that water absorption capacity enables bakers to add more water to dough and so improve handling characteristics and maintain freshness of the baked products. This showed that the addition of date palm fruit flour to wheat flour increased the sugar and protein contents which significantly reduced the water absorption capacity of the wheat flour blends thereby making the dough handling very difficult. The oil absorption capacity values of samples also decreased from 170.33% (wheat-refined sugar blends) to 131.68% (100g wheat flour-40g date palm fruit flour) as date palm fruit flour increased. This result is in contrast with value reported by Peter et al. (2017), who reported high oil absorption capacity, in 50% whole wheat flour and 50% date palm pulp in the production and evaluation of cookies. The bulk density of the flour blends increased significantly with flour blends (100g wheat flour-40g date palm fruit flour) having the highest value (0.65g/ml). Oladele and Aina (2009) reported that low bulk density of flour to be useful for food formulation since its products have less retrogradation. The bulk density values for wheat-date palm fruit flour blends are in line with values reported for

defatted date seed (0.6g/ml), tiger nut flour samples (0.55–0.62 g/ml) and African bread fruit seed flour (0.54 g/ml) by Akasha (2014), Oladele and Aina (2007) and Akubor and Badifu (2004) respectively. Foaming capacity and foam stability were significantly increased as level of date palm fruit flour increased. Foaming capacity was significantly increased from 13.86% (wheat-refined sugar blends) to 16.31% (100g wheat flour-40g date palm fruit flour) as date palm fruit flour increased. The high foaming capacity of the wheat-date palm fruit flour could be due to the higher protein content of the blends as Kaushal et al. (2012) reported that protein in the dispersion may cause a lowering of the surface tension at the water air interface, thus always been due to protein which forms a continuous cohesive film around the air bubbles in the foam. The emulsification activity index of flour blends increased significantly as palm fruit flour increases with 100g wheat flour-40g date palm fruit flour (16.53%) having the highest value while the wheat-refined sugar flour (12.35%) had the lowest value. The addition of date palm fruit flour had varied effects on emulsifying capacity of flour blends. Wheat-refined sugar blends had the least gelatinization temperature (70.25^{o}C) while 100g wheat flour-40g date palm fruit flour blend had the highest gelatinization temperature (72.91^{o}C). The pH and swelling index of the flour blends decreased as level of date palm fruit flour increases with 100g wheat flour-40g date palm fruit flour blend had least value. This showed that the addition of more quantity of date palm fruit to wheat flour reduced the pH of the flour blends.

3.2 **Sensory properties of cookie and chinchin produced from wheat-date palm fruit flour blends.**

Table 2 shows sensory properties of cookie and chinchin produced from wheat-date palm fruit flour blends. The values of sensory properties ranged from 6.83 – 8.33, 6.43 – 7.70, 6.60 – 8.00, 6.27 – 7.70 and 6.80 – 8.20 for colour, flavour, taste, texture and overall acceptability respectively. Colour attribute is a major criterion that affects the quality of the baked products.

Colour is a very important parameter in judging properly baked cookies that not only reflect the suitable raw materials used for the preparation but also provides information about the formulation and quality of the product (Ikpeme et al., 2010). The colour of the cookies and chinchin produced from wheat-date palm fruit flour blends were darker and more preferred by the panelists, since the values of the colour of the cookies and chinchin ranged from 6.83 (like moderately like) to 8.33 (like very much). The darker colour of the cookies and chinchin could be due to high carbohydrate content of flour blends which reacted with heat during baking and frying, hence gives the cookies and chin-chin acceptable colour. The values of flavour of the cookies and chinchin ranged from 6.43 (like slightly) to 7.70 (like very much) while the values of taste ranged from 6.60 (like slightly) to 8.00 (like very much). The results obtained showed that addition of date palm fruit flour to wheat flour increased the flavour of the snacks. The values of texture of the cookies and chinchin ranged from 6.27 (like slightly) to 7.7 (like very much) while the values of overall acceptability ranged 6.80 (like moderately) to 8.20 (like very much). It should be noted that the cookies produced from 100g wheat flour and 30g date palm fruit flour blend was most acceptable in terms of colour while the chinchin produced from the two flour blends were most acceptable in terms of texture. Also, the chinchin produced from 100g wheat flour and 40g date palm fruit flour blend was most acceptable in term of flavour, taste and overall acceptability. The result of overall acceptability of the cookie and chinchin is line with Peter *et al*. (2017) who reported high general acceptability in 20% and 40% of date palm pulp substitution in cookies production.

TABLE 1: FUNCTIONAL PROPERTIES OF SUGAR-FLOUR BLEND AND DATE PALM FRUIT -FLOUR BLENDS

Sample	Water absorption capacity (%)	Oil absorption capacity (%)	Bulk density (g/ml)	Foaming capacity (%)	Foaming stability (%)	Emulsification activity index (%)	Gelatinization (^{O}C)	pH	swelling index (%)
100:30S	161.29^{a}±2.05	170.33^{a}±1.25	0.55^{c}±0.01	13.86^{c}±0.18	45.51^{a}±0.81	12.35^{a}±0.55	70.25^{a}±0.36	6.54^{a}±0.01	13.54^{a}±0.5
100:30D	142.68^{b}±0.77	151.14^{b}±1.12	0.59^{b}±0.02	15.00^{b}±0.04	48.70^{b}±0.55	13.69^{b}±0.57	72.35^{b}±0.26	5.91^{b}±0.01	11.46^{a}±0.48
100:40D	137.63^{c}±0.53	131.68^{c}±1.51	0.65^{a}±0.02	16.31^{a}±0.5	50.66^{c}±0.55	16.53^{c}±0.48	72.91^{b}±0.06	5.43^{c}±0.01	10.80^{b}±0.16
LSD (p<.05)	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**

Samples with different superscripts within the same column were significantly ($p<0.05$) different
Mean and standard deviation of three determinations
100:30S = 100g wheat flour and 30g of refined sugar
100:30D = 100g wheat flour and 30g of date palm fruit flour
100:40D = 100g wheat flour and 40g of date palm fruit flour

Table 2: Sensory attributes of cookies and chinchin produced from wheat-date palm fruit flour blends

Sample	Colour	Flavour	Taste	Texture	Overall appearance
WDF_1	8.33±0.88^{a}	7.60±0.93^{a,b}	8.00±0.91^{a}	7.57±1.07^{ab}	8.20±0.89^{a}
WDF_2	7.23±1.30^{bc}	6.53±1.14^{c}	6.60±1.22^{b}	6.63±1.22^{bc}	7.00±0.95^{c}
WDF_3	7.10±1.27^{c}	6.67±1.21^{bc}	6.87±1.33^{b}	6.27±1.39^{c}	6.97±1.19^{c}
WDF_A	8.03±0.85^{ab}	7.70±1.39^{a}	7.90±1.18^{a}	7.70±1.15^{a}	7.87±0.97^{ab}
WDF_B	6.83±1.18^{c}	6.43±1.43^{c}	6.73±1.39^{b}	6.67±1.32^{bc}	6.80±1.24^{c}
WDF_C	6.87±1.43^{c}	6.93±1.57^{a,bc}	6.93±1.55^{b}	6.67±1.47^{bc}	7.10±1.42^{bc}
LSD (p=0.05)	0.001	0.001	0.001	0.001	0.001

Samples with different superscripts within the same column were significantly different ($p<0.05$)
Mean and standard deviation (n=50)
Samples = WDF_1= 100g wheat flour and 30g refined sugar cookies
WDF_2 = 100g wheat flour and 30g date palm fruit flour cookies
WDF_3 = 100g wheat flour and 40g date palm fruit flour cookies
WDF_A= 100g wheat flour and 30g refined sugar chin-chin
WDF_B = 100g wheat flour and 30g date palm fruit flour chin-chin
WDF_C = 100g wheat flour and 40g date palm fruit flour chin-chin

Pictures showing processes involve in production of date fruit powder

De-pitting of Date fruit (date before drying)

Date fruit after oven-dried

Date after milling (date powder)

4. CONCLUSION

The study showed that wheat-date palm fruit flour blends have better functional properties. Inclusion of date palm fruit flour improves bulk density, foaming capacity, foaming stability, emulsification activity index and gelatinization temperature of the flour blends. The study revealed that acceptable cookie and chinchin could be produce from wheat-date palm fruit flour blends especially blending 100g of wheat flour with 30g or 40g of date palm fruit flour.

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