

# Quality Improvement of Biscuits using Citrus Peels and Date Palm Fruits

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## ABSTRACT

**Background:** Several studies have been made on the use and function of citrus rind and date fruit and it has been found that they are healthy foods.

**Objective:** To develop a healthy biscuit incorporated with citrus peels and date fruit powders and also to determine the nutritional composition and sensory quality of the biscuits samples.

**Material and Methods:** Experimental method was used to produce four samples of biscuits using 10% of three different citrus peels (orange, tangerine and lemon) with date flour blends and the control sample with refined sugar. Production of biscuit samples was done under the same conditions. Proximate and mineral contents were determined using standard methods. Sensory attributes were also evaluated using 50 panelists selected among staff and students of Obafemi Awolowo University, Ile-Ife, using a nine point hedonic scale.

**Results:** Results showed that the biscuits samples produced with 10% lemon peel powder had the highest protein ( $18.15 \pm 0.05\%$  DM), ash ( $2.32 \pm 0.02\%$  DM), calcium ( $8.95 \pm 0.00\text{mg}/100\text{g}$ ), potassium ( $60.14 \pm 0.01\text{mg}/100\text{g}$ ) and sodium ( $62.06 \pm 0.02\text{mg}/100\text{g}$ ) contents and biscuits sample containing 10% orange peel powder had the highest fiber ( $2.64 \pm 0.02\%$  DM) content. The results of the Sensory analysis showed that the biscuits containing 10% lemon peel powder was rated the highest in color ( $7.88 \pm 1.32$ ), flavor ( $7.68 \pm 1.28$ ), texture ( $7.72 \pm 1.31$ ) and overall acceptability ( $7.60 \pm 1.73$ ).

**Conclusion:** The incorporation of wheat biscuits with 10% citrus peels powder and 30g date powder indicated an enhanced nutritional value.

**Keywords:** Nutritional, snack, biscuits, pectin, citrus peels

## INTRODUCTION

Dietary fibers can be obtained from foods such as vegetables, fruits, nuts and seeds, legumes, whole grains. Citrus is also a good source of fiber and exhibits 25-75% fiber content, although citrus fruits are mainly used for juice, oil and pectin production and are underutilized sources for dietary fiber and antioxidants. The amount of residue obtained from citrus fruits amounts to about 50% of the original amount of whole fruit (1). Citrus is one of the most popular world fruit

crops, containing active phytochemicals that can protect health. In addition to this, it provides ample supply of vitamin C, folic acid, potassium and pectin. The contribution of citrus species in deterrence of life-threatening diseases have been accessed and it has been reported that citrus fruits, citrus fruits extracts and citrus flavonoids exhibit a wide range of promising biological properties due to their phenolic profile and antioxidant properties (2).

Dietary fiber is considered as one of the food ingredients with a significant contribution to health. It refers to the part of fruits, vegetables, crops, nuts and legumes that cannot be digested by the human body. Consumption of dietary fiber plays a vital role in the prevention, reduction and treatment of chronic diseases such as bowel, gastro-intestinal disorders, obesity, diabetics, cardio-vascular diseases, cancer and also promotes physiological functions such as lowering blood triglycerides and glucose control (3). Dietary fiber may reduce insulin secretion by slowing the rate of nutrient absorption following a meal, a property that is particularly associated to the soluble fraction of fiber. Fractions of dietary fiber include; cellulose, lignin, pectin, hemicellulose, gums and mucilage but all are categorized in soluble and insoluble fibers.

Recent epidemiological studies have shown that the consumption of whole wheat grains and whole wheat flour sometimes called graham flour and grain-based products is associated with the reduced risk of oxidative stress related to chronic diseases and age-related disorders, such as cardiovascular diseases, carcinogenesis, type II diabetes and obesity (4).

The popular diet known to control such chronic disease is fiber. The consumption of a high fiber diet, replacement of sugar (sucrose) and reduction of salt would go a long way in the fight against coronary diseases. In a study conducted by (5), it was reported that an increase in the daily consumption of soluble fiber by 3g reduced the health risk of coronary death by 27%. The citrus peel is considered as having certain properties which makes the gastro intestinal tract function well and it is excellent for the diabetic and obese patient as well. Besides the nutritional aspect, it is having the affordable aspect as well (6).

The major component of dates are carbohydrates (mainly the sugars; sucrose, glucose, and fructose), which may constitute about 70%. The sugars in dates are easily digested and can immediately be moved to the blood after consumption and can quickly be metabolized to release energy for various cell activities (7). Dates are also a good source of fiber, and contain many important vitamins and minerals, including significant amounts of calcium, iron, fluorine, and selenium (7, 8, 9, 10, 11, and 12). Dates have also been shown to contain antioxidant and antimutagenic properties. Recent studies have shown that dates and their aqueous extracts have demonstrated the free radical scavenging activity, inhibition of free radical-mediated macromolecular damages, anti-mutagenic, and

immuno-modulatory activities (13, 11, 14, and 15).

Biscuits are consumed by a wide range of population, due to its ready-to-eat nature, long shelf life and relatively affordable cost. High competitions in the market and increased awareness by the consumers for healthy and quality products of nutritive value and safety has led to the modification of some bakery products, such as biscuits.

Date fruit contains more than 70% sugar mainly glucose and fructose and therefore are high energy food sources (8), thus making it an ideal replacement for sugar (sucrose) in the biscuit recipe, which is also of great nutritional benefit to diabetics and other metabolic health related patients. Besides, date fruit is rich in fiber (16), very rich in antioxidant flavonoids such as beta-carotene, lutein and zeaxanthin. This research was therefore aimed at:

- i. To determine nutritional composition of the wheat biscuits and wheat biscuits fortified with citrus peels powders and date palm fruits.
- ii. To determine the sensory quality attributes of the wheat biscuits and wheat biscuits fortified with citrus peels powders and date palm fruits

## **MATERIALS AND METHODS.**

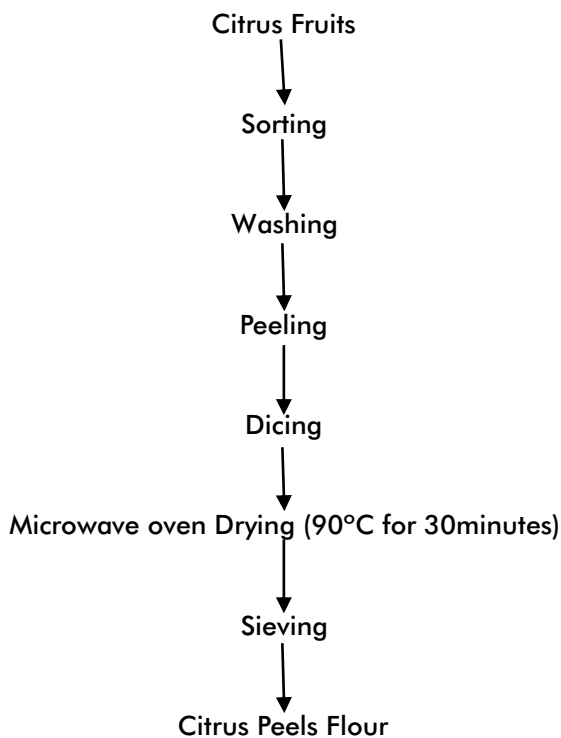
Good quality commercial wheat flour, baking powder, eggs, milk, margarine, refined sugar and all other necessary ingredients were purchased from Sabo market in Ile-Ife, Osun State, Nigeria. The preparation and sensory analysis of the products took place at the Food and Nutrition laboratory, Department of Family, Nutrition and Consumer Sciences, Faculty of Agriculture, Obafemi Awolowo University, Ile-Ife. The prepared samples were subjected to chemical analysis at the Central laboratory, Obafemi Awolowo University, Ile-Ife.

### **Preparation of Citrus Peel Powder**

The peels of each sample of ripe citrus fruits (orange (*Citrus sinensis*), tangerine (*Citrus Reticulate*) and lemon (*Citrus limon*) were prepared and the cut peels were then sliced into bits and the slices was spread evenly in a microwave oven and dried at 90°C temperature for 30 minutes. After that, the dried peels were ground with a food processor and then sieved using a sieve of 250µm aperture to obtain a fine texture of smooth citrus peel flour (6).

### Preparation of Date Powder

The date fruits were sorted out and washed to remove dirt and unwanted materials. Afterward, the date fruits were deseeded (depitting) 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 72 hours and was subsequently milled into flour with a blender and sieved through a 0.35mm mesh sieve to obtain flour (Figure 2). The date palm flour was sealed in an airtight container and stored at room temperature (10).

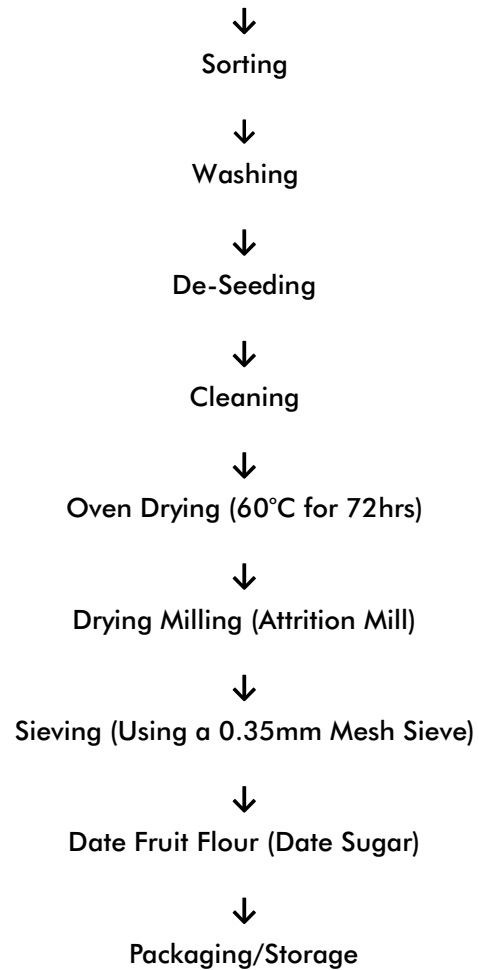


**Fig.1: Flow Chart showing preparation of citrus peels flour**

### Preparation of the Supplemented Biscuits

An electric oven was preheated at 200°C. The dough was mixed for 10 minutes to obtain a homogeneous consistency and then placed into the fridge at a temperature of about 6-7°C over a period of 30 minutes. After which, the dough was covered with a sheet of 3mm thickness. The sheeted dough was then cut into different sizes and shapes with an appropriate cutter and placed on an aluminum tray. The cut dough was put in an electric oven for baking at 150°C for 10-15 minutes. The fortified biscuits were then prepared using the same method as the control sample. The

### Date Palm Fruit



**Fig. 2: Flow chart for production of date fruit flour**

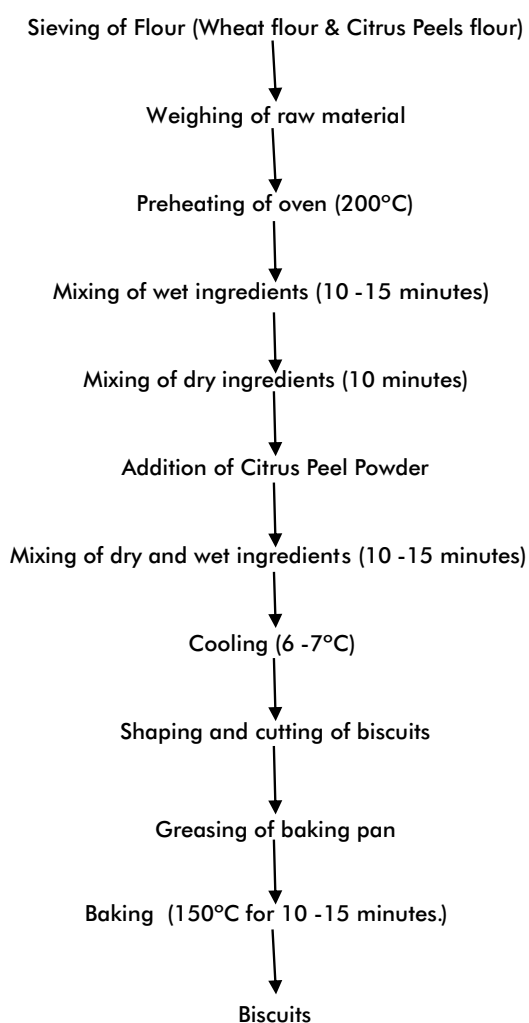
dried date powder was present in all samples except the control as it was used in replacement of sugar powder in the preparation.

### Sensory Evaluation of the Biscuits

Sensory attributes analyzed by the consumers include color, texture, taste, odor and overall acceptability. It was carried out by fifty (50) sensory panelists from Obafemi Awolowo University, in Ile-Ife, Osun state. A numerical nine-point hedonic scale method was used for the sensory evaluation of the different samples of biscuits produced. The panellists were supplied with water to rinse their mouth between samples. Samples were rated alongside with the control samples.

**Table 1: The biscuits mixing proportion**

Ingredients	Control	10% flour blends	10% flour blends	10% flour blends
Wheat flour (g)	300	270	270	270
Orange Peel Powder (g)	.....	30	.....	.....
Lemon Peel Powder (g)	.....	.....	30	.....
Tangerine Peel Powder	.....	.....	.....	30
Date Powder (g)	30g refined sugar	30g date powder	30g date powder	30g date powder
Margarine (g)	65	65	65	65
Eggs (Jumbo size)	2	2	2	2
Baking powder (g)	15	15	15	15
Flavor(g) (Vanilla)	5.3	5.3	5.3	5.3
Milk (g)	50	50	50	50
Salt (g)	7.5	7.5	7.5	7.5



**Fig.3: Flow Chart for preparation of fortified Biscuit**

**Nutritional Composition of biscuits**

Moisture, protein, total fat, crude ash content, estimated dietary fiber, carbohydrate and energy values and mineral content were determined in this analysis according to the method described in (17). All results were recorded in triplicates with the mean. The caloric value was calculated using values of 4k.cal/g of carbohydrate, 4k.cal/g of protein and 9k.cal/g of fat according to (18).

**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.

**RESULTS**

The sensory mean scores for colour, taste, texture, flavour and overall acceptability for the biscuit samples are presented in Table 2. The attributes were significantly different (p<0.05). Sample D was rated highest with mean score of 7.88±1.32 in terms of colour, followed by sample B with mean score of 7.64±1.22 while sample C with mean score of 7.22±1.66 was rated least out of the four samples.

Sample B was rated highest with mean score of 7.80±1.05 in terms of taste, followed by sample D with mean score of 7.74±1.45, while sample A with mean score of 7.44±1.37 was rated least out of the four samples.

Sample D was rated highest with mean score of

7.72±1.31 in terms of texture, followed by sample C with mean score of 7.60±1.48, while sample A with mean score of 7.14±1.46 was rated least out of the four samples.

Sample D was rated highest with mean score of 7.68±1.28 in terms of flavour, followed by sample B with mean score of 7.56±1.34 while sample C with mean score of 7.14±1.44 was rated least out of the four samples.

Sample D was rated highest with mean score of 7.60±1.73 in terms of overall acceptability, followed by sample B with mean score of 7.60±1.12, while sample A with mean score of 7.44±1.28 was rated least out of the four samples.

The proximate and mineral composition of the biscuit samples are presented in Table 3. Sample D had the highest protein content with mean score of 18.15±0.05 % DM followed by sample C (17.30±0.02 % DM) then sample B (16.40±0.02) and sample A (15.30±0.02) had the lowest protein content. Sample A had the highest moisture content with mean score of 10.48±0.02 followed by sample B (9.30±0.02) then sample C (6.84±0.05) and sample D (3.56±0.02) had the lowest moisture content. Sample B had the highest fat content with mean score of 1.92±0.02 followed by C (1.36±0.02) then D (1.33±0.06) and sample A (1.25±0.01) had the lowest fat content. Sample B had the highest crude fibre content with mean score of 2.64±0.02 % DM followed by A (2.55±0.01) then C (2.36±0.01) and sample D (2.25±0.01) had the lowest crude fibre content. Sample A had the highest carbohydrate content with mean score of 72.39±0.08 % DM followed by C (69.56±0.59)

then D (68.31±0.04) and sample B (67.58±0.02 % DM) had the lowest carbohydrate content. Sample D had the highest calcium content with mean score of 8.95±0.00 mg/100g followed by sample C (8.91±0.00 mg/100g) then sample B (8.61±0.00) and sample A (8.12±0.00) had the lowest calcium content. Sample A had the highest iron content with mean score of 2.02±0.00 mg/100g followed by C (1.96±0.00 mg/100g) then D (1.75±0.00 mg/100g) and sample B (1.70±0.00 mg/100g) had the lowest iron content.

## DISCUSSION

Wheat flour was combined with citrus peels flour to produce biscuit samples that came out really well. This study is in agreement with (6) that observed that other flours can be used to produce biscuit.

The result showed that there were significant difference ( $P < 0.05$ ) in the colour, flavour, taste, texture and overall acceptability of all the biscuit samples. The study also indicated that there was no significant difference at ( $p < 0.05$ ) in the overall acceptability of samples D and B. There was an observable increase in preference for overall acceptability of the biscuit samples with addition of citrus peels powder. This may be due to the change in taste.

The fact that biscuits are typically high in fat and sugar makes them 'unhealthy' for consumption, the biscuit samples produced contained nutrients that have the functional roles to reduce the risk of coronary heart disease and this will serve as a safe source of in-between meal for adults. This is in agreement with the finding of (6). (19) also reported that low fat content in a product will help

**Table 2: Sensory mean score of biscuit produced using citrus peels and date flour blends**

Samples	Colour	Taste	Texture	Flavour	Overall Acceptability
A	7.52±1.28 <sup>c</sup>	7.44±1.37 <sup>d</sup>	7.14±1.46 <sup>d</sup>	7.26±1.35 <sup>c</sup>	7.44±1.28 <sup>d</sup>
B	7.64±1.22 <sup>b</sup>	7.80±1.05 <sup>a</sup>	7.56±1.11 <sup>c</sup>	7.56±1.34 <sup>b</sup>	7.60±1.12 <sup>ab</sup>
C	7.22±1.66 <sup>d</sup>	7.46±1.54 <sup>c</sup>	7.60±1.48 <sup>b</sup>	7.14±1.44 <sup>d</sup>	7.50±1.39 <sup>c</sup>
D	7.88±1.32 <sup>a</sup>	7.74±1.45 <sup>b</sup>	7.72±1.31 <sup>a</sup>	7.68±1.28 <sup>a</sup>	7.60±1.73 <sup>ab</sup>

\*Different superscript in the same column indicates significant difference ( $p < 0.05$ )

A: 300g wheat flour, 30g refined sugar

B: 270g, 30g orange peel powder, 30g date

C: 270g wheat flour, 30g lemon peel powder, 30g date powder

D: 270g wheat flour, 30g tangerine peel powder, 30g date powder

in increasing the shelf life of the sample by decreasing the chances of rancidity and also contribute to low energy value of the food product while high fat content product will have high energy value and promotes lipid oxidation. The higher protein content of the composite biscuits than 100% wheat biscuit is in agreement with (20) who 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 Biscuits had higher crude fibre content and is in line with the finding of (4) who reported that citrus fruit peel contains carbohydrates, pectin and fiber. The biscuit sample that contained lemon citrus peel flour had the highest calcium, potassium and sodium content while biscuit sample that contained no citrus peel powder had the highest iron content.

## CONCLUSION

The study showed that essential nutrients which have been proven to reduce risks of some diet-related diseases are embedded in the citrus peels biscuits produced. The study also revealed that acceptable biscuits can be produced from wheat, citrus peels and date flour blends and sensory attributes of 100% whole wheat flour biscuit could be improved by addition of citrus peels and date fruit.

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**Table 3: Nutritional composition (% DM Proximate; mg/100g Mineral) of biscuit produced from wheat flour, citrus peel and date flour blends**

Nutrient	Sample A	Sample B	Sample C	Sample D
Protein	15.30±0.02 <sup>d</sup>	16.40±0.02 <sup>c</sup>	17.30±0.02 <sup>b</sup>	18.15±0.05 <sup>a</sup>
Moisture	10.48±0.02 <sup>a</sup>	9.30±0.02 <sup>b</sup>	6.84±0.05 <sup>c</sup>	3.56±0.02 <sup>d</sup>
Fat	1.25±0.01 <sup>d</sup>	1.92±0.02 <sup>a</sup>	1.36±0.02 <sup>b</sup>	1.33±0.06 <sup>c</sup>
Ash	2.13±0.01 <sup>d</sup>	2.16±0.01 <sup>c</sup>	2.24±0.02 <sup>b</sup>	2.32±0.02 <sup>a</sup>
Crude fibre	2.55±0.01 <sup>b</sup>	2.64±0.02 <sup>a</sup>	2.36±0.01 <sup>c</sup>	2.25±0.01 <sup>d</sup>
Carbohydrate	68.31±0.04 <sup>c</sup>	67.58±0.02 <sup>d</sup>	69.56±0.59 <sup>b</sup>	72.39±0.08 <sup>a</sup>
Dry matter	91.51±3.45 <sup>c</sup>	90.70±0.02 <sup>d</sup>	92.83±0.53 <sup>b</sup>	96.60±0.30 <sup>a</sup>
Calcium (Ca)	8.12±0.00 <sup>d</sup>	8.61±0.00 <sup>c</sup>	8.91±0.00 <sup>ab</sup>	8.95±0.00 <sup>ab</sup>
Potassium (K)	60.31±0.02 <sup>a</sup>	55.12±0.01 <sup>d</sup>	58.10±0.02 <sup>c</sup>	59.31±0.01 <sup>b</sup>
Sodium (Na)	62.35±0.02 <sup>a</sup>	56.48±0.01 <sup>b</sup>	53.21±0.02 <sup>c</sup>	51.06±0.02 <sup>d</sup>
Iron (Fe)	2.02±0.00 <sup>a</sup>	1.70±0.00 <sup>d</sup>	1.96±0.00 <sup>b</sup>	1.75±0.00 <sup>c</sup>

\*Different superscript in the same column indicates significant difference ( $p < 0.05$ )

\*Mean and standard deviation of three determinations

### Key:

A: 300g wheat flour, 30g refined sugar

B: 270g, 30g orange peel powder, 30g date powder

C: 270g wheat flour, 30g lemon peel powder, 30g date powder

D: 270g wheat flour, 30g tangerine peel powder, 30g date powder

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