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Nutritional quality of gluten free biscuits supplemented with sweet chickpeas and date palm powder

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Abstract
Studies were conducted to develop gluten-free biscuits comparable in quality to wheat biscuits and superior to those made from commercial gluten-free flour suitable for coeliac sufferers. A mixture of broken rice flour, sweet chickpeas and date powder (0, 5, 10, 15, 20, 25, 30, 35, 40% date powder). Physico-chemical analysis was tested for ingredients and colour. Results showed that addition of date powder decreases the diameter, thickness, weight, spread ratio and density of biscuits. Increase in date powder level led to a significant increase in the darkness of biscuits with increasing level of date powder, the hardness decreased simultaneously. The addition of date powder improved the mineral quality of biscuit. On the other hand, ash, fiber and carbohydrate level increases with the increase of date powder level. Date powder could be incorporated up to 20% in the formulation of biscuits without affecting their sensory quality. Supplementation of biscuits with 20% date powder and 20% chickpea flour covers up to 31.6% of protein requirement, 17.2% of iron requirement and 13.02% of calcium.

Keywords: Gluten free, date powder, chickpea powder

1. Introduction
Lerner [34] defined celiac disease (CD) as a syndrome characterized by damage to the mucosa of the small intestine caused by ingestion of certain wheat proteins and related proteins in rye and barley. The treatment is mainly a lifelong gluten-free diet. It is a challenge to provide CD patients with a variety of nutritious and healthy bakery products. Studies were conducted to develop gluten free biscuits comparable, in quality and nutritional value, to those prepared from wheat flour [17, 29, 38].

Broken rice is the by-product of rice milling industry and rice flour, which was prepared from broken rice and could be used as an important ingredient for the production of many food products. (FAO, 2012) reported Egypt's rice losses to be between 8.16 to 28.50%. Omran and Hussien [37] reported that low commercial value of some rice products could be suitable for food manufacture.

The date palm, *Phoenix dactylifera*, is one of most important plants of arid, desert area of the Middle East, Southern Asia and Northern Africa for over 5000 years. The total production of Egypt from dates is (646,039 tons). Dates have a high nutritional value since it contains sugars, which is the major component (more than 70%) and minerals as reported by Al Farsi and Lee [3]. The date fruit pulp is rich in phytochemicals like phenolics, sterols, carotenoids, anthocyanins, procyanins and flavonoids [13]. Beside the nutritional value, date fruits are rich in phenolic compounds possessing antioxidant activity [42]. They are a good source of antioxidants, mainly carotenoids and phenolics [3] that possess antioxidant and antimutagenic properties in vitro [53, 35]. In this concern, the same authors mentioned that date fruits can be considered a rich source of hydrophilic antioxidants and this reducing property is generally associated with the presence of polyphenols specifically flavones.

Dates have been utilized in different bakery products. As in the production of cookies and biscuits. During the peak of the harvesting season, considerable quantities of the fruit are wasted. In addition, wastes are generated from transformative processes of Dates. These by-products are generally discarded and eventually constitute environmental problem or sometimes are used as animal feed. This constitutes a real economic loss since some of these by-products can be converted to high added value products such as powder rich in fibers (PRF). Alzamora *et al.* [6] estimated that about 30-50% of fruits produced in developing countries during peak seasons, are lost due to post-harvest losses. This constitutes a real economic loss since some of these by-products can be converted to high added value products such as powder rich in fibers. There is, therefore, a need to further process them or incorporate them into other products.

Date powder has not been widely used in bakery products. Sulieman *et al.* [48] and El-Sharnouby *et al.* [15] produced biscuits with date powder and wheat flour. While Barimah *et al.* [8] successfully used date powder as a sugar replacer, up to 50%, in rock buns. Fikry and Al-Awaadh [19] studied the adsorption and desorption isotherms for powder rich in fiber (PRF) produced for Sifri cultivar date powder. In fact, Fikry [18] produced fine PRF from Palm Date flesh (Sifri cultivar) with total dietary fiber 72.65 %.

Chickpea (Cicer arietinum L.) is one of the oldest and most widely consumed legumes in the world, particularly in tropical and subtropical areas. Chickpea and its flour are being used extensively in food processing. It is considered a good and inexpensive healthy vegetarian food due to its beneficial nutritional profile and medicinal properties. Its chemical composition shows that it is a good source of proteins, dietary fibers, carbohydrates and vitamins [4].

The aim of the study is to produce gluten-free biscuits supplement with date powder. To evaluate the effect of supplementing rice flour with date powder and chickpea flour on physical properties, chemical and nutritional values. Also, to study the consumer acceptability to the produced biscuits.

2. Materials and Methods
2.1. Materials
Broken rice was obtained from a local rice mill in Cairo, Egypt. Date fruit (Siwi date variety) was obtained from Central Laboratory of Date Palm Research and Development,

Agricultural Research Center, Giza, Egypt. Other ingredients were purchased from the local market in Cairo, Egypt. Chemicals were of analytical reagent grade.

2.2. Methods

2.2.1 Preparation of Raw Materials

The pulp of the date fruits were separated from their seeds, dried, weighed and kept in an airtight polyethylene bag. The sun-dried date fruits were grated and later sieved to obtain a fine powder that passed through a 60 mesh sieve.

Sweet chickpeas and broken rice were ground using a grinder, to obtain a fine powder that passed through a 60 mesh sieve. All powders obtained were kept in an airtight polyethylene bag.

2.2.2 Functional Properties of Rice Flour, Sweet Chickpea and Date Powder

Water and oil holding capacity were performed according to the method of Beuchat [11]. 2 g of sample (W1) was weighed into a pre-weighed centrifuge tube (W2), and 20 ml of distilled water or sunflower oil were added. Samples were vortexed and allowed to stand for 30 min at 25±2 °C before being centrifuged at 4000g for 25 min. Excess water or oil was decanted by inverting the tubes over absorbent paper, and samples were allowed to drain and re-weighed (W3). The percentage of water or oil holding capacity was calculated as follows:

WHC or OHC % = ((W3 – W2)/W1) x 100

2.2.3 Proximate Analysis of Ingredients and Biscuits

Broken rice flour, sweet chickpeas, date powder and biscuits were analyzed for moisture, protein, ash, fat and crude fiber according to the methods of AOAC [7]. Total carbohydrate was calculated by difference. Total calories were calculated by the formula of James [26] as follows: Total calories = Fat x 9 + Protein x 4 + Total carbohydrate x 4.

2.2.4 Preparation of Biscuits

Hard sweet biscuit was prepared by partially replacing the broken rice flour with 5 to 40% date powder. 20% sweet chickpeas were added in the formula to increase the protein levels of broken rice flour. Biscuits were prepared according to method described by El-Sharnouby *et al.* [15].

Table 1: Formula of biscuits

	Control	5	10	15	20	25	30	35	40
Rice flour	80	75	70	65	60	50	50	45	40
Chickpea powder	20	20	20	20	20	20	20	20	20
Date powder	-	5	10	15	20	25	30	35	40
Butter	33	33	33	33	33	33	33	33	33
Sugar	36	36	36	36	36	36	36	36	36
Vanilla	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Baking powder	3	3	3	3	3	3	3	3	3
Water	As needed								

2.2.5 Physical Characteristics of Biscuits

Biscuits were evaluated for weight (g), thickness (mm), diameter (mm) and spread ratio as described by Gaines [21]. Six biscuits edge-to-edge, were used for the evaluation and the average was noted. Diameter and thickness were measured using a Vernier Caliper. Spread ratio was calculated from the ratio of diameter to thickness and calculated using the following equation:

Spread ratio = Diameter / Thickness

2.2.6 Colour measurement

Colour of raw materials and biscuit samples was measured by a hand-held Tristimulus reflectance colorimeter Minolta Chroma-meter (model CR-400, Konica Minolta, Japan) and recorded in the L* a* b* colour system. L values are indicative of the lightness of samples. Lower L values indicate a darker surface color. The values indicate the degree of redness or greenness, with positive values signifying redness and negative values indicating greenness. The b values indicate yellowness or blueness: positive values represent yellow, while negative values represent blue.

Numerical total colour difference (ΔE) was calculated as follows:

$\Delta E = [(L-L_0)2+(a-a_0)2 +(b-b_0)2]½$

Where L_0, a_0 and b_0 were the L, a, and b values of the reference sample which herein is the control sample.

2.2.7 Hardness of Biscuits

Biscuits hardness was determined using a Texture Profile Analyzer (TPA) according to AACC [1]. Biscuits hardness was determined by a universal testing machine (Brookfield Engineering Lab. Inc., Middleboro, MA 02346- 1031, USA). A 25-mm diameter cylindrical probe was used in a TPA at 2 mm/s speed. Hardness was calculated from TPA graphic in Newton (N).

2.2.8 Sensory Evaluation of Biscuits

Biscuit samples were organoleptically evaluated for their sensory characteristics according to the method of Alsenaien *et al* [5]. Samples were scored for colour, flavour, texture and overall acceptability by ten trained panelists form Food Technology Research Institute.

2.2.9 Statistical analysis

The analytical data were analyzed using SPSS 16.0 software. Means and standard deviations were determined using descriptive statistics. Comparisons between samples were determined using analysis of one-way variance (ANOVA) and multiple range tests. Statistical significance was defined at $P \leq 0.05$.

3. Results and Discussion

3.1 Physico-chemical analysis of rice flour, chickpea flour and date powder

The analysis of raw materials, shown in table 2, revealed that date powder contained 0.35 gm/100 gm fat; 2.0 gm/100 gm protein; 2.05 gm/100 gm fiber; 2.5 gm/100 gm ash and 93.1 gm/100 gm carbohydrates. The results of our analysis on date powder agrees with work by Barimah *et al.* [8]. They reported

date powder to contain 0.98 gm/100 gm fat; 3.39 gm/100 gm protein; 1.47 gm/100 gm fiber and 2.45 gm/100 gm ash. Insoluble dietary fiber were 60.75 gm/100gm as reported by Fikry [18] (between 55.57 and 69.85 gm/100gm). Ghribi *et al*. [23] reported chickpeas to contain between 10.69 and 12.5 gm/100gm IDF and SDF between 8 and 9.75 gm/100gm. Water holding capacity of date powder was 595% and oil holding capacity was 8.87% which is in range with work by Fikry [18], who reported water holding capacity 6.03 g water/g dry sample and oil holding capacity 9.1 g oil/100g dry sample for Sifri date powder.

As for broken rice flour, our analysis showed 0.22gm/100 gm fat; 7.75 gm/100 gm protein; 0.23 gm/100 gm fiber; 0.62 gm/100 gm ash and 90.54 gm/100 gm carbohydrates. Our results for broken rice flour were in agreement to work by Omran and Hussien [37]; reported that broken rice flour had 7.78% proteins; 0.21% crude fiber; 0.66% ash, and 91.36% carbohydrates. While Dahab [12], who reported that broken rice flour had 7.68% proteins; 0.27% crude fiber; 0.36% ash, and 90.81% carbohydrates.

Results of chickpea analysis indicated that fat was 6.50gm/100 gm; protein reached 25.14 gm/100 gm. While fiber was 2.27 gm/100 gm; ash was 3.00 gm/100 gm and carbohydrates 63.61 gm/100 gm. These results are in range of work by Sakr *et al*. [41] and Ghribi *et al* [23] who reported values of 6.49gm/100 gm fat; 25.04 gm/100 gm protein; 2.73 gm/100 gm fiber; 2.96 gm/100 gm ash and 62.78 gm/100 gm carbohydrates. Water holding capacity was found to be 130.95 gm/100gm which was in range with Sreerama *et al*. [46] who reported water holding capacity of chickpea flour to be 131.60 gm/100gm. While Ghribi *et al* [23] reported WHC to range between 82.88 and 97.49 gm/100gm.

The colour values in chickpeas and rice flour were close to Emami *et al* [16], and Torbica *et al*. [51], respectively. The colour of date powder was darker, these results agree with Benamara and Chekroune [10].

Table 2: Chemical composition of raw materials

	Rice Flour	Sweet Chickpea Flour	Date Powder
Moisture (%)	9.54±0.05	10.35±0.15	11.50±0.90
Fat (%)	0.22±0.03	6.50±0.13	0.35±0.03
Protein (%)	7.75±0.15	25.14±1.17	2.00±0.40
Ash (%)	0.62±0.01	3.00±0.03	2.50±0.06
Crude Fiber (%)	0.23±0.02	2.75±0.05	2.05±0.04
Dietary Fiber (gm/100)	2.60±0.04	2.71±0.02	64.45±0.07
Soluble Fiber (gm/100)	0.80±0.07	2.4±0.06	3.70±0.05
Insoluble Fiber (gm/100)	1.80±0.02	0.3±0.15	60.75±0.44
Carbohydrate (%)**	90.54±1.12	63.61±1.19	93.10±**1**.31
Calcium (mg/100gm)	16.3±1.19	9.65±0.07	47.00±0.54
Iron (mg/100gm)	1.58±0.01	1.08±0.05	1.25±0.04
Zinc (mg/100gm)	0.95±0.03	2.33±0.02	0.30±0.05
Potassium (mg/100gm)	75.86±0.02	119.0±1.21	683.00±**1**.54
Oil Holding Capacity%	92.30±0.02	87.75±0.31	8.87±0.02
Water Holding Capacity%	176.49±0.03	130.95±1.19	595.00±0.06
L	74.33±0.05	83.51±0.33	53.5
a*	-0.83±0.03	1.35±0.02	14.20
b*	8.33±0.03	18.79±0.29	24.11

Values are means of three replicates ±SD, on dry weight basis. ****** Total carbohydrates were calculated by difference. *******L (lightness with L = 100 for lightness, and L = zero for darkness), a [(chromaticity on a green (-) to red (+)], b [(chromaticity on a blue (-) to yellow (+)]

3.2 Physical Properties of Biscuits

Physical properties of biscuits are important for both manufacturers and consumers. Table 3 shows the results of the evaluation of biscuits prepared from mixture of sweet chickpea flour and date powder, at different levels, for several physical characteristics. Incorporation of date powder decreased the diameter of biscuits from 55.67 mm to 53.24 mm. The decreasing trend was directly proportional with increasing level of date powder substitution. Ajila *et al* [2] referred the significant decrease in the diameter of biscuits to the increase in fiber contents, which in our case is due to the addition of date powder, which is a rich source of insoluble dietary fiber (60.75 gm/100gm) compared with 0.3 gm/100gm for chickpeas. Alsenaien *et al* [5] explained this result by the fact that date powder, being less soluble, maintaining its un-dissolved nature longer during baking, which would restrict the flow of the dough.

A slight, but significant changes in the thickness of biscuits was noticed (Table 3).The results revealed a reduction in spread ratio of biscuits from 8.30 (control) to 7.90 among treatments with the increase in the level of date powder and decrease in chickpea flour. Non-wheat high protein flours or any other ingredient which absorbs water during dough mixing will reduce the spread ratio because the water available in such system would be insufficient to dissolve sugar during baking, increasing the viscosity and resulting in lower spread ratio [30]. While Vieira *et al*. [54] has established that the spread ratio is strongly correlated to the water absorption capacities of the flour. Therefore, the higher water absorption capacities values for date powder compared with control could have resulted in the lower spread ratio. Alsenaien *et al* [5] referred this reduced spread ratios of cookies to the fact that date powder increased the numbers of hydrophilic sites available for competing for the limited free water in cookie dough. Hooda and Jood [24] reported an increase in dough viscosity, thereby limiting cookie spread and top grain formation during baking. Therefore, it can be concluded that addition of date powder decreases the spread ratio of biscuits. The results indicated that there were a significant increase in the moisture content (from 3.23 to 4.68 gm/100gm) with increase in date powder content. Our results are in range of those reported

by El-Sharnouby *et al.* [15] (3.81 -4.00 gm/100gm) for biscuits supplemented with wheat bran and date powder. Barimah *et al.* [8] referred this increase in moisture may be due to the high water holding capacity of date powder.

Table 3: Physical Properties of Biscuits

% Date Powder	Diameter (D, mm)	Thickness (T, mm)	Weight (W, g)	Spread Ratio (D/T)
Control	55.67±0.06^{a}	6.69±0.05^{a}	8.18±0.02^{a}	8.30±0.07^{a}
5%	55.55±0.12^{a}	6.71±0.04^{ab}	8.17±0.09^{a}	8.29±0.14^{a}
10%	55.35±0.09^{a}	6.71±0.06^{ab}	8.14±0.04^{ab}	8.28±0.03^{a}
15%	55.00±0.15^{b}	6.72±0.25^{ab}	8.13±0.07^{ab}	8.20±0.01^{b}
20%	54.75±0.13^{b}	6.72±0.11^{ab}	8.12±0.03^{ab}	8.19±0.01^{b}
25%	54.35±0.07^{c}	6.73±0.09^{ab}	8.07±0.08^{ab}	8.08±0.06^{c}
30%	53.89±0.21^{d}	6.75±0.05^{bc}	7.99±0.10^{b}	8.05±0.02^{c}
35%	53.50±0.19^{e}	6.75±0.08^{bc}	7.97±0.01^{b}	7.92±0.05^{d}
40%	53.24±0.14^{e}	6.76±0.10^{c}	7.85±0.06^{c}	7.90±0.09^{d}

Values are means of three replicates ±SD, numbers in the same column followed by the same letter are not significantly different at 0.05 level

3.3. Colour

Color plays a major role in consumers' perception and acceptability. The L, a and b color values of tested cookies ware showed in Table 4. Increase in date powder level led to a significant increase in the darkness of biscuits. Biscuits with date powder were significantly darker than the control as indicated by lower L values. The difference in redness was also statistically significant. Increase in redness was observed as date powder level was increased. Our results agree with work by Alsenaien *et al* [5]. The lower L value and higher a value observed for date fortified biscuits were possibly related to Maillard browning reactions in the baking process, causing darker color for the cookies. Ndife *et al.* [36] explained that the browning may have resulted from Maillard reactions or caramelization. While Hu *et al.* [25] reported a direct relation between the fiber content and browning. Therefore, the increased fiber content of the biscuits due to the presence of the date powder may have also caused some browning effects. Moreover, the color of the date powder was brown and may have been a contributory factor. In any case, whole wheat cookies have even lower L values, accounting for 55.28 [38].

Table 4: Colour of Biscuits

% Date Powder	L	A	b	ΔE
Control	88.50±0.06^{a}	4.62±0.02^{a}	35.85±0.05^{a}	-
5%	87.98±0.02^{a}	4.42±0.06^{a}	35.50±0.03^{a}	0.66±0.05^{a}
10%	86.75±0.05^{a}	4.15±0.07^{a}	35.21±0.06^{a}	3.38±0.02^{a}
15%	85.21±0.03^{a}	3.87±0.05^{a}	35.00±0.04^{a}	3.48±0.06^{a}
20%	82.34±0.07^{a}	3.52±0.09^{a}	34.98±0.02^{a}	6.32±0.03^{a}
25%	79.73±0.02^{a}	6.29±0.04^{a}	34.59±0.05^{a}	9.02±0.09^{a}
30%	75.45±0.05^{a}	9.78±0.03^{a}	34.26±0.07^{a}	14.12±0.04^{a}
35%	69.89±0.03^{a}	13.11±0.08^{a}	34.03±0.02^{a}	20.54±0.05^{a}
40%	63.53±0.04^{a}	15.18±0.02^{a}	33.85±0.04^{a}	27.18±0.07^{a}

Values are means of three replicates ±SD, numbers in the same column followed by the same letter are not significantly different at 0.05 level

3.4. Texture Profile of Biscuits

The importance of texture in the consumer acceptance is highly recognized. Karaoğlu and Kotancilar [27] reported that hardness is the most important in evaluation of baked goods, because of its close association with human perception of freshness. Fig 1 showed hardness in substituted and control biscuits; nevertheless, with increasing level of date powder, the hardness increased simultaneously (from 30.09 to 50.15 N). The hardness of biscuits is much affected by the composition of flour. Increase in hardness of date biscuits is in agreement with work by El-Sharnouby *et al.* [15]. The increase in hardness may be because the high fiber content of date powder. It is suggested by Becker *et al* [9] that the high fiber content contributes to increase the hardness of cookies in comparison to the control formula. Similar relation between fiber content and hardness was reported previously to biscuits made with different levels of

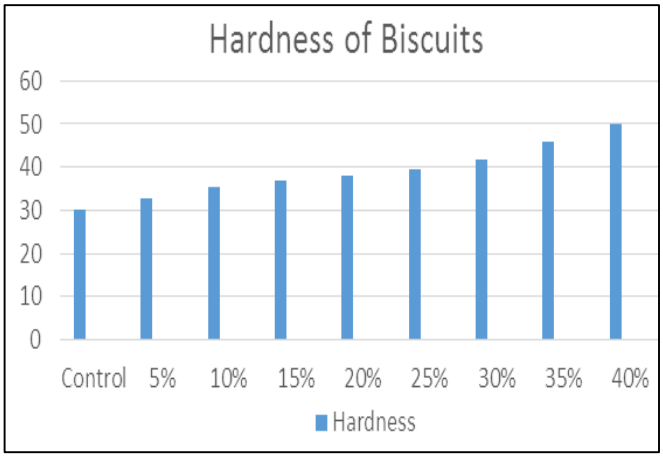

Fig 1: Hardness of Biscuits

3.5. Chemical Composition of Biscuits

The chemical composition of biscuits produced are shown in Table 5. The results indicated that fiber levels increased as the amount of date powder increased (0.79 gm/100gm to 1.21 gm/100gm as a result of increasing date powder level. This may result from the high fiber content of date powder (2.05 gm/100gm) compared with only 0.23% in rice flour. These results are in line with those reported by Barimah *et al*. [8]. Also, the results indicated that protein gradually and non-significantly decreased from 12.57 gm/100gm to 12.40 gm/100gm. Fat slightly decreased from 18.83, for control, to 18.81 gm/100gm, for 40% date powder. This is a result of increasing the percent of date powder and decreasing the rice flour, since the date powder contain small amount of protein and fat (only 2% and 0.35%, respectively). These results are in line of work by Sulieman *et al.* [48], who reported a decrease in protein for biscuits with 10% date powder.

As expected, carbohydrates increased in all samples compared to the control. These results are in agreement with those reported by El-Sharnouby *et al.* [15]. This is a result of high carbohydrate content of date powder (74.20%).

Results showed that iron and calcium progressively increased when levels of date powder increased. From Table 5, it could be noticed that as the levels of date powder increased in formula, the calcium and iron values increased in biscuits produced compared to the control sample. But the value of zinc slightly, but non-significantly, decreased, as date powder is low in zinc (only 0.30 mg/100gm).

It could be concluded that the addition of date powder improved the mineral quality of biscuit. The obtained results are in agreement with the results of El-Sharnouby *et al.* [15].

Table 5: Chemical Composition of Biscuits

% Date Powder	Moisture	Protein	Fat	Ash	Fiber	Carbohydrate*	Calcium	Iron	Zinc
Control	3.23±0.07^{i}	12.57±0.08^{a}	18.83±0.05^{a}	0.97±0.01^{c}	0.79±0.01^{i}	67.63±0.04^{i}	44.14±0.03^{e}	0.93±0.0^{e}	0.98±0.05^{a}
5%	3.36±0.01^{h}	12.56±0.02^{a}	18.83±1.17^{a}	0.98±0.03^{b}	0.83±0.02^{h}	67.70±0.09^{h}	124.88±0.09^{d}	1.13±0.05^{d}	0.98±0.03^{a}
10%	3.58±0.05^{g}	12.54±0.09^{a}	18.82±0.08^{a}	0.98±0.02^{b}	0.88±0.07^{g}	67.84±0.08^{g}	124.94±0.01^{d}	1.14±0.08^{d}	0.98±0.04^{a}
15%	3.86±0.03^{f}	12.52±0.02^{a}	18.82±0.07^{a}	0.98±0.04^{b}	0.94±0.03^{f}	67.98±0.05^{f}	125.30±0.04^{c}	1.18±0.03^{c}	0.97±0.07^{a}
20%	3.92±0.02^{e}	12.50±0.07^{a}	18.81±0.05^{b}	0.99±0.06^{a}	0.99±0.04^{e}	68.09±0.02^{e}	126.24±0.05^{c}	1.19±0.01^{c}	0.97±0.05^{a}
25%	4.09±0.09^{d}	12.48±0.03^{a}	18.81±0.01^{b}	0.99±0.01^{a}	1.05±0.09^{d}	68.16±0.07^{d}	127.04±0.03^{b}	1.21±0.02^{b}	0.96±0.03^{a}
30%	4.27±0.02^{c}	12.46±0.01^{a}	18.81±0.02^{b}	0.99±0.02^{a}	1.10±0.05^{c}	68.26±0.01^{c}	127.84±0.07^{b}	1.22±0.09^{b}	0.96±0.02^{a}
35%	4.44±0.05^{b}	12.42±0.05^{a}	18.81±0.03^{b}	0.99±0.03^{a}	1.16±0.01^{b}	68.31±0.04^{b}	128.63±1.17^{a}	1.24±0.07^{a}	0.95±0.04^{a}
40%	4.68±1.17^{a}	12.40±0.02^{a}	18.81±0.04^{b}	0.99±0.01^{a}	1.21±0.04^{a}	68.39±0.03^{a}	129.21±0.04^{a}	1.25±0.05^{a}	0.95±0.09^{a}

Values are means of three replicates ±SD, numbers in the same column followed by the same letter are not significantly different at 0.05 level; ***** Total carbohydrates were calculated by difference.

3.6. Sensory Evaluation of Biscuits

The preference for the products, in terms of the sensory parameters used in assessing the product. As shown in Table 6, taste and texture of the biscuits were affected at levels above 15% date powder. Biscuits had a dry texture at level of 35% date powder. Meanwhile, at 10% mixture, the quality of the biscuits was not adversely affected.

The colour of biscuits had low score as a result of increasing the level of date powder. Barimah *et al*. [8] reported the high sugar content in the date powder may have caused browning in the rock buns produced, and this affected the color and therefore the preference for color of the products decreased with increasing substitution.

Above 20% date powder, the biscuit had darker colour and hard texture. The colour, taste and texture of biscuits were acceptable up to 20% date powder. The obtained results are in an agreement with those of El-Sharnouby *et al.* [15]. They reported that biscuits are acceptable incorporating 30% of wheat bran and date powder. While Sulieman *et al.* [48], reported that biscuits with 5% date powder were acceptable.

From the above evaluation, it could be concluded that date powder could be incorporated up to 20% in the formulation of biscuits without affecting their sensory quality.

Table 6: Sensory Evaluation of Biscuits

% Date Powder	Appearance	Colour	Odour	Texture	Taste	Overall
Control	9.99±0.01^{a}	9.99±0.02^{a}	9.99±0.00^{a}	9.83±0.40^{a}	9.83±0.45^{a}	49.65±0.82^{a}
5%	9.97±0.51^{a}	9.97±0.75^{b}	9.98±0.51^{a}	9.80±0.40^{a}	9.80±0.45^{a}	49.51±2.25^{a}
10%	9.80±0.84^{b}	9.94±0.63^{b}	9.98±0.41^{a}	9.80±0.81^{a}	9.80±0.51^{ab}	49.32±2.80^{a}
15%	9.65±1.03^{b}	9.94±0.54^{b}	9.96±0.86^{b}	9.65±0.72^{b}	9.63±0.51^{b}	48.85±3.61^{b}
20%	9.55±1.03^{b}	9.78±0.57^{c}	9.96±0.51^{b}	9.50±0.76^{b}	9.55±0.81^{c}	48.34±2.87^{b}
25%	9.47±0.63^{c}	9.53±0.81^{d}	9.96±0.56^{b}	9.00±0.75^{c}	9.50±0.75^{c}	47.46±3.06^{c}
30%	9.30±0.66^{c}	9.41±0.77^{d}	9.96±0.54^{b}	8.93±0.72^{c}	9.00±0.77^{d}	46.60±3.16^{d}
35%	9.25±0.40^{c}	9.32±0.75^{e}	9.94±0.98^{c}	8.80±1.03^{d}	8.95±1.41^{d}	46.26±3.18^{d}
40%	9.11±0.45^{c}	8.96±0.72^{e}	9.94±0.91^{c}	8.66±1.03^{d}	8.80±1.47^{e}	45.47±3.63^{e}

Values are means of ten replicates ±SD, numbers in the same column followed by the same letter are not significantly different at 0.05 level.

3.7. Percentages of the recommended dietary allowances (% RDA) provided from Date Powder Biscuits for Children (4-8 years)

The percentages of the recommended dietary allowances (% RDA) are provided from 100g of biscuits for children are showed in table -7-, it could be observed that supplementation of biscuits with 20% date powder and 20% chickpea flour covers up to 63.74% of protein requirement, 11.90% of iron requirement, 18.4% of zinc and 12.62% of calcium. It could be noticed that consuming date powder biscuits could provide

children with part of their daily requirements of protein, dietary fiber, carbohydrate, calcium, iron and zinc. The obtained results are in agreement with the results of El-Sharnouby *et al.* [15]. It could be concluded that the addition of date powder improved the mineral quality of biscuits.

Table 7: Nutritional Evaluation of Biscuits

% Date Powder	Protein (19 g/d)	Dietary Fiber (25 g/d)	Carbohydrate (130 g/d)	Calcium (1000 mg/d)	Iron (10 mg/d)	Zinc (5 mg/d)
Control	66.16	3.16	52.02	1.41	9.3	19.6
5%	65.74	3.32	52.08	12.49	11.30	19.6
10%	65.05	3.52	52.18	12.49	11.40	19.2
15%	64.32	3.76	52.29	12.53	11.80	19.2
20%	63.74	3.96	52.38	12.62	11.90	18.4
25%	63.37	4.2	52.43	12.71	12.21	18.4
30%	62.84	4.4	52.51	12.78	12.22	17.8
35%	62.58	4.64	52.55	12.86	12.40	17.8
40%	62.16	4.84	52.61	12.92	12.50	17.0

4. Conclusion

The potential of date fruit powder as a flour replacer in gluten free biscuits was studied. Increasing substitution increased the ash and dietary fiber in the product. The preference for the products increased with increasing substitution, although inconsistent, in all the sensory parameters (appearance, color, taste, texture, aroma, mouthfeel and overall acceptability). The two most preferred products were those with the 20 per cent substitution and no substitution. Upon determining the mineral composition of the two most preferred products, the minerals (Ca, K and Fe) were significantly higher in the 50 per cent substituted product. This will help in the utilization of date fruit while micronutrients and fiber present in the date fruit will provide some nutritional and health benefits for consumers.

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