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Research Article

Utilization of Date Seeds Flour as a Source of Functional Ingredient in Biscuits

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Abstract:

This work has been carried out to shed some light on the chemical composition and total phenolic compounds of date's seed flour (DSF). The rheological properties and the sensory assessment of the sweet biscuit prepared from wheat flour (72 % extract) partially replaced by different ratios of DSF were evaluated. The results indicated that the chemical composition of DSF contained higher amounts of ether extract (EE 7.66 %), ash (1.55 %) and crude fiber (CF 10.39 %) than those in wheat flour (1.02 %, 0.55 % and 0.76 % respectively).Analogous, DSF contained more total phenolic compounds and higher antioxidant activity. Also, calcium, iron and zinc of DSF were close to twice the amounts in wheat flour. On the other hand, crud protein (CP), total carbohydrates (TC) and nitrogen free extract (NFE) of the wheat flour were higher than those DSF. The water absorption, arrival time and dough weakening increased as the ratio of DSF in the formula increased. Contrary to the dough development and dough stability decreased. The EE, ash, CF and minerals increased in the prepared biscuit as the DSF increased in the formula, while CP, NFE and total calories decreased. The minimum weight of biscuit study was control sample, while the maximum value of biscuit volume and specific volume was control sample. The DSF has significant effect of physical properties of biscuit study. Sensory evaluation showed no significant difference between control and prepared biscuit substituted up 30% with DSF. In conclusion, DSF could be used up to 30% replacement of wheat flour to prepare nutritious and healthy biscuits.

1. Introduction

Date palm (*Phoenix dactylifera* L.) is an economically and traditionally important crop in the Middle East and North Africa. Egypt is the largest date-producing country in the world that produced 1.7 million tons contributing over 21% of global date production (FAO, 2023).

Generated by date processing industries and are used as animal feed or ended up in drains and dumps (Majzoobi et al., 2019). These residues are rich in carbohydrates, dietary fibers, antioxidants, and phenolic compounds, making them a suitable feedstock for processing to a variety of value-added products (Rambabu et al., 2020).

To reduce the date waste's environmental effects, and to move towards a sustainable economy in the date processing industry, proper waste management and disposal strategies are needed. One of the strategies in sustainable waste management is recycling or waste treatment to make value-added products that reduce the cost of making processed foods and minimize environmental pollution (Khedkar and Singh, 2018).

Date seed comprises 11%–18% of the weight of the date fruit (Siddiq et al., 2013). Vast quantities of date seeds are obtained from the date processing industry, of which a small fraction is used as animal feed 17–28% or sometimes as a food ingredient (Heidarinejad et al., 2018) while the major fraction is discarded as waste (Farooq et al., 2018). Thus, recycling date seeds is very important to solve the waste pollution and increase the income to the food industrial sector (Al- Farsi et al., 2007).

Date seeds have been shown to be a carbon-rich substance containing lignin, cellulose, hemicelluloses, and proteins, as well as a high fatty acid content such as oleic acid (Mahdi et al., 2018). Several studies have shown that the date seed is rich in chemicals and nutrients (Oladzad et al., 2021). Moreover, the date seeds may use in folk remedies for the conduct of diabetes, liver diseases and gastrointestinal disorders in traditional Egyptian medicine (Kchaou et al., 2016). Also, its extracts have been used ameliorate gastric ulceration in rats (Al-Qarawi et al., 2004). The good nutritional value of date seeds is based on their dietary fiber content, which makes them suitable for the preparation of fiber-based foods and dietary supplements. Since a large quantity of date seeds are being produced as a waste material and the seeds contain a significant amount of dietary fiber.

Biscuits are the favorite and distinctive food consumed by different sections (children and adults) of society. Because of its availability in different forms, low price with high nutritional value, and taste as well as longer shelf-life (Hussein et al., 2011). Bakery products are sometimes used as a vehicle for the incorporation of different nutritionally rich ingredients (Gandhi et al., 2001; Sudha et al., 2007). However, there are some reservations about using wheat flour in baked products due to its gluten, which causes some health problems such as Celiac disease and wheat allergy (Hager et al., 2012). Add to this the severe shortage that the Arab Republic of Egypt suffers from in the production of wheat flour.

Thus, this work was designed to replace a part of wheat flour with date seed flour in preparation for biscuits. Rheological characteristics and physicochemical properties of the prepared biscuit were studied.

2. Materials and Methods

2.1. Materials

Wheat flour (72 % extraction) was obtained from South Cairo Mills Co., Cairo, Egypt. Date seed (DS) was kindly supplied from a date drying factory in the Agricultural Research Center, Food Technology Institute, Giza as a gift. Other ingredients such as sugar, corn oil, fresh egg, dry milk powder, baking powder, salts, and vanilla were purchased from the local market of Giza governorate, Egypt. All chemicals used in this study are AR grade.

2.2. Methods

2.2.1. Preparation of date seeds flour (DSF)

Date seeds were washed well several times with warm tap water, dried at 50°C, crushed in a heavy-duty grinder (Qijian QJ-10B, China), and sieved to pass through a 110µm (21 mesh) sieve to produce date seeds flour (DSF). The flour was packed in polyethylene bags and stored in a deep freezer at -18ºC for further analysis.

2.2.2. Preparation of laboratory sweat biscuits

Sweet biscuits were prepared in the laboratory using the traditional creamery method described by SaiManohar and HaridasRao (1997) using wheat flour partially replaced with DSF at different ratios (5, 10, 15, 20, 25, and 30%) as displayed in Table (1). All dry ingredients (baking powder, skimmed milk powder, and salt) were mixed and sifted through 60mesh to obtain a uniform mixture. Sugar and corn oil were beaten in a planetary mixer for 6 min to obtain a creamy texture and the fine dry mixture was added gradually to blend at low speed (speed 2) for 4 min at with adding water depending of by Farinograph. The dough was sheeted to a thickness of 5 mm, cut using a circular mold into 55 mm diameter. Biscuits were baked for 15 min at 180±10°C in an electric oven with hot air. After baking, the biscuit samples were cooled at room temperature (25±5ºC) and then stored in tightly sealed polyethylene bags until further analysis.

2.3. Determination of rheological properties of the dough

Rheological properties of the dough of wheat flour and its mixture including water absorption, arrival time, dough development time, dough stability, and degree of weakening were performed by a Farinograph (Model: 827504, Brabender, Duisburg, Germany) according to the standard method (AACC, 2016). The determination of the dough resistance to extension (BU), extensibility (mm), proportional number, and energy (cm2) was carried out using a Brabender Extensograph (Model 860001, Brabender, Duisburg, Germany) according to the standard procedure (AACC, 2016).

2.4. Determination of chemical composition:

Proximate chemical analysis including moisture (method No 930.15), ash (method No 942.05), crude fiber (CF) (method No 978.10), ether extract (EE) (method No 2003.05), and total nitrogen content using micro-Kjeldahl (method No 2001.11) were performed as described in AOAC (2016). Crude protein (CP) was calculated by multiplying total nitrogen by the factor 6.25. Total carbohydrates, nitrogen-free extract (NFE %), and total calories were calculated by following the equations:

Total carbohydrates (TC %)=100 – (CP% + EE% + Ash %)

Nitrogen free extract (NFE %) =TC% –CF%

Total calories (Kcal/100g sample) were calculated as mentioned by FAO/WHO (1974) following the equation:

Total calories (Kcal/100g) = (protein content + carbohydrate) X 4 + EE X 9

Table 1. Formula of sweet biscuits containing different levels of date seed flour

Ingredients (g)	C	T1	T2	T3	T4
Wheat flour (WF)	100.0	90.0	80.0	70.0	60.0
Date seeds flour (DSF)	0.00	10.0	20.0	30.0	40.0
Skimmed milk powder	10.0	10.0	10.0	10.0	10.0
Corn oil	25.0	25.0	25.0	25.0	25.0
Sugar	36.0	36.0	36.0	36.0	36.0
Baking powder	3.00	3.00	3.00	3.00	3.00
Vanilla	0.10	0.10	0.10	0.10	0.10
Salt	2.00	2.00	2.00	2.00	2.00
Water	**According to Farinograph**				

WF = Wheat flour, DSF = Date seeds flour, C = Control 100 % wheat flour (WF)
T1= Treatment no 1 (90% WF + 10 % DSF), T2= Treatment no 2 (80% WF + 20 % DSF)
T3= Treatment no 3 (70% WF + 30 % DSF),T4 = Treatment no 4 (60% WF + 40 % DSF)

Minerals such as Ca, Mg, Fe, Cu, Mn and Zn were determined by Atomic Absorption Spectrophotometer (Agilent technologies 4210 MP-AES) according to AOAC (2016). While K and Na were determined using Flame Photometer as described by AOAC (2016).

2.5. Total phenolic content assay

Total phenolic content was assessed calorimetrically using the FolinCiocalteau reagent as explained by Al-Farsi et al. (2005), with minor changes.

2.6. Total flavonoid content assay

The total flavonoid content was estimated ac-cording to the method (Amira et al., 2012).

2.7. Determination of physical properties of biscuits

Volume (cm^3) by seed replacement method, weight (g) using an accurate balance and specific volume (cm3/g) was calculated by dividing the volume by weight according to AOAC (2016).

2.8. Sensory evaluation of biscuits

The sensorial evaluation of sweet biscuits was carried out according to the sensory evaluation test described by Galvez and Resurrection (1990) by ten trained panelists from the staff of the Agricultural Research Center, Food Technology Institute, Giza. The panelists were asked to evaluate the following quality attributes: color, odor, taste, and crispiness where digital 9 are extremely desired and 1 extremely disliked. The overall acceptability was calculated as the mean of the previous values.

2.9. Statistical analysis of data

The obtained data were statistically analyzed by least significant (LSD) at the 5% level of probability procedure using version of costate 6.451 according to Snedecor and Cochran (1980).

3. Results and Discussion

3.1. Farinograph characteristics of WF-DSF blends

The influence of the substitution of WF with DSF at four levels (10, 20, 30, and 40%) on the rheological properties of sweet biscuit dough was evaluated. The results of the Brabender Farinograph equipment revealed the amount of water absorbed by of wheat flour substituted with date seed flour generally increased compared to the control sample (Table 2). Where control sample (100% wheat flour) absorbed 54% water/100g wheat flour which gradually increased by increasing the ratio of date seed flour in the blend reaching the maximum (72.5 % water/100g blend flour) in the blend containing 40% date seed flour (T4). Also, the arrival time increased as the DSF level increased in the dough formula. The lowest time (0.5 min) is recorded by the control sample which increased gradually as the WF was substituted by DSF in the blended flour. The maximum arrival time (2.5 min) was recorded by the flour containing 40g DSF/ 100 g blend flour (T4). This could be attributed to the high fiber content of date seed flour (Rasper and Walker, 2000). On the other hand, dough development time (DT) decreased as DSF increased. Since, the DT of the control sample was 5 min decreased to 4.5, 4.0, 3.5, and 3.0 min for 10, 20, 30, and 40g DSF/100g blend, respectively. These results are in agreement with those reported by Halaby et al. (2014). The dough weakening (DW) gradually augmented as the DSF ratio increased in the blended flour reaching the minimum value (40 B.U) at 40 DSF / 100 g. blended flour (T4). On the contrary, dough stability (DS) decreases to reach the minimum level in the same flour mixture. These results are in agreement with those reported by Al-Shammari (2023), who reported that the dough of the control sample recorded the lowest weakening (B.U) value.

Table 2. Farinograph characteristics of WF-DSF blends

Samples	Farinograph parameters				
	Water absorption (g/100g flour)	**Arrival time (min)**	**Dough development time (min.)**	**Dough stability (min.)**	**Dough weakening (B.U)**
C	50.0	0.5	5.0	14.4	10
T1	54.1	1.0	4.5	12.0	20
T2	60.5	1.0	4.0	9.9	20
T3	64.2	2.0	3.5	6.0	30
T4	72.5	2.5	3.0	5.0	40

WF Wheat flour, DSF = Date seeds flour, C = Control 100 % wheat flour (WF)
T1= Treatment no 1 (90% WF + 10 % DSF), T2= Treatment no 2 (80% WF + 20 % DSF)
T3= Treatment no 3 (70% WF + 30 % DSF), T4 = Treatment no 4 (60% WF + 40 % DSF)

3.2. Extensograph characteristics of wheat flour - date seeds powder blends

The results of Extensograph parameters including dough extensibility (E), Resistance to extension (R), Proportional number (R/E), and dough energy (DE) decreased as the DSF incorporation increased in the dough formula (Table 3). As the substitution level of DSP increased, resistance to extension (BU) and proportional number (R/E) increased, from 140 BU and 2.15 R/E for control to 580 BU and 3.09 for T4. While dough extensibility (mm) and dough energy (cm²) decreased from 190 mm and 45Cm^2 for control to 65 mm and 22 Cm2 for T4. This can be attributed to the presence of high fiber in date seeds, which dilutes the gluten content in the dough, affecting its stretching ability. These results are in full agreement with those reported by El-Salam et al. (2024).

Table 3. Extensograph characteristics of WF-DSF blends

Samples	Extensograph parameters			
	Dough extensibility (E) (mm)	Resistance to extension (R) (B.U)	Proportional number (R/E)	Dough energy (Cm^2)
C	190	140	0.74	45
T1	180	240	1.33	40
T2	140	320	2.28	37
T3	100	450	4.50	31
T4	65	580	8.92	22

WF=Wheat flour, DSF = Date seeds flour, C = Control 100 % wheat flour (WF)
T1= Treatment no 1 (90% WF + 10 % DSF), T2= Treatment no 2 (80% WF + 20 % DSF)
T3= Treatment no 3 (70% WF + 30 % DSF), T4 = Treatment no 4 (60% WF + 40 % DSF)

3.3. Chemical composition and minerals content of wheat flour (72% ext.) and date seed flour

Data in table 4 show the chemical composition of both wheat flour and date seed flour. Data show a variation in composition between both flours. The moisture content of WF is higher than that of DSF (12.15% and 8.59%), alsoprotein is higher in WF (11.26%) than that of DSF (5.28%). While fat, ash and crude fiber contentsare higher in DSF (7.66%, 1.55% and 10.39%) compared with (1.02%, 0.55% and 0.76%) for WF. These results are in close agreement with Bedeir (2014) who reported that WF (72% extraction) contained moisture (13.70%), protein (12.11%), ash (0.54%), fat (1.04%) and total carbohydrates (73.01%). While, Alharbi (2021) mentioned that the protein, fat, and ash of DSF ranged from 4.81–5.84%, 5.71–8.77%, and 0.82–1.14 %, respectively.

Table 4. Chemical composition (g/100g dry weight basis) of WF and DSF

Samples	Moisture	Crude protein	Ether extract	Ash	Total carbohydrates	Crude fiber	NFE
WF (72%)	12.15^a±0.50	11.26^a±0.13	1.02^b±0.09	0.55^b±0.03	87.17^a±0.75	0.76^b±0.11	86.41^a±0.06
DSF	8.59^b±0.70	5.28^b±0.11	7.66^a±0.07	1.55^a±0.05	85.51^b±0.81	10.39^a±0.15	75.12^b±0.10

WF= Wheat flour, DSF= Date seed flour, NFE= Nitrogen free extract
Values are average and standard deviation (M±SD) of three successful trails.
In the column, values having the same superscript letters are not significantly different at 0.05% level

The content of date seeds of minerals that were analyzed are given in Table 5. Data show that most of mineral contents of DSF are much higher than WF. Calcium, iron and zinc are close to twice the amount in wheat flour (27.00; 2.00 and 2.24 mg/100 g compared with 13.85, 1.15 and 1.00 mg/100 g, respectively). Results are higher than Oshunniyi and Aderinola (2023) who reported iron and zinc to be 1.37 and 1.050 mg/100g but lower in calcium 44.87 mg/100g. While the wheat flour contents wheat flour are in line with Alshehry (2020).

Table 5. Minerals content (mg/ 100 g on dry weight basis) of WF and DSF

Samples	K	Ca	Mg	Mn	Cu	Fe	Zn
WF	131.09^b ±1.30	13.85^b ±0.59	105.10^b ±0.92	0.80^b ±0.35	0.24^b ±2.02	1.15^b ±0.55	1.00^b ±0.82
DSF	225.11^a ±0.13	27.00^a ±0.32	1.66^a ±0.87	6.47^a ±0.93	1.41^a ±0.55	2.00^a ±0.03	2.24^a ±0.19

WF= Wheat flour, DSF= Date seed flour, NFE= Nitrogen free extract
Values are average and standard deviation (M±SD) of three successful trails.
In the column, values having the same superscript letters are not significantly different at 0.05% level

3.4. Total phenolic, flavonoid compounds and antioxidant activity of wheat flour (72% ext.) and date seed flour

For total phenolic, flavonoid contents, and antioxidant activity of wheat flour 72% (WF) and date seed flour (DSF) are presented in table 6. Data show that DSF has higher total phenolic, flavonoid and antioxidant activity (3240.86 mg GAE/100 g DW, 23.11 mg RE/100 g DW, and 225.90 DPPH g/L, respectively) compared to (126.11mg GAE/100 g DW, 19.5mg RE/100 g DW, and 13.45 DPPH g/L, respectively for WF. The values for both total phenolic and flavonoids are high, therefore the rises the antioxidant activity. Data on date seed flour agrees with work by Ahfaiter et al. (2018). Results of wheat flour are in line with work by Ali et al. (2020).

Table 6. Total Phenolic, flavonoid compounds and antioxidant activity of WF and DSF

Properties	WF (72%)	DSF
Total phenolic (mg GAE/100 g DW)	126.11±1.06	3240.86 ±1.15
Total flavonoids (mg RE/100 g DW)	19.5±1.13	23.11 ±1.09
Antioxidant activity DPPH (g/L)	13.45±0.11	225.90 ±0.18

3.5. Physical Properties of Date Seed Biscuits (DSB)

Table (7) displays the physical properties of date seed substituted wheat flour biscuits biscuit (DSB) produced from a blend of WF and DSF at different levels (10, 20, 30, and 40%). The results indicate that the levels of DSF have a significant impact on the produced biscuits.

The lowest weight (12.05 g) was recorded by the control sample followed by the DSB containing 10% DSF (12.45 g) and the highest (13.65 g) was recorded by the DSB containing 40% DSF in its formula. The increased weight might be caused by the higher water holding capacity of fiber.

Data in the same table indicted that the volume biscuit (m3 /g) and specific volume has reversible relationship with the DSF substitution of WF. These results are in agreement with those obtained by El-Salam et al. (2024).

Table 7. Physical Characteristics of Date Seed Biscuits (DSBB)

Samples	Weight (g)	Volume (cm^3)	Specific volume (cm^3/g)
C	12.05 ^{e} ±2.58	20.10^{a}±4.36	1.66^{a}±0.04
T1	12.45 ^{d} ±3.54	20.0^{a}±6.24	1.60^{b}±0.11
T2	12.89 ^{c} ±2.58	19.95^{a} ±6.24	1.55^{c}±0.09
T3	13.22 ^{b} ±4.32	19.54 ^{b} ±4.36	1.49^{c}±0.03
T4	13.65 ^{a} ±5.66	19.21^{c} ±7.94	1.42^{d}±0.06

Means with the same latter in the same column are not significant different ($p>0.05$).
WF=Wheat flour, DSF = Date seeds flour, C = Control 100 % wheat flour (WF)
T1= Treatment no 1 (90% WF + 10 % DSF), T2= Treatment no 2 (80% WF + 20 % DSF)
T3= Treatment no 3 (70% WF + 30 % DSF), T4 = Treatment no 4 (60% WF + 40 % DSF)

3.6. Chemical composition and minerals content of prepared sweet biscuits

The chemical composition of the substituted and control biscuits is shown in Table 8. When compared to date seed substitution biscuits, the control group exhibits the lowest levels of fat, ash, and fiber.

The chemical composition of control sweet biscuits is protein 6.38%, fat 17.30%, ash 0.45 % and 75.33% NFE with total energy of 482.52 Kcal/100. Both protein and NFE decrease by adding DSF to the biscuit formula reaching 14.91 and 71.68%, for biscuits with 40% DSF.However, ash, ether extract, and crude fibers increase. The decrement of protein and NFE was associated with increasing DSF amount in the biscuit formula (Table 8). This may be related to the low protein and NFE content of DSF (Table 4). While fat, ash and crude fiber increases with increasing DSF amount in the biscuit formula. This is due to the higherfat, ash and crude fiber content of DSF than that of WF. The results are in agreement with those reported byZidan and Samea (2019). As a result, the total energy of the control biscuit gradually decreased by the increasing of the DSF ratio in the biscuit formula. So, the significantly lowest total energy is 407. 47Kcal/100g found in biscuits containing 40% DSF.

Table 8. Chemical composition (g/100g dry weight basis) and total calories (Kcal/100g) of the prepared sweet biscuits

Treatment	Moisture	Protein	Fat	Ash	Fiber	NFE.	Total Calories
Con.	11.78 ^{a} ±0.09	17.30 ^{a}±0.72	4.68 ^{c}±0.46	0.65^{d}±0.09	1.74^{e}±0.34	75. 63 ^{a}±0.90	413.84
T1	11.43 ^{ab}±0.06	17.34 ^{a} ±0.09	4.85^{c}±0.39	0.75 ^{c} ±0.05	2.70 ^{d}±0.36	74.46 ^{b} ±0. 91	410.85
T2	11.07^{bc}±0.17	16.32 ^{b}±1.07	5.46 ^{b}±0.48	0.84^{bc}±0.10	3.67 ^{c}±0.38	73.71 ^{c}±.0.86	409.26
T3	10.72 ^{c} ±0.35	15.51 ^{c}±0.13	6.20^{a}±0.36	0.95 ^{ab}±0.03	4.62^{b}±0.19	72.72^{d}±0.90	408.72
T4	10.26 ^{d}±0.19	14.91 ^{d}±0.82	6.79 ^{a}±0.79	1.05 ^{a} ±0.03	5.57^{a}±0.47	71.68^{e}±0.80	407.47

In a column, means with the same superscript letters are not significant different at (*p*>0.05).
WF=Wheat flour, DSF = Date seeds flour, C = Control 100 % wheat flour (WF)
T1= Treatment no 1 (90% WF + 10 % DSF), T2= Treatment no 2 (80% WF + 20 % DSF)
T3= Treatment no 3 (70% WF + 30 % DSF), T4 = Treatment no 4 (60% WF + 40 % DSF)

Table (9) illustrated the mineral contents of date seeds flour supplemented biscuits. It is clear mineral content was gradually and significantly (p<0.05) increased by increasing DSF in biscuits. The biscuits with 40% have the maximum amount of most minerals among the other studied samples compared with the control. The calcium content was (62.76, 97.68, 132.59, 167.51, 202.42mg/100g) for control and DSF substituted biscuits; respectively. Similarly, the values were obtained for potassium, manganese, iron and zinc were (178.06 to 256.8442mg/100g),(2.25 to 3.82 mg/100g), (7.35 to 16.3742 mg/100g) and (3.28 to 6.0742 mg/100g) compared with control 156.24, 1.72, 4.35 and 2.78 mg/100g respectively. The increment was due to addition of date flour which has high contents of calcium, potassium, manganese, iron and zinc (Table 5). Data agree with work by El-Salam et al., 2024.

Table 9. Minerals content of biscuits (mg/100 g on dry weight basis)

Minerals	C	T1	T2	T3	T4
Ca	62.76^{e}±8.93	97.68 ^{d}±2.60	132.59 ^{c}±17.87	167.51^{b}±8.67	202.42^{a}±17.97
K	156.24^{e}±8.66	178.06^{d}±3.56	206.54 ^{c}±8.88	231.69^{b}±8.88	256.84^{a}±8.98
Mg	174.29^{c}±8.88	243.48^{bc}±9.19	312.67^{ab}±8.98	381.86^{n}±8.81	406.77 ^{a} ±4.39
Mn	1.72 ^{e}±0.17	2.25 ^{d}±0.09	2.77 ^{c}±0.09	3.30 ^{b}±0.17	3.82 ^{a}±0.09
Cu	0.84 ^{e}±0.09	1.32 ^{d}±0.11	1.61 ^{c}±0.09	2.26 ^{b}±0.07	2.74^{a}±0.09
Fe	4.35 ^{e}±0.09	7.35^{d}±0.09	10.36 ^{c}±0.96	13.3 7 ^{b}±1.59	16.37 ^{a}±1.59
Zn	2.78 ^{c}±0.09	3.28^{bc}±0.09	4.18 ^{b}±0.23	5.33 ^{a}±1.27	6.07^{a}±0.07

In a row, means with the same superscript latters are not significant different at (*p*>0.05).
WF=Wheat flour, DSF = Date seeds flour, C = Control 100 % wheat flour (WF)
T1= Treatment no 1 (90% WF + 10 % DSF), T2= Treatment no 2 (80% WF + 20 % DSF)
T3= Treatment no 3 (70% WF + 30 % DSF), T4 = Treatment no 4 (60% WF + 40 % DSF)

3.7. Sensory properties of prepared sweet biscuits

Effect of different contents of date seed powder on sensory properties of biscuit is presented in Table (9). It showed the sensory properties including color, odor, taste, crispy and overall acceptability of biscuits containing date seed flour ratios 10, 20, 30 and 40% and the results are found in Table (9). It showed that increasing date seed powder in biscuit led to significantly decrease in the sensory scores of color. A significant difference was observed between control (6.95) and supplemented samples 10, 20, 30 and 40% date seed powder (6.90, 6.50, 6.10) and 5.35, respectively. Such a decrease in color score was due to their dark nature of date seed. The sensory scores of odor, showed no significant difference between control and supplemented samples. While data on taste showed no significant difference between control and supplemented samples T1 and T2 and a slight decrease in scores of samples T3 and T4.Crispiness and overall acceptability follow the same trend.

Based on our results of sensory evaluation, we concluded that nutritious and healthy biscuits can be produced by substituting wheat flour up to 30% with date seed powder without negative effect on the general acceptability of biscuits. These results are in agreement with those obtained by Ghasemi et al. (2020) and Zidan and Samea (2019).

Table 10. Sensory properties of biscuit

Treatments	Color	Odor	Taste	Crispiness	Overall acceptability
C	6.95^{a}±0.77	8.10^{a}±0.09	8.80 ^{a}±0.77	8.70 ^{a}±0.23	8.50 ^{a}±0.03
T1	6.90^{a}±0.48	8.10 ^{a}±0.31	8.70 ^{a}±0.22	8.66^{a}±0.57	8.50 ^{a} ±0.66
T2	6.50^{b}±0.2	8.15^{a} ±0.99	8.50 ^{ab}±0.45	8.60 ^{a}±0.51	8.55^{a}±0.84
T3	6.10^{c}±0.15	8.15^{a}±0.55	8.35 ^{ab}±0.8	6.70 ^{b}±0.86	7.70^{b}±0.54
T4	5.35^{d}±0.66	8.10 ^{a}±0.81	8.10 ^{b}±0.44	5.95 ^{c}±0.54	7.20 ^{c}±0.75

In a column, means with the same superscript letters are not significant different at ($p>0.05$).

WF=Wheat flour, DSF = Date seeds flour, C = Control 100 % wheat flour (WF)

T1= Treatment no 1 (90% WF + 10 % DSF), T2= Treatment no 2 (80% WF + 20 % DSF)

T3= Treatment no 3 (70% WF + 30 % DSF),T4= Treatment no 4 (60% WF + 40 % DSF)

4. Conclusion

The increase of Agro-industrial waste especially the date industry which generates nearly a one third of the amount of the raw date. The seeds are rich in dietary fiber, minerals, phenolic compounds and antioxidants. The results of the research have proven that wheat flour can be replaced with date seed flour up to 40% in the production of sweet biscuits of high quality and pleasant taste. Therefore, these seeds can be used to fill part of the gap of the shortage in wheat production or importing it from abroad.

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