

Sensory and nutritional attributes of samh flour and dates powder supplemented cookies

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Abstract

Although cookies formulation is based on soft wheat, hard-wheat flour grown in Saudi Arabia was used to prepare cookies. Hard-wheat flour was dry-heat treated at 120 °C for 2 h and 15 min in order to weaken the gluten. Heat treated flour was blended with samh flour (*Mesembryanthemum forsskalei* Hochst) and date powder (*Phoenix dactylifera*) at 25 or 50% replacement of the base flour. Cookies prepared from 100% heat treated flour showed poor quality. The addition of samh flour and dates powder significantly improved the sensory quality ($P=0.05$) and cookies spread. Larger diameter and spread in presence of date powder and full fat samh flour was noted. Cookies with date powder and samh flour exhibited superior colour due to Maillard reaction caused by high sugar content of date powder and the high protein in samh flour. Significantly high potassium, calcium, iron, and copper in blends with both date powder and samh flour were recorded. A mixture containing both dates powder and samh flour is therefore recommended for improved quality parameters and nutritional values for the commercial production of cookies.

Keywords: samh seed, prevalence, protein, dough

1. Introduction

Among the different bakery products, cookies are consumed by all members of the society due to their nutritional value, different forms, ready to consume and availability at a reasonable price. This product has a long shelf life and can easily be stored without noticeable change in quality (Al-Ghamidi, 2010). The main ingredients of cookies that have direct effect on cookies quality are flour, sugar, fats and water (Maache-Rezzoug *et al.*, 1998; Manohar and Rao, 1999; Vaclavik and Christian, 2003; Wehrle *et al.*, 1999). Cookies are considered rich in carbohydrates and fats. Usually, up to 20-60% fat is used in cookies dough and 25-55% of sucrose by weight of flour (Sanchez *et al.*, 1995). Many types of fruit are also used in cookie manufacturing (Mepba *et al.*, 2007) such as cuts of plantains (*Musa paradisiaca*), dried mango fruit peels (Ajila *et al.*, 2007) and breadfruit (*Artocarpus communis*) (Olaoye *et al.*, 2007; Omobuwajo, 2003). Substitution of wheat flour with different seed flours in order to improve taste, flavour and nutritional value of cookies is common. For example,

cookies prepared by substituting of wheat flour with 50% of mango seed powder exhibited improved colour, flavour, texture and general consumer acceptance (Arogba, 1999). Akubor (2003) used cowpea flour to replace 30% of plantain flour to obtain cowpea/plantain flour (CPF) blends for cookies preparation. Cookies prepared from CPF/WF (wheat flour) blends showed that water and oil absorption capacities has increased with higher CPF. In another study, substitution of 15% wheat flour with mucuna seed flour increased the protein content from 7.36-11.29 g/100 g of dry matter (Ezeagu *et al.*, 2002). Cookies were also prepared from composite flours of full fat flaxseed flour and showed quality improved (Hussain *et al.*, 2006). Wheat flour was also replaced with linseed flour to determine changes in baking properties of cakes and cookies. The study showed an increase in the percentage of moisture, ash, fat and protein of cakes and cookies with increasing amount of linseed flour in the composite mixture (Bashir *et al.*, 2006). Cookies were also prepared by the addition of 15% low-fat mustard flour to improve the nutritional value, textural properties, and the general consumer acceptance (Tyagi *et*

al., 2007). Similarly, cookies produced by substituting wheat flour with 15% low fat wheat germs or sprouts showed the highest consumer acceptability (Arshad *et al.*, 2007). Furthermore, addition of 10% soaked and germinated fenugreek flour to cookies blend at the maximum quantity was also studied to prepare high quality and acceptable product (Hooda and Jood, 2005).

Since cookies are important among bakery products due to their variety in taste, colour, flavour, crispiness, digestibility and long shelf life (Gandhi *et al.*, 2001), the addition of 20% date paste to cookies blends was a success in the preparation of high quality product (Mustafa and Wahdan, 1989). Presently, many different types of date-based confectionaries such as Maamouls, cookies, Kalazas and breads are being produced with date-paste and wheat flour in different part of Saudi Arabia. Moreover, the addition of samh flour improved the nutritional value, prevalence rate and appearance of cookies, especially, the colour (Mustafa *et al.*, 1995), but there is very little information on the use of wild samh seeds with wheat flour for the production of various bakery products. Traditionally, the population of the northern areas of the Kingdom of Saudi Arabia use samh seeds (*Mesembryanthemum forsskalei* Hochst) as an important food, by mixing samh with butter and date for the preparing of the traditional recipe called Pakilla (Al-Sharari, 1988).

Samh flour is also used in preparing breads, cookies, and other traditional recipes. According to Al-Qahiz (2009), samh seeds are rich in proteins (22.3%) and the consumption of 15% of samh seeds flour in baked products reduced the creatinine concentration and improved blood lipids, especially, the cholesterol, HDL and LDL. In addition, another researcher, Al-Drewish (2005), reported that samh flour is rich in protein (20.5%), carbohydrate (63.05%) and fats (4.8%). Samh seeds are a good source of dietary fibre (10.6%) (Najib *et al.*, 2004). Since samh seeds are rich in protein they could be considered as a potential protein source especially in developing countries (Al-Drewish, 2005; Al-Jassir *et al.*, 1995).

The main technical and economical objectives of this study were: to prepare cookies from hard wheat by heat-treat hard wheat flour in order to weaken the gluten so that to produce hard wheat flour suitable for producing cookies which is primarily made of soft wheat. The main indicator of the final quality will be overall acceptability of the produced cookies. The treated flour will be blended with different levels of locally produced samh flour and dates powder in order to further dilute the gluten and improve the organoleptic properties of the produced cookies. These objectives are expected to accomplish two outcomes, allow the local cookies industry to use locally produced hard wheat and make use of locally produced samh flour and dates powder. Keep in mind that Saudi Arabia produces hard wheat only.

Overall, the developed cookies blends will directly expand the use of samh seeds flour and dates powder, which will increase the profitability of local farmers.

2. Materials and methods

Raw materials

All-purpose untreated wheat flour was obtained from the Saudi Establishment of Flour Mills and Grain Silos, Riyadh, Saudi Arabia. Wheat flour was dry heated at 120 °C for 2 h in a drying oven. Samples were mixed every 15 min for heating consistency. Date powder was produced from Al-Labana variety from Almadinah Almunawarah located in the north-west part of Saudi Arabia. Class A pitted dates were dried in a drying oven at 60 °C for 3 h in order to maintain quality (Benamara, *et al.*, 2009). Dried dates were cooled at room temperature, milled, packed in polyethylene bags and stored until use. Samh seeds flour was obtained from the city of Tabarjal in Al-Jouf region, Northern Saudi Arabia and stored in polyethylene bags. Samh flour was defatted using hexane at a flour:hexane ratio of 2:4 (w/v) according to the method of the Association of Official Analytical Chemists (AOAC) as described by Al-Qahtani (2007).

Production of cookies

Cookies were prepared by blending 100 g wheat flour, 100 g sugar, 100 g margarine, 50 ml of fresh egg, 14 g vanilla, 16 g baking powder, and 5 g table salt. The dough was mixed in a Kitchen Aid mixer (St. Joseph, MI, USA) equipped with a paddle beater. Cookies were prepared in an oven (Euromat; WIESHEU GmbH, Affalterbach, Germany) at 130 °C for 20 min, cooled at room temperature (25 °C), and packed in plastic bags until sensory evaluation. Cookies were prepared from three different blends: (1) untreated wheat flour and heat treated; (2) substituting heat treated wheat flour with date flour and samh seed flour full-fat or low-fat by 25 or 50%; and (3) substituting heat treated wheat flour with a combination of both dates or samh flour at 25% and 50% date flour along with either full-fat or low-fat samh flour in various proportions such as 25:25, 25:50, 50:25 and 50:50 plus the base flour as shown in Table 1 (Al-Ghamdi, 2010).

Sugar determination of date powder

Sugars were determined according to AOAC method 945-66 (AOAC, 2000). The extracted sugars were identified using high performance liquid chromatography, Shimadzu 10Avp (Shimadzu Co., Tokyo, Japan). The standard was purchased from Sigma Aldrich Co. (St Louis, MO, USA) and a Shim-pak CLC-NH₂ column (5 µm, 4.6×25 cm) from Shimadzu (Tokyo, Japan). Aqueous acetonitrile (80%) was used as mobile phase.

Mineral determination

Minerals content was determined according to AOAC (2000) using atomic absorption for the determination of magnesium, calcium, iron, zinc, and copper. Samples (10-15 g) were incinerated at 550 °C for 5 h, where 0.5 g of the ashes were dispersed in distilled water and injected in the instrument.

Farinograph and amylograph test

The control flour, as specified in Table 1, was tested according to farinograph method no. 54-21 and moisture content as determined by method no. 39-06. The 10 g mixing bowl was used under standard conditions (60% absorption, 14% moisture, 500 farinograph units consistency, and 20 min run time). The dough water absorption, stability profiles, and mixing tolerance index (MTI) were determined. Amylograph was done according to AACC (2000) method no. 22-10 by using 40 g wheat flour (14% moisture content) and 360 ml distilled water.

Cookie analysis and physical testing

The moisture content and the crude fat of the selected cookie samples were done according to the AOAC approved methods 926.08 and 989.05, respectively (AOAC, 2000). The proportion of crude fibre was estimated by using All Fibrtec System 8000; Foss, Hillerød, Denmark. Total carbohydrates

were determined by using the difference method according to the equation:

$$\text{total carbohydrates} = 100 - (\% \text{ moisture} + \% \text{ of crude fat} + \% \text{ crude protein} + \% \text{ ash})$$

Cookie spread was calculated by dividing the width by the thickness according to the method of AACC method no. 10-53 (AACC, 2000).

Sensory evaluation of the extrudate

The product was tested by a trained panel, where samples were given random numbers using hedonic scale which included two preferences. The panellists were asked whether they like or dislike the product based on its colour, flavour, taste, and texture plus the overall acceptability.

Statistics

All measurements were carried out in triplicate. One way analysis of variance was used to determine the effect of samh or dates powder levels on the tested flour including the two types of mixture of samh and dates powder. Duncan's multiple range test at $P \leq 0.05$ was used to compare means using PASW® Statistics 18 software (IBM; Armonk, NY, USA). The statistical analysis of the sensory evaluation was done using the chi-square test.

Table 1. Mixing ratios of date flour (D), samh seeds flour, full-fat (S), or low-fat (LFS) samh and heat-treated wheat flour (CT) or untreated (CU) in different cookie samples.

Set	Sample ¹	Samh seed flour (%)	Date flour (%)	Wheat flour (%)
First set	CU	0	0	100
	CT	0	0	100
	CTD1	0	25	75
	CTD2	0	50	50
	CTS1	25	0	75
	CTS2	50	0	50
	CTLFS1	25	0	75
	CTLFS2	50	0	50
Second set	CTD1S1	25	25	50
	CTD1S2	50	25	25
	CTD2S1	25	50	25
	CTS2D2	50	50	0
	CTLFS1D1	25	25	50
	CTD1LFS2	50	25	25
	CTD1LFS1	25	50	25
	CTD2LFS2	50	50	0

¹ CU = untreated wheat flour; CT = heat-treated wheat flour; D = date powder; S = samh flour (full-fat); LFS = low fat samh flour.

3. Results and discussion

Proximate analysis

Proximate analysis showed that date powder contained similar amounts of fructose and glucose (about 6.8%), whereas samh flour showed no sugar content (Table 2). Samh flour had 10 times more fat or crude protein and two times more crude fibre compared to date powder. Conversely, date powder contained about 20% more carbohydrates. The sugars content in date powder is in agreement with those reported by Sawaya (1986). The high quantity of sugar in Al-labanah date is due to the low moisture in this type of dates since they are marketed as dry or semi-dry. Higher ash percentage indicates high amount of minerals in samh flour.

Farinograph and amylograph

Farinograph data showed an increase in the water absorption of the flour by 15% (83–68%), which could be attributed to the change in the oxidation of -SH groups of the gluten (Table 3). This will limit the formation of S-S groups needed for dough formation allowing other components of flour (starch and other polysaccharides) to absorb the excess water thus causing higher farinograph absorption and delay in dough formation. The effect of heat on wheat protein was reported by a number of researchers (Colonna *et al.*, 1987; Larmond, 1977; Mohamed *et al.*, 2004). Heating gluten above 70 °C causes aggregation and reduces solubility and extractability. The increase in heat-treated gluten extractability in the presence of reducing agents implies that heat-induced changes in gluten's rheological and extractability properties are related to changes in disulphide bonding (Weegels *et al.*, 1996). Heat treatment may cause changes in starch granules integrity, thus increases the overall water absorption of the flour as shown by the farinograph data. The data in Table 3

showed higher farinograph parameters values for the heat-treated flour compared to untreated. The dough MTI is the difference in Brabender units (BU) between the top of the farinograph-profile peak and 5 min later, where high differences in BU indicate increasing heat treatment influence on the control flour. The MTI of treated flour was 100% higher than the control (20 versus 40 BU), whereas dough stability was 44.4% higher than the control (control 18 min treated 26 min). Dough-stability is the difference between the time when the top of the curve reaches 500 BU and the time where it leaves the 500 BU. The effect of heat treatment on the farinograph profile of the control could be attributed to gluten protein aggregation and intra-molecular hydrophobic interaction induced by heat. The influence of heat treatment on MIT and dough stability is due to prolonging disulphide bonds formation caused by heat. The arrival time is also one of the dough quality parameters obtained from the farinograph testing. It is the time needed for the curve to reach the 500 BU mark, where longer arrival time indicates slower gluten development during mixing. Consequently, this will increase dough mixing time and delay production. The arrival time for the control flour was 2 min versus 4 min for the sample.

The amylograph data (Table 3) showed no change on the gelatinisation or pasting temperatures of the flour, but the maximum viscosity of heat-treated flour was 30% higher than the control. It is widely accepted that the viscosity of pre-heated starch slurry increase due to granules ability to absorb and trap water. The dry heat treatment of flour (11% moisture content) increased starch granules ability to absorb water and build up viscosity faster thus lower pasting time. Therefore, delayed water penetration into untreated granule postponed increase in overall viscosity of untreated flour, which could be attributed to higher granules integrity. Consequently, slower water absorption, delayed granules disruption at the end of the gelatinisation process which determines the final viscosity.

Table 2. Chemical composition (%) of date flour (D), full-fat samh seed flour (S) and low-fat samh seeds flour (LFS).

Parameters	D	S	LFS
Moisture	7.13±0.12	3.09±0.32	7.73±1.30
Ash	2.73±0.25	3.42±0.45	3.31±0.47
Fat	0.32±0.06	2.46±0.03	4.73±0.78
Crude protein	2.50±0.04	24.40±1.05	19.50±1.06
Total carbohydrate ¹	87.32±0.09	66.63±0.73	64.73±0.33
Crude fibre	2.58±0.99	7.26±0.77	5.60±1.08
Fructose	6.84±0.87	-	-
Glucose	6.89±0.44	-	-
Sucrose	61.8±0.20	-	-

¹ % total carbohydrate = 100 – (% moisture + % ash + % crude fat + % crude protein).

Table 3. Comparison between overall average farinogram and amylogram readings of heat-treated and untreated wheat flour.

Farinograph						
Material	Mixing tolerance index (BU)	Departure time (min)	Dough stability (min)	Dough development time (min)	Arrival time (min)	Absorption (%)
Un-treated	20	20	18	9.50	2	68
Heat-treated	40	30	26	10.50	4	83
Amylograph						
Material	Gelatinisation temperature (°C)		Maximum viscosity (BU)		Pasting temperature (°C)	
Untreated	55		320		86.50	
Heat-treated	55		470		86.50	
BU = Brabender units.						

Sensory evaluation of cookies

The sensory evaluation of the prepared cookies was done for two reasons. The first was to determine the effect of date powder and samh flour on the characteristics of the cookies prepared from heat-treated hard wheat and the second was to select the sample with the highest overall acceptability from each blend. For instance, the best blends containing date powder, samh flour, or a blend of both, were chosen and grouped for final comparison i.e. a sample can have high score within its group, nonetheless scores low when compared with samples in another group.

Including the overall acceptability, the sensory evaluation for determining the effect of dates powder on cookies colour, flavour, and taste indicated significant improvement ($P=0.05$)

(Table 4). Texture, on the other hand, was negatively affected by the date powder. The sensory evaluation of the untreated wheat flour showed much better results than the 100% treated wheat flour, but with the addition of date powder, the heat-treated flour recovered much of its quality attributes lost during heat treatment of the base flour (Table 4). This was especially true for the colour, where the acceptability reached 93% compared to 83% for the untreated flour. Improvement of cookies quality due to date powder addition was decreased at higher date powder levels (50%) versus (25%). This can be attributed to the high sugar content in date powder that generated more Maillard reaction products causing darker colour, which means that the amount of sugar in the sample with 25% date powder was just enough to improve the colour (Table 4). It appears that, heat treatment limited wheat flour water absorption leading to limited

Table 4. Sensory evaluation of cookies prepared from untreated and treated wheat flour blended with various amounts of date powder (number of trained panellists = 30).

Characteristics	Samples ¹				
	CU	CT	CD1	CD2	P-value ²
Colour	82.8 ³	69	93.1	86.2	0.01
Flavour	75.9	27.6	82.2	51.7	0.02
Taste	58.6	27.6	79.3	51.7	0.03
Texture	65.5	51.7	62.1	41.4	0.24
Overall Acceptance	72.4	48.3	89.7	62.1	0.01

¹C = cookie; CU = untreated wheat flour; CT = heat-treated wheat flour; D = date powder; CD1 = 75CT + 25D; CD2 = 50% CT + 50% D.

² P-value corresponds with the chi-square value.

³ % acceptability.

starch gelatinisation and overall effect on dough mechanical properties. The effect of the full fat and low fat samh flour on cookies quality was significantly negative ($P=0.05$) including individual attribute or the overall acceptability, as presented in Table 5. The addition of both, date powder and samh flour significantly improved all sensory attributes of the cookies as shown in Table 6, where the blend prepared from 25% treated wheat flour, 50% date powder, and 25% full fat samh flour, exhibited the highest colour and texture scores. The texture improvement of this blend is interesting because the texture of all other blends deteriorated significantly due to heat treatment as well as the presence of only date powder or samh flour. It was also noticed that full fat samh flour performed better than the defatted, especially on the colour and the overall cookies acceptability (Table 6). The blend with 25% date powder and 25% full fat samh flour exhibited the highest acceptability score together with the

sample containing 50% date powder and 25% full fat samh flour (Table 6). This could be attributed to the high sugar content of the date powder.

Cookies with the highest sensory score of the three groups, heat treated flour containing date powder, full fat samh flour, low fat samh flour, or a blend of both were selected for another round of sensory evaluation so as to make final comparison and selection. The selected samples include, 25% date powder only, 25% date powder plus 25% full fat samh flour, 50% date powder and 25% full fat samh flour, 50% date powder plus 50% full fat samh flour (0% heat treated wheat flour), and 25% low fat samh flour, as shown in Table 7. The selected samples were subjected once again for sensory evaluation, where the colour of the cookies was significantly improved for all of the above mentioned blends except for the sample containing 25% low fat samh flour. This could be

Table 5. Sensory evaluation of cookies prepared from untreated and treated wheat flour blended with various amounts of full fat and low fat samh flour (number of trained panellists = 30).

Parameters	Samples ¹						P-value ²
	CU	CT	CSF1	CSF2	CLSF1	CLSF2	
Colour	82.8 ³	69.0	44.8	62.1	48.3	61.2	0.04
Flavour	75.9	27.6	34.5	17.2	41.4	48.3	0.17
Taste	58.6	27.6	24.1	27.6	31.0	41.4	0.06
Texture	65.5	51.7	55.2	48.3	48.3	41.4	0.57
Overall Acceptance	72.4	48.3	31.0	31.0	44.8	34.5	0.10

¹ C = cookie; CU = untreated wheat flour; CT = heat-treated wheat flour; SF = full fat samh flour; CSF1 or LSF = 75CT + 25SF; CSF2 or LSF = 50% CT + 50% SF; LSF = low fat samh flour.

² P-value corresponds with the chi-square value.

³ % acceptability.

Table 6. Sensory evaluation of cookies prepared from treated wheat flour blended with various amounts of dates powder, full-fat and low fat samh flour (number of trained panellists = 30).

Parameters	Samples ¹									P-value ²
	CT	CTD1S1	CTD1S2	CTD2S1	CTD2S2	CTD1LSF1	CTD1LSF2	CTD2LSF1	CTD2LSF2	
Colour	69.0 ³	93.1	75.9	93	72.4	69	51.7	58.6	51.7	0.01
Flavour	27.6	86.2	65.5	75.9	65.7	62.2	51.7	69	58.6	0.02
Taste	27.6	89.7	69	69.1	79.3	58.6	58.6	75.9	62.2	0.01
Texture	51.7	44.8	27.6	69	48.3	37.9	20.7	44.8	34.5	0.02
Overall Acceptance	48.3	79.3	69	79.3	75.9	58.6	51.7	69	62.1	0.01

¹ C = cookies; CT = heat-treated wheat flour; D = date powder; S = samh flour; LSF = low fat samh flour; CTD1S1 = 50CT + 25D + 25S; CTD2S1 = 25% CT + 50% D + 25%S; CTD1S2 = 25% CT + 25%D + 50%S; CTD2S2 = 0%CT + 50%D + 50%S.

² P-value corresponds with the chi-square value.

³ % acceptability.

accredited to the presence of sugars in the samples with date powder and the high protein in samh flour causing Maillard reaction which contributes to better colour. The colour of the selected cookies was not any different from chocolate cookies (pictures not shown). The flavour and the taste of the selected cookies showed results similar to those of the colour (Table 7). It is noticeable that the presence of samh flour cause drop on the texture score due to its high fibre content. The high fibre reduces water absorption of wheat flour which in turn reduces dough mixing properties and the overall cookies texture. This was clear in the data shown in Table 7, where higher samh flour led to lower texture score. The overall acceptability was significantly improved for all blends except for the sample containing low fat samh flour (Table 7), where the sample prepared from heat treated wheat flour plus 25% date powder (no samh) exhibited the highest overall acceptability score.

Untreated wheat flour showed the highest moisture content of all samples. As expected, lower moisture content was recorded for the heat treated wheat flour (Table 8). The moisture content of the selected cookies increased by 2% in the presence of date powder, which can be attributed to the humectant property of the sugars found in date powder. Blends with samh flour and less date powder exhibited lower moisture contents. Samples with high samh content showed higher ash where the sample containing 50% samh exhibited the highest ash content (Table 8). The fat content of all samples was not significantly different ($P=0.05$), whereas blends with higher date powder exhibited lower protein content due to the low protein content of date powder (Table 8) and the opposite for samh-containing samples. The total carbohydrates increased as a function of date powder content, where samples with date powder and wheat flour showed significantly higher values. The fibre content of blends with both samh flour and wheat flour had significantly higher values; however samples with

Table 7. Sensory evaluation of selected cookie blends prepared from treated wheat flour blended with various amounts of dates powder, full-fat and low-fat samh flour (number of trained panellists = 30).

Parameters	Samples ¹						P-value ²
	CT	CTD1	CTD1S1	CTD2S1	CTD2S2	CTLSF1	
Colour	69.0 ³	93.1	93.1	93.1	72.4	48.3	0.01
Flavour	27.6	82.8	86.2	75.9	65.5	41.4	0.02
Taste	27.6	79.3	89.7	69.1	79.3	31	0.01
Texture	51.7	72.1	44.8	69	48.3	48.3	0.37
Overall Acceptance	48.3	89.7	79.3	79.3	75.9	44.8	0.01

¹ C = cookies; CT = heat-treated wheat flour; D = date powder; S = samh flour; LSF = low fat samh flour; CTD1 = 75CT + 25D; CTLSF1 = 75% CT + 25%LSF; CTD1S1 = 50% CT + 25%D + 25%S; CTD2S1 = 25%CT + 50%D + 25%S; CT D2S2 = 0% CT + 50% D + 50% S.

² P-value corresponds with the chi-square value.

³ % acceptability.

Table 8. Chemical composition of selected cookies samples.¹

Parameters ²	Moisture	Ash	Fat	Protein	TC	Crude fibre
CU	7.38 ^a ±0.16	2.18 ^d ±0.11	12.79 ^a ±0.87	11.04 ^b ±0.10	66.61 ^c ±0.97	1.32 ^{abc} ±0.11
CT	4.26 ^c ±0.16	2.41 ^{cd} ±0.24	11.65 ^a ±0.09	10.30 ^c ±0.15	71.39 ^a ±0.07	1.54 ^{ab} ±0.33
CTD1	6.81 ^{ab} ±0.59	2.28 ^{cd} ±0.15	11.97 ^a ±0.53	8.67 ^d ±0.49	70.27 ^{ab} ±0.50	1.15 ^c ±0.80
CTD1S1	4.28 ^c ±0.02	2.60 ^{bc} ±0.26	12.46 ^a ±0.51	10.26 ^c ±0.07	70.40 ^{ab} ±0.66	1.59 ^a ±0.27
CTLSF1	5.99 ^b ±0.78	2.48 ^{cd} ±0.14	12.83 ^a ±0.38	12.13 ^a ±0.15	66.57 ^c ±1.16	1.32 ^{abc} ±0.02
CTD2S1	4.10 ^c ±0.47	2.87 ^b ±0.09	12.35 ^a ±0.43	8.38 ^d ±0.14	72.30 ^a ±0.97	1.18 ^c ±0.11
CTD2S2	4.27 ^c ±0.42	3.23 ^a ±0.09	12.59 ^a ±1.25	9.93 ^c ±0.09	69.98 ^{ab} ±1.40	1.24 ^b ±0.09

¹ Means followed by the same superscript letter across columns are not significantly different ($P=0.05$).

² TC = total carbohydrates crude fibre; C = cookies; CT = heat-treated wheat flour; D = date powder; S = samh flour; LSF = low fat samh flour; CTD1 = 75CT + 25D; CTD1S1 = 50% CT + 25%D + 25%S; CTLSF1 = 75% CT + 25%LSF; CTD2S1 = 25%CT + 50%D + 25%S; CTD2S2 = 0% CT + 50% D + 50% S.

less or no wheat flour exhibited the lowest values (Table 8). As shown in Table 9, the sucrose content increased as a function of date powder for obvious reasons, where the absence of date powder caused the sample to contain the lowest sucrose value (Table 9).

Sodium, calcium, potassium, and magnesium in prepared cookies were 650–680 mg/100 g, 51–52 mg/100 g, 310–400 mg/100 g, and 90–100 mg/100 g, respectively. The increase in these mineral could be mostly due to date powder as reported by Khatab and Alzahrani (2006) and Ahmed *et al.* (1995). Zinc, iron, and copper were 25% higher in cookies prepared from blends, especially formulations with samh flour.

Cookies prepared from untreated hard wheat flour showed lower spread compared to heat treated as well as all blends (Table 10). Significant increase in cookies diameter in the presence of full fat samh flour, whereas 25% date powder and low fat samh flour significantly reduced the diameter (Table 10). High cookies-height was recorded for samples prepared with low fat samh flour which automatically reduced the spread (spread = width/thickness), while samples containing date powder showed more spread due to the high sugar content in date powder. Previous

reports indicated increase in cookies diameter at high sugar concentration (Doescher *et al.*, 1987). Therefore, the use of heat-treated hard wheat flour and the addition of date powder plus full fat samh flour, allowed the preparation of acceptable product using hard wheat, which is significant because cookies are primarily made of soft wheat.

4. Conclusions

It is obvious from the data presented here the possibility of preparing cookies formulation using hard wheat flour. Heat treatment of hard wheat improved the final quality of the prepared cookies. The most acceptable cookies formula contained heat-treated flour, date powder and full fat samh flour.

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Table 9. Sucrose content of selected novel food product (cookies) expressed as (g/100 g).¹

Cookie sample ²	Sucrose
CU	14.00 ^c ±1.06
CT	13.59 ^c ±2.16
CTD1	24.66 ^b ±4.19
CTLSF1	14.33 ^c ±1.98
CTD1S1	24.96 ^b ±3.52
CTD2S1	35.24 ^a ±4.18
CTD2S2	35.46 ^a ±2.43

¹Means followed by the same superscript letter across columns are not significantly different ($P=0.05$).

²C = cookies; CT = heat-treated wheat flour; D = date powder; LSF = low fat samh flour; S = samh flour; CTD1 = 75CT + 25D; CTLSF1 = 75% CT + 25% LSF; CTD1S1 = 50% CT + 25%D + 25%S; CTD2S1 = 25%CT + 50%D + 25%S; CTD2S2 = 0% CT + 50% D + 50% S.

Table 10. Physical properties of the selected cookies prepared from wheat flour blended with dates, Full-fat, and low-fat samh flour.¹

Parameter ²	CU	CT	CTD1	CTLSF1	CTD1S1	CTD2S1	CTD2S2
Diameter (mm)	57.8 ^d ±0.75	56.72 ^a ±1.04	9.33 ^c ±0.41	6.25 ^e ±0.61	9.50 ^c ±0.01	61.58 ^a ±0.49	60.58 ^b ±0.38
Height (mm)	11.67 ^a ±1.21	8.83 ^b ±0.55	6.00 ^d ±0.63	8.17 ^b ±0.98	6.33 ^{cd} ±0.52	7.00 ^c ±0.00	6.33 ^{cd} ±0.52
Spread	5.00 ^d ±0.53	6.44 ^c ±0.46	10.00 ^a ±1.10	6.97 ^c ±0.73	9.52 ^{ab} ±0.74	8.80 ^b ±0.7	9.65 ^{ab} ±0.73

¹Means followed by the same superscript letter across rows are not significantly different ($P=0.05$).

²C = cookies; CT = heat-treated wheat flour; D = date powder; LSF = low fat samh flour; S = samh flour; CTD1 = 75CT + 25D; CTLSF1 = 75% CT + 25% LSF; CTD1S1 = 50% CT + 25%D + 25%S; CTD2S1 = 25%CT + 50%D + 25%S; CTD2S2 = 0% CT + 50% D + 50% S; spread = width / thickness.

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