Effect of partial substitution of wheat flour with date powder on biscuit quality

Abdel Moneim E. Sulieman, Mouada K. Masaad and Ali O. Ali

Department of Food Science and Technology, Faculty of Engineering and Technology, University of Gezira, Wad-Medani, Sudan

ABSTRACT

In this study, date powder obtained from date *(Phoenix dactylifera* L.) fruits was used at 5% and 10% replacement levels of wheat flour for production of biscuits. The proximate chemical composition was determined for *jawa* and *gondella* date fruit cultivars. The chemical analysis of biscuit supplemented with date powder indicated that the contents of moisture and ash ranged between 3.00±0.09% to 3.8±0.24% and 1.23±0.084% to 1.84±0.084%, respectively, while protein, oil, crude fiber and carbohydrates contents were 10.7±0.084% to 11.9±0.09%, 16.00±0.73% to17.7±0.16%, 1.00±0.22% to 1.9±0.084% and 63.46±0.09% to 66.5±0.18%, respectively. On the other hand, the content of sodium and potassium were within the range of 3.00 to 3.44 and 20 to 32.54 mg/100 g, respectively. The content of iron ranged between 2.00 to 4.70 mg/100 g. Microbial analysis revealed the presence of $5x\ 10^5$ to 1.8×10^4 c.f.u/g total viable count and all biscuit samples were free from moulds and yeasts. The sensory evaluation of the different biscuit samples revealed that there were no significant differences between biscuit made from the different blends of wheat flour and date powder. However, panelists gave higher scores to the 5% date powder (*Jawa*) than the biscuit made from other blends.

INTRODUCTION

Dates are considered as a complete food material and highly important in Arab countries. They are also highly considered in the Holy Qur'an. Date palm is mainly cultivated in the northern region of Sudan. The total area under cultivation is 35000 hectares with an annual production of approximately 330000mt (Mohamed, 2007). The prevailing environmental conditions of the region are characterized by dry hot summers and relatively cool winters. Over 85 % of the existing cultivars are the dry ones, while the rest are considered soft and semi-dry. The latter cultivars are dominantly grown in the southern parts of the northern region. Some of the main dry cultivars are *barakawi, gondella, tamoda, kulma, burair* and *jawa* (Mohamed, 2007).

The soft and semi-dry cultivars are represented by *mishrig wad laggi, mishrig wad khateeb* and *madina* (Mohamed, 2007). The nutritional value of dates is high because it contains sugars and minerals (El-shaarawy, 1971). Sugars are the major and most important nutrients in dates and they constitute more than 70% of the dry weight. Dates supply the body with the energy required for various activities. Dates activate the liver and kidneys and improve their functions (Al-Baker, 1972). Also, dates were found to play an important role in both mental and sexual activities. Dates provide protection against aging related diseases. It is believed that their high content of antioxidant compounds is the key to such protection (Ashraf, 2007).

Foods such as biscuits and crackers received less attention than bread; however, they offer several important advantages including wide consumption, relatively long shelf life, good eating quality, highly palatable and acceptable in most countries and can be modified to suit specific nutritional needs of any target population (Elkhalifa and El-Tinay, 2002). Production of biscuit is considered as an important food industry because biscuit has a high nutritive value especially when supplemented with various substances which are rich in sugar, minerals or protein. The quality of biscuits depends on quality and quantity of ingredients, especially the flour (Hegazy and Ibrahim, 2009). It has been reported that mixing two or more different materials will solve the deficiency problem of cereals in (Manohar and Haridas, 1997). The objective of the present study was to evaluate the effect of biscuit partial supplementation with date powder.

MATERIALS AND METHODS

Materials

Date fruits of *jawa* and *gondella* cultivars were purchased from Wad Medani local market during (2009). The origin of these fruits is the northern region of Sudan. These samples were cleaned, destoned, dried in an oven under vacuum at 60ºC for 8 hrs, cooled and ground to small particles. The experimental work was carried out at the Department of Food Science and Technology, Faculty of Engineering and Technology, University of Gezira, Wad Medani, Sudan.

Methods

Proximate chemical composition

The proximate chemical analyses were carried out on samples consisting of date fruits powder from *jawa* and *gondella* cultivars, as well as the biscuits made from different formulations of wheat flour and wheat-date powder flours. The analyses which consisted of moisture, ash, proteins, crude fibre and oil, were determined according to AOAC (2000) methods. Total carbohydrate contents were determined by difference.

Determination of minerals content

Sodium, calcium and potassium were determined using flame photometer, and iron was determined using the colorimeter (AOAC, 2000).

Biscuit manufacture

Biscuit was manufactured from the different formulations of wheat and date fruit powder according to the method followed by Baraka Biscuit Factory (Wad Medani).

The control sample was made from 100% wheat flour while the other samples were made by using the following formulations:

1. 5% level contained 14250 g of wheat flour and 750 g of date powder.
2. 10% level contained 13500 g of wheat flour and 1500 g of date powder.

A second mixture composed of butter oil, lipids, glucose and sucrose (powder) was prepared. A third mixture composed of sodium bicarbonate, salt, ammonium bicarbonate and water was also prepared. All the above prepared formulations were mixed together to form biscuit dough. Grooved rollers were used for cutting and forming the biscuits. Biscuit samples were baked at 420-422ºC for 5-10 minutes. Then the biscuit samples were cooled to room temperature and then packed in cellophane packages to keep them dry. The manufactured biscuit samples were subjected to chemical, microbiological and sensory evaluation

Microbiological analyses of biscuit samples

Ten gram samples of biscuit were homogenized with 90 ml of distilled water by shaking for several minutes. One ml was taken from this suspension and transferred to another tube to make serial dilutions.

Total count of bacteria

The total plate counts of microbes were enumerated by culturing them on plate count agar (PCA) which was dissolved in distilled water, boiled, then transferred to potel and sterilized in an autoclave at 121°C for 15 minute, then the media with culture was incubated for 24 – 48 hours at room temperature.

Yeast and mould count

The yeast and mould strains were enumerated by culturing them on potato dextrose agar (PDA) medium and incubated for 72 hours at 25°C. The media was first dissolved in distilled water by boiling

and distributed in 250 ml conical flasks and sterilized in an autoclave at 15 psi and 121°C for 15 min and then cooled to room temperature before use.

Sensory analyses

The different biscuit samples (date – wheat biscuit) and control (wheat biscuits) were evaluated by 10 panelists for taste and acceptance using score points assigned to each quality parameter. Hedonic test was used to assess the taste and acceptability of the product according to Larmond (1982).

Statistical analyses

Data were subjected to analysis of variance. Means were separated according to Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

Proximate chemical composition of date powder

The moisture contents of *jawa* and *gondella* date powder were 11.3 ± 0.11% and 10.9± 0.08%, respectively (Table 1). These values were lower than those reported by Khattab *et al,* (1982) which were 13% and 16.9%, respectively. The ash content of *jawa* and *gondella* date powder were 2.8± 0.05% and 2.3 ± 0.71%, respectively, and these values fall within the range 1.33% to 2.81 reported by Ali (1985). The protein contents of *jawa* and *gondella* date powder were 2.6 ± 0.08% and 2.8±0.94, respectively. Generally, all values of protein reported in this study were within the range 1.25% to 2.9% reported by Ali (1985). The fat contents of *jawa* and *gondella* date powder were 0.41±0.73% and 0.5 ± 0.14, respectively; this value was higher than those reported by Sulieman *et al,* (2007) which was 0.39%. The crude fiber contents of *jawa* and *gondella* date powder were 1.9 ±0.07% and 2.3±0. 01%, respectively, both values were higher than that reported by Sulieman *et al*. (2007) which was 1.51%. Carbohydrates content of *jawa* and *gondella* date powder were 81.00 ± 0.94 and 80.61± 0.09%, respectively. These values were lower than those reported by Sulieman *e. al*. (2007) which were 84.26% and 82.12%, respectively.

Table 1. Proximate chemical composition of wheat flour and date fruits powder (*jawa* and *gondella*).

Parameter	Moisture	Protein	Fat	Ash	C. F.	Carbohydrate*
			(%)			
WF	8.6± 0.16	14± 0.01	1.0± 0.14	1.5± 0.17	1.7± 0.22	73.2± 0.6
JDP	11.3± 0.11	2.6± 0.08	0.41± 0.73	2.8± 0.05	1.9± 0.07	81.00± 0.94
GDP	10.9± 0.08	2.8± 0.94	0.5± 0.14	2.3± 0.71	2.3± 0.01	80.61± 0.09

WF: wheat flour; JDP: *jawa* date powder; GDP: *gondella* date powder; C.F.: Crude fibre
* calculated by difference

The minerals content of *jawa* and *gondella* date powder (mg/100g) were presented in Table 2. The contents of sodium were 0.9 and 1.00 mg/100g, respectively, while the contents of potassium were 144.6 and 93 mg/100 g, respectively. The contents of iron were 2.8 and 1.5 mg/100 g, respectively.

Table 2. Mineral content of *jawa* and *gondella* date powde.

Minerals (mg/100g	JDP	GDP
Sodium	0.9	1.0
Potassium	144. 6	93.0
Iron	2.8	1.5

JDP: *jawa* date powder
GDP*: gondella* date powder

Proximate chemical composition of biscuits

Proximate chemical analysis of biscuit made from wheat flour partially replaced by date powder (*jawa* and *gondella*) showed that the moisture content of the various biscuit types supplemented with 5% of *jawa* and *gondella* date powder were 3.2±0.73% and 3.00±0.09%, respectively (Table 3), while the moisture content of biscuit supplemented with 10% date powder was 3.4±0.09% and 3.8 ±0.24%, respectively. All these values were higher than that of the control biscuits which was 2.0±0.16%, and lower than 3.85% and 3.97% reported by El-Sharnouby *et al.* (2007) for biscuit made from 5% and 10% date powder and wheat bran, respectively.

Table 3. Proximate chemical composition (%) of various types of biscuits.

Biscuit type	Moisture	Protein	Fat (%)	Ash	C. F.	Carbohydrate*
Control	2.0± 0.16	12.2± 0.84	18.9± 0.01	0.92± 0.24	0.11± 0.09	65.84± 0.08
JDP 5%	3.2± 0.73	11.1± 0.01	16.8± 0.16	1.4± 0.05	1.4± 0.01	66.5± 0.18
JDP 10%	3.4± 0.09	10.7± 0.084	16.0± 0.73	1.53± 0.084	1.9± 0.084	66.08± 0.14
GDP 5%	3.0± 0.09	11.6± 0.14	17.7± 0.16	1.23± 0.084	1.00± 0.22	65.47± 0.0
GDP 10%	3. 8± 0.24	11.9± 0.09	17.1± 0.084	1.84± 0.084	1.9± 0.84	63.46± 0.09

JDP: *jawa* date biscuit GDP: *gondella* date biscuit *Calculated by difference

Protein contents of various biscuit types were 11.1±0.01% and 11.6±0.14% in biscuit supplemented with 5% *jawa* and *gondella* date powder, respectively, while the biscuit supplemented with 10% *jawa* and *gondella* date powder contained 10.7±0.084% and 11.9±0.09%, respectively. The values were lower than that of the control biscuit which was 12.2±0.84%. The reduction in protein in biscuit supplemented samples could be attributed to the small amount of protein in date fruits. These values were higher than 9.14% and 9.66% for biscuit made from 5% and10% date powder and wheat bran, respectively, reported by El-Sharnouby *et al.* (2007).

The fat content of biscuit supplemented with date powder was16.8±0.16% and 17.7±0.16% in biscuits supplemented with 5% *jawa* and *gondella* date powder, respectively, while the biscuits supplemented with 10% *jawa* and *gondella* date powder contained 16±0.73% and 17.1±0.084% fat, respectively. All these values were lower than that of control biscuit 18.9±0.01% and higher than 8.62 % and 9.20

reported by El-Sharnouby *et al.* (2007) for biscuit made from 5% and10% date powder and wheat bran, respectively.

The crude fiber content of biscuits supplemented with date powder were 1.4±0.01% and 1.0±0.22% in biscuits supplemented with 5% *jawa* and *gondella* date powder, respectively. However, the crude fiber of biscuits supplemented with 10% *jawa* and *gondella* date powder was 1.9±0.084% in both types. All the above values were higher than that of the control biscuit. This was probably due to the addition of date powder which is rich in fiber. The crude fiber contents of control biscuits was 0.11±0.09%, and lower than 2.00 % and 2.20%, respectively, reported by El-Sharnouby *et. al.* (2007) for biscuit made from 5% and 10% date powder and wheat bran, respectively.

There was an increase in ash content in the different supplemented biscuit samples. This was probably due to the increase of the mineral content as a result of the addition of date powder which has higher ash content than the wheat flour. Ash contents gradually increased with an increase in the replacement level with date powder. Ash contents of supplemented biscuits were 1.4±0.05% and 1.23±0.084% in biscuits supplemented with 5% *jawa* and *gondella* date powder, respectively, while ash content of biscuits supplemented with 10% *jawa* and *gondella* date powder were 1.53±0.08% and 1.84±0.08%, respectively. All these values were lower than that of control biscuit which was 0.92±0.24, and higher than those reported by El-Sharnouby *et. al.* (2007) for biscuit made from 5% and10% date powder and wheat bran which were 0.92% and 1.00%, respectively.

The carbohydrate content of biscuit supplemented with date powder was 66.5± 0.18 % and 65.47±0.09 % in biscuits supplemented with 5% *jawa* and *gondella* date powder, respectively, while the carbohydrate contents of biscuits supplemented with 10% *jawa* and *gondella* date powder were 66.08±0.14% and 63.46±0.09%, respectively, and the carbohydrate content of control biscuits was 65.84±0.08 %. All these values were lower than 75.47% and 73.97% reported by El-Sharnouby *et al.* (2007) for biscuit made from 5% and10% date powder and wheat bran, respectively.

The minerals content of biscuit samples are presented in Table 4. The contents of sodium were 3.00 and 3.2 mg/100g in biscuit supplemented with 5% *jawa* and *gondella* date powder, respectively. These values were lower than 3.45 % reported by El-Sharnouby *et al,* (2007) for biscuit made from 5% date powder and wheat bran. On the other hand**,** biscuit supplemented with 10% *jawa* and *gondella* date powder contained 3.44 and 3.18 mg/100g sodium, respectively. These values were lower than 3.64% reported by El-Sharnouby *et al*, (2007) for biscuit made from 5% and 10% date powder and wheat bran. All these values were higher than that of control biscuit which was 2.22 mg/100g. The contents of potassium were 20.00 and 28.00 mg/100 g in biscuit supplemented with 5% *jawa* and *gondella* date powder These values were lower than 20.53 reported by El-Sharnouby *et al,* (2007) for biscuit made from 5% and 10% date powder and wheat bran. On the other hand, biscuit supplemented with 10% *jawa* and *gondella* date powder contained 22.56 and 32.54 mg/100g potassium, respectively. These values were higher than that of the control biscuit which was 19.67.

The contents of calcium were 24 and 25 mg/100 g in biscuit supplemented with 5% *jawa* and *gondella* date powder, respectively. These values were similar to these reported by El-Sharnouby *et al. (*2007*)* for biscuit made from 5% date powder and wheat bran. While biscuit supplemented with 10 % *jawa* and *gondella* date powder contained 33.00 and 44.56 mg /100g calcium, respectively. These values were higher than those reported by El-Sharnouby *et al***.** (2007**)** for biscuit made with 10% date powder and wheat bran. All these values were higher than the control biscuit which contained 22.00 mg/100g calcium.

The contents of Iron were 2.00 mg/100g in both biscuit supplemented with 5% *jawa* and *gondella* date powder, respectively. These values were similar to those reported by El-Sharnouby *et al.* (2007) for biscuit made from 5% date powder and wheat bran which was 2. 01 mg /100g. On the other hand**,** biscuit supplemented with 10% *jawa* and *gondella* date powder contained 4.70 and 4.56 mg/100g iron, respectively. These values were higher than 2.45 mg/100g reported by El-Sharnouby *et. al.* (2007) for biscuit made from 5% and 10% date powder and wheat bran. All values of iron were higher than that of the control biscuit which was 2.22 mg/100g.

Table 4. Mineral content of biscuits

Biscuit type	Sodium	Potassium	Calcium	Iron
		mg/100g		
Control	2.22	19.67	22.00	2.22
JDP 5%	3. 00	20.00	23.98	2.00
JDP 10%	3.44	22.56	33.00	4.70
GDP 5%	3.2	28.00	25.00	2.00
GDP 10%	3.18	32.54	44.56	4.56

JDP: *jawa* date biscuit GDP: *gondella* date biscuit

Microbial analyses of biscuit

The microbial analyses of biscuit partially supplemented with date powder are shown in Table 5. The analyses revealed the presence of $5x\ 10^5$ and $1.95x\ 10^3$ c.f.u/g of total viable counts in 5% *jawa* date biscuit and *gondella* date biscuit, respectively. The total viable counts of biscuits supplemented with 10% *jawa* and *gondella* date powder were $1.35x\ 10^4$ c.f.u/g and $1.8x\ 10^4$ c.f.u/g, respectively. It also showed the absence of yeast and moulds in all tested biscuit samples. The presence of these microbes in such high levels is not acceptable, however, it could be due to cross–contamination during processing or post contamination. Moreover, usually heat treatment employed during production of biscuit reduces the microbial load and eliminates the spoilage and pathogenic bacteria.

Table 5. Microbial load (c.f.u/g) of biscuits.

Biscuit type	Total viable count(c.f.u/g)	Yeast and mould (c.f.u/g)
Control	$5x\ 10^5$	Nil
JDP 5%	$5x\ 10^5$	Nil
JDP 10%	$1.35x\ 10^4$	Nil
GDP 5%	$1.95 x\ 10^3$	Nil
GDP 10%	$1.8 x\ 10^4$	Nil

JDB: *jawa* date biscuit GDB: *gondella* date biscuit.

Sensory evaluation

Biscuits made from wheat flour supplemented with date powder (*jawa* and *gondella*) did not show significant differences in most of the quality attributes in comparison with the control. The data in Table 6 showed non-significant difference in appearance, texture, color and overall acceptability between control biscuit and biscuit supplemented with 5% and 10% date powder except the flavor and overall acceptability which showed significant differences between samples. The best flavor and overall acceptability were obtained by biscuits supplemented with 5% *jawa* date powder, and the worst parameters were obtained with those supplemented with 10% *gondella* date powder.

Table 6. Mean scores for sensory attributes of biscuit types.

Biscuit type	Appearance	Texture	Color	Flavor	Overall acceptability
Control	7.10	6.60	6.90	7.00 c	7.10 a
JDP 5%	7.00	7.20	6.60	7.70 a	7.00 a
JDP 10%	6.30	6.70	5.30	6.10 d	6.20 c
GDP 5%	6.90	7.00	5.90	7.30 b	6.60 b
GDP 10%	6.50	6.90	5.50	6.20 d	5.90d

Means within the same column followed by the same letter (s) are not significantly different according to Duncan's Multiple Range Test at 5% level.
JDP : *jawa* date biscuit. GDP: *gondella* date biscuit.

In conclusion, biscuit could be supplemented with 5% *jawa* date powder without any adverse effects on its flavor or overall acceptability.

REFERENCES

A.O.A.C. 2000. Official Methods of Analysis (17th ed.). Association of Official Analytical Chemists, Arlington,VA. USA.

Al-Baker, A. 1972. Date Palm Tree, its Past and Present Status. Alani Press Baghdad (in Arabic).

Ali, K.T. 1985. Physicochemical Evaluation of Fruits of Some Sudanese Date Palm Cultivars. M.Sc. Thesis. University of Gezira, Wad Medani, Sudan

Ashraf, J.F. 2007. Antioxidant content of dates. In: Proceedings of the 4th Symposium on Date Palm: Al-Hassa, Saudi Arabia. Duncan, D.B. 1955. Multiple range and tests. Biometrics 11: 1-6.

El-Shaarawy, M.I. 1971. Intakes of phosphorus and calcium through excessive consumption of certain food items. In: Phosphorus and Calcium Intakes by Dutch Diets. Ph.D. Thesis. Utrecht University, Holland.

Elkhalifa, A.E. and A.H. El-Tinay. 2002**.** Effect of cystene on bakery products from wheat-sorghum blends. Food Chemistry 77: 133-137.

El-sharnouby, G.A., S.M. Al-Eid and M.M. Al-Otaibi. 2007. Effect of replacement of wheat flour by date palm powder and wheat bran on dough rheological properties and nutritional quality of biscuit.4th Symposium on Date Palm. AlHassa, Saudi Arabia.

Hegazy, A.I. and M.I. Ibrahim. 2009. Evaluation of the nutritional protein quality of wheat biscuit supplemented by fenugreek seed flour. World Journal of Dairy and Food Sciences 4(2): 129-135.

Khattab, A.G., A.H. Eltinay and A.A.M. Nour. 1982. Chemical composition of some date palm cultivars grown in Sudan. In: Proceedings of 13th Symposium on Date Pam, Al-Hassa, Kingdom of Saudia Arabia.

Larmond, E. 1982. Laboratory Methods for Sensory Evaluation of Food. Ministry of Supply and Services. Canada.

Manohar, S.R. and P.R. Haridas. 1997. Effect of mixing period and additives on the rheological characteristics of dough and quality of biscuits. Journal of Cereal Science 25: 197-199.

Mohamed, M.A. 2007. Termites: A Threat to Date Palm *(Phoenix dactylifera* L.) Industry in Sudan; Cultivar Responses and Control Measures. University of Khartoum, Sudan. 4th Symposium on Date Palm. Al-Hassa, Saudi Arabia.

Sulieman, A.E., Z.A. Saleh and A.A. Al Seed. 2007. Use of some Sudanese Local Varieties of Date Palm in Manufacturing of Date's Honey for Consumption and Exportation. Proceedings of the 4th Sypmosium on Date Palm. Al-Hassa, Saudi Arabia.

أثر الإستبدال الجزئي لدقيق القمح ببدرة التمر على جودة البسكويت

عبد المنعم الهادي سليمان ومودة كمال مساعد حسين وعلي عثمان علي

قسم علوم و تكنولوجيا الأغذية، كلية الهندسة و التكنولوجيا، جامعة الجزيرة، وادمدني، السودان.

الخلاصة

في هذه الدراسة تم استخدام بدرة التمر المتحصل عليها من ثمار التمر في إنتاج البسكويت بنسبة 5% و10% من دقيق القمح لانتاج البسكويت. تم اجراء التحليل الكيميائي التقريبي لعينات ثمار التمر جاوا وقنديله. أوضح التحليل الكيميائي للبسكويت المضاف إليه بدرة التمر الى أن محتوي الرطوبة والرماد كان بين 3.00 $\pm$ 0.09 الى 3.8 $\pm$ 0.24 و 1.2 $\pm$ 0.084 إلى 1.84 $\pm$ 0.084 على التوالي بينما محتوى البروتين والدهن والألياف والكاربوهيدريتات تقع بين 10.7 $\pm$ 0.08 الى 11.9 $\pm$ 0.09 ، 16.00 $\pm$ 0.73 الى 17.7 $\pm$ 0.16 ، 1.00 $\pm$ 0.22 الى 1.9 $\pm$ 0.084 و 63.46 $\pm$ 0.09 الى 66.5 $\pm$ 0.18 على التوالي. وقع محتوي الصوديوم والبوتاسيوم (ملجم/100جم) فى المدى 3.00 الى 3.44 و 20 الى 32.54 على التوالي. أظهر التحليل الميكروبي وجود 5×10^5 الى 1.8×10^4 (مستعمرة/الجرام) للعدد الكلي للبكتريا وكانت جميع عينات البسكويت خالية من خلايا الأعفان والخمائر. أجرى تقييم حسي بواسطة محكمين لكل أنواع البسكويت ولقد أعطى المحكمون درجة قبول أعلى نسبياً للبسكويت المصنّع بإضافة 5% من بدرة تمر الجاوا.