



EFFECT OF SUCROSE SUBSTITUTION WITH DATE SYRUP ON THE PROXIMATE, PHYSICAL AND SENSORY PROPERTIES OF COOKIES

*Sengev, A. I. and Oguche, E. C.

Department of Food Science and Technology, Federal University of Agriculture, P.M.B, 2373, Makurdi, Benue State, Nigeria.

Corresponding author: talk2sengev@gmail.com; Tel: +2348035020615

ABSTRACT

In this study, the effect of date syrup as a sucrose substitute on the proximate composition, physical properties and sensory attributes of cookies were studied using standard methods. Sucrose was substituted with date syrup at the levels of 5, 10, 15, 20 and 25 g, and was compared with cookies made with 30 g sucrose as control. The proximate composition of the cookies produced using date syrup showed increase in ash (1.35-2.18 %), fibre (1.42 - 5.72 %), protein (8.14 - 10.87 %) and moisture content (9.30 - 9.32 %) and a decrease in fat (3.42 - 2.99) and carbohydrate (82.92 - 80.86 %). A decrease in thickness, diameter and spread ratio with increasing levels of date syrup was observed. Sensory evaluation indicated that up to 25 g date syrup could replace sucrose without adversely affecting the sensory qualities of cookies. The results obtained in this study showed the possibility of utilizing date syrup to develop acceptable cookies. It is therefore recommended that up to 25 g of date syrup could be used to replace sucrose in cookies production

Keywords: Cookies, Sucrose substitution, Date syrup, Proximate analysis, Sensory properties

INTRODUCTION

Cookies are examples of pastries made from ingredients; e.g flour, butter, sucrose, shortening, baking powder or eggs and widely consumed all over the world by people of all ages [1, 2]. Several authors [3, 4] have reported that cookies are one of the most popular bakery items consumed nearly by all population. The reasons advanced could mainly be due to its ready-to-eat nature, good nutritional quality and availability in different varieties and affordable cost. Reports have it that increased intake of added sugar might increase the risks of obesity,

cardiovascular diseases, dental caries, glucose intolerance, diabetes mellitus, hypertension and behavioral complications such as hyperactivity in children [5]. The World Health Organization recommends that the limiting added sugar intake should be <10% of total energy [6]

Date fruits are considered one of the major sources of carbohydrate which include simple sugars like glucose, fructose and sucrose [7]. They are good sources of dietary fibre and some important minerals which include iron, potassium, selenium, calcium and vitamins and it also contains

vitamin C, B₁, B₂, A, riboflavin and niacin but it is low in fat and protein contents.

The effect of sucrose replacement in cookies has been studied by many authors. Researchers [8] employed reducing sugars as sucrose replacers in cookies and studied their rheological characteristics. They concluded that liquid glucose and invert syrup produced greater changes in adhesiveness and stickiness, while high fructose corn syrup had a greater effect on the colour of the cookies. Oligosaccharides have been used to replace 20 - 30 % sugar in the cookies and obtained softer eating cookies and different surface colour attributes [9]. Previous study [10] used arabinoxylan oligosaccharides as potential sucrose replacers in sugar-snap cookies to replace up to 30 % sucrose. The cookies produced had diameters and heights comparable to the control sample; however, the colour of the cookies was darker in comparison with the control. Dates can be added to cookies formula to increase its nutritional value as well as taste. Several studies [11 – 13] on the effect of dates on the quality of white pan and Arabic bread have been reported. The aim of this study was to determine the effect of date syrup as a sucrose substitute on the proximate composition, physical properties and sensory attributes of cookies.

MATERIALS AND METHODS

Materials

Fresh dates and ingredients such as wheat flour, sugar (sucrose), egg, baking powder, flavour, and salt were obtained from North-Bank Market in Makurdi, Nigeria. Equipment used included water bath, crucibles, blender, mortar, meter rule and weighing balance. It was ensured that the chemicals and equipment used for the sample preparation and analyses were of analytical grade and obtained from the Department of Food Science and Technology, Federal University of Agriculture, Makurdi.

Preparation of Date Syrup

The date syrup was prepared using the method described by Alseneien *et al* [14] with modification. The date fruits were de-pitted, cut into small pieces with a sharp knife and dried in the oven (Model: Binder ED53, Germany) to a moisture content of 10.79 %. The oven-dried (75 ± 2 °C, 24 h) date sample was pounded in a mortar to facilitate milling using a hammer mill (Model: Brook Crompton Series 2000, England) to the size of 0.5 mm. The milled dates (900 g) were boiled for 1½ h in 4000 mL of water and the slurry was filtered using muslin cloth instead of micro-filter.

The date extract was re-boiled for 3½ h to obtain concentrated date syrup with a brix

value of 84.2 %, moisture content of 15.8 %, refractive index of 1.52 and pH of 5.00. The date syrup was sealed in a glass bottle and refrigerated until analyses.

Product Formulation

Sucrose (30 g) was substituted with date syrup at five replacement levels of 5, 10, 15, 20 and 25 g (i. e. samples B, C, D, E and F respectively) in the cookies formula. One treatment with 30 g sucrose was used as a control (sample A). The blend formula for cookies preparation is shown on Table I.

Recipe for Cookies Production

The dough was prepared as described by Sangev *et al* [15] and shown in Table II with modification. In this method, the

ingredients were weighed accurately followed by proper mixing. The dough was rolled out, cut into sizes and transferred to lightly greased tray. The cookies were baked at 180 °C for 22 min. The baked cookies were cooled and stored in airtight container before further analyses.

Product Formulation

Sucrose (30 g) was substituted with date syrup at five replacement levels of 5 g, 10 g, 15 g, 20 g, and 25 g (i.e. samples B, C, D, E, and F respectively) in the cookies formulation. One treatment with 30 g sucrose was used as a control (sample A). The blend formula for cookies preparation is shown on Table I.

Table I: Blend Formulation for Cookies Preparation

Sample	Sucrose (g)	Date syrup (g)
A	30	0
B	0	5
C	0	10
D	0	15
E	0	20
F	0	25

Table II: Experimental Cookies Formulae

Ingredients	Quantity (g)
Wheat flour	100
Sucrose	30
Fat	45
Egg (mL)	15
Baking powder	3
Flavour (mL)	1
Sodium chloride	1
Water (mL)	Variable

Source: Sengev *et al.* [9] with modification

Proximate Composition of Cookies

The proximate composition of the cookies was determined using standard methods of AOAC [16]. Carbohydrate content of the cookies was determined by the difference according to the method reported by Sengev *et al* [17].

Physical Properties of Cookies

The thickness (T), diameter (D) and spread ratio (SR) of cookies were determined as described by Sengev *et a* [15]. For thickness, six cookies were placed on top of one another. The total height was measured in millimetres (mm) with the help of the meter rule. This process was repeated to obtain the average thickness of the cookies. For diameter, the cookies were placed horizontally edge to edge. The total diameter of the six cookies was measured in mm using a meter rule. The cookies were rotated two more times at an

angle of 90° to obtain triplicate readings while the spread ratio was calculated using the average values of diameter and thickness as shown in the equation below:

$$SR = \frac{D}{T}$$

Sensory Evaluation

The method described by Alsenaien *et al* [14] was adopted with modification. Panelists for sensory evaluation were 15 semi-trained volunteers, aged 18 - 25 years instead of 25 – 50 years old. They were selected from both students and staff of the Department of Food Science and Technology, Federal University of Agriculture, Makurdi, Nigeria. The panelists tasted the cookies at self-determined pace with no time limit for completing the session. Although the cookies evaluation sessions lasted 15-30 min. and to minimize adaptation, panelists were instructed to take breaks as they desired for 2 - 3 min. and the evaluation

was associated with the control treatment. The panelists evaluated the cookies one week after baking. The samples were evaluated for after-taste, appearance, crispness, flavour, texture and overall acceptability using a 9-point Hedonic scale, where 9 indicates “like extremely” and 1 indicates “dislike extremely”.

Statistical Analysis

The data generated were subjected to analysis of variance (ANOVA) and means were separated using Duncan’s Multiple Range Test (DMRT). Significance was accepted at $p \leq 0.05$ [18].

RESULTS AND DISCUSSIONS

Proximate Composition and Brix Value of Cookies

The effect of substitution of sucrose with date syrup on the proximate and brix composition of cookies is presented in Table III. Proximate analysis of cookies such as moisture, ash, fat, fibre and protein

as well as carbohydrate contents ranged from 8.90 – 9.32 %, 1.35 – 2.18 %, 2.99 – 3.42 %, 1.42 – 5.72 %, 8.14 – 10.87 % and 80.86 – 82.93 %, respectively.

Physical Properties of Cookies

The results of the effect of date syrup on the physical properties of cookies are presented in Table IV. The results showed that thickness decreased from 14.7 – 13.2 mm, diameter ranged from 40.1 – 48.4 mm and spread ration ranged from 2.91 – 3.35 mm with significant differences ($p < 0.05$) between the products.

Sensory Evaluation of the Cookies

The mean sensory scores of cookies as affected by substitution of sucrose with date syrup are presented in Table V. The results indicated that after taste, appearance, crispness, flavour, texture and overall acceptability ranged from 5.93 – 7.60, 5.3 – 7.2, 6.20 – 8.33, 6.07 – 8.20 and 6.53 – 8.40, respectively.

Table III: Effect of sucrose substitution with date syrup on the proximate composition (% dry basis) and brix values of cookies

Product	Moisture	Ash	Fat	Crude fibre	Crude Protein	CHO	Brix (%)
A	8.90±0.03 ^b	1.35±0.03 ^e	3.42±0.03 ^a	1.42±0.30 ^b	10.87±0.02 ^a	82.93±2.11 ^a	8
B	9.32±0.01 ^a	2.02±0.01 ^d	3.05±0.01 ^b	5.47±0.20 ^a	8.14±0.01 ^e	81.32±2.01 ^a	2.5
C	9.30±0.12 ^a	2.06±0.01 ^c	3.07±0.00 ^b	5.52±0.11 ^a	8.17±0.02 ^d	81.18±2.33 ^a	7.5
D	9.35±0.20 ^a	2.04±0.02 ^{cd}	3.03±0.02 ^b	5.64±0.10 ^a	8.21±0.01 ^c	81.08±3.34 ^a	9.5
E	9.31±0.11 ^a	2.14±0.01 ^b	3.00±0.01 ^c	5.69±0.04 ^a	8.24±0.01 ^b	82.08±3.01 ^a	11.5
F	9.32±0.13 ^a	2.18±0.01 ^a	2.99±0.03 ^c	5.72±0.01 ^a	8.24±0.01 ^b	80.86±3.02 ^a	14.5

Values are means ± standard deviation of three determinations.

Means in the same column with the same superscript are not significantly different at $p > 0.05$

DS=Date syrup; A = Control, B = 5 g DS; C = 10 g DS; D = 15 g DS; E = 20 g DS; F = 25 g DS.

Table IV: Effect of sucrose substitution with date syrup on physical properties of cookies

Samples	Thickness (mm)	Diameter (mm)	Spread ratio
A	14.7±0.00 ^a	48.4±0.09 ^a	3.29±1.00 ^a
B	14.7±0.01 ^a	43.2±0.10 ^b	2.94±1.04 ^{ab}
C	13.9±0.02 ^b	41.8±0.04 ^c	3.01±0.50 ^{ab}
D	13.8±0.10 ^b	40.1±0.02 ^d	2.91±1.06 ^b
E	13.7±0.00 ^b	42.1±0.01 ^c	3.07±0.25 ^{ab}
F	13.2±0.01 ^b	44.2±0.01 ^b	3.35±0.05 ^a

Values are means ± standard deviation of three determinations.

Means in the same column with the same superscript are not significantly different ($p > 0.05$)

DS=Date syrup; A = Control, B = 5 g DS; C = 10 g DS; D = 15 g DS; E = 20 g DS; F = 25 g DS.

Table V: Effect of sucrose substitution with date syrup on the sensory properties of cookies

Product	After taste	Appearance	Crispness	Flavour	Texture	Overall Acceptability
A	7.60±0.47 ^a	8.27±0.15 ^a	7.27±0.28 ^a	8.33±0.23 ^a	8.20±0.18 ^a	8.40±0.21 ^a
B	5.47±0.39 ^b	6.27±0.25 ^b	6.33±0.45 ^{ab}	6.33±0.39 ^b	6.20±0.44 ^b	6.53±0.19 ^b
C	5.93±0.49 ^b	6.00±0.37 ^b	6.40±0.39 ^{ab}	6.33±0.47 ^b	6.13±0.48 ^b	6.80±0.44 ^b
D	6.13±0.52 ^b	5.73±0.54 ^b	5.73±0.43 ^b	6.80±0.37 ^b	6.07±0.40 ^b	6.53±0.38 ^b
E	6.53±0.26 ^{ab}	6.27±0.27 ^b	6.14±0.36 ^{ab}	6.33±0.49 ^b	6.40±0.25 ^b	6.87±0.35 ^b
F	6.53±0.49 ^{ab}	6.47±0.40 ^b	5.73±0.47 ^b	6.20±0.46 ^b	6.60±0.24 ^b	6.80±0.44 ^b

Means in the same column with the same superscript are not significantly different at $p > 0.05$

DS=Date syrup; A = Control, B = 5 g DS; C = 10 g DS; D = 15 g DS; E = 20 g DS; F = 25 g DS.

Proximate Composition and Brix Values of Cookies

The results showed that moisture, ash and crude fibre increased and differ significantly ($p < 0.05$) from the control. However, there was no significant difference ($p > 0.05$) between the products containing date syrup in terms of moisture and crude fibre. The increase in moisture content could be due to the introduction of water/dilution during date syrup preparation. This agreed with the findings of Alsenaien *et a* [14] which reported that the moisture content of cookies using date syrup increased and differ significantly from the control. The increase in ash content is consistent with [19] which reported that the ash content of biscuit increased on addition of date syrup. Several authors [20, 21] have shown that date is a good source of ash; this obviously might have enhanced the ash content of the cookies prepared with date syrup.

The high fibre content of the product containing date syrup could be attributed to the use of muslin cloth as a sieve which allowed the passage of fibre materials into the filtrate. The high fibre content of the cookies is expected to benefit the prospective consumers of these products.

Reports indicated that fibre containing foods are known to expand the walls of the colon of human digestive system, easing the passage of waste, thus making it an effective anti-constipation; it lowers cholesterol level in the blood and reduces the risk of various cancers [22].

The fat and protein contents of the products decrease significantly ($p < 0.05$) with increase in date syrup. This may be ascribed to the low amount of fat and protein in date syrup. Reports [23] indicated that date syrup contains 0.005 and 1.43 % fat and protein respectively. Hence, addition of date syrup is expected to reduce the fat and protein contents of the cookies. Substitution of sucrose with date syrup did not significantly ($p > 0.05$) affect the carbohydrate content of the cookies. The brix values increased with increase in substitution levels as expected.

Physical Properties of Cookies

The spread ratio of the cookies represents a ratio of diameter to thickness. The spread ratio for most of the samples containing date syrup decreased slightly with no significant difference ($p > 0.05$). This suggests that the performance of date syrup compares favourably with sucrose in

cookies production. This may be attributed to the presence of high fibre in addition to the hydrophilic groups in date syrup competing for available water in the dough resulting to reduction in gluten development. This interaction reduces the viscosity of the dough due to dissolution of sugars and increase spreading of the cookies [24, 14, 25].

Sensory Evaluation of Cookies

The sensory evaluation results of cookies indicated that significant difference ($p < 0.05$) exists between the control (30 g sucrose) and the rest of the samples, but no significant difference was observed in the samples containing date syrup. It was generally observed that substitution of sucrose with date syrup did not significantly improve the sensory attributes of the cookies evaluated. For after taste, though no significant difference exists among the product with date syrup, marginal increases were observed as the level of substitution increased. The sweet taste improved compared to the control using 20 g and 25 g of date syrup. Therefore, date syrup of 20 g and above could be used to replace sugar in cookies production when considering improving the after taste characteristics.

The same trend of marginal increases was also observed for appearance, flavour, texture and overall acceptability. The decrease in appearance compared to the control could be due to the dark-brownish nature of the date syrup. It was also observed by Manickavasagan *et al* [5] that substituting sucrose with date syrup in idili production did not improve its appearance. The trend of appearance, flavour, texture and overall acceptability agreed with the findings of Obiegbuna *et al* [26]. Crispness of the cookies with date syrup compares favourably with the control. This suggests that date syrup also has the capacity to absorb moisture from the dough thereby making the cookies crispy.

CONCLUSION

This study revealed that cookies could be successfully produced using date syrup as sucrose substitute. The chemical composition of the cookies prepared using date syrup showed increases in ash, fibre, protein and moisture content and a decrease in fat and carbohydrate contents. The ash, fibre, and moisture content of the cookies formulated using date syrup were higher than of the control while the fat, carbohydrate and protein content were lower. The physical properties of the

cookies prepared using date syrup showed a decrease in thickness, diameter and spread factor. Substitution of sucrose with date syrup produced cookies with darker and redder colours. Sensory evaluation indicated that up to 25 g date syrup could replace sucrose without adversely affecting the qualities of cookies. Hence, the results obtained in this study showed the possibility of utilizing date syrup to develop acceptable cookies. It is therefore recommended that up to 25 g of date syrup could be used to replace sucrose in cookies production.

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