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DEVELOPMENT OF BISCUITS BY PARTIAL SUBSTITUTION OF REFINED WHEAT FLOUR WITH CHICKPEA FLOUR AND DATE POWDER

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ABSTRACT

The current investigation was undertaken to optimize the process for development of biscuits using composite flours prepared by addition of chickpea flour and date powder to refined wheat flour. Composite flours utilized in biscuit manufacture were obtained by mixing refined wheat flour, chickpea flour and date powder in different ratios as 100:0:0 (T_0), 80:10:10 (T_1), 60:20:20 (T_2), 40:30:30 (T_3) and 20:40:40 (T_4) respectively. The flours were analyzed for their physico-chemical as well as functional properties. Of all the flours studied, chickpea flour had the highest value for ash, fat and protein content as 3.30%, 5.40 % and 21.88% respectively. Date powder contained highest crude fiber content (9.05%) but lowest protein content (1.96%). Refined wheat flour had highest values for most functional properties like water absorption capacity (158%), oil absorption capacity (139.60%) and bulk density (0.95 g/ml). Foaming capacity and LGC were observed to be highest for chickpea and date powder respectively. There was no significant difference ($p>0.05$) was observed in diameter and thickness of different biscuit samples however, spread ratio and spread factor differed significantly ($p<0.05$). Spread ratio and spread factor of biscuits increased with incorporation of chickpea flour and date powder with the value being highest for highest level of substitution. Sugar level could be reduced up to 60% by use of date powder as sweetening agent for replacing sugar. Overall acceptability scores of biscuits revealed that substitution of chickpea flour and date powder up to 30% each for refined wheat flour was appropriate to develop acceptable biscuits.

Keywords: Biscuits, chickpea, date powder, functional properties, spread ratio, Overall acceptability

INTRODUCTION

Bakery products have served as dietary staples for the mankind from the ancient times by providing the consumers with delectable choices. Among the wide range of different bakery products available in market, biscuits represent the one of the major categories consumed by masses. Biscuits are favorite food items among large segments of population on account of being affordable, inexpensive, savory, convenient, and shelf stable (**Arshad *et al.*, 2007**). The key ingredients generally used in the manufacture of biscuits are flour, sugar and fat. Biscuits may be enriched with other ingredients to improve upon their nutritional value. The incorporation of ingredients like proteins, vitamins, mineral, fibers etc. into the basic formulation can enhance the nutritional as well as sensory quality of cookies. Generally, biscuits are characterized not only by low content of protein, vitamins, dietary fiber and minerals but also contain high amount of sugar and fat; making them not so healthy option for consumers. This has led to introduction of concept of composite flour that represents the flour obtained by blending different flours derived from cereals, roots and tubers, legumes etc. with or without the addition of wheat flour **(Adeyemi and Ogazi, 1985)**. There are many flours which can be used as base materials for the formulation of composite flours like rice flour, barley flour, oat flour, chickpea flour, date powder, pumpkin peel powder etc.

Chickpea (*Cicer arietinum L.*) is the one of the most widely consumed as well as cultivated legume crops across the world. Within India, chickpea represents one of the most cultivated crops occupying almost 35% of total area under cultivation for pulses **(Purushothamana *et al.*, 2014)**. Chickpea contains high level of nutrients like fibers, proteins, minerals and natural polyphenols **(Singh, 1985)**. It is rich source of high digestibility proteins, good source of essential amino acid lysine; is relatively free of anti-nutritional factors and protein content is nearly twice as much present in wheat flour **(Muller, 1983)**. It exhibits low glycaemic index due to high amount of complex carbohydrates and has dietary fiber content almost three times than that of wheat flour **(Sathe *et al.*, 1983)**. It possesses numerous vitamins like riboflavin, thiamine, niacin, folate and the vitamin A precursor, β-carotene. It is also a good source of minerals like Ca, P, Fe, Mg and K and unsaturated fatty acids such as oleic acid and linoleic acid **(Jukanti *et al.*, 2012)**. Chickpea has been reported to decrease incidence of diseases like diabetes, cardiovascular disease, cancer and some digestive diseases **(Jukanti *et al.*, 2012)**.

Date palm (*Phoenix dactylifera* L.) is a sweet edible fruit belonging to the family Arecaceae. Dates have low fat content, and are therefore, suitable for heart patients who can consume dates as such or their products in different forms **(Panda, 2001)**. Carbohydrate content in dates is quite high (70%) and is predominated by sugars. Generally, invert sugar is the main sugar present in dates which is comprised of glucose and fructose. Glucose is beneficial as it represents the most readily available source of energy **(Myhara *et al.*, 1999; Liu *et al.*, 2000)**. Fructose on account of being sweeter than glucose (almost two times) generates the feeling of fullness in consumer and thereby decreases the calorie intake in comparison to fat rich diet. Date fruits are energy dense food sources. Dates have low percentage of fat (0.2 to 0.5%); high level of protein (2.3 to 5.6%), vitamins and a good source of dietary fiber (6.4 to 11.5%). Date fruits are good sources of minerals like of selenium, copper, potassium, and magnesium and also contain high levels of phenolic compounds and antioxidants **(Iftikhar *et al.*, 2015)**. Dates have been shown to mitigate the effect of hypertension, hyperglycemia and hyperlipidemia in diabetic patients **(Appel *et al.*, 1997)**.

Biscuits are the bakery products widely consumed by most of the people but are lacking in several nutrients including some vitamins, minerals, fiber and protein. Due to high level of protein in chickpea and high fiber as well as mineral content in date powder, both of them could complement each other for preparation of composite flour and hence, enhance the nutritive value of biscuits. Furthermore, the use of date powder as sweeting agent is promising alternative for sugar addition in biscuits. So biscuits with refined wheat flour, chickpea flour and date powder offer a reliable solution for producing biscuits with higher protein and fiber content.

Therefore, the current study was aimed at optimization of recipe for development of biscuits by partial replacement of refined wheat flour with chickpea flour and date powder; date powder was also optimized to serve as a sweetening agent.

MATERIALS AND METHODS

Basic raw material required for preparation of biscuits viz., refined wheat flour, chickpea flour, sugar, fat, baking powder etc., were purchased from local market in Rohtak. Dried dates were purchased from local market and cleaned; further dried in oven for 6-7 hours at 60℃. After cooling dried dates were ground and passed through 20 mm mesh sieve to obtain fine powder.

Preparation of composite flours

Composite flour was prepared in five compositions (T_0 to T_4) with refined wheat flour, chickpea flour and date powder in the ratio of 100:0:0, 80:10:10, 60:20:20, 40:30:30 and 20:40:40 respectively.

Preparation of biscuits

Biscuits were prepared as per standardized formulation with slight modification **(Vatsala and Haridis Rao, 1990)**. A known weight of flour (100 g) and baking powder (1.5 g) were taken for dough preparation. It was mixed with fat and sugar and required amount of water was added until smooth dough was obtained. In the formulation of partially substituted biscuits, date powder was substituted for sugar in the proportionate amount. The dough was rolled out with rolling pin into flat base having 10 mm thickness and shaped into round form of 5cm in diameter with a cutter. The biscuits were baked in laboratory oven at 180℃ for 30 minutes. Biscuits were afterwards taken out of oven, cooled & kept in an air tight package for further studies.

Analytical methods

The crude protein in the samples of flour and cookies was estimated according to Kjeldhal nitrogen estimation as described in AACC method **(2000)**. Moisture content was estimated in flour sample and cookies using AOAC method **(1999)**. The ash content was calculated as per AOAC method **(2000)** and crude fiber was estimated as per AOAC standard method **(1995)**.

Functional properties of flour

Water and oil absorption capacity of flour

The water and oil absorption capacities (WAC and OAC) were evaluated as per method given by **Sosulski *et al*. (1976)**. Different flour samples were weighed accurately (1 g) each in separate weighing dishes and made into suspensions by mixing with 10 ml (V_1) of distilled water or refined soybean oil. Suspensions were aged for 30 min and centrifuged at 2200 g for 10 min. After centrifugation, the supernatant was poured into a 10 ml graduated cylinder, and the volume was noted as (V_2). Water absorption was evaluated as ml of water bound per gram flour and was expressed as percentage of water bound by flour sample.

$$\text{WAC (\%)} = \frac{\text{V1} - \text{V2 x 100}}{\text{weight of Sample}} \quad (1)$$

Oil absorption capacity was evaluated as ml of oil bound per gram flour. The absorbed oil was expressed as the percentage of oil bound by sample.

$$\text{OAC (\%)} = \frac{\text{V1} - \text{V2 x 100}}{\text{weight of Sample}} \quad (2)$$

Bulk density of flour

The bulk density of flour was determined as per **Okaka and Potter (1977)** method. 50 g of each flour sample was filled in a 100 ml graduated cylinder and tapped for specified number of times (20-30). The volume finally attained after the tapings was noted and bulk density was determined as weight per unit volume of sample.

Swelling capacity (SC) and water solubility index (WSI)

The swelling power of samples was determined by the method **Schoch (1964)**. 15 ml of distilled water was mixed with 1g of each flour sample and shaken to form suspension. Suspensions formed were then kept in water-bath at 80ºC for 30 min and then submitted to centrifugation at 3000 rpm for 10 min.

$$\text{Swelling capacity} = \frac{\text{weight of sediment x 100}}{\text{weight of flour} - \text{weight of dried solids in supernatent}} \quad (3)$$

Foaming capacity and foaming stability of flour

Foaming capacity and foaming stability were estimated according to **Narayana and Narasinga Rao (1982)**. 50 ml distilled water was mixed with 1 g of sample in a graduated cylinder at 30±20ºC and vortexed for 5 min to cause foaming.

$$\text{FC} = \frac{\text{volume of foam(AW)} - \text{volume of foam(BW)}}{\text{volume of foam(BW)}} \times 100 \quad (4)$$

Least gelation concentration

Coffman and Garcia (1977) method with slight modification was used for determination of least gelation concentration. Different flour dispersions of 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22 and 30, 32, 34% (w/v) were made with 5 ml of distilled water and incubated at 90°C for 1 h in a water bath. Samples were then cooled under tap water and left undisturbed for 2 h at 10±20°C.

Physical analysis

Diameter was calculated by placing three biscuits side by side and rotating them 90º. The diameter was again measured for three biscuits (cm) and mean value was obtained. Thickness was evaluated by keeping 3 biscuits one over another and recording the mean value of such two observations. Spread ratio was determined by dividing mean diameter value of biscuits by mean thickness of biscuits. Weight of biscuits was calculated as average weight of four biscuits weighed individually.

Sensory analysis

Sensory analysis of biscuits was done by a group of 8 semi trained members with a 9-point hedonic scale in accordance with **Ranganna (1986)**. The biscuits were analysed for their flavor, color, appearance, texture and overall acceptability.

Statistical analysis

Statistical analysis of data was carried out using one-way analysis of variance (ANOVA) with three replications in a randomized block design. Statistical analysis was performed with the help of OPSTAT software version OPSTAT 1.exe (Hisar, India).

RESULTS AND DISCUSSION

Proximate composition of raw flour samples

The statistical data on proximate composition of refined wheat flour, chickpea flour and date powder are presented in Table 1. It is evident from table, values of various parameters studied for different flours used as base material in biscuit preparation varied significantly ($p<0.05$). The value for ash content was highest in chickpea flour (3.30%) while refined wheat flour displayed the lowest value (0.3%). **Hefnawy *et al.* (2012)** also observed similar ash content in chickpea flour (3.4%). However, **Osorio-Diaz *et al.* (2008)** observed lower values for the same (2.7 %). Fat content (5.81%) was highest in chickpea flour (5.40%) and lowest in date powder (0.50%). **Jagannadham *et al.* (2014)** reported higher value of fat content for chickpea flour and **El-Sharnouby *et al.* (2012)** reported similar value for date powder (0.40%). The crude fibre content was highest in date powder (9.05%) and lowest in refined wheat flour (1.25%). Similar results were obtained by **El-Sharnouby *et al.*· (2012)**. The highest value for protein content was observed in chickpea flour (21.88%) while date powder contained lowest protein content (1.96%). The observed values of protein are in agreement with the values obtained by **Demir *et al.* (2010)** for chickpea flour (21.88%) while **Ma *et al.* (2011)** reported higher content for dehulled desi chickpea flour (24.47 %). The carbohydrate content was observed highest for date powder (74.98%), followed by refined wheat flour (74.71%) and lowest for chickpea flour (58.77%). Therefore, it seems logical to supplement refined wheat biscuits with chickpea flour and date powder to increase the nutritional value of biscuits.

Table 2 Functional properties of flours

Parameters	RWF	CP	DP
Ash (%)	0.30±0.14a	3.30±0.14c	2.30±0.14b
Moisture (%)	12.20±0.84c	8.16±0.02a	11.20±0.56b
Fat (%)	1.75±0.07b	5.40±0.56c	0.50±0.14a
Crude fiber (%)	1.25±0.21a	2.50±0.14b	9.05±0.21c
Protein (%)	9.84±0.93b	21.87±0.62c	1.96±0.30a
Carbohydrate (%)	74.71±0.15b	58.77±0.93a	74.98±0.79c

Legend: Where, RWF= Refined wheat flour, CP= Chickpea flour, DP Date powder. The values are average of triplicate analysis with ± SD. Mean values having different superscript in a row are significantly different ($p<0.05$).

Functional properties of flour

The statistical data regarding functional properties of refined wheat flour, chickpea flour and date powder are presented in Table 2.

Table 2 Functional properties of flours

Properties	RWF	CP	DP
WAC (%)	158.05±3.32[c]	114.60±20.50[b]	89.80±14.14[a]
OAC (%)	139.60±0.70[c]	127.25±2.33[b]	112.80±1.55[a]
BD (g/ml)	0.95±0.04[c]	0.73±0.035[b]	0.69±0.04[a]
SC (%)	8.30±0.14[c]	4.71±0.077[a]	6.46±0.35[b]
Solubility (%)	16.85±3.60[b]	10.50±1.83[a]	61.20±3.25[c]
FC (%)	14.54±0.17[b]	28.67±1.27[c]	6.75±0.65[a]
FS (%)	92.65±0.09[b]	97.81±0.41[c]	87.72±1.50[a]
LGC (%)	20±1.26[b]	14±1.05[a]	28±1.83[c]

Legend: Where, RWF= Refined wheat flour, CP= Chickpea flour, DP= Date powder, WAC= Water absorption capacity, OAC= Oil absorption capacity, BD= bulk density, SC= Swelling capacity, FC= Foaming capacity, FS= Foaming stability, LGC= Least gelation concentration. The values are average of triplicate analysis with ± SD. Mean values having different superscript in a row are significantly different ($p<0.05$).

Water absorption capacity

Water absorption capacity (WAC) signifies the amount of water absorbed by a sample when subjected to filtration and centrifugation. Water absorption capacity of flour is a critical function that governs the handling characteristics of flour, its machinability and suitability for use in variety of foods like dough, sausages, processed cheese, soups and bakery products **(Adeyeye and Aye, 1998)**. Water holding capacity differed significantly ($p <0.05$) for all flour samples and values varied from 89.8% to 158%. Highest value was observed for refined wheat flour (158%) while lowest value was recorded for date powder (89.80%). Higher values of WAC in wheat flour could possibly be due to higher content of hydrophilic components such as protein and soluble fibers present in it. **Butt and Batool (2010)** attributed the difference in WAC of different flours to the protein concentration, conformational characteristics of protein, and the degree of interaction of protein with water. The relative surface distribution of hydrophilic amino acids and hydrophobic amino acids also affects the WAC of flours **(Kuntz, 1971)**. Other factors have also been ascribed in the previous studies to explain the higher level of WAC of flour like the level of damaged starch, level of amylose fraction and pentosan proportion present in sample **(Pauly *et al*., 2013)**.

Oil absorption capacity

All the flours varied significantly ($p<0.05$) in their oil absorption capacity. The oil absorption capacity for refined wheat flour (139.60%) was recorded higher than chickpea flour (127.25%) and date powder (112.80%). Similar results were observed by **Sanjeewa *et al.* (2010)** for chickpea flour. It is evident from the results that the OAC of refined wheat flour was higher than other flours (date and chickpea) due to inclusion of lower fat levels upon increase of the proportion of other flours. Oil absorption capacity is an important characteristic in bakery products that influences mouth feel, flavor retention, palatability and shelf life of a product **(Aremu *et al*., 2007)**. The essential component influencing OAC is protein as it contains both hydrophilic and hydrophobic amino acids which interact with lipids in food. The different values of OAC among different flours could be attributed to the variability in the levels of hydrophobic side chains of amino acids which possibly interact with the non polar side chain of the lipid moieties through hydrophobic interaction **(Jitngarmkusol *et al*., 2008)**.

Bulk density

Bulk density of flour indicates the weight of a flour sample that can be contained in a fixed volume and is generally expressed as g/cm^3 or g/ml. It is mainly governed by particle size, internal porosity, and spatial arrangement of particles in the container. This functional property of sample is significant in deciding its packaging requirements and material handling attributes.

Of all the flour samples analyzed, highest value was noted for wheat flour (0.95) followed by chickpea flour (8.30) and date powder (0.69) respectively. Flours with high bulk densities are useful as stabilizers in processed foods **(Akubor and Badifu, 2004)**. Similar results to the present study were observed by **Jagannadham *et al*. (2014)** for chickpea flour. Low bulk density is an important requirement in manufacture of infant and weaning foods **(Nicole *et al*., 2010)**.

Swelling capacity and solubility

Statistical data reveals significant variation ($p<0.05$) among all the flour samples. Swelling capacity had highest value for refined wheat flour (8.35%) but lowest for chickpea flour (4.71%). Swelling power is related to hydration capacity of flour and is measured as weight of water occluded by swollen flour components when flour sample is soaked in water. The relatively higher value of swelling capacity recorded in refined wheat flour could be due to higher amount of soluble component like starch granules and hydrophilic fiber that are expected to bind sufficient amount of water and thereby contributes to increased swelling property. Starch is typically the main component governing the extent of swelling depending upon the variety and category of starch present in flour sample (**Schoch, 1964**). Similar results were observed by **Manickavasagan *et al*. (2013)**.

Foaming capacity and foaming stability

Foam capacity of sample signifies the extent of interfacial area that can be generated by the protein **(Fennema, 2000)**. Foam capacity varied significantly ($p<0.05$) among all the flour samples (Table 2) and ranged from 28.67% to 6.75%. Chickpea displayed the highest value (28.67%) and date powder showed lowest value (6.75%). Higher value recorded for the parameter in chickpea coincides with higher level of protein in chickpea. Flour with higher protein may be expected to show higher value for foam capacity as large air bubbles can be entrapped by thinner and viscoelastic film of protein, when air is whipped into protein suspension. Similar results to the present study were confirmed by **Jagannadham *et al.* (2014)** for chickpea flour and refined wheat flour.

The foam stability (FS) is described as the potency of protein to support itself against gravitational and mechanical forces[40]. Foam stability followed a trend similar to FC with higher values recorded for chickpea flour and lowest for date powder. Similar results to the present study were confirmed by **Jagannadham *et al*. (2014)** for chickpea flour and refined wheat flour. As soon as the air bubbles are formed, they tend to collapse and undergo leakage at a fast rate, consequently lowering the foam stability. The level of solubilized protein as well as the content of polar and non-polar lipids in a sample influences the foam stability of protein[41]. Also, foam stability is related to the amount of solubilized protein, and the amount of polar and non-polar lipids in a sample **(Zhou *et al*., 2011)**.

LGC (Least gelation concentration)

Least gelation concentration is referred to as that protein concentration at which gel is able to support itself without dropping off the inverted tube. The least gelation concentration varied significantly ($p<0.05$) for all flour samples. The value obtained of LGC was highest for date powder (28%) and lowest for chickpea flour (14%). Least gelation concentration (LGC) indicates the index of gelation capacity. The differences in the main constituents of the flour i.e. protein, carbohydrates and lipids; and the interaction that occurs between them eventually governs the difference in LGC of flours (**Sathe *et al*., 1983**). Gelling ability of the protein ingredient follows an inverse relationship with LGC (Akintayo *et al.*, 1999).

Proximate composition of biscuits

Table 3 represents proximate composition of biscuits and shows significant difference ($p<0.05$) for most of parameters.

Table 3 Proximate composition of biscuits

Properties	T0	T1	T2	T3	T4
Ash (%)	1.96±0.36[a]	3.18±0.22[b]	3.83±0.15[c]	4.33±0.12[d]	4.73±0.26[e]
Moisture (%)	4.51±0.09[e]	4.21±0.04[d]	4.04±0.02[c]	3.89±0.09[b]	3.68±0.02[a]
Fat (%)	22.83±0.40[a]	23.40±0.43[a]	24.13±0.26[b]	24.76±0.30[c]	26.05±0.21[d]
Crude fibre (%)	1.41±0.01[a]	3.16±0.20[c]	3.16±0.20[c]	3.58±0.15[d]	3.95±0.07[e]
Protein (%)	12.21±0.43[a]	13.74±0.24[b]	14.99±0.18[c]	16.40±0.74[d]	17.79±0.14[e]
Carbohydrate (%)	57.07±0.25[e]	52.61±0.96[d]	49.84±0.77[c]	47.03±1.23[b]	43.78±0.47[a]

Legend: T_0 = control 100(RWF):0(CF):0(DP), T_1= 80(RWF): 10(CF):10(DP), T_2=60(RWF):20(CF):20(DP), T_3=40(RWF):30(CF):30(DP), T_4=20(RWF):40(CF):40(DP). The values are average of triplicate analysis with ± SD Mean values having different superscript in a row are significantly different ($p<0.05$).

Ash content of different biscuit samples increased with the increase in amount of chickpea flour and date powder in basic formulation and varied from 1.96 to 4.73%. The ash content was highest for sample T_4 (4.73%) and lowest for control (1.96%). The increase in ash content of supplemented biscuits might be due to relatively higher mineral content of chickpea flour and date powder compared to refined wheat flour. The fat content was observed highest for sample T_4 (26.05%) and lowest for sample control (22.83%). The increase in fat content of partially substituted biscuit samples might be due to high fat content of chickpea flour (5.40%). Similar result for fat content of chickpea flour has also been observed by **Jagannadham *et al*. (2014)**. Fiber and protein content increased with the corresponding increase in level of substitution of chickpea flour and date powder in the formulation. Fiber content of biscuit samples increased corresponding to increase in date powder due to high fiber content of date powder. Similar results were observed by **El-Sharnouby *et al*. (2012)** in biscuits supplemented with wheat bran and date palm fruits. The protein content was studied highest in sample T_4 and lowest in sample T_1. The higher protein content could be attributed to increase in concentration of chickpea flour. **Demir *et al*. (2010)** reported that chickpea flour contain large amount of protein (21.88%). The carbohydrate content of the biscuits was calculated by difference method which involves summing up of all the proximate components on their analysis and subtraction of that sum total from 100. The observed results indicated that the carbohydrate content of biscuits decreased with increased substitution of chickpea flour and date powder in refined wheat flour. The highest value was obtained for sample T_0 (57.0%) while lowest was analyzed for T_4 (43.7%).

Physical properties of biscuits

The physical attributes of biscuits prepared with refined wheat flour, chickpea flour and date powder blends as well as 100% refined wheat flour biscuits are presented in Table 4.

Table 4 Physical characteristics of biscuits

Samples	Diameter (W, cm)	Thickness (T, cm)	Spread ratio (%)	Volume (cm^3)	Spread factor (%)
T_0	5.14±0.28	0.68±0.03	7.42±0.28[a]	17.30±0.86[b]	100[a]
T_1	5.14±0.12	0.68±0.02	8.37±0.25[b]	16.28±0.69[b]	112.71±0.12[b]
T_2	5.15±0.34	0.67±0.03	9.53±0.45[c]	14.70±0.29[a]	128.20±0.31[c]
T_3	5.14±0.52	0.67±0.02	10.26±0.48[d]	14.35±0.43[a]	138.40±0.18[d]
T_4	5.14±0.18	0.68±0.03	11.15±0.49[e]	13.71±0.70[a]	149.73±0.74[e]

Legend: T_0 = control 100(RWF):0(CF):0(DP), T_1= 80(RWF): 10(CF):10(DP), T_2=60(RWF):20(CF):20(DP), T_3=40(RWF):30(CF):30(DP), T_4=20(RWF):40(CF):40(DP). The values are average of triplicate analysis with ± SD. Mean values having different superscript in a column are significantly different (p<0.05). * Non-significant difference

Values for diameter and thickness of different biscuit samples were found to be identical (p>0.05) .The diameter of biscuits ranged from 5.045 to 5.345cm. However, other attributes like spread ratio and weight of biscuit samples differed significantly (p<0.05) and spread ratio of biscuits ranged from 7.42 to 11.15%. In case of spread ratio, positive trend was observed with the increase in level of substitution of chickpea flour and date powder, though a reverse trend was observed for weight. Greater content of protein negatively affects the spread ratio of cookies **(Gaines and Finney, 1989)**. However, cookies prepared with higher levels of chickpea flour, despite having high protein content demonstrated higher spread ratio. This anomalous behavior could be attributed to the reduced viscosity chickpea dough and hence the greater spread rate. Reduction in viscosity of dough was observed upon addition of 15% chickpea flour or more to the mixture of corn flour **(**Barron and Espinoza, 1993). Lower is the viscosity of dough, faster is the spreading rate of cookies **(Hoseney and Rogers, 1994)**. Spread factor of biscuits ranged from 112.71 to 149.73%. These values of spread factor observed higher as compared to control sample. Spread factor increased with increase in spread ratio it could be due to incorporation of chickpea that increased the lipid content in dough thus contributing to higher spread ratio of biscuits **(Gaines and Finney, 1989).**

Reduction in sugar level

Normally, the sugar used in biscuit making is 50g per 100g of refined wheat flour. In present study, the mentioned sugar level was reduced with the use of date powder as sweetening agent and thus cutting down the amount of sugar required for biscuit manufacture. The sugar level was optimized by substituting date powder up to 20, 40, 60 and 80% with different combinations of sugar and date powder in different treatments. The high level of sugar present in dates was the main factor responsible for different undertaking substitution trials. It was observed that substitution of date powder beyond 30% level resulted in biscuits with harder texture and darker colour. The biscuits were harder probably due to high fiber content present in date powder and caramelization of sugar resulting in darker colour which was not acceptable. **Ahmed *et al*. (1995)** and **Vandercook *et al*. (1980)** stated that dates have a high carbohydrate content (70%), predominated by sugars. Fructose and glucose constitute the main sugars present in date which are present in level one with each other and both are reducing sugars. Generally, consumption of glucose cause instant spike in blood sugar levels as it most rapidly absorbed sugar (**Liu *et al*., 2000**). On the other hand, fructose might act to reduce calorie intake compared to fat rich foods as it carries high level of sweetness (twice as much as glucose). On carrying out different trials by substitution of date powder for sugar, it was revealed that sugar may be substituted with date powder and reduction of sugar level to 60% was possible without any pronounced effect on sensory characteristics of biscuits.

Sensory analysis of biscuits

Table 5 shows the sensory characteristic of biscuits developed from refined wheat flour, chickpea four and date powder in different ratios and 100% refined wheat flour biscuits.

Table 5 Sensory characteristics of biscuits

Sample	Color	Taste	Texture	Overall acceptability
T_0	8.29± 0.16[d]	8.33±0.57[c]	7.66±0.57[c]	7.99±0.33[b]
T_1	7.88±0.22[c]	8.33±0.32[c]	7.33±0.29[c]	7.95±0.20[b]
T_2	7.85±0.37[c]	7.33±0.27[b]	7.00±0.26[b]	7.90±0.19[b]
T_3	7.00±0.31[b]	7.33±0.17[b]	7.00±0.20[b]	7.80±0.19[b]
T_4	6.33±0.27[a]	6.66±0.27[a]	6.33±0.47[a]	6.44±0.19[a]

Legend: T_0 = (Control) 100(RWF):0(CF):0(DP), T_1= 80(RWF):10(CF):10(DP), T_2=60(RWF):20(CF):20(DP), T_3=40(RWF):30(CF):30(DP), T_4=20(RWF): 40(CF):40(DP). The values are average of triplicate analysis with ± SD Mean values having different superscript in a column are significantly different (p<0.05).

Biscuits were estimated for color, taste, texture and appearance. The highest quality scores (7.99) was obtained for control. The taste of biscuits prepared with up to 60% substitution of mixture of chickpea flour and date powders for RWF was acceptable and quite close to control in overall acceptability. In terms of nutrient profile, substituted biscuit had higher fat, protein and carbohydrate compared to control biscuits.

The score for texture and overall acceptability decreased with increase in amount of chickpea flour and date powder but was in acceptable range up to 60% level of substitution of chickpea flour and date powder. Further substitution was not acceptable as samples were harder in comparison to control biscuits. **El-Sharnouby *et al*. (2012)** reported similar results and stated that incorporation of 30% of wheat bran and date powder was appropriate for palatable biscuits.

CONCLUSION

The study concludes that it is possible to prepare biscuits by incorporation of chickpea flour and date powder in refined wheat flour. It was revealed in the study that biscuits with higher protein (up to 33%) and fiber content (153%) could be prepared by addition of chickpea flour and date powder in the basic formulation. It was found that biscuits prepared with substitution up to 30% chickpea flour and 30% date powder were most acceptable in terms of colour, taste and texture. The incorporation of date powder in biscuits may cut down the sugar levels by nearly 60% compared to commercially available sugar enriched biscuits. These biscuits may be a nutritionally relevant option in the existing wide range of bakery products.

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