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QUALITY CHARACTERISTICS AND FORMULATION OF COOKIES FROM SWEET POTATO (IPOMOEA BATATAS)

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Abstract

Sweet potato contains many high nutrients, which are high in carbohydrates and fiber. Moreover, they are delicious and inexpensive. Producing food products from sweet potato are very attainable in worldwide due to vast availability, natural colour, high-energy, low-protein, good biological activity in the humans, as a result, it becomes a key ingredient for the production of new products in the current global tenure. Furthermore, the formulation of sweet potato Cookies was examined. The mature sweet potato were washed, peeled, cut into thin slices and dried in an oven and then milled and sieved. The optimization of sweet potato flour Preparation with drying temperature of 50°C, 60°C and 70°C was studied. It was found that appropriated drying temperature for preparation of sweet potato flours was 60ºC for 10 hr. The cookies formulation with 50%, 60% and 40% sweet potato flour at 130°C for 10, 15 and 20 min were examined. The samples were quality

characterized for physical and sensory parameters. The sensory qualities showed that the cookies supplemented with 50% sweet potato flour at 130°C temperature for 15 min of time period were well acceptable in terms of colour, texture, taste and overall acceptability.

Keywords: Sweet potato, cookies, drying, sensory analysis, physical analysis.

I. INTRODUCTION

Cookie is a baked in oven that is transformed into typically small, flat and sweet toothsome product. Cookies are habitually produced from wheat flour which possesses gluten that is known for its unique viscoelastic characteristics which is desirable in the bakery industry (okpala & ofoedu 2018). Bakery products are commonly made from wheat flour containing gluten, without gluten, baked goods will not hold their shape. Therefore, wheat flour is used in baking. A mixture of wheat flour and sweet potato flour could make a quality baking product, which should increase its economic value (Zuraida 2003).

Gluten is a storage protein compound formed from the prolamins glutenin and gliadin present especially in wheat, which is one of the most complex protein networks and having an vital function in determining the rheological behavior of bakery food products.

Today, people are becoming aware of their health, food, and nutrition. They are seeking for convenient foods with good taste, cheap price, and nutritious product. Sweet potatoes are rich in β-carotene, anthocyanins, total phenolics, dietary fiber, ascorbic acid, folic acid and minerals (Woolfe, 1992; ILSI, 2008).

Sweet potato (Ipomoea batatas) is an extremely multifaceted and delicious vegetable that possesses high nutritional value (Mohanraj and Sivasankar 2014). Among the world's utmost food crops, sweet potato produces the excessive amount of edible energy per hectare per day (Sukhcharn et al. 2008). It may contain about 70% carbohydrates (dry basis) of which a major portion is starch, which can be utilized as a functional ingredient in certain food preparations (Avula 2005).

Addition of assorted proportion of sweet potato flour in flour will increase the nutritious values in terms of fiber and carotenoids and conjointly helps in lowering the protein level and stop humans from celiac malady (Tilman et al. 2003). Most of the technical analysis on sweet potato flour centered on the event of recent product victimisation sweet potato flour instead of on economical ways to supply and store the flour (lizado and guzman, 1982; sukhcharn et al. 2008).

Sweet potato based products are of high in quality and may compete with the other products in the market (Sneha et al. 2012). Nowadays, cereal based snacks have attained importance due to their nutritional value and sensory attributes (S.A. Mir et al. 2019).

Incorporating of honey into cookies formulation is offer functional benefits, enhance water-binding capacity of dough, provide increased production volumes and improve shelf life of baked products. The use of sweet potato flour for supplementing with wheat, oats and rice flour in the bakery industry could significantly increase the value of sweet potato, reduce the use of sugar and decrease the dependence on wheat flour. Sweet potato flour was used as an antioxidant (samiha, A. alloush 2015).

Sweet potato flour, plays a vital role in the preparation of various food products, which can boost consumer nutritional and health status. It is low in protein and a quality source of resistant starch which is excellent for digestive health and blood sugar management. Because it is low in protein and high in starch, it is best to use in food formulation as an ingredient.

II. MATERIAL AND METHODS

2.1. Procurement of raw materials:

Sweet potato, wheat flour, rice flour, oats and all other ingredients (honey, butter as fat, baking powder, almonds, milk etc.) used for the cookies formulation were procured from local market of Vadodara, Gujarat.

2.2. Preparation of sweet potato flour

Flour from sweet potato was produced using the method described by Srivastava *et al.*[11] The fully matured sweet potato were selected, washed to remove dirt, peeled and cut into thin slices at around 1mm thickness. The sliced sweet potatoes were then dried at 60°C for 10 hours in a microwave oven and milled to pass through a 250µm mesh sieve to obtain flour of uniform size. The flour was packaged in airtight plastic containers and stored at room temperature until needed.

2.3. Formulation of flours

Mixture of sweet potato flour (SPF), wheat flour (WF), rice flour (RF) and oats flour (OF) was formulated and samples were labelled as T_0, T_1, T_2 and T_3 respectively as shown in Table.no.1. Sample T_0 with 80% WF, 10% RF and 10% OF were served as a control sample.

Table.no.1. Formulation of sweet potato flour, wheat flour, rice flour and oats flour

	T0	**T1**	**T2**	**T3**
Sweet potato flour	**0**	**50 g**	**60 g**	**40 g**
Wheat flour	**80 g**	**30 g**	**20 g**	**30 g**
Rice flour	**10 g**	**10 g**	**10 g**	**15 g**
Oats flour	**10 g**	**10 g**	**10 g**	**15 g**

2.4. Production of Cookies

The essential ingredients for the formulation of cookies and their various proportion are shown in Table.no.2. Powdered milk, butter, baking powder, honey and almonds were the same for all the proportion. After weighing, The butter were manually mixed with the sweet potato flour, wheat flour, rice flour and oat flour in mixing bowl to make a stiff dough. During mixing add a baking powder, honey and milk to make soft dough. The mixing of the dough was continued until reached full development. After complete mixing, Take little by

little dough and shape them into lime size roundels and place them on a greased baking tray and Brush the round cookies with milk and press some almond flakes in the center of the ball. The cookies were baked at 130 °C for 15 minutes in electric oven. The samples were evaluated for both physical and sensory characteristics immediately after cooling.

Table.no.2. composition of the cookies samples

	T0	T1	T2	T3
Sweet potato flour	**0**	**50 g**	**60 g**	**40 g**
Wheat flour	**80 g**	**30 g**	**20 g**	**30 g**
Rice flour	**10 g**	**10 g**	**10 g**	**15 g**
Oats flour	**10 g**	**10 g**	**10 g**	**15 g**
Butter	**80 g**	**80 g**	**80 g**	**80 g**
Baking powder	**4 g**	**4 g**	**4 g**	**4 g**
Honey	**4 table spoon**	**4 table spoon**	**4 table spoon**	**4 table spoon**
Milk	**10 g**	**10 g**	**10 g**	**10 g**
Almonds	**4 pieces**	**4 pieces**	**4 pieces**	**4 pieces**

2.5. Determination of proximate composition of the cookies

Cookies were analyzed for moisture, protein, fat, crude fiber and ash contents according to the methods described in Association of Official Chemists [AOAC] (2005). The total carbohydrate (CHO) was calculated by difference method as: Carbohydrate (g/100g) = 100 - [Protein (g) + Fat (g) + Fiber (g) + Ash (g) + Moisture (g)]. Food energy value (Kcal/100 g) was determined according to the method of Marero et al. (1998) using the factor (4 × %Protein) + (4 × %Carbohydrate) + (9 × %Fat).

2.6. Determination of physical characteristics of the cookies

2.6.1. Weight

The weight of the cookies was determined according to the method of Ayo, Ayo, Nkama and Adeworie (2007). The weights of cookie samples were determined with the aid of a weighing balance (model) immediately after cooling.

2.6.2. Diameter

The diameter (D) of the cookies was determined according to the method of AACC (2000). Three cookies were placed edge to edge and their total diameter was measured with the aid of a ruler. The cookies were rotated at angel of 90° for duplicate reading. The experiment was repeated twice and average diameter was recorded in millimeter.

2.6.3. Thickness

The thickness of the cookies was determined according to the method of Ayo et al. (2007). The cookies thickness was measured with the aid of a digital vernier caliper with 0.01 mm precision.

2.6.4. Spread ratio

Spread ratio of the cookies sample was determined according to the method of Gomez, Obliana, Martins, Madzavamuse, and Monyo (1997). For spread ratio, two rows of three well-formed cookies were made and the height measured. They were arranged horizontally edge to edge and the sum of their diameter measured. The spread ratio was calculated as diameter divided by thickness, using the formula below;

$$\text{SF} = \frac{D \times CF \times 10}{T}$$

Where, CF is a correction factor at constant atmospheric pressure. It has a value of 1.0 in this case (AACC, 2000).

2.6.5. Breaking strength

The breaking strength was determined according to the method described by Okaka and Isiehs (1997). Cookies of known thickness (0.4 cm) were placed centrally between two parallel metel bars (3 cm apart) and weights were applied until the cookies anapped. The least weight that caused the breaking of the cookies was regarded as the break strength of the cookies.

2.7. Sensory evaluation of the cookies

Cookies sample were evaluated by a students and staff of the faculty of food technology, Parul University, after cooling from baking. In order to evaluate cookies sensory characteristics (appearance, hardness, chewiness, odour, taste and overall acceptability). Ratings of preference were followed by ratings of taste and texture attributes. Cookies produced from each flour, along with the reference sample were presented in coded form on white plates and were randomly presented to the penelist. The panellists are used 9 – point hedonic scale (1 = dislike extremely to 9 = like extremely). The panellist assigned scores for each parameter as against the maximum score of 9.

2.8. Statistical analysis

Generated data were subjected to appropriate statistical analysis of variance (ANOVA) using a statistical package for the social sciences, SPSS (version 16). Mean separation was done using Duncan multiple range test. The level of significance was set at $p<0.05$.

III. Result and Discussion

3.1. Proximate composition of the cookies

The result of the proximate composition of the cookies are shown in table.no.3. The result shows that the highest protein content 12.78% in cookies sample T_0, while the lowest protein content 11.21% in cookie sample T_2. The highest protein content of the T_0 sample is due to the level of wheat flour, which contain high protein content. The T_2 sample had the highest carbohydrate content while the T_0 sample had the lowest carbohydrate content. A decrease was observed in the level of carbohydrate from 60.51% - 55.54%. The moisture content of cookie sample ranged from 4.87% (T_0) - 5.98% (T_2) as the proportion of sweet potato flour increased. The decrease in moisture level with increase the level of substitution might serve as an indication of increasing storage stability. The highest fat content 23.56% of cookie sample T_0, while the lowest fat content 11.21% of cookie sample T_2. The highest Ash and Fiber content of 1.75% and 3.11% were recorded for the cookie sample T_2. Considering the importance of these nutrients to human health, the cookies from SPF (sweet potato flour) is likely to have massive benefits to the consumers. The control T_0 (cookies made with 80% WF, 10% RF and 10% OF) had the highest calorific value (485.32 Kcal/100 g).

Table.no.3 proximate composition of the cookies samples

Proximate composition (%) of cookies							
Sample code	Moisture	Protein	Ash	Fat	Crude fibre	Carbohydrate	Energy value (Kcal/100 g)
T_0	4.87	12.78	1.41	23.56	1.84	55.54	485.32
T_1	5.75	11.46	1.62	18.64	2.92	59.61	452.04
T_2	5.98	11.21	1.75	17.44	3.11	60.51	443.84
T_3	5.69	11.96	1.54	19.39	2.50	58.92	458.03

3.2. Physical characteristics of cookies

Table.no.4 shows that physical properties of the prepared cookies. The control had a spread ratio that was not significantly different control had ($p>0.05$) from the cookies with SPF (sweet potato flour). It seems like that the break strength of the cookies increased with increasing levels of SPF. The breaking strength is referred to the force required to break the cookies. The breaking strength significantly ($p < 0.05$) decreased as the substitution level of sweet potato flour increased. The reduction could be attributed to the carbohydrate/starch content of sweet potato flour which may not be as hard/strong like that of wheat.

Table.no.4 Physical characteristics of prepared cookies samples

Sample code	Weight (g)	Diameter "D" (mm)	Thickness "T" (mm)	Spread ratio (D/T)	Breaking strength (g)
T_0	16.38	50.3	8.30	6.06	290.21
T_1	18.11	56	8.55	6.55	261.54
T_2	19.74	57.4	8.60	6.67	211.86
T_3	17.29	54	8.50	6.35	269.26

Mean value with different subscripts on the same row are significantly different ($p \leq 0.05$); wheat flour – WF, sweet potato flour – SPF, Rice flour – RF, oats flour – OF; T_0 – 80% WF + 10% RF + 10% OF, T_1 – 50% SPF + 30% WF + 10% RF + 10% OF, T_2 – 60% SPF + 20% WF + 10% RF + 10% OF, T_3 – 40% SPF + 30% WF + 15% RF + 15% OF.

3.3. Sensory characteristics of cookies

The result of sensory evaluation of the prepared cookies samples from sweet potato flour, wheat flour, rice flour and oats flour are presented in table.no.5. The mean score of color, taste, texture, aroma, appearance and overall acceptability for the cookies were significantly different ($p < 0.05$) from one another.

The mean score for the cookies colour ranged between 6.4 and 8.2. Cookie sample (T_2) had the lowest value while sample (T_1) had the highest value. In addition, this could be an indication that substitution of sweet potato flour with other flour for cookies formulation actually provide more protein for maillard reaction to take place, which is normally encountered and desirable in baked goods.

Based on taste, the score for the cookies ranged from 6.8 to 8.6; cookie sample (T_2) had the lowest value while the cookie sample (T_1) had the highest value. The mean score for texture ranged between 7.4 and 9 for cookie sample (T_0) and (T_2) had the same lowest value and (T_1) had the highest value respectively.

The mean score for the cookies aroma ranged between 6.3 and 8.8; cookie sample (T_2) had the lowest value while sample (T_1) had the highest value. On the basis of appearance, the score for cookie samples ranged from 7.6 to 8.4; cookie sample (T_2) had the lowest value while cookie sample (T_1) had the highest value respectively.

The mean scores (6.9 – 8.6) for the overall acceptability of the cookies were above the average (4.5), which indicating the high acceptability of the cookies sample. The cookie sample (T_1) had the highest value while cookie sample (T_2) had the lowest value. It was observed that for most of the parameters studied, cookies containing 50% SPF were better than other for cookies formulation from sweet potato flour.

Table.no.5 sensory analysis of prepared cookies samples

Sample code	Colour	Taste	Texture	Aroma/smell	appearance	Overall acceptability
T_0	8	7.5	7.4	7.8	8	7.7
T_1	8.2	8.6	9	8.8	8.4	8.6
T_2	6.4	6.8	7.4	6.3	7.6	6.9
T_3	7.4	8	8.2	7.6	7.8	7.8

IV. CONCLUSION

The result distinctly showed that it could be possible to produce nutritious and acceptable cookies through the substitution of wheat flour, rice flour and oats flour with sweet potato flour. The result also showed that substitution with sweet potato flour did not alter the physical characteristics and consumer acceptability of the cookie sample. The result of sensory analysis showed that cookie samples were well evaluated for appearance by panellists. The highest values for overall acceptability had sample T_1.

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