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CHEMICAL ANALYSIS AND SENSORY EVALUATION OF FLAXSEED COOKIES FORTIFIED WITH DRIED DATES AND RAISINS

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Baking is a method of cooking food that uses prolonged dry heat, normally in an oven, but also in hot ashes. Baking Industry is considered as one of the major segments of food processing in India. Cookies hold an important position in snack food industry due to variety in taste, crispiness and digestibility. Flaxseed is emerging as an important functional food ingredient because of its rich contents of α -linolenic acid (ALA, omega-3 fatty acid), lignans, and fibre. Flaxseed oil, fibers and flax lignans have potential health benefits such as in reduction of cardiovascular disease, atherosclerosis, diabetes, cancer, arthritis, osteoporosis, autoimmune and neurological disorders. Ingredients involved in preparing the samples are flaxseed flour, wheat flour, salted butter and castor sugar. Four samples were prepared: sample 1 (S_1): wheat flour-flaxseed powder + dates (25%) cookies, sample 2 (S_2): wheat flour-flaxseed powder + raisins (25%) cookies, sample 3 (S_3): wheat flour-flaxseed powder (50:50) cookies, sample 4 (S_4): wheat flour-flaxseed powder (30:70) cookies. According to AOAC method, ash, moisture and pH were measured. The sensory evaluation test was conducted. On the basis of the Hedonic Scale, marks were given by 50 individual subjects to the samples and p-value was calculated using MS EXCEL. Hence, overall the products were considered optimally good enough to be edible, economically efficient and nutritionally enriched.

Keywords: Baking, Flaxseeds, Cookies, Hedonic scale, p-value

BACKGROUND

Baking Industry is considered as one of the major segments of food processing in India. Baked products are gaining popularity because of their availability, ready to eat convenience and reasonably good shelf life. Cookies hold an important position in snack food industry due to variety in taste, crispiness and digestibility. Cookies are made in a variety of style using an array of ingredients including sugars, spices, chocolates, butter, peanut butter, nuts or dried fruits (Vijayakumar *et al.*, 2013).

Baking is a method of cooking food that uses prolonged dry heat, normally in an oven, but also in hot ashes, or on

hot stones. The most common baked item is bread but many other types of foods are baked. Heat is gradually transferred “from the surface of cakes, cookies, and breads to their centre. As heat travels through it transforms batters and doughs into baked goods with a firm dry crust and a softer centre” (Figoni Paula, 2011).

Cookies are ideal for nutrient availability, palatability, compactness and convenience. They differ from other bakery products like bread and cakes because of having low moisture content, comparatively free from microbial spoilage long shelf life of the product (Vijayakumar *et al.*, 2013).

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The term [cookie] first appeared in print as long ago as 1703 (Van der Sijs and Nicoline, 2009). Leavened crackers had been made as early as 1800, but not until compressed yeast became available about 1870 their production was not attempted on a large scale. Sweet biscuits had previously been imported from England. When such sweets achieved a measure of popularity in this country, Belcher and Larrabee, cracker bakers in Albany, New York, imported machinery and methods for baking them shortly after the Civil War. The change in the demand for biscuit and cracker output was clearly a shift from staple to 'luxury' product (William Panschar, 1956).

Biochemistry Involved

Gluten is the protein component of bread; it is what gives bread its lovely, airy, chewy texture and allows the bread to rise by trapping carbon dioxide released by yeast, and retains this texture by trapping the steam released during baking. Gluten is actually a composite of the two major proteins found mainly in wheat, glutenin and gliadin.

Water is a polar molecule, which means it has strong intermolecular forces like dipole-dipole interactions. In baking, we rely on water to do a lot of heavy lifting, so to speak. Most types of dough and batter start out as essentially a suspension of ingredients in water. The water allows the important structural molecules, like proteins, and other components like sugars and lipids to interact and produce their chemistry. If water is properly introduced through the addition of butter and eggs, the sugar would dissolve and the proteins in the flour would interact to give the dough its proper consistency. Then, once the dough enters the oven, the water vaporizes, drying out the dough and allowing the solid structure to form. The water vapour also expands to provide mechanical leavening to our cookies.

The oil also performs another very important function, it prevents retrogradation of the starches in the dough. Retrogradation occurs when amylose and amylopectin chains realign to re-form a crystalline structure by forming hydrogen bridges while the chains are parallel. It is one of the processes that causes a baked product to go stale. When starches are dissolved in water, the crystalline structure is lost and they form a gel. This is one of the reasons why proper hydration is so important when making bread, cookies, etc., so that the starch crystals don't interfere with gluten formation. When cookies are baked, water is removed but the starches remain gelatinized. After the cookie is removed from the oven, starches solidify without returning

to their crystalline structure, so it can take many days before any effects of retrogradation in baked bread are noticed (Jillian Browning Claire, 2014).

Flaxseed is emerging as an important functional food ingredient because of its rich contents of α -linolenic acid (ALA, omega-3 fatty acid), lignans, and fiber. Flaxseed oil, fibers and flax lignans have potential health benefits such as in reduction of cardiovascular disease, atherosclerosis, diabetes, cancer, arthritis, osteoporosis, autoimmune and neurological disorders. Flax protein helps in the prevention and treatment of heart disease and in supporting the immune system. As a functional food ingredient, flax or flaxseed oil has been incorporated into baked foods, juices, milk and dairy products, muffins, dry pasta products, macaroni and meat products. The present review focuses on the evidences of the potential health benefits of flaxseed through human and animals' recent studies and commercial use in various food products (Ankit Goyal *et al.*, 2014).

The objective of this work was to find the chemical attributes and acceptability of the flaxseed wheat flour cookies fortified with dates and raisins in different proportions among the population. Dates are rich in iron, hence incorporated in the product to increase mineral content reflected through the ash % of the product. Raisins can contain up to 72% sugars by weight (Albert Julius Winkler, 1962) most of which is fructose and glucose. They also contain about 3% protein and 3.7%-6.8% dietary fiber. Hence, raisins were incorporated to increase the nutritional attributes in the product.

METHODS AND MATERIALS

Materials

Procurement of Material

Wheat flour and flaxseeds were used in the study. The wheat flour was used as a base material for the preparation of flour mix with flaxseed and other ingredients used in the preparation of *biscuits* included flour, sugar, baking soda, butter, and water. All ingredients were purchased from local market of BARRACKPORE city.

Processing and Mixing of Raw Material

The cleaning of flaxseed and wheat grains was performed manually to remove damaged seeds, dust particles, seeds of other grains/crops and other impurities such as metals, stones and weeds. Flaxseeds were powdered in a mixer grinder to prepare flour.

Table 1: Ingredients Used in Standard Recipe of Cookies

Ingredients	Amount (gm)
Wheat flour	50
Flaxseed flour	50
Salted butter	75
Castor sugar	20
Baking soda	A Pinch

Method

4 Types of Biscuits are Prepared

Sample 1 (S₁): Wheat Flour – Flaxseed Powder + Dates (25%) Cookies

Sample 2 (S₂): Wheat Flour – Flaxseed Powder + Raisins (25%) Cookies

Sample 3 (S₃): Wheat Flour – Flaxseed Powder (50:50) Cookies

Sample 4 (S₄): Wheat Flour – Flaxseed Powder (30:70) Cookies

Preparation Of 50:50 and 30:70 (Wheatflour: Flaxseed Powder) Cookies

At first flaxseeds are grounded to powder using a mixer grinder. This powder is taken in 50:50 and 30:70 ratio with wheat flour respectively into two separate bowls. Salted butter is melted and poured into the mixture. The mixture is kneated well to give a dough like consistency. The dough is given a proper shape like biscuits. Cookies are individually put into preheated cake oven at 170 °C for 15 minutes. Biscuits are cooled and packed into air tight container

Preparation of Flaxseed-Wheatflour + Dates Biscuits and Flaxseed - Wheatflour + Raisins Cookies

At first flaxseeds are grounded to powder using a mixer grinder. This powder is taken in 50:50 ratio with wheat flour respectively into two separate bowls with 25% dates and raisins pastes respectively. Salted butter is melted and poured into the mixture. The mixture is kneated well to give a dough like consistency. The dough is given a proper shape like cookies. Cookies are individually put into preheated cake oven at 170 °C for 15 minutes. Biscuits are cooled and packed into air tight container.

Analytical Methods

Determination of Moisture Content

Moisture was estimated by weighing accurately 5 g of ground sample and subjected to oven drying at 110 °C for 4 h. It was again weighed after cooling in desiccators until the constant weight was obtained. The resultant loss in weight was calculated as moisture content (AOAC, 1998)

$$MC = (W_2 - W) \times 100 / W_1 - W$$

where,

W = Weight of empty petridish

W₁ = Weight of petridish with sample before drying

W₂ = Weight of petridish with sample after drying to constant weight

Determination of Ash Content

5 g of sample was weighed into crucible which was heated at low flame till all the material was completely charred and cooled. Then it was kept in muffle furnace for about 5 hrs at 600 °C. It was again cooled in desiccators and weighed and repeated until two consecutive weights were constant. The percent ash was calculated by knowing the difference between initial and final weight (AOAC, 1998).

$$\text{Total ash} = (W_2 - W) \times 100$$

W₁ - W

where,

W = Weight of empty dish

W₁ = Weight of dish with sample

W₂ = Weight of dish with ash (Vijayakumar *et al.*, 2013)

Determination of pH

The pH is a measure of the acidity or alkalinity in solutions or water containing substances. pH values lower than 7 are considered acidic, while pH values higher than 7 are considered alkaline. A pH of 7 indicates neutrality.

The pH can be measured by following methods:

1. Digital pH meter
2. Chemical indicator method

Digital pH Meter: Portable instruments are battery driven and have glass electrodes. The pH value in some products can be measured by direct contact between the sensitive diaphragm of the electrode. Though the diaphragm

differences in electrical load between the product and electrolyte solution inside the glass electrode are measured and directly indicated as pH reading. For accurate pH reading the pH-meter should be calibrated before use and adjusted to the temperature of the product to be measured. The electrode must be rinsed thoroughly with distilled water after each measurement.

Sensory Evaluation

Sensory evaluation of acceptance of the four samples prepared was done using the Hedonic Scale scoring. Scoring was given by 50 subjects on different parameters like aroma, texture, appearance, taste, colour and general evaluation and then subjected to ANOVA. Similar were the findings of Hussain *et al.* who developed cookies by using full fat flaxseed flour supplemented with wheat flour at 5, 10, 15, 20, 25 and 40% level. The mean quality scores of the cookies decreased with the increase in the level of the flaxseed flour supplementation (Hussain, 2006).

After collecting data from 50 panel members about Taste, Aroma, Colour, Texture, Appearance and General Evaluation of the samples, the Mean, Standard Deviation, Standard Error, F value and F critical value were calculated with the help of MS Excel. Mainly in this study a 9 point hedonic scale with scores ranging from 9 to 1 which represents extremely good and extremely disgusted was used. F value was done between two samples, to find that if there is any significant difference is present between two variances of two samples. In this study for F value the 'Level of Significance' is 1%. Mainly one tailed test was done. If p-value is lower than F value we accept the null hypothesis and that is there is no significant difference is present between two variances but if p-value is excess than F value we reject the null hypothesis.

Null Hypothesis (H_0)

If p-value is less than 2.54 then the variability among taste,

aroma, colour, texture, appearance and general evaluation of the four biscuits is significant to 0.01% level of significance.

Alternative Hypothesis (H_a)

If p-value exceeds 2.54 then there is no significant variation among the four products.

Statistical Analysis

The difference in mean acceptability scores of different variation of flour and fortification of dates and raisins, assessing the acceptability of flour mix in biscuits were analyzed in term of analysis of variance (ANOVA).

RESULTS

The findings of ash, moisture and pH content of the four samples are given below (Table 2):

DISCUSSION

According to the above findings maximum moisture content is found in raisins flaxseed wheat flour cookies because of higher moisture content in raisins and highest ash content is found in 30:70 wheat flour flaxseed cookies because of higher amount of flaxseed content which is rich in mineral content. pH of all cookies are nearly at 6 because the pH of flaxseeds is moderately alkaline.

Table 2: Findings of Ash, Moisture and pH

Name of Cookies	Moisture Content (%)	Ash Content (%)	pH Content
Sample 1	4	1.15	6.23
Sample 2	4.3	1.29	6.16
Sample 3	4.1	1.05	6.5
Sample 4	4	2.33	6.72

Table 3: Hedonic Scale Evaluation of the Products

No	Name of the Samples	Scores on 9 Point Hedonic Scales					
		Taste	Aroma	Colour	Texture	Appearance	General Evaluation
Sample 1	S ₁	7.39 ± 0.76	7.24 ± 0.79	7.24 ± 1.02	7.22 ± 0.74	7.26 ± 1.05	7.16 ± 0.79
Sample 2	S ₂	7.52 ± 0.71	7.56 ± 0.84	7.46 ± 0.91	7.4 ± 0.95	7.4 ± 1.07	7.28 ± 0.81
Sample 3	S ₃	7.42 ± 0.73	7.38 ± 0.78	7.26 ± 0.94	7.3 ± 0.76	7.28 ± 0.13	7.26 ± 0.66
Sample 4	S ₄	7.62 ± 0.73	7.42 ± 0.76	7.4 ± 0.91	7.3 ± 0.81	7.18 ± 1.00	7.36 ± 0.63

Sensory Evaluation Test

The findings of sensory evaluation test conducted on the basis of Hedonic scale scoring are as follows:

From the statistical data, it is clear that, there was significant difference in their difference at $p \leq 0.01$ in all the sensory attributes, viz., color, appearance, texture, aroma, taste and general evaluation at 1% level significance as p-value was found to be less than 0.01. Above result depicts that flaxseed wheat flour cookies are well accepted in all proportions but fortification of dates and raisins enhanced the taste of the cookies.

Supplementation of wheat biscuits with bengal gram flour was tried by Shakuntala *et al.* at 10, 15, 20, and 25% levels along with modifications in water, fat and of biscuits. It was found that sensory attributes of biscuits improved on supplementation of bengal gram flour at 15 to 20% level (Shakuntala Masur *et al.*, 2008).

CONCLUSION

Cookies are ideal for nutrient availability, palatability, compactness and convenience. The ingredients used for making the cookies are wheat flour and flaxseed powder in 50:50 and 30:70 ratio respectively. Dates paste and raisins paste are also incorporated to enhance the taste and nutritional attributes of the products respectively in two different sets of biscuits. Chemical tests were performed according to AOAC (1998) method to find the ash, moisture and pH of the products and all were found to be within the acceptable range. Through sensory evaluation test it is evident that the products are well accepted by the panel members in terms of taste, aroma, colour, appearance and general evaluation. New formulations could therefore be tested aiming towards the development of nutrient enriched and economically acceptable products.

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