Acta Scientific NUTRITIONAL HEALTH (ISSN:2582-1423)

Volume 7 Issue 6 June 2023

Research Article

Development of Functional Biscotti with Incorporation of *Triticum Aestivum Spelta, Salvia Hispanica* Seeds and *Tribulus Terrestris* Fruit

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DOI: 10.31080/ASNH.2023.07.1243

Received: April 26, 2023

Published: May 06, 2023

Abstract

Nowadays consumers are becoming increasingly interested in health and the demand for foods that offer health benefits has been increasing. Bakery foods being the most acceptable in all age groups and having longer shelf life are considered as ideal products for nutritional improvement. An outstanding coincidence between indigenous medicinal plant uses and scientifically proved pharmacological properties of compounds present in them has been observed along the years. In view of the above aspects, the present work provides nutritional and antioxidant potential of *Triticum aestivum* spelta (Spelt), *Salvia hispanica* seeds (Chia seeds) and *Tribulus terrestris* fruit (Gokhru) and a functional biscotti based on the mentioned functional ingredients. The study revealed that among the basic ingredients, chia seeds have the highest value of protein, fat and calcium whereas gokhru is reported to contain a high amount of fibre and iron content at $p \leq 0.05$ level. The standard biscotti and its three variants of functional biscotti were developed in which Variant A was highly acceptable by the panel. Variant A had significantly higher value for nutritional and antioxidant properties at $p \leq 0.05$ when compared to standard biscotti. Thus, for such bakery product to be conventional by the modern consumers, it has to satisfy few determinants like sensory quality and positive health image, so functional biscotti has been prepared by keeping in mind about the consumers preferences about nutritious and tasty food.

Keywords: Functional Food; Healthy; Health Benefit; Bakery Food; Omega-3; Functional Ingredients

Introduction

Food and nutrition science has moved from identifying and correcting nutritional deficiencies to designing foods that promote optimal health and reduce the risk of diseases [1]. Also, consumers' demand for foods that offer health benefits has made functional foods a common name in the market. Functional foods are 'Similar in appearance to conventional foods, but they demonstrate physiological benefits, and/or to reduce the risk of chronic metabolic disorders beyond basic nutritional functions'. A food product can be made functional by increasing the concentration of a component naturally present in food to a point at which it will induce predicted effect or by adding a component that is not normally present in most foods. Value addition in a product that is consumed and liked by people of all age groups is the most convenient way of introducing a functional food in the market. Bakery food are the most popular snacks universally available at competitive prices in varied taste and flavor [2]. But, most of the bakery foods are high in carbohydrates, fat and calories but low in fiber, vitamins, and minerals, which make it unhealthy for frequent consumption. With this purpose, additional raw materials like pseudocereals, legumes and oilseeds are included in the bakery products, in order to increase the nutritional value. Both *Tribulus terrestris* fruit (Gokhru) and *Salvia hispanica* L. (Chia seeds) are good sources of protein, fat and fiber [3-5]. Gokhru is also a cheap source of iron and can easily be afforded by people of lower income group [6,7]. The chia seed oil is characterized by high contents of polyunsaturated fatty acids, such as ω-3 alphalinolenic acid and ω-6 linoleic acid [4,8-10]. These fatty acids play important roles in neuronal growth, brain development during both the fetal and postnatal period. Though Spelt wheat (*Triticum aestivum* subsp. spelta) is similar and related to the modern wheat (*Triticum aestivum*), its nutritional composition is very different from the modern wheat. Spelt is a richer source of ash, protein, fat, fiber, vitamins and minerals [11-14]. So, the aim of present study was to develop functional biscotti and evaluate the proximate, mineral and antioxidant content of Gokhru, Chia seeds and Spelt flour.

Material and Methods

Collection of raw material

In order to prepare the biscotti, materials like sugar, vanilla essence, cocoa powder, lemon, salt, butter, sodium bicarbonate, *Tribulus terrestris* fruit (Gokhru) and *Salvia hispanica* L. seeds (Chia seeds) were purchased from a local market of Delhi, while *Triticum aestivum spelta* (Spelt flour) was collected from an online grocery application. The spelt flour was screened through a 0.25 mm sieve and stored at 4 degree Celsius in a refrigerator to prevent spoilage particularly rancidity until usage. Gokhru were cleaned manually and stored in plastic containers. Chia seeds and Gokhru were then reduced into fine powder by the use of grinder for making the biscotti.

Development of biscotti

Biscotti was developed with functional ingredients such as; Spelt flour, Gokhru and Chia seeds of three different concentrations as shown in table 1. A control sample of biscotti, made up of refined wheat flour with no functional ingredients was also developed to check the contribution of functional ingredients.

Material	Standard	Variant A	Variant B	Variant C
Triticum aestivum spelta (Spelt flour)	100%	60%	60%	60%
Tribulus terrestris fruit (Gokhru)	-	8%	16%	32%
Salvia Hispanica L. seeds (Chia seeds)	-	32%	24%	8%

Table 1: Composition of Functional Biscotti developed with different proportions of functional ingredients.

Sensory evaluation of biscotti

Selection of panel members involved the screening of 20 post-graduate students from the department of Home Science, Banasthali Vidyapith, Tonk, Rajasthan. All of these were subjected to triangle difference test and 15 students having sharp discrimination, discretion and communication powers were selected for further evaluation as they identified cumin seeds as a difference factor. In the present study, the panellists evaluated different variations of biscotti according to the Five point composite rating scale and 9 point Hedonic scale.

Proximate composition

Proximate analysis of the functional ingredients and most accepted developed biscotti (after sensory evaluation) was performed using standard AOAC (2009) and Sharma (2007) methods [15,16].

Mineral estimation

Aliquots were prepared and mineral analysis (Iron and Calcium) of functional ingredients and most accepted developed biscotti was performed.

Antioxidant estimation

Aqueous and methanol extracts of functional ingredients and most accepted developed biscotti were prepared using 1:10 ratio of sample and water/methanol respectively, by evaporating the mixture on hot water bath to drying till powder formation.

Statistical analysis

The analysis of data was done with the help of mean, standard deviation, bar graph and student t test.

Results and Discussion

Table 1 and figure 2 shows that the sensory evaluation panellists selected Variant A as the most accepted biscotti which was composed of 60% Spelt flour, 32% Chia seeds and 8% Gokhru powder. Further, proximate composition, mineral content and antioxidant content of functional ingredients (Spelt flour, Chia seeds and Gokhru) and functional biscotti (Variant A) was determined.

Data are reported as MEAN ± SD from a group of 15 panels each. Biscotti is incorporated with *Triticum aestivum spelta*, *Salvia hispanica* and *Tribulus terrestris* in different ratios. Standard - (100% *Triticum aestivum spelta*, Variant A - (60:32:8), Variant B - (60:24:16% *Tribulus terrestris* fruit), Variant C - (60:8:32).

Attributes	Standard	Variant A	Variant B	Variant C
Colour	4.30 ± 0.63	4.13 ± 0.80	3.93 ± 0.57	3.80 ± 0.74
Appearance	4.40 ± 0.61	4.33 ± 0.69	4.06 ± 0.67	3.93 ± 0.80
Texture	4.46 ± 0.71	4.20 ± 0.74	3.8 ± 0.8	3.6 ± 0.8
Flavour	4.33 ± 0.69	4.06 ± 0.70	3.70 ± 0.57	3.6 ± 0.6
Taste	4.27 ± 0.67	4.1 ± 0.7	3.90 ± 0.68	3.76 ± 0.70

Table 2: Acceptability Evaluation of Functional Biscotti in Terms of Sensory Attributes (5 point composite score).

Proximate composition of functional ingredients and biscotti

The moisture content in *Triticum aestivum spelta* (8.09 ± 0.10), *Tribulus terrestris* fruit (6.16 ± 0.30a) and *Salvia hispanica* seeds (5.38 ± 0.10a) is found to be of lesser value as compared to *Triticum aestivum* (Refined wheat flour). Similar findings were shared by Duarte., *et al*., 2019; Combarieu., *et al*., 2003 and Wieser, 2001 in their respective studies [11,18,19]. Also, if we compare the Standard and Functional biscotti, the moisture content of Functional biscotti (1.25 ± 0.02) is the least, making Functional biscotti, a non-perishable food product with a good shelf life, as low moisture content prevents microbial attacks.

Amount of protein is significantly higher in *Triticum aestivum* spelta, *Tribulus terrestris* fruit and *Salvia hispanica* seeds in comparison to the Refined wheat flour. This resulted in better protein content in functional biscotti when compared to the standard

Proximate Composition	Triticum aestivum (Refined wheat flour) *	Triticum aestivum spelta (Spelt flour)	Salvia hispanica seeds (Chia seeds)	Tribulus terrestris fruit (Gokhru)	Standard Biscotti	Functional Biscotti (Variant A)
Moisture (g/100g)	13.3 ± 0.2	8.09 ± 0.10a	5.38 ± 0.10a	6.16 ± 0.30a	1.45 ± 0.10a	1.25 ± 0.02a
Ash (g/100g)	0.60 ± 0.15	2.1 ± 0.1a	4.13 ± 0.03a	10.08 ± 0.35a	1.75 ± 0.10a	2.82 ± 0.02a
Protein (g/100g)	11.01 ± 0.10	15.02 ± 0.11a	21.02 ± 0.01a	15.09 ± 0.07a	5.23±0.11a	8.43 ± 0.01a
Fat (g/100g)	0.90 ± 0.02	2.08 ± 0.02a	20.00 ± 0.02a	8.63 ± 0.04a	26.05 ± 0.02a	46.33 ± 0.01a
Fibre (g/100g)	0.3 ± 0.1	11.90 ± 0.02a	19.00 ± 0.26a	51.10 ± 0.04a	12.93 ± 0.02a	19.45 ± 0.04a
Carbohydrates (g/100g)	73.90 ± 0.02	61.17 ± 0.15a	30.55 ± 0.27a	9.00 ± 0.36a	60.56 ± 0.15a	48.73 ± 0.03
Energy (Kcal/100g)	348.0 ± 0.3	323.50 ± 0.14a	386.28 ± 0.50a	173.75 ± 0.51a	1030.75 ± 0.14a	1224.93 ± 0.02a

Table 3: Proximate Composition of functional ingredients (*Triticum aestivum spelta, Salvia hispanica* seeds and *Tribulus terrestris* fruit) and functional biscotti.

Values are expressed as Mean ± SD of triplicate determinations, a denotes significant difference at p≤0.05 level when compared to *Triticum aestivum* (Refined wheat flour).

*Secondary data obtained from NIN, 2011 [17].

biscotti. Among the functional ingredients, highest amount of protein was recorded in *Salvia hispanica* seeds, which is in accordance with studies conducted by Combarieu., *et al.* 2003 and Bartosova, 2010 [19,20]. Functional biscotti is a good source of protein and can be used to fulfil the protein requirements of vulnerable groups, i.e., children and pregnant women.

The data delineated that functional biscotti had significantly high value of ash content at p ≤ 0.05 level in comparison to the value of ash content of standard biscotti. The high ash content in functional biscotti can be attributed to the presence of gokhru and chia seeds, which contains minerals such as phosphorus, calcium, potassium, iron and magnesium, making functional biscotti a nutritious snack to munch on [21,22]. As the functional biscotti is rich in minerals, it may help to eliminate the micronutrient deficiencies in the vulnerable groups like pregnant women and children.

The data outlines that functional biscotti provides significantly increased value of energy at p≤0.05 level in comparison to the standard biscotti. But, the energy provided by it is mostly from proteins and healthy fats present in it, and not just by the simple carbohydrates as it can be seen that *Salvia hispanica* seeds are rich in healthy fats. Its fatty acid profile is characterised by high contents of polyunsaturated fatty acids, containing with 60% of (omega) ω-3 alpha linolenic acid and 20% of (omega) ω-6 linoleic acid. This makes it a nutritious snack and may help in preventing the risk of various metabolic disorders [4,8-10,23].

The data also indicated that the variant A (48.73 ± 0.3) had significantly low value of carbohydrate content (60.56 ± 0.15) at p ≤ 0.05 level in comparison to the value of carbohydrate content of standard biscotti. The lower carbohydrate content in functional biscotti can be attributed to the presence of chia seeds and gokhru in the functional biscotti. Among the functional ingredients, lowest amount of carbohydrate content was observed in gokhru powder (9.00 ± 0.36) and chia seeds (30.55 ± 0.27). Carbohydrates perform a lot of functions like they are the preferred fuel of energy for the body and are important for the proper functioning of brain. So, for a leading a healthy life, inclusion of appropriate amount of carbohydrates in the diet are important. Also, the type of carbohydrate present is more of a complex carbohydrate as Gokhru was reported to contain the highest amount of fibre in comparison to *Triticum aestivum spelta*, *Salvia hispanica* seeds and *Triticum aestivum*.

Energy (Kcal/100g) provided by standard biscotti and variant A was found to be 1030.75 ± 0.14 and 1224.93 ± 0.02. The data delineates that Variant A provides significantly increased value of energy at p ≤ 0.05 level in comparison to the value of energy provided by standard biscotti. As we have observed earlier, that the carbohydrate content in variant A is less in comparison to the standard, so the energy provided by the functional biscotti is mostly from proteins and healthy fats present in it, which makes it a nutritious snack and may help in the preventing the risk of various metabolic disorders.

Antioxidant properties

Values are expressed as Mean ± SD of triplicate determinations of aqueous extracts of *Triticum aestivum spelt, Salvia hispanica* seeds, *Tribulus terrestris* fruit on dry weight basis.

The data depicts that standard biscotti contains significantly lower value of total phenols content and flavonoids content at p ≤ 0.05 level when compared to the value of total phenols content of functional biscotti. High value of polyphenols and flavonoids content in functional biscotti can be due to the presence of chia seeds and gokhru in it. The standard biscotti also had significantly reduced value of vitamin C content at p ≤ 0.05 level when compared to the value of vitamin C content of variant A and among the basic ingredients, gokhru (6.83 ± 0.03) had highest vitamin C content

Antioxidant properties	Triticum aestivum spelta (Spelt flour)	Salvia hispanica seeds (Chia seeds)	Tribulus terrestris fruit (Gokhru)	Standard Biscotti	Functional Biscotti (Variant A)
Total Phenols (mg GAE/100g)	324.7 ± 0.2	208.01 ± 0.34	370.01 ± 0.01	216.46 ± 0.20	226.84 ± 0.01a
Total Flavonoids(mg QE/100g)	219.95 ± 0.01	260.67 ± 0.67	345.1 ± 0.1	153.68 ± 0.10	161.99 ± 0.02a
Vitamin C(mg/100g)	2.33 ± 0.01	4.6 ± 0.2	6.83 ± 0.03	0.61 ± 0.02	2.28 ± 0.03a

Table 4: Antioxidant properties of functional ingredients (*Triticum aestivum spelta, Salvia hispanica* seeds and *Tribulus terrestris* fruit) and functional biscotti on Dry Weight Basis.

whereas the spelt flour (2.33 ± 0.01) had the lowest vitamin C content.

The above data showed that functional biscotti is richer in terms of antioxidants than the standard biscotti. Various synthetic antioxidants are used in processed foods to inhibit oxidation. These antioxidants are effective in improving the shelf life of processed foods [24]. However, the use of synthetic antioxidants has been restricted due to their toxigenic, mutagenic, and carcinogenic effects. Thus, the demand for use of natural antioxidants derived from plants has increased to a large extent [25]. In this regard, extracts obtained from chia seeds and gokhru can be used as a source of natural antioxidants in bakery products.

Mineral content

Mineral	Triticum aestivum (Refined wheat flour) *	Triticum aestivum spelta (Spelt flour)	Salvia hispanica seeds (Chia seeds)	Tribulus terrestris fruit (Gokhru)	Standard Biscotti	Functional Biscotti (Variant A)
Calcium(mg/100g)	23.03 ± 0.15	50.1 ± 0.2a	611.12 ± 0.01a	32.08 ± 0.01a	33.33 ± 0.20	152.11 ± 0.01a
Iron (mg/100g)	2.70 ± 0.08	7.19 ± 0.01a	7.99 ± 0.02a	18.29 ± 0.02a	4.79 ± 0.01	5.54 ± 0.02a

Table 5: Mineral Content of functional ingredients (*Triticum aestivum spelta, Salvia hispanica* seeds and *Tribulus terrestris* fruit) and functional biscotti.

Values are expressed as Mean ± SD of triplicate determinations, a denotes significant difference at p≤0.05 level when compared to *Triticum aestivum.*

*Secondary data obtained from NIN, 2011 [17].

The data indicated that Functional biscotti (152.11 ± 0.01) had significantly attenuated calcium content at p ≤ 0.05 level in comparison to the standard biscotti (33.33 ± 0.02). High calcium content in variant A can be attributed to the presence of gokhru (32.08 ± 0.01a) and chia seeds (611.12 ± 0.01), which contain very high amount of calcium. Optimal calcium intake is also relevant during adolescence, when most bone mineral accretion occurs. So, ready to eat snacks like functional biscotti can help people fulfil their daily calcium requirements, especially children.

Data revealed that standard biscotti (4.79 ± 0.01) contained significantly decreased iron content (mg/100g) at p ≤ 0.05 level in comparison to Variant A (5.54 ± 0.02). Higher iron content in variant A can be attributed to the presence of chia seeds (7.99 ± 0.02) and gokhru (18.29 ± 0.02). Anemia is a global public health problem and is more prevalent in pregnant women and young children. Foods incorporated with chia seeds and gokhru can be used to prevent and treat the condition of anemia, if consumed regularly [3]. It is a cheap source of iron that can easily be afforded by people belonging to lower income group.

Conclusion

Functional biscotti (incorporated with *Tribulus terrestris* fruit, *Salvia hispanica* L. seeds and *Triticum aestivum spelta*) is a nutritious food that provide sufficient amount of nutrients needed for normal body function and maintenance. The outcome of the study demonstrated that functional biscotti can serve as a good nutritious snack helping people to better their health while consuming tasty food. Osteoporosis and anemia is a global public health problem is affecting both the sexes with major consequences for human health as well as social and economic development. Consuming iron and calcium rich products like functional biscotti can help in preventing the occurrence of osteoporosis and anemia. Antioxidants present in the functional biscotti may help in preventing innumerable health disorders related to oxidative stress, diabetes and CVDs. Also, due to its strong antioxidant properties, it is known

to diffuse the toxic free radicals, and can be reduced to detoxify the body.

Recommendations

Since long Gokhru is known for its aphrodisiac properties and as a traditional medicine for treating male infertility. Ergogenic (anabolic) properties are attributed to this plant, since it supposedly elevates the blood testosterone level and stimulates skeletal

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