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Development and quality assessment of fortified brittle (Chikki) prepared by using sesame seed, Jaggery, flaxseed, and ragi flour

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Abstract

India with divergent food habits is having a number of traditional foods, including sweet products. Brittle (Chikki) is one of the popular Indian traditional sweet snacks. Brittle (Chikki) is mainly prepared using jaggery as a sweetener and roasted nuts. Mostly liked by all age groups, also possesses nutritional importance in it. The aim behind making this Fortified Brittle (Chikki) was to make a combination of healthy ingredients in a consumable form and to make a healthy product at an affordable cost. In present study utilization of sesame seed, jaggery, flaxseed and Ragi flour is carried out in brittle (Chikki) to evaluate the acceptance of consumers towards T₁ to T₃ sample i.e. T₁ (65:10:20:05), T₂ (65:10:15:10) and T₃ (65:10:10:15) % while the sesame and jaggery brittle T₀ (100:00:00) Served as control brittle. The results obtained from the statistical analysis concluded that a novel product fortified with sesame seed, jaggery, flaxseed, and Ragi flour was successfully produced Fortified Brittle (Chikki). The physicochemical analysis, microbial analysis, sensory evaluation results showed that the treatment T₁ (65:10:20:05) was found to be most favorable because of higher nutrition profile carbohydrate (73.83), protein (7.50), fat (11.70), ash (2.44), and iron (5.83) as well as it scored maximum for all sensory appeal, microbial count within permissible limit. Also, its preparation cost is low. Based on the result it was concluded that nutritious and beneficial components of ingredients which used in brittle (chikki) is a more favorable choice for food technologist to develop Fortified Brittle (Chikki) especially for anemia patients. It also useful for malnutrition patients because according to WHO (World Health Organization) malnutrition is deficiency, excess or imbalance in a person's intake of energy and/or nutrients.

Keywords: Fortified brittle, sesame seed, jaggery, flaxseed, ragi flour

Introduction

India with divergent food habits is having a number of traditional foods, including sweet products. *Chikki* is one of the popular Indian traditional sweet snacks. *Chikki* is mainly prepared using jaggery as sweetener and roasted peanuts.

There are several different varieties of chikki in addition to the most common groundnut (peanut) chikki. Each variety of chikki is named depending upon the ingredients used, which include puffed or roasted Bengal gram, sesame, puffed rice, khobara (desiccated coconut). It is a very popular sweet item in both rural and urban South Asia (spanning India, Pakistan, Bangladesh, Nepal and Sri Lanka). Most popular chikkis are sourced from the Indian towns of Lonavala, Matheran, Mahabaleshwar, Panchani Karjat in Maharashtra and Bhuj in Gujarat.

In the world, India ranks first in the production and area of sesame seeds and is grown in different seasons covering practically all agro-ecological zones (Bisht IS *et al.*, 1998; Banerjee PP *et al.*, 2009) [2, 1] Sesame is a rich source of calcium (approx 1%) and phosphorous (approx 0.7%). Sesame contains ample amounts of oleic (43%), linoleic (35%), palmitic (11%) and stearic acid (7%) which together comprise 96% of the total fatty acids (saydut A *et al.*, 2008) It has many uses and it is markedly different from other vegetable oils due to its high nutritional and therapeutic values.

Gur (Jaggery) is a natural, traditional sweetener made by the concentration of sugarcane juice and is known all over the world (FAO 2007) [6] in different local names. India is the largest producer and consumer of jaggery. Out of total world production, more than 70% is produced in India (Jagannadha Rao PVK *et al.*, 2007) [7] Jaggery is prepared by concentrating the sugarcane juice and it is available in the form of solid blocks and in semi-liquid form. Gur is known to produce heat and give instant energy to a human body. In many parts of India, there is a tradition of serving a glass of water with Gur to welcome the guests. Gur is also used as a cattle feed, in distillery, medicine manufacturing unit, ayurvedic medicines,

and ayurvedic health tonics. Recently Gur has also found a place in confectionary items.

Whole flaxseeds, which have a crisp and chewy texture and a pleasant, nutty taste, are consumed either as diet supplement or as an ingredient in prepared food. They are rich in fat, high-quality protein and dietary fibre, a large proportion of the latter being water-soluble viscous fibers (Kristensen *et al.*, 2012) ^[9]. Chemical analysis of flaxseed averaged 30–40% fat, 20–25% protein, 20–28% total dietary fibre, 4–8% moisture and 3–4% ash, and the oil contains vitamins A, B, D and E, and minerals. The observed variability in composition is attributed mainly to genotype and environmental parameters (Coskuner & Karababa, 2007) ^[5].

Finger millet commonly known as ragi and mandua in India is one of the minor cereals a native of Ethiopia, but grown extensively in various regions of India and Africa, constitutes as a staple food that supply a major portion of calories and protein to large segments of the population in these countries especially for people of low income groups (M.M. O’Kennedy *et al.*, 2006) ^[10]. The nutraceutical importance of finger millet lies in its high content of calcium (0.38%), protein (6%–13%), dietary fiber (18%), carbohydrates (65%–75%), minerals (2.5%–3.5%), phytates (0.48%), tannins (0.61%), phenolic compounds (0.3–3%) and trypsin inhibitory factors, and is recognized for its health beneficial effects, such as anti-diabetic, antitumorigenic, anti-diarrheal, antiulcer, anti-inflammatory, atherosclerogenic effects, antioxidant and antimicrobial properties (Chethan S. and Malleshi N.G. 2007).

Justification

Today’s consumer is becoming more concerned about the health benefits of reduced calories and consuming additional proteins and dietary fiber in the diet. Diabetes, blood pressure and malnutrition are the major health problems of the majority of the Indian population and those suffering from them need high protein, high fiber, and low-calorie diet. So the aim behind making these fortified brittle (chikki) was to make a combination of healthy ingredients in a consumable form and to make a healthy product at an affordable cost.

Fortified brittle (chikki) is made by nutritious ingredients which are ragi flour, sesame seed, flax seed, and jaggery. Ragi, sesame, and flax are rich in calcium. Sesame seeds are a very good source of copper. Flax seeds are very good for the heart as they contain a high level of omega-3 fatty acids.

Jaggery is loaded with antioxidants and minerals such as zinc and selenium, which in turn help prevent free-radical damage and also boost resistance against infections. Jaggery also helps increase the total count of hemoglobin in the blood. Jaggery is rich in iron and folate which help prevent anemia by ensuring that a normal level of red blood cells is maintained. This is especially beneficial for pregnant women. It ensures that a normal level of red blood cells is maintained. Moreover, it provides instant energy to the body.

Therefore the fortified brittle (chikki) is best for the many health benefits and also anemia patients because the ingredients used in fortified brittle is beneficial and 65 % of the ingredients are jaggery. Jaggery also boosts intestinal strength due to its high magnesium content. With every 10 grams of jaggery, you get 16 mg of magnesium, which is 4 percent of the daily requirement of this mineral. It is also useful for malnutrition patients. The World Health Organization defines malnutrition as deficiency, excess or

imbalance in a person’s intake of energy and/or nutrients. And fortified brittle (chikki) is highly nutritious and affordable for every class of people.

Review of Literature

(Vidyasagar *et al.*, 1964) stated that *Chikki*, called peanut brittle in the West, is a popular Indian sweet snack and is consumed by a large section of the population. *Chikki* is golden brown, hard crunchy product containing peanut pieces, with a characteristic peanut flavor. It fulfills the requirements of Indian army as a ready to eat food and as a concentrated source of energy. It is prepared in the shape of balls or slabs, various ingredients like puffed rice, puffed Bengal gram, sesame, beaten rice and khobara also go in the preparation of the product.

Peanut bars are consumed all over the world in different forms. They are prepared after coating the partially ground peanuts with sugar or jaggery after blanching and demoinsturizing the kernels. In India, it is popularly called as “chikki” (Narayan *et al.*, 1994) Peanut bars are consumed all over the world in different forms. They are prepared after coating the partially ground peanuts with sugar or jaggery after blanching and demoinsturizing the kernels. In India, it is popularly called as “chikki” (Narayan *et al.*, 1994).

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(Chahal and Sehgal, 1996) ^[3] Stated that Peanut *chikki*, peanut and sesame seed *chikki* and peanuts and spices mixed with Bengal gram meal were developed and evaluated for sensory and nutritional properties with regard to their use as nutritional supplements for school children.

(Shahi, 1999) Stated that India is with divergent food habits, having a number of traditional foods including sweet products. *Chikki* is one of the most popular Indian traditional sweet snacks and is prepared by mixing of roasted groundnut with jaggery as a sweetener. Sweets or confections with jaggery are gaining popularity due to the awareness of its health benefits. Jaggery is obtained by concentrating sugar cane juice to solid or semi solid state. It is a natural sweetener having a sweet winy flavor.

(Manay and Swamy, 2001) Studied that Jaggery is a concentrated product of date, cane juice or palm sap without separation of molasses and crystals. It contains proteins, minerals and vitamins and a potent source of iron and copper.

(Oomah, 2001) Stated that the flaxseed has new prospects as functional food because of consumer’s growing interest for food with superb health benefits. Owing to its excellent nutritional profile and potential health benefits, it has become an attractive ingredient in the diets specially designed for specific health benefits.

(Phillips *et al.*, 2005) Reported that sesame seeds are used extensively in India. In most parts of the country, sesame seeds assorted with jaggery, sugar, or palm sugar is prepared into Ladoos or brittles similar to peanut brittle and consumed as snacks. Sesame Ladoos, in jaggery, is made and eaten in various forms during the festival of Makar Sankranti in Maharashtra. Sesame seeds are an excellent source of copper, a very good source of manganese, and a good source of magnesium, calcium, phosphorus, iron, zinc, molybdenum, and selenium.

Table 1: Chemical composition of sesame seed, jaggery, flaxseed and Ragi (all values are expressed per 100g edible portion)

Constituents	Sesame seed	Jaggery	Flaxseed	Ragi
Moisture %	3.62	3.9	5.48	10.89
Protein %	21.61	1.82	18.55	7.16
Fat %	43.22	0.16	35.67	1.92
Ash %	4.58	1.92	3.15	2.04
Carbohydrate %	9.76	84.87	10.99	66.82
Iron (mg)	14.95	4.63	5.44	4.6

Source: Indian food composition tables, nin (2017)

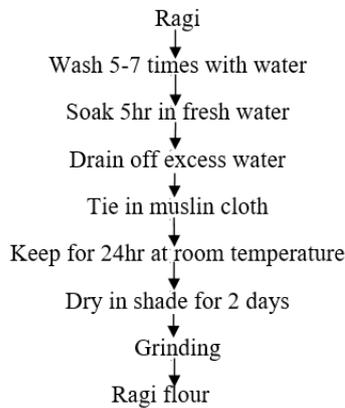
Materials and Methods

Fortified Brittle (chikki) manufacturing materials

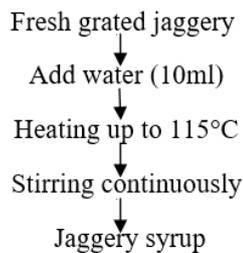
The material and methods to be adopted during this investigation are given below:

1. Jaggery was collected from local market.
2. Sesame seed (til) was collected from local market.
3. Flaxseed was collected from local market.
4. Ragi flour (nachani) was collected from local market.

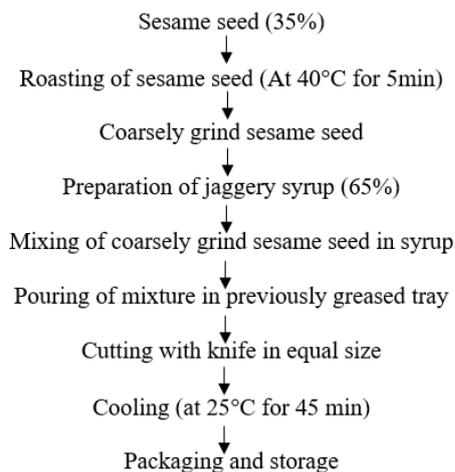
Flow diagram for the preparation of ragi flour



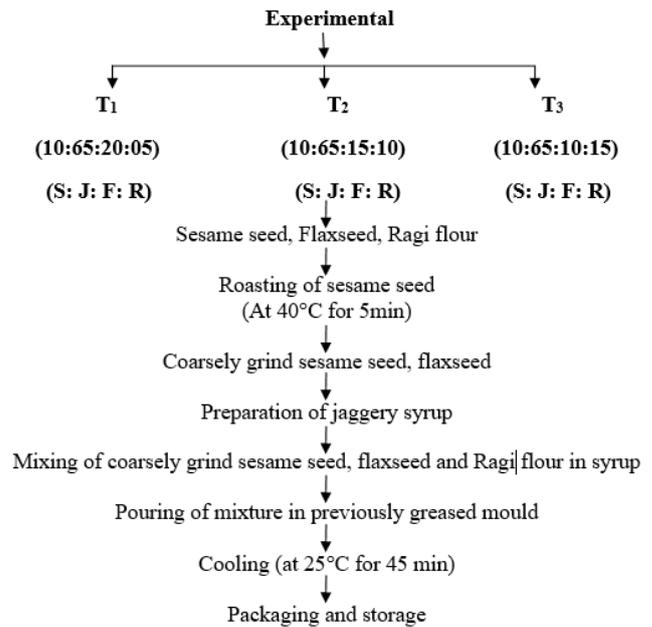
Flow diagram for the preparation of jaggery syrup



Flow diagram adopted for control sample: Control (T₀)



Flow diagram for experimental sample



Results and Discussion

The data collected on different aspects were tabulated and analyzed statistically using the method of analysis of variance and critical difference technique. The significant and non-significant differences observed have been analyzed critically within and between the treatment combinations.

Table 2: Average data for different parameter of control and experimental fortified brittle (chikki)

Parameter	Treatment			
	T ₀	T ₁	T ₂	T ₃
Physico-chemical analysis (in present)				
Moisture	3.80	4.53	4.80	5.00
Fat	15.32	11.70	9.96	8.30
Protein	8.80	7.50	6.90	6.30
Carbohydrate	69.22	73.83	76.02	78.07
Ash	2.86	2.44	2.32	2.33
Total solid	96.20	95.47	95.2	94.98
Mineral analysis				
Iron	8.25	5.83	5.77	5.73
Microbiological analysis				
Yeast and mold count (cfu/gm)	12.40	6.80	8.00	9.20
Coliform count	Nil	Nil	Nil	Nil
Organoleptic score (9- point hedonic scale)				
Color and appearance	8.90	8.30	8.10	7.40
Body and texture	8.60	8.00	7.20	6.70
Flavor and taste	8.80	8.40	8.10	7.60
Overall acceptability	8.74	8.12	8.74	7.20
Cost analysis				
Cost in Rs. / 100gm	8.33	6.34	6.35	6.36

Summary and Conclusion

Physico-Chemical Analysis

Moisture Percentage

There was significant difference in moisture content of different treatment combination. Maximum moisture percent was recorded in the sample of T₃ (5.00) followed by T₂ (4.80), T₁ (4.53) and T₀ (3.80). The difference in moisture was due to the difference in composition of sesame seed, jaggery and flaxseed and ragi flour. Which are used in different proportions in different treatments.

Fat Percentage

There was significant difference in fat content of different

treatment combination. Maximum fat percent was recorded in the sample of T₀ (15.32) followed by T₁ (11.70), T₂ (9.96) and T₃ (8.30). The difference in fat was due to the difference in composition of sesame seed, jaggery and flaxseed and ragi flour. Which are used in different proportions in different treatments.

Protein Percentage

There was significant difference in protein content of different treatment combination. Maximum protein percent was recorded in the sample of T₀ (8.80) followed by T₁ (7.50), T₂ (6.90) and T₃ (6.30). The difference in protein was due to the difference in composition of sesame seed, jaggery and flaxseed and ragi flour. Which are used in different proportions in different treatments.

Carbohydrate Percentage

There was significant difference in carbohydrate content of different treatment combination. Maximum carbohydrate percent was recorded in the sample of T₃ (78.02) followed by T₂ (76.01), T₁ (73.83) and T₀ (69.22). The difference in carbohydrate was due to the difference in composition of sesame seed, jaggery and flaxseed and ragi flour. which are used in different proportions in different treatments.

Ash Percentage

There was significant difference in ash content of different treatment combination. Maximum ash percent was recorded in the sample of T₀ (2.86) followed by T₁ (2.44), T₂ (2.32) and T₃ (2.33). The difference in ash was due to the difference in composition of sesame seed, jaggery and flaxseed and ragi flour. Which are used in different proportions in different treatments.

Total Solid (Ts) Percentage

There was significant difference in TS content of different treatment combination. Maximum TS percent was recorded in the sample of T₀ (96.20) followed by T₁ (95.47), T₂ (95.20) and T₃ (94.98). The difference in TS was due to the difference in composition of sesame seed, jaggery and flaxseed and ragi flour. which are used in different proportions in different treatments.

Iron Percentage

There was significant difference in iron content of different treatment combination. Maximum iron percent was recorded in the sample of T₀ (8.25) followed by T₁ (5.83), T₂ (5.77) and T₃ (5.73). The difference in iron was due to the difference in composition of sesame seed, jaggery and flaxseed and ragi flour. Which are used in different proportions in different treatments.

Microbiological Analysis

Yeast and Mould Count

There was significant difference in yeast and mould count of different treatment combination. Maximum yeast and mould count was recorded in the sample of T₀ (12.40) followed by T₃ (9.20), T₂ (8.00) and T₃ (6.80).

Coliform Count

Coliform count was study for addition of different samples of flaxseed and ragi flour based fortified brittle (chikki). The coliform count showed negative result assuring hygienic production of the product.

Organoleptic Analysis

Color and Appearance Score

There was significant difference in color and appearance score of different treatment combination. Maximum color and appearance score was recorded in the sample of T₀ (8.90) followed by T₁ (8.30), T₂ (8.10) and T₃ (7.40). The difference in color and appearance was due to the difference in composition of sesame seed, jaggery and flaxseed and ragi flour. Which are used in different proportions in different treatments.

Body and Texture Score

There was significant difference in body and texture score of different treatment combination. Maximum body and texture score was recorded in the sample of T₀ (8.60) followed by T₁ (8.00), T₂ (7.20) and T₃ (6.70). The difference in body and texture was due to the difference in composition of sesame seed, jaggery and flaxseed and ragi flour. Which are used in different proportions in different treatments.

Flavor and Taste Score

There was significant difference in flavor and taste score of different treatment combination. Maximum flavor and taste score was recorded in the sample of T₀ (8.80) followed by T₁ (8.40), T₂ (8.10) and T₃ (7.60). The difference in flavor and taste was due to the difference in composition of sesame seed, jaggery and flaxseed and ragi flour. Which are used in different proportions in different treatments.

Overall Acceptability Score

There was significant difference in overall acceptability score of different treatment combination. Maximum flavor and taste score was recorded in the sample of T₀ (8.74) followed by T₁ (8.12), T₂ (7.74) and T₃ (7.20). The difference in overall acceptability was due to the difference in composition of sesame seed, jaggery and flaxseed and ragi flour. Which are used in different proportions in different treatments.

Cost Analysis

The cost price of flaxseed and ragi flour based fortified brittle (chikki) sample were less than the Market price of brittle (MRP 15Rs. /100gm). The highest cost price was found in sample T₀ (8.33 Rs. /100gm) Followed by T₃ (6.36 Rs. /100gm), T₂ (6.35 Rs. /100gm) and T₁ (6.34 Rs. /100gm).

Conclusion

Sesame seed, jaggery, flaxseed, and ragi flour were used in this study because a possible synergistic relationship is thought to exist between these ingredients. They protect against many same diseases and their health benefits may be increased when they are together in the food products. The use of ragi flour and flaxseed gave the low cost but nutritious product.

The results obtained from the statistical analysis concluded that a novel product fortified with sesame seed, jaggery, flaxseed, and ragi flour was successfully produced fortified brittle (chikki). After the optimization of various ingredients, the treatment T₁ (65:10:20:05) was found to be most favorable because of higher nutrition profile as well as it scored maximum for all sensory appeal, microbial count within the permissible limit. It fulfills the 40% iron intake of males and females (According to Recommended Dietary Allowance (RDA) intake of the iron/day) and also its preparation cost is low.

Hence it can be concluded that the brittle that was prepared/created in this study fallow under high carbohydrate, high protein but low-cost food and acceptable nutty flavor that would be an appeal to consumers following these in their diets as a fortified food product.

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