

Development of multi-flour gluten free flat bread sticks

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Abstract

Gluten-free foodstuffs are a challenge for Technologist and Nutritionist since alternative ingredients used in their formulations have poor functional and nutritional properties. A study was lead to standardize an innovative nutritious product for consumer's acceptance. The product designed was a nutritious product for all age groups, gluten allergic people, pregnant and lactating mothers and malnourished or underweight children and adults. Therefore, Gluten-free flat bread stick was formulated which gave high nutrient valued product with best possible combination of Bengal gram, Black gram, Samo, Amaranth, Oats, Arrowroot powder and Rice flour. The Multi-flour Gluten free Flat bread stick was prepared with different flavors like Cheese, Cheese & Onion and Tomato-chili. The other aspects covered in the study were packaging, nutritional labeling and marketing. The result showed that the product can have wide commercial acceptability.

Keywords: Amaranth, Gluten-free, Multi-flour, Oats

Introduction

Snacks contribute to an important part of daily nutrient and calorie intake for many consumers. Generally snacks evolve according to the consumer behavior. Each generation has different needs and roles for snacking, and the need for on-the-go eating options continues to increase. These changes provide many different options to drive the continued growth in snacking. The consumers are looking forward for healthier and flavorful options. Therefore a set up was made to provide healthier option to a consumer with gluten free ingredients, by which celiac disease patient could also consume it.

Celiac disease (CD) is an inflammatory disease of small intestine triggered by gluten

proteins from wheat, barley rye. Its prevalence is 1:100 – 1:200 in any population over the world (Schuppan *et al.* 2009). Therefore, gluten free products commercialization has grown at an annual rate of 28 % in last years (Glover,2009). This chronic disease is recognized as long-life disease and the only solution is adherence stickiness to gluten-free products. But this is not easy as many foodstuffs contain gluten (Motrena *et al.*, 2011). Frequently celiac disease patients, especially children in a strict gluten-free diet, are undernourished because of the reduced intake of energy which is largely taken from wheat based food stuffs. Additionally they suffer from calcium and other minerals

deficiency because of the previous mal-absorption in active CD, as well as the actual low content of micronutrients into the alternative flours used in gluten free formulation (Thompson *et al.*, 2005). Hence, it is very important to develop gluten free foodstuffs with high nutritional quality ingredients.

Bread is a staple diet that is consumed daily and its quality and sensory attributes are highly considered by consumers. But the quality of the gluten-free bread might be different than conventional heat bread due to lack of gluten (Motrena *et al.*, 2011)

The diet of celiac patients must be completely free of any gluten, so all the products from wheat, rye, barley must be replaced with corn, rice, millet equivalents, chickpea, amaranth and various types of starch (corn, rice and potato) or appropriate mixtures.

This investigation aimed to use Bengal gram (Chick pea), Black gram, Samo, Amaranth, Oats, Arrowroot powder and Rice flour in preparing gluten-free flat bread sticks with high nutritional value for people suffering from celiac disease.

Bengal gram (*Cicerarietinum L.*) is legume, grown in tropical and subtropical areas that present high potential as a functional ingredient for the food industry. The chickpeas contain moderately high protein (17-22 %), low fat (6.48%), high available carbohydrate (50%) and crude fiber contents of 3.82% on dry basis (Saleh and Tarek, 2006). The available carbohydrate is mainly starch which is reported to be slow digestible, thus eliciting low glycemic responses in human nutrition. Hence, Bengal gram can play an important role as a low glycemic functional ingredient in a healthy diet. The chick pea contains maximum amount of chromium than any other legumes with an account of 0.032mg per 100 g of sample (Gopalan *et al.*, 2004).

Amaranth (*Amaranthus cruentus L.*) is the third most important staple crop for pre-

Colombian people. The amaranth grain as a cereal used for snack food with good acceptance and high nutritive value have been developed by extrusion cooking of the defatted flour obtained from milling the grain. Over the last few years Amaranth has become famous among patients with celiac disease because it does not cause allergic reactions in the intestinal mucosa (Thompson T., 2001). It contains considerably high protein (14.7%), low fat (9.6%) and high available carbohydrates (60.7%), crude fiber (9.6%) and good amount of calcium (510mg) and phosphorous (397 mg).

Rice (*Oryza sativa*) is a staple food crop for a large part of the world's human population, making it the second most consumed cereal grain. It is known as queen among cereals after wheat. Rice is characterized by low prolamin, hypoallergenic activity, insipid taste, low sodium and high digestible carbohydrate contents, which is suitable to be incorporated into celiac diets (Phimolsiripol, 2012). Rice provides more than one fifth of the calories consumed worldwide by humans. Rice contains approximately 7.37% protein, 2.2% fat, 64.3% available carbohydrate, 0.8% fiber and 1.4% ash content (Zhou *et al.*, 2002).

Oats (*Avena sativa L.*) are an important source of livestock feed worldwide, both as a nutritious grain and forage. Oats production currently ranks sixth in the world grain – production statistics. Oatmeal contains vitamin B1, magnesium, manganese, phosphorous, selenium, fiber and protein. β -glucan found in oats is found to show hypocholesterolaemic effect by reducing 20-30 % of LDL cholesterol and thus reducing overall effect of cardiovascular diseases risk (Gallaher, 2000). β -glucan is also considered a prebiotic as it can support the growth of some beneficial bacteria in colon.

Arrowroot (Maranta arundinacea) which comes from the Marantaceae family of plants contains several B vitamins, including thiamine, niacin and pyridoxine, and minerals such as copper and iron, manganese, magnesium, phosphorus and zinc, all providing necessary nutrients for your body. Although it is a starch, it contains no gluten, and studies show it to be highest in protein compared to other native starches and flours. Individuals with celiac disease must eliminate gluten to improve their condition, so arrowroot offers possibilities for eating similar foods without the discomfort. Arrowroot was also found to be effective for treating diarrhea in people with irritable bowel syndrome. Arrowroot may help prevent birth defects, supports proper growth and development, improve your circulation, blood pressure, weight and digestion. It also contains high amount of dietary fiber and it is highly digestible.

Black gram is one of the important pulses used in everyday diet of south Indians. Due to its fermentation capacity it is used in the preparation of various foods like idli and dosa. It contains approximately 25.21 % protein, low fat that is 1.64% and carbohydrate 58.99%. It also contains high level of potassium (983 mg per 100 g), calcium (138 mg per 100 g), iron (7.57 mg per 100 g), niacin (1.447mg per 100 g), Thiamine (0.273 g per 100 g) and riboflavin (0.254 mg per 100 g) (USDA national nutrient database). Black gram complements the essential amino acids provided in most cereals and plays an important role in the diets of people of Nepal and India. Black gram has been shown to be useful in mitigating elevated cholesterol level (Indira, *et al.*, 2013)

Samo (Echinochloa colona) is rich in digestible fibers, minerals and vitamins and offer excellent nourishment. Because of fiber content it will make you feel fuller for a longer period of time, thus reducing the food intake and helping in portion control

and loss weight. It has ability to improve heart health, stimulate growth and repair throughout body, slows the signs of aging, protects against chronic diseases, prevents the onset of diabetes, optimizes the digestive process, strengthens your bones, boosts your immune system, and helps with weight loss efforts.

Thus study was aimed to assess the combination of above mentioned all the ingredients with its best formulation, composition and acceptability.

Materials and methods

The seven different types of flours like Bengal gram, Black gram, Oats, Rice flour, Amaranth flour, Arrowroot powder and Samo flour were procured from Hadapsar market, Pune. Salt, Spices (Ajowan, Cumin seeds, Coriander seeds, Fennel seeds), Sunflower oil, Flavours were also bought from Hadapsar market, Pune. The whole processing was carried out in pilot plant bakery, Pune. All the ingredients including water were taken as per the formulation finalized and for the frying sunflower oil was used followed by flavors application like tomato-chili, cheese-onion, Cheese.

Initially all the flours were pre examined at primary level and were sieved to ensure separation of foreign particles such as stones or any metallic material if present in it. All the ingredients were weighed, where spices like ajowan, cumin seeds, fennel seeds, coriander seeds were roasted at 90 °C for 4 minutes individually followed by cooling at room temperature and powder grinding. Roasting gave distinct aroma to the final product. These different ingredients flours were sieved from a sieve of mesh size No.30-40. This uniform size particle flours were mixed with Spices (Red chilli powder, Ajowan powder, Cumin seeds powder, Fennel seeds powder, Coriander seeds powder), salt and water. Fig. 1 shows the process flow diagram for gluten free flat bread sticks. All the ingredients, hot water

and salt were uniformly mixed and dough was prepared using dough kneader. Kneading was continued till visco-elastic rheology of dough was attained. Cold extrusion of the kneaded dough was carried out manually in the required shape. Extruded pieces were transferred into fryer where frying was done at 160-180 °C. After frying immediately flavors were added like tomato-chilli, cheese-onion and cheese. These gluten free flat bread sticks were cooled at room temperature for 20 minutes and then packed, sealed in HDPE bags.

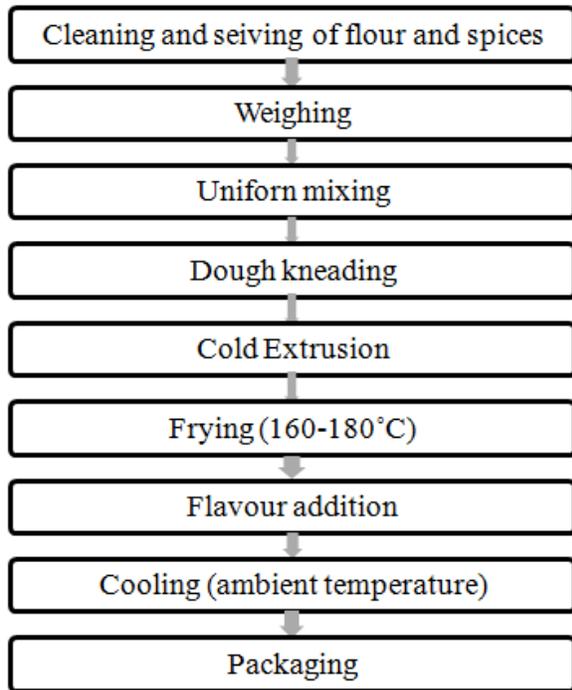


Figure 1: Process flow diagram for gluten free flat bread stick.

Result and discussion

Finalized formulation of Gluten free flat bread stick of 100 g contained Bengal gram 35g (35%), black gram 10 g (10%) , Arrowroot powder 15 g(15%), Oats, Rice, Amaranth, Samo 10 g each(10%) respectively. Addition of spices like fennel seeds, coriander seeds, Cumin, Ajowan was done as per acceptance.

Physico-chemical, microbiological and sensory analysis of these gluten free flat

bread sticks was carried out. Moisture content was determined by using standard oven method. Fat by soxhlet method, Protein by microKjeldhal method, energy by using bomb calorimeter, carbohydrate by Anthrone method, ash was determined by using muffle furnace method (Ranganna, 2007).Dietary fibre was estimated by IS 11062-1984, Calcium was estimated by AOAC 983.19 and iron content by Colorimetric method. Under physical analysis of Flat bread stick , diameter and thickness of flat bread stick were measured by using vernier caliper. Proximate analysis of product formulation obtained was energy value 448.5 kcal/100g; protein 14.2g/100g; carbohydrate 60.8g/100g; fat was 16.5g/100g; the Calcium content were 120mg/100g , Iron content 6mg/100g and Dietary fiber as 25g/100g respectively.

Table 1: Nutritional composition of gluten free flat bread stick.

Sr. No.	Nutrient	Per 100 g
1.	Energy (Kcal)	448.5
2.	Carbohydrates(g)	60.8
3.	Proteins(g)	14.2
4.	Fat (g)	16.5
5.	Calcium(mg)	120
6.	Dietary fiber(g)	2.5
7.	Iron(mg)	6
8.	Ash (g)	2.6
9.	Moisture (%)	5.2

Microbial analysis was carried out for Total plate count and fungal growth. For sensory analysis semi-trained members were selected and it was done based on 9 point hedonic scale (Ranganna, 2007). Sensory tests included appearance, colour, texture, taste and flavor. Sensory test was carried out among 12 semi-trained persons. The average score obtained is mentioned in Table 2. Overall result can be noted as, completely healthy product with the acceptable innovation making people to think and buy a

healthy still tasty Snack. Organoleptic evaluation was carried out in composite serial sticks by semi- trained panel of judges on a 9 Point Hedonic Scale (Ranganna, 2007) to check the acceptance of final taste and flavor combination. Table 2 represents average score obtained for the product on the basis of color, appearance, texture, taste, flavor and overall acceptability. Later it was found that cheese and onion, plain cheese and tomato-chilli were the most acceptable flavor.

Microbial populations like bacteria and fungus were estimated by serial dilution followed by solidification in petriplate using nutrient agar for HDPE packed material. After solidification both bacteria and fungus

colony containing plates were incubated at room temperature for 24 to 48 hours. Obtained colonies were counted and converted as number of colony forming units (CFU) per gram of sample. Microbial load estimation for the Flat bread stick was carried out for fresh as well as 30, 60 and 90 days old samples. Microbial load obtained were under the acceptable limits for a period of 3 months from the date of manufacture. Bacterial count for the flat bread stick was lower than the acceptable limit of 1×10^5 CFU/g of sample. The bacterial count for the fresh, 30 days, 60 days and 90 days obtained were 1.5×10^2 CFU/g, 2.91×10^3 CFU/g, 5.6×10^3 CFU/g and 6.2×10^4 CFU/g . Fungal growth was not observed in all the cases.

Table 2: Organoleptic score chart of Gluten free flat bread sticks.

Sample	1 (control)	2 (Cheese)	3 (Tomato-chilli)	4 (garlic)	5 (Cheese and onion)	6 (Chat masala)
Color & appearance	7.05	7.72	7.2	6.8	7.2	6.94
Texture	7.22	7.5	7.6	6.8	7.3	6.44
Taste	7.1	7.38	7.5	7.2	7.2	6.1
Flavors	6.88	7.5	7.6	7.2	7.5	7
Overall Acceptability	7.05	7.61	7	6.8	7.5	7.05

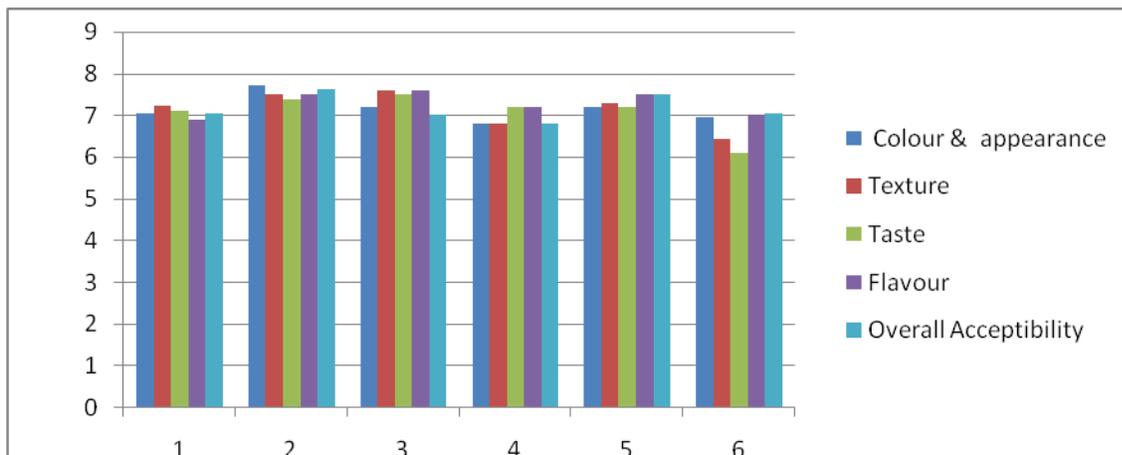


Figure 2: Graphical Representation of Sensory Characteristics.

The finalized formulation of flat bread stick was kept for a storage study of 3 months using LDPE, HDPE, HDPE and aluminium laminated bag as the packaging material. Where the comparison of this packaging material was done based on increase in initial moisture content readings obtained for 3 months storage period. During 3 months storage period, In case of LDPE type of packaging material, 2.9% moisture rise in the initial moisture content of Flat bread stick was observed, where as in case of HDPE, there was 0.8% moisture rise in the initial moisture content of Flat bread stick and HDPE and aluminium laminated bag moisture rise in the initial moisture content of Flat bread stick was found out as 0.7%. Storage was found to have a noteworthy effect on the moisture content of Flat bread stick. The above observations indicated that moisture was absorbed during three months of storage by the Flat bread stick. The gain in moisture content might be due to storage environment (temperature and relative humidity) as well as the nature of packaging material. Moisture uptake in the LDPE pouches might be due to its permeability to moisture and air. Though HDPE and aluminium laminated bag was found superior than HDPE, HDPE was the suggested packaging material, as HDPE and aluminium laminated bag increased the cost of the final product.

Conclusion

Multi-flour Gluten free flat bread stick product made with innovation gave good consumer acceptability. It contains seven different types of flours which help to provide number of micronutrients like Iron, β -glucan, Lysine, PUFA, Calcium, Copper, Vitamin B, B1. Crispy texture, basic taste, colour and flavours effectively impart to its overall acceptability. The packaging material HDPE was found more suitable for packaging flat bread stick with respect to its stability. The product remained

microbiologically safe and stable during entire storage. Thus, it can be concluded that innovative and healthy products like Multi-flour Gluten free Flat bread stick can be commercialised successfully in the Snacks Industry.

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