International Journal of Science and Research Archive

eISSN: 2582-8185

Cross Ref DOI: 10.30574/ijsra

Journal homepage: https://ijsra.net/

(REVIEW ARTICLE)

Check for updates

Beyond common breads: Innovative gluten-free baked foods

K. Manivel, A. Vasanth Adhithya, A. Ajin Mon and H.M. Moyeenudin *

Department of Hotel and Catering Management, Vels Institute of Science Technology and Advanced Studies.

International Journal of Science and Research Archive, 2025, 15(01), 1211-1216

Publication history: Received on 04 March 2025; revised on 14 April 2025; accepted on 16 April 2025

Article DOI: https://doi.org/10.30574/ijsra.2025.15.1.1083

Abstract

In recent years there is an opportunity to sample a whole host of gluten free bread. From sourdough to whole grain, store bought to fresh from the bakery, For people who are suffering from this autoimmune disease, even a small amount of gluten can cause a lot of trouble. In the case of gluten-free bread, cutting out wheat, rye, barley and the other grains that provide gluten helps to avoid any such instances. So, if you or any of your loved ones have this condition, you should switch to gluten-free bread and other products as soon as possible. Some individuals have a bit of a sensitive digestive system which leads to some digestive problems from time to time. Gluten-free foods, mainly bread, help with some of these digestive problems which include bloating, diarrhoea or constipation, gas, fatigue and many other symptoms and some other symptoms that are rare. This article focuses on developing gluten-free bakery products, specifically sorghum cookies, coconut muffins, and jackfruit bread. The primary objective is to create nutritious and palatable alternatives for individuals with gluten sensitivities or those opting for gluten-free diets.

Keywords: Bread; Gluten-free product; Baking Products; Muffins

1. Introduction

The global rise in celiac disease diagnoses and gluten sensitivities has heightened the demand for gluten-free food options. In India, this trend is particularly significant, with an increasing number of individuals seeking gluten-free alternatives to traditional wheat-based products. This project aims to address this need by developing gluten-free bakery items—sorghum cookies, coconut muffins, and jackfruit bread—that are both nutritious and flavorful. Consumer acceptance of a new product is a multifaceted process that is crucial for market success and involvement in health aspects of product consumption can play an important role in this process. Involvement is a motivational construct widely analyzed in the literature, and it deals with the personal relevance given by consumers to a product choice and its consumption. It is correlated to self-reported knowledge, but not necessarily to the objective one, and has effects on consumers' decision processes and purchase behavior. Food consumers' perception is heavily influenced by health information, which can drive acceptance and consumption patterns. In fact, one of the main motivations reported in the scientific literature for food consumer acceptance is health. Many studies have analyzed the effects of information on some products' characteristics or health benefits on their sensory evaluation and the willingness to pay (WTP) of consumers.

2. Literature Review

The cereals and pseudocereals base flour allowed in the development of gluten-free bread are rice, sorghum, maize, millets and teff, and buckwheat, amaranth and quinoa, respectively. Rice flour is the most suitable cereal flour for the production of gluten-free breads. There are many attributes that make rice the best cereal grain for patients suffering from allergies. Rice flour has low levels of prolamins and easily digested carbohydrates. In addition to good digestibility and hypoallergenic properties, rice proteins bring additional sensorial advantages such as bland taste and white colour

* Corresponding author: HM Moyeenudin

[1]. Anyway, rice proteins have rather poor functional properties relevant for food production. The baking products made of rice flour have low specific volume and very compact crumbs, because of the low content of prolamins fractions required for developing the specific dough's' protein network. Most of the gluten-free bread formulas are based of flour blends of rice with other cereal or pseudocereal and starch of different sources [2].

Despite a growing popular perception that GF products are healthier than the gluten-containing (GC) counterparts, their real nutritional quality is still far to be conclusively defined. Actually, a limited number of conflicting studies have assessed the nutritional quality of GF products and compared it to that of their GC counterparts. Some authors others have found no differences between the two types of product in terms of such nutrients. In addition, inconsistent results about the content of dietary fiber have been reported Such discrepancies in nutritional quality definition of GF products may also be attributable to the high variation of GF formulations and/or to a low ability of the methods used to measure the nutritional quality [3]. To try to partially address this issue, and referring to the Italian market of GF products, we have developed a score based method in order to assess the quality of packaged GF products and to compare with that of similar GC counterparts. The focus of this work is on the bakery products as they represent staple foods largely consumed and important sources of nutrients for the general population [4].

Gluten enteropathy is a disease caused by an inappropriate immune response to dietary wheat gluten or similar proteins of barley or rye. Patients suffering of this disease have to exclude gluten-containing cereals from their diet. For these consumers, a special category of food products designated ''gluten-free'' is produced, which have to meet specific requirements regarding the contents of gluten (Joint FAO/WHO food standards programme Codex Alimentarius Commission,2000; Joint FAO/WHO food standards programme Codex Alimentarius Commission,2002). Besides food products which are gluten-free because of its traditional composition, ''gluten-free'' bakery products have become available [5]. These comprise mostly various types of biscuits, which are based on naturally gluten-free flours from rice, maize, soya, guar or amaranth. However, contamination of these food products by gluten-containing cereals may take place at the stage of flour production or at the stage of the production of the final product. For this reason, final bakery products as well as ingredients used for their production have to be analysed [6].

Gluten free breads are characterized by a heterogeneous recipe, being a combination of rice and corn, starch and flour, as well as proteins, fibers, fats, hydrocolloids, and specific enzymes. Commercially available gluten free breads are incompetent with their gluten containing counterparts in terms of quality and acceptability. Gluten free breads show poor crumb and crust characteristics as well as poor mouth feel and flavor. Since gluten free breads mainly contain starch, they lack other nutrients and undergo fast staling. Commonly encountered defects with gluten-free bread arise due to inefficient gas expansion and retention during leavening, resulting in reduced volume bread with low crumb softness. Such products also do not exhibit the rheological, textural properties and baking quality that are unique to gluten based products [7].

The production of traditional bakery products involves four steps: ingredient mixing, dough kneading, fermentation and baking. Gluten plays an important role in all of these procedures. As a result, GF bakery products are often less desirable in terms of their appearance, taste, aroma and texture. The simplest way to improve the structure of GF products is by adding other functional ingredients and additives (e.g. starches, protein, gum, hydrocolloids, emulsifiers, dietary fibre) to the wheat flour substitutes (e.g. rice, maize, sorghum, buckwheat, amaranth, quinoa, corn, chickpea) as reported by numerous authors Extensive review on GF bread-making, including compositions of the standard recipes as well as the GF recipes consisting of flour or starch from various sources and additives [8].

The market for gluten-free products is increasing. Owing to better diagnostic methods, more and more people are identified to have coeliac diseases. Production of bakery products that do not harm these people is a big challenge for bakers and cereal scientists in the twenty-first century. The use of different cereals and flours makes it necessary to find possibilities to take over the task of gluten by other flour ingredients, by the addition of different components, by different flour and dough treatment or by changing the method of baking. The purpose of this review is to give an overview about the various possibilities to increase the baking quality of gluten-free bakery products, increasing their water-binding capacity, uniform the crumb structure and increase the final bread volume. All the listed methods and ingredients are already in single use helpful to increase the quality in gluten-free bread production [9].

Notwithstanding a growth in popularity and consumption of gluten-free (GF) food products, there is a lack of substantiated analysis of the nutritional quality compared with their gluten-containing counterparts. To put GF foods into proper perspective both for those who need it (patients with celiac disease) and for those who do not, we provide contemporary data about cost and nutritional quality of GF food products. The objective of this study is to develop a food composition database for seven discretionary food categories of packaged GF products. Nutrient composition, nutritional information and cost of foods from 63 GF and 126 gluten-containing counterparts were systematically

obtained from 12 different Austrian supermarkets. The nutrition composition (macro and micronutrients) was analyzed by using two nutrient composition databases in a stepwise approximation process. A total of 63 packaged GF foods were included in the analysis representing a broad spectrum of different GF categories (flour/bake mix, bread and bakery products, pasta and cereal-based food, cereals, cookies and cakes, snacks and convenience food)

From a market perspective, the gluten-free diet moved from a specialty diet toa mainstream market due to consumers associating a gluten-free diet with a healthy lifestyle . In fact, the gluten-free bakery market is projected to reach USD 1819.4 million by the end of 2022 and is expected to expand at a compound annual growth rate of 8.2%by 2030. The demand for gluten-free ketogenic bakery products is increasing exponentially as a "high-fat, low-carbohydrate, adequate-protein" diet strategy is being adopted for weight loss, and treating/preventing diabetes, and neurological disorders. Gluten free ketogenic bakery products have not been researched extensively. For consumers, a deeper understanding of the nutritional facts of bakery products labeled gluten-free, ketogenic, and/or low carbohydrate could help in making a conscious and suitable decision of purchase/consumption. Therefore, the objective of this

From a market perspective, the gluten-free diet moved from a specialty diet toa mainstream market due to consumers associating a gluten-free diet with a healthy lifestyle. In fact, the gluten-free bakery market is projected to reach USD 1819.4 million by the end of 2022 and is expected to expand at a compound annual growth rate of 8.2%by 2030. The demand for gluten-free ketogenic bakery products is increasing exponentially as a "high-fat, low-carbohydrate, adequate-protein" diet strategy is being adopted for weight loss, and treating/preventing diabetes, and neurological disorders. Gluten free ketogenic bakery products have not been researched extensively. For consumers, a deeper understanding of the nutritional facts of bakery products labeled gluten-free, ketogenic, and/or low carbohydrate could help in making a conscious and suitable decision of purchase/consumption. Therefore, the objective of this Various products can be developed by using combination of flours prepared from nutritious grains at different levels because combination of these flours im-proves the nutritional quality and the acceptability of the products [10]. By keeping in view all the properties of foods and rising demands for gluten free products for celiac patients, study was planned to develop some gluten free bakery products by using quinoa, rice and oats flours which will also be nutritionally balanced. The combination of these three flours will fulfill all the nutrient requirements of the individuals and also pro-vide good mouth feel, taste and flavour to the products. Quinoa, rice and oats are potential healthy and high quality ingredients in gluten free products. The present study was carried out to study the development and sensory evaluation of gluten free bakery products us-ing quinoa *(Chenopodium Quinoa)* flour.

3. Gluten-Free Baked Foods

Preparation of cookies Cookies dough prepared from wheat flour (control) and gluten free flours combinations using flour (100%), sugar (58%), shortening (28%), salt (0.9%), sodium bicarbonate (1.0%), dextrose (13.8 ml, 8.9 g glucose in 150 ml water) and distilled water optimum. The dough was mixed in a Hobart mixer, sheeted to a thickness of 5 mm, cut into circular shapes of 5.5 cm diameter, transferred on a baking tray and baked in an oven pre-heated to 204 °C for 10 min. The cooled biscuits were packed in low density polyethylene (LDPE) pouches and were evaluated after 24 h. Evaluation of cookies Cookies were weighed and measured for their width, thickness, spread ratio and peak force.

Figure 1 Millet cookies

Figure 2 Apple Pi

Figure 3 Banana Millet Bread

Figure 4 Coconut Muffins

Average values obtained with four cookies were recorded. The sensory evaluation of cookies was carried out by a panel of nine experienced judges using 9-point hedonic scale. Coconut flour is an excellent source of unique taste and aroma and rich in vitamins, minerals and dietary fibers, which might have potential application in baking products and human nutrition. The study is aimed to investigate the effect of honey and different levels of coconut flour on muffins. Four types of muffins such as, T1 -0%, T2-5%, T3-15% and T4 25% of coconut flour incorporation were investigated and T4 is found more acceptable in terms of physicochemical properties of muffins. T4muffins secured the highest score in color, texture and overall acceptability. The results showed that the addition of 25% coconut flour to the batter has

improved the sensory and physico-chemical characteristics of the samples of the muffins obtained, and consequently increased their nutritional value.

4. Starch in Gluten-Free Dough and Products

Starch, together with flours from gluten-free crops, is one of basic ingredients in gluten-free bread and bakery products. It is involved in the formation of the crumb structure, responsible for the volume and colour of the product. It is also used as a thickening, gelling, stabilizing, moisture retention and anti-staling agent, starch influences gluten-free products in three ways: it enhances crumb softness, ensures dough consistency and affects starch gelatinization. Starch is stored in starch grains of various sizes and shapes according to its plant source. Individual starches differ in their composition, size and shape depending on the plant species and the interactions between genes and environment. The amylose starch fraction forms single chains, whereas amylopectin is branched with a significantly larger molecule. When heated in suspension/dough, the starch grains swell, are partially solubilized, and gradually lose their cohesiveness. Starch gelatinization occurs at a temperature of 50–70 ° C, when their chains are released, and a viscous solution is formed from the suspension. Upon cooling, the viscosity increases, new bonds are formed between the molecules and a gel is formed. During storage, the gel further changes, loses water and eventually retrogrades. Amylose retrogradation proceeds faster than the same process for amylopectin. It follows that by choosing the type of starch, it is possible to partially influence the staling of the bread. Starch behavior may be affected by bound lipids.

Native starches are the most commonly used in gluten-free products, e.g., potato, corn, rice and tapioca, and pea starch has also appeared. Specially prepared gluten-free wheat starch is also used for its properties ensuring an optimal bread texture. Modified starches are produced for food purposes have a wide range of physical properties according to the purpose they are used. Starches can be modified by heating of the starch solution or by heating in the dry state; the heating can be performed by drying or extrusion. Chemical modification of starch is also possible. For gluten-free products, starches with good water absorption and slow retrogradation are selected. Specially modified starches are suitable for frozen products. A new modification is the so-called superheated starch, prepared by heating the starch suspension to high temperatures until dissolved and then cooling to form a spreadable gel with a creamy consistency. Additionally, various types of banana flour can be applied as well as the direct use of bananas in the dough.

There are significant differences in granular structure among various types of starches, which affect their ability to produce high quality gluten-free baked goods. When the baked goods are based on starch, they show higher volume, lower hardness and a lighter crust since Maillard reactions are reduced. The starch addition results in softer, and resilient crumbs. The type of starch also influences the quality of the baked goods. For the specific gluten-free formulations different mixtures of flours and starches must be optimized. Preventing the retrogradation of starch and thus prolonging the shelf life of gluten-free bread and bakery products can be achieved in several ways

5. Conclusion

Gluten intolerance is becoming more common in the population, and patients with this intolerance must follow a gluten-free diet. Bread and other bakery products are staple foods and pose a problem in a gluten-free diet due to their short shelf life and the need to replace gluten. Naturally gluten-free cereals and pseudocereals, but also milled legumes, seeds and nuts, are being increasingly used for the preparation of gluten-free baked goods. The additions of hydrocolloids are traditionally used in gluten-free product formulations. Recently, amylase, transglutaminase and other enzymatic preparations have been applied to bakery gluten-free mixtures. The use of fermentation for native sourdough preparation or the addition of dried sourdough to dry baking mixes improves the taste and shelf life of gluten-free bread. The quality of gluten-free dough and bread is improved by the addition of modified starches and protein isolates or concentrates. Rheological properties of gluten-free dough, the texture and sensory quality of gluten-free bread also improve the utilization of sourdough with specific microbial strains selected for the gluten-free raw materials. Newly tested baking technologies could improve the texture and slow down the staling of these products. New packaging materials and packaging methods can affect the shelf life of gluten-free bread and pastries. In the future, it is possible to anticipate the use of other non-traditionally processed gluten-free raw materials as well as new technologies for sour dough preparation and bread baking.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] Badiu, Elena, Iuliana Aprodu, and Iuliana Banu. "Trends in the development of gluten-free bakery products." The Annals of the University Dunarea de Jos of Galati. Fascicle VI-Food Technology 38.1 (2014): 21-36.

[2] Morreale, Federico, Donato Angelino, and Nicoletta Pellegrini. "Designing a score-based method for the evaluation of the nutritional quality of the gluten-free bakery products and their gluten-containing counterparts." Plant Foods for Human Nutrition 73 (2018)Naqash, Farah, et al. "Gluten-free baking: Combating the challenges-A review." Trends in Food Science & Technology 66 (2017): 98-107. : 154-159.

[3] Gao, Y., Janes, M.E., Chaiya, B., Brennan, M.A., Brennan, C.S. and Prinyawiwatkul, W., 2018. Gluten-free bakery and pasta products: prevalence and quality improvement. International Journal of Food Science and Technology, 53(1), pp.19-32.

[4] Houben, A., Höchstötter, A. and Becker, T., 2012. Possibilities to increase the quality in gluten-free bread production: an overview. European Food Research and Technology, 235, pp.195-208.

[5] Missbach, B., Schwingshackl, L., Billmann, A., Mystek, A., Hickelsberger, M., Bauer, G. and König, J., 2015. Gluten-free food database: the nutritional quality and cost of packaged gluten-free foods. PeerJ, 3, p.e1337.

[6] Gómez, M. and Martínez, M.M., 2016. Changing flour functionality through physical treatments for the production of gluten-free baking goods. Journal of Cereal Science, 67, pp.68-74.

[7] Kaur, S. and Kaur, N., 2017. Development and sensory evaluation of gluten free bakery products using quinoa (Chenopodium Quinoa) flour. Journal of Applied and Natural Science, 9(4), pp.2449-2455.

[8] Rai, Sweta, Amarjeet Kaur, and Baljit Singh. "Quality characteristics of gluten free cookies prepared from different flour combinations." Journal of food science and technology 51 (2014): 785-789.

[9] Ramya, H.N. and Anitha, S., 2020. Development of muffins from wheat flour and coconut flour using honey as a sweetener. International Journal of Current Microbiology and Applied Sciences, 9(7), pp.2231-2240