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Exploring New Ingredients and Technologies in Order to Enhance the Quality of Gluten Free Bakery Products

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Abstract – Wheat bread is eaten worldwide and has played an significant role in society history since agriculture grew. Although most people prefer to enjoy and fulfil the fragrance and taste of this staple product, certain individuals have a special aversion to wheat or a hereditary propensity to celiac disease. To enhance the quality of life of these people, food manufacturers have sought to produce good quality gluten-free bread from a nutritional viewpoint. As the consistency of the wheat breads depends in large part on the viscoelastic properties of gluten, several additives, including hydrocolloids, transglutaminases and proteases, were used to intensify their effectiveness. Latest efforts also involved the usage of redox and particle-stabilized foam control. We are discussing the success in the production of gluten free bread by our laboratory and others, with an emphasis on rice-based breads.

Key Words: New Ingredients, New Technologies, Gluten Free Bakery Products

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INTRODUCTION

The scent of a bread bakery is unmistakably enticing. The taste and crunchy feel of wheat breads enhance our hunger and meet our inherent human need for warmth and nutrition. Indeed, people are so pleased with bread that it is something more than "staple food;" it's considered "the workers of life." Breadmaking has an interesting and lengthy tale. Breadmaking dates from 8000 to 10,000 BC are widely agreed and occurred around Fertile Crescent and comprise of emmer and einkorn grains of wheat. The cereals were first eaten as porridge. Then grains that were handcrafted with knocking stones were mixed with water and then baked with the cover of hot ash on a heated surface, which created an unfermented, flat loaf. Era, about 6000 BC, people began to use sourdough in southern Mesopotamia, speculating that it was inadvertently produced in a discarded flour and water blend. The first leavened bread dough comprising fermentation gas swelled up during baking. In about 3000 BC, the Egyptians developed bread by introducing yeast and creating the prototype of the current loaf. They dehulled and milled wheat with saddle strings, the oldest form of squirrels, which were later substituted by spinning strings and are still used nowadays. The development of bread and beer in Egypt is strongly associated and is an indicator of a high degree of culture. Brot was produced not only from whole grain flour but also from malt (germinated grains). Water was often used in fermentation with a combination of cooked and uncooked barley. The mixture was strained without husk until yeast was inoculated.

The specific origin of bread has not yet been determined. Archaeobotanical proof suggests 14400 years ago the source of bread. Development in archaeology will finally illuminate the roots of food, along with a sense of how it blends into the wider society of ancient civilizations. Wheat bread is also one of the world's most important crops. A special feature of wheat gluten creates good quality bread. But certain genetically predisposed individuals cannot consume wheat bread, since gluten is toxic.

ROLE OF GLUTEN IN BAKERY PRODUCTS

Gluten functions as a stable element in bread baking. The gluten protein may be isolated from the flour by soaking the starch and other tiny components with cold water. According to the solubility of gluten protein in alcohol-water solutions, it is categorised into soluble gliadins, which give viscosity and extension to dough and the hardness, elasticity and viscosity of the dough are distinguished by gluten-insoluble glutenines. The gliadins are monomer and glutenins are heavy- and low-weight polymers. The glutenin portion of the gluten protein is insoluble in alcohol and is preserved by intercellular disulphide connexions as polymeric protein. Moreover, various proteins bound to disulphide attachments are found in gluten either as monomers or oligomers and polymers that are filled with glutamines and prolamins, the poorly charged amino acids. The large molecular weight (HMW) of glutenine is deemed the key determinant of gluten and dough's viscoelastic properties. The contribution of HMW glutenin to gluten elasticity has been related to its capacity to shape β-type secondary structures that play an important role in the elasticity of gluten. Glutenins become hard and rubbery after their initial hydration, while gliadin develops a viscous fluid mass during hydration. The highly visco-elastic (strong) dough is formed due to the high content of glutenin polymers. Glutenine's polymeric large molecular-weight subunits build an elastomeric network for the backbone to bind with the other glutenin subunits and monomeric gliadins. The interchain disulphide bonds play a crucial role in the network's stability. After hydration of food, which increases gas keeping ability and produces extensible mass with a high-quality crumb framework for discomfort, the properties of gluten become apparent. In the absence of gluten, the liquid batter is made, contributing to a lower colour and quality crumbling texture of the bread. In pasta making, the function of gluten is more significant, as gluten provides a strong network of proteins to avoid the disintegration of pasta during cooking. However, there is a low chance of such problems during gluten-free cookies, as a gluten protein network in the dough is minimally needed to grow (with the exception of semi-sweet biscuits that will need a gluten-network). The structure of biscuits is largely responsible for starch gelatination and super-cooled sucre rather than a protein / starch network.

Ingredients Considerations

Some gluten-free foods contain barley, wheat, rice meal and numerous starches. As the expectations and expectations of customers shift, the market must also adjust. This is expressed in the growing usage of multiple grains to develop gluten-free fresh and higher quality baked goods. Pseudocereal seeds, such as amaranth, quinoa and buckwheat, were researched along with other gluten-free substitutes including teff, sorghum, corn, and nuts and fruits.

FLOURS & STARCHES

Flour mixtures

Since the 1990s, barley, rice and oat meal, along with wheat, potatoes, cassavas and rice starches have been used in the manufacture of gluten-free baked goods. The consistency of gluten-free baked products has been tested in conjunction and separately. Generally speaking, a combination of flours and starches rather than a homogeneous solution was represented in terms of more favourable consistency and sensory characteristics. When gluten free breads are produced solely from rice , maize or oat gluten-free food, only the oatmeal has a comparable consistency to the wheat bread. However, oatmeal is also not included in gluten-free baked goods developed by industry. Oats are at risk of gluten exposure owing to the commonly employed processing and frying processes. The final product is at risk of having > 20 ppm gluten that will allow it impossible to call the commodity "gluten-free."Starches

Starch is a major component of flour and it helps to structure and link flours, especially gluten-free meals. Some gluten-free baked goods recipes contain extra starch for viscosity raise to build a satisfactory structure for the gluten-free batter or dough and the final product. Starches of wheat, maize, rice and tapioca are popular ingredients in gluten-free baked commodities. Starch additives have been seen in gluten-free bread to enhance the quality of both the dough and the final product. Pongjaruvat et. al. find that applying up to 20% tapioca starch pregelatinised to a rice meal-based dough contributes to more effective dough, with the resultant bread providing a larger volume and a smoother texture than a test sample that does not include starch. The baked goods developed with combinations of rice flour, potato starch and maize starch were contrasted with the formula containing the highest specific volume and lowest hardness values of rice flour and potato starch.

Pseudocereals

Buckwheat, amaranth and quinoa are known as pseudocereal plants; their seeds may be ground and used as food, although they are not in the cereal community. Buckweat flour in a number of gluten-free baked product uses has been tested, including breads and biscuits, crackers and cookies. Buckwheat flour normally has positive results in the finished product , particularly when the formula includes a hydrocolloid. In a research investigating the usage of sophisticated and whole sweet wheat meal crackers relative to processed wheat crackers, the crackers that comprise sophisticated 8 sweet wheat meal obtained the maximum ranking for a number of sensory properties and were slightly better graded than the samples of sweet wheat meal for appearance and texture. Adding sweet wheat to cookies will reduce the toughness and fracturity of the final product, contributing to better likes ratings via a sensory stand. These findings were seen as buckwheat flour substituted rice flour for gluten-free cookies. The substitution of ten percent, twenty or thirty percent rice flour by buckwheat flour in a recipe comprising hydrocolloid additives has resulted in smoother and less fracturable cookies and greater approval of sensory testing by a customer group. Sweetheart meal lacks the protein structure, and is therefore frequently explored with other flours or starches or with gums or hydrocolloids which help to shape a desirable breadlike structure. Buckwheat alones may be ideal for items such as crackers , cookies and biscuits where less gluten-like structure is required to obtain a good texture and a dough-workability. Where buckwheat was developed as the sole meal without any chemicals for gluten-free bread, the resultant consistency and sensory characteristics are deficient as compared to regular wheat bread. Buckwheat flour bread was moist, rugged and not as springy as conventional wheat bread. When, though, additives like gums or emulsifiers applied to buckwheat-based dough, consistency and sensory characteristics conform with the conventional formulas of wheat bread or surpass them. Research on the usage of other pseudo-cereals such as quinoa and amaranth in gluten-free baked items has been restricted. One research contrasted food samples for standard wheat bread with a single substitute meal source. The study of quinoa meal was ranked lower than the standard wheat loaf. A 50:50 combination of rice flour and pseudocereal flour was found to be a greater product in bread formulations. Quinoa and amaranth based formulations created bread with a harder crumb as opposed to control gluten-free bread primarily made from rice flour and potato starch. The bread-containing quinoa had improved loaf volumes due to the absence of pseudo-cereal enrichment without gluten management. It is often used in conjunction with conventional gluten-free foods such as potatoes or rice and/or by incorporating hydrocolloids or gums.

Rice bran

The usage in gluten-free baked goods of rice bran is linked to its fibre material. Phimolsiripol et al. also refined the gluten-free recipe of bread that includes large quantities of soluble dietary fibres like rice bran. The soluble food fibre in the bran of rice. The addition of the rice bran resulted in a bread with favourable characteristics, such as greater loaf length, finer crumb and improved flavour than gluten-free bread without rice bran. In comparison, the bread-containing high soluble fibre rice bran had better sensory acceptability overall and a longer shelf life than other research specimens. The effects of soluble dietary fibres on the consistency and sensory characteristics of baked items without gluten.

Sorghum

Meal variations of too many different flours allow space for more discovery and innovation. Multiple research point to sorghum flour as an outstanding replacement for cookies with wheat flour and 10 have positive sensory outcomes. Different forms of flour blends for consistency and sensory metrics have been checked. They noticed that a mixture of 50:50 sorghum and perl millet flours provided sensory approval values higher than the control wheat flour cookie. During the analyses of various flour mixes (including corn, maize, perl millet and sorghum), sorghum and perl millet mixtures were better performed.

Legumes

In addition to delivering unique nutritious properties, legume meals provide baked products with textural and structural advantages. For this cause, ingredients of gluten-free baked items have been researched in legumes such as chickpea, pea, soy and carob. Carob germ flour has been stated to have gluten-like properties in baked goods. The final powder is lower in consistency and sensory performance relative to other legume-based brooms whereas carob germ flour shapes a thicker batter than other legume-based formulations. Chickpea meal has been identified several times to provide gluten-free, high-quality baked meals. The formulation on chickpea developed the least dense bread (highest basic volume) and the softest crumb. The chickpea study also received the longest longevity of the tests and was one of the best scores for sensory admissibility.

Nuts

Additions of corn and chestnut meal in gluten-free baked goods is examined. In gluten-free bread formulation, substitution of 20 percent of total starch with acorn flour 11 had a beneficial impact on some tactile characteristics of the food and on overall sensory acceptability. With 20% of the inclusion of granular grain, the overall amount decreased, the stiffness diminished, the sensory acceptability improved and the shelf-life improved. It also enhanced the acceptability of the final goods. The nutmeg improved the strength of the paste and was only successful up to 20%. A substitution between 40 percent and 60 percent of total starch with acorn was also evaluated, with the growing concentrations of acorn flour raising the toughness and reducing the overall thickness. 20 percent addition of chestnut meal provided bread with an increased shelf life. During the shelf-life of the food, chestnut meal reduced the toughness of the bread while the test sample without chestnut meal improved throughout its shelf life..

Fruit-based ingredients

During the manufacturing of the goods dependent on produce, up to 1/3 of the fruit and vegetable content is sent to waste. Most of this waste is high in fibre and may be used in other items as a nutritional ingredient. Fruit juice waste, citrus pomace, in gluten-free bread formulations. Fiber abundant in orange pomace. The physical properties of fibre, including the development of gelling, shape and liquids, improve gluten-free bread dough. While the orange pomace had little impact on the overall appropriate impact of the final product from a sensory standpoint, the composition of the battery had been enhanced by improving its viscosity because, owing to the strong water binding potential of the orange pomace, it had to be dealt with (i.e. process). 12 Blackcurrant and strawberry seeds have been tested in gluten-free bread recipes of up to 15 percent inclusion. Defatted strawberry seeds had a stronger beneficial influence than blackcurrant seeds on texture values. They claim the gluten-free bread dough may be added to defatted strawberry seeds up to 10 percent to display less stiffness and higher loaf volume in contrast to a control recipe. The 10-per-cent strawberries seed sample is as appropriate as the feature, colour and structure / porosity control; the approval ratings for taste and smell are considerably higher. It should be remembered that a limited number of participants (n=10) completed the approval exam. Raisin juice, both distilled and dry, has been used for gluten-free bread as an ingredient. While concentrated raisin savoury breads were favoured from a sensory point of view, the product's shelf life was limited by added moisture. The addition of dried raisin juice at 3% or 5% of the weight of the flour demonstrated improved loaf quality and longer shelf life compared with control formulations.

TECHNOLOGIES TO ENHANCE THE QUALITY OF GLUTENFREE PRODUCTS

New strategies such as gluten proteolysis, genetically modified wheat raising, sourdough fermentation, frozen storage and partial baking have recently been implemented, either individually or in combination, to enhance GF food consistency.

1. Gluten proteolysis and Sourdough fermentation

A very recent development is the usage of proteolytic enzymes to detoxify gluten with intervention from prolyl-endopeptidases (PEPs), by cleavage the peptide bonds next to proline and glutamine residues. PEPs can degrade gluten to amino acids or to nontoxic peptides (less than nine amino acid residues) in comparison to human gastrointestinal protease (Heredia-Sandoval et. al. 2016). Cereal germination may also weaken immunostimulatory gluten peptides and thereby decrease their toxic effects. At some temperatures (20 ° C, pH 5.5), wheat grains hydrolyzed displayed the lowest gluten content on the seventh day of germination.

Lactic acid bacteria (LABs) have a complex protease mechanism which can hydrolyze different proline gluten residues. The collection of LAB strains with selective proteolytic effects is critical because of the complexity of the gliadin localus with many expressed genes. 11 LAB strains that can hydrolyze albumin / globulin and gliadin in surdough bakery have recently been identified. The polypeptide concentration with IgE-reactive epitopes is, however, still strong, and formulations were therefore established with the combination of fungal proteases and lactobacilli, offering a new method to mitigate toxicity to gluten. Identified sourdough LAB and fungal proteases were prepared with meal and had identical physicochemical properties to regulate.

The use of surdough can enhance the features of breads such as texture , taste, nutritional value and shelf life due to LAB metabolites. Ses constructive inputs may be used to render high-quality GFBs with different GF meals.

Powdered sourdough has advantages over fresh sourdough, including shorter fermentation periods and longer surdough shelf life. Recently, GF formulation has used freeze-dried sourdough to boost the consistency of the final breads. The results of incorporating fresh and freeze-dried amaranth, sweetweat and rice sourdough in the GFB output in various ratios. They concluded that 400 C dried sourdough was the best fit for GFB development. Additions of 20 % and 30% of freeze-dried buckwheat sourdough provided the strongest baking results and only up to 10% could be applied to amaranth. In comparison, 10% to 20% rice sourdough proved to be a reasonable replacement for fresh sourdough.2. Genetically modified wheat breeding

Researchers are primarily involved in the usage of the RNA (RNAi) platform to down-regulate-coeliac-toxic gliadins and/or glutenins. RNAi is a genetically modified tool that produces double-stranded RNA that makes gene silence before gluten forming.

Down-regulation of α-gliadins with the use of RNAi and a range of transgenic lines with silenced α-gliadins. Results of reverse phase liquid chromatography (RP-HPLC) relative to wild meals shows that the amount of α-gliadins in transgenic meals has been decreased by more than 60 per cent (Becker et al., 2012). In the case of compensatory rise in other stockpiling proteins such as albumins and globulins, the total amount of gliadins was decreased by 9 percent, with the exception of low molecular weight glutenin subunits (LMW-GS). The transgenic gluten is higher, possibly owing to the decreased gliadin-to-glutenin ratio arising from the α-gliadin decline.

The rheological features of both lines were identical. RNAi was also implemented in the manufacture of transgenic lines with decreased amounts of osteo-5 gliadins that were ideal for wheat-dependent anaphylaxis.

3. Frozen and partial baking technologies

Frozen dough is a viable solution to standard pan development and a freezing mechanism is introduced at various stages of the bread making phase. It is a value-added product that improves the availability of fresh bread. Patients with CDs can also prepare and eat it at home, if necessary. Frozen dough breads produced smaller amounts as the strength of the yeast declined and the composition of the GF dough was modified. Moreover, the crumbs were harder and the colour characteristics of the crust were changed.

The demand has quickly moved from frozen dough to partly baked bread (part-fried, fried or pre-baked bread) in recent years. The semi-finished product is partially baked, with an adequate crumb texture and minimal colouration of crust. Two steps are used for the partial baking process: an initial baking stage before the bread framework is set followed by storage and a second baking stage to establish a satisfactory flavour and crust colour. The effect of the partial baking method on GFB and how the integration of CMC and XG has changed the operation. Baked breads exhibited smaller quantities, more compact crumb appearances and higher crumb strength. These harmful effects were partly reduced by the incorporation of hydrocolloids, in particular CMC**.**

CONCLUSION

As a consequence of the growing worldwide incidence of celiac disease in adults, it is an urgency to give patients with celiac disease a sufficient consistency and wide choice of GF baking foods. The absence of gluten, which influences the overall appearance and textural properties of bread manufactured items, however, renders it a technical task.

Different substitute fabrics, usable components (added separately or together) and GFB innovations of acceptable consistency. They should concentrate on finding and introducing more novel gluten alternatives and developing and selling coeliac-safe wheat. The mixture should be done to identify unintended synthetic results and to produce GF goods with the same properties as wheat breads.

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