ABSTRACT

Atef Rashed Mohammad Alawneh: Production and Quality Evaluation of Gluten-Free Bread. Unpublished Master of Science Dissertation, Department of Food Sci., Fac. of Agric., Ain Shams University, 2012.

The current study was designed in order to improve the quality of products available for consumers who require gluten-free bread. This study examined the effects of rice flour , potato starch and corn starch as well as, different gluten replacer such as xanthan and guar gums on physical, sensory and freshness properties of gluten-free bread were storage at room temperature (25± 2^{o}C) for three day . In the case of gluten-free pan bread (GFPB) formulation, gums clearly improved the weight, volume, specific volume of breads by allowing the entrapment of air bubble in dough and providing stability to the dough mixture during baking. Specific volume values of GFPB were not high; this may be explained by making dough system too rigid to incorporate gases which also resulted in low specific volume values, although xanthan had the most pronounced effect on viscoelastic properties of the dough. Color is an important characteristic for baked products because it, together with texture and aroma, contributes to consumer preference. It depends on physicochemical characteristic of dough (water content, pH, reducing sugars and amino acids content) and on operating conditions. Hydrocolloids are added to bread to extent their shelf-life by keeping the moisture content and retarding the staling **,** during storage of GFPB for 72 h at room temperature (25 ±2^{o}C), the most evident change are related to moisture content loss and hardening of bread, it can be observed the effect of selected hydrocolloid on the moisture retention of GFPB. Breads formulation A4, A5 and A1 with xanthan gums showed lower loss of moisture content after 72 h of storage at room temperature, Bread staling is a very complex process that cannot be explained by a single effect, amylose retrogradation, reorganization of polymers within the amorphous region, loss of moisture content, distribution of water content between the

amorphous and crystalline zone and the crumb macroscopic structure must participate in the staling process**.** The effect of different bread formulation on staling of gluten-free flat bread (GFPB) is shown significant difference ($p \leq 0.05$) was evident in the staling of control bread and other GFPB formulations. Bread with A5-XG3, A5-X3, A4-X3 and A4-XG2 remained softer. The sensory evaluation data demonstrated that GFBB did not very significantly in all of the sensory characteristic evaluation. Generally, all GFPB formulations were acceptable, since they received much higher in selected quality characteristics. Positive significant correlations were found between taste and bread formulation; odor and freshness; staling and freshness, odor, bread formulation, moisture content and crust color, as well as between volume, staling, freshness and odor.

In conclusion, the effect of rice flour , corn starch and potato starch at different levels with addition of 3% xanthan and 2 or 3% xanthan-guar blend (50:50) on the physical, sensory and staling properties of GFFB was studied. Results show that gums clearly improved the weight, volume, specific volume and circulation of GFBB. Bread formulations A4-X3, A1-X3,A5-XG3 and A4-XG2 showed lower loss of moisture content after 72 h of storage at room temperature, which recorded higher moisture retention 94.4, 93.7, 92.3 and 92.1% , respectively compared to control (89.4 %). All GFBB formulations were sensory acceptable, since they recorded higher scores in studied quality characteristics. Bread formulations A4-X3, A4-XG2, A5-X3 and A5-XG3 had lower hardness and remained softer up to 72 h of storage period compared to other treatments. It could be concluded that the formulations A4 (rice flour: corn starch: potato starch, 40: 20: 40%) followed by A5 (rice flour: corn starch: potato starch, 40: 40: 20%) with 3% xanthan were the best for production of GFFB.

Key words: Gluten-free bread, xanthan gum, guar gum, flat bread, rice flour, potato starch, corn starch.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

Bread is an important staple food consumed all over the world; Wheat (Triticum aestivum) flour of both hard and soft wheat classes has been the major ingredient of bread for many years. Celiac disease (gluten-sensitive enteropathy) is an autoimmune disease triggered by consumption of cereal wheat (gliadin), rye (secalin), barley (hordein). The substance is that these prolamins can cause the characteristic symptoms of celiac disease (CD), like damaging the small intestine in subjects who are predisposed to it. Therapy consists of a gluten-free diet. Although nowadays oats are generally considered not to be harmful, it has to be pointed out that it is still a potential problem that oats are frequently contaminated by wheat, therefore it is also prohibited in the celiac diet. There are no conclusive clinical data on the threshold of gluten sensitivity of celiac patients. Contamination of foodstuff constituents and inadvertent dietary transgressions are not rare. Accordingly, the food producers have to guarantee that their products are free from gluten; otherwise the labeling of gluten content is obligatory (**Gallagher, 2004).**

Gliadin is one of two proteins in flour that make up gluten. As the structure-forming protein in bread, gluten provides the dough capacity to entrap and expand with gas-cell development creating the flexible open cell crumb, when gluten is removed ,the bread crumb quality is reduced producing a dense crumbly loaf .Since the only treatment for CD is a life-long adherence to a gluten-free lifestyle, it is imperative to develop consumer-acceptable gluten-free breads (GFB).Sine final loaf quality is dependent of the physicochemical properties of the dough, material deformation and water migration behavior becomes essential to characterize the system (**Crockett,2009**) .

Gluten-free bread (GFB) containing more starch, and lack with viscoelastic protein make up of wheat flour .A common practice to increase the gluten free dough elasticity, improving gas retention, is the addition of alternative proteins and hydrocolloids, many research has

been conducted using a combination of hydrocolloids and proteins in bread formulation, since the functionality of ingredients will be interaction of all components of the matrix (**Gambuś et al., 2007).**

The effect of hydrocolloids on dough rheology and bread quality parameters in GF formulations based on rice flour ,corn starch was studied, the rheological behavior of the batter containing hydrocolloids showed that xanthan had the most pronounced effect on viscoelastic properties **(Lazaridou et al., 2007**). Sensory parameter of GFB depend on the amount and type of hydrocolloids used as gluten replacers , as this determines interactions between them and starch ,the evaluation of GFB supplemented with various amounts of guar gum and xanthan, proved that bread with addition of xanthan has higher volume in comparison with guar gum (**Gambus et al., 2001).**

Since the batter undergoes stress during proofing and mixing it is also critical to study the batter rheological properties .In wheat dough, there is a direct correlation between dough handling ability and final loaf quality, the rheological properties of GFB studied using rheometer and compared with wheat dough to find its suitability for making GFB **(Demirkesen et al., 2010a & Sivaramakrishnan et al., 2004**).

Gluten-free bread often has poor crust and crumb characteristics (**Gallagher et al., 2003a)**.

The aim of this study was to improve the quality of gluten-free bread made from corn starch, potato starch and rice flours. Therefore, the purpose of the present study was to investigate the following main points:

- Studying the effect of replacement of rice flour, corn starch and potato starch at different levels on quality properties of gluten-free bread.
- Investigate the effect of gum addition on dough rheological behavior.
- Feasibility of production of pan and flat gluten-free bread with different levels of rice flour, corn starch and potato starch.

- Characterize quality attributes in the gum –added gluten-free bread and determine an optimal formulation with gum addition.
- Investigation the physical properties, sensory attributes and staling rate of resultant breads.

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2. REVIEW OF LITERATURE

Bread is a product with great nutritional value, consumed worldwide. In order to extend its shelf life, bread is one of the most consumed food products known to humans, and for some people, it is the principal source of nutrition. Bread is an inexpensive source of energy: it contains carbohydrates, lipids, and proteins, and it is important as a source of essential vitamins of the B complex and of vitamin E, minerals and trace elements. The history of bread can be traced back about six millennia. Breadmaking is an ancient art that is closely connected with the development of the human race and civilization, but the development of the baking oven, the industrial production of baker's yeast in the nineteenth century, was decisive for the technology of breadmaking. The twentieth century led to technical advances and the rationalization of bread production. Some of these advances in breadmaking include knowledge about physical–chemical changes in dough, the rheology of flour and dough, and the development of different instrumentations of rheology. Research into breadmaking is currently concerned with staling, the influence of the different additives on the breadmaking process, and the rheological properties of flour, dough, and bread, in order to improve its quality (Clerci **et al., 2009).**

2.1. Celiac Disease

Celiac disease (CD), also known as celiac sprue and gluten-sensitive enteropathy, is a permanent intolerance to the ingestion of gluten. Gluten triggers the atrophy and flattening of the villi in the small intestine, resulting in, among other things, inadequate digestion and absorption of nutrients**.** Celiac disease is a syndrome characterized by damage of the small intestinal mucosa caused by gliadin fraction of wheat gluten as are similar proteins in barley (hordein), rye (secalin) and possibly oats (avinins) in genetically susceptible subjects .The presence of gluten in these subjects leads to self-perpetuating mucosal damage, whereas elimination of gluten results in full mucosal recovery .The