GLUTEN-FREE BREAD PRODUCTION FROM CORN AND DETERMINATION OF SENSORY PROPERTIES[1*]

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ABSTRACT

Bread is a product that is produced mainly from grains such as wheat, barley and oats and is consumed in many societies as a staple food. However, due to gluten causing small bowel disease called celiac, extensive research is being done on producing bread from gluten-free raw materials such as corn and rice. In this study, the sensory properties of breads produced using corn flour, and corn flour together with corn starch were investigated. The addition of corn starch to corn flour had a positive effect on both the rheological and sensory characteristics of bread and was more appreciated by panelists. Continuing the studies on gluten-free bread production using different gluten-free raw materials is important in terms of meeting the needs of celiac patients.

Keywords: *Celiac disease, Gluten-free bread, Cornbread, Corn starch, Quality characteristics*

INTRODUCTION

Bread is considered to be a staple food. When the historical development of bread is investigated, evidence showing that people were able to bake bread in special ovens in Mesopotamia in 4000 B.C. was found. Bread production using yeast was made in ancient Egypt in 1800 B.C. When a piece of bread dough was separated and stored in a cool place, it was observed that the dough was better when added to the new dough. This method, which is known as "sour yeast" and which is traditionally used in the production of fermented foods, has been used since ancient times **[1]**. In the documents belonging to the ancient Egyptians in 2600 B.C. it was reported that when yeast is added to the dough obtained from a mixture of wheat flour and water, more

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fluffy and soft bread is obtained. The production of bread from commercial bakeries observed after the 5th century. In Europe, bread making started much later (15th century) and bread was produced from rye and then from wheat.

In recent years, depending on consumer preferences, it is seen that classical wheat bread has gained more variety with the addition of other cereals such as rye and oats. It is observed that the demand for bread enriched with corn, potatoes or chickpeas gradually increases depending on the raw material supply. One of the important reasons for this variety in bread is that some people are extremely sensitive to grain proteins. Small bowel disease, which occurs due to gluten consumption in cereals such as wheat, rye, oats and barley, is called 'Celiac Disease' **[2]**. Celiac disease is an autoimmune enteropathy that occurs in genetically susceptible people. The incidence of the disease worldwide is 1%, and it is considered as one of the most common genetic diseases **[3]**. The disease was first diagnosed in 1888 by Samuel Gee. Clinical manifestations in celiac disease can be seen in the early stages of life or in the following years. The disease typically shows two symptoms, diarrhea and growth retardation **[4]**. Treatment of celiac disease can be done with a gluten-free diet. As a result of gluten deficiency in gluten-free bread production, unstable liquid dough formation is encountered instead of dough formation **[5,6]**. The bread produced from such a dough is of low quality and is fragile and without flavor **[6]**. In order to overcome these deficiencies, researches continue to increase bread quality similar to gluten bread, using mixtures supported by various starches (corn, potatoes, cassava and rice), fibers and hydrocolloids. Gluten-free raw materials such as sorghum, millet, buckwheat, corn, rice, chickpeas and other legumes, amaranth, quinoa, flaxseed, chestnut, carob, lupine, acorn are used in the production of gluten-free bread **[7-9]**. In this study, corn flour was replaced with wheat flour. In order to improve the technological properties of bread, gluten-free bread was produced using natural hydrocolloid and dietary fiber and the sensory properties of the bread were examined.

MATERIALS AND METHODS

In this study, bread was produced using corn flour, water, sugar, salt and corn starch. The organoleptic properties were examined 24 hours after the breads were baked in a domestic oven by a group of 20 people.

RESULTS AND DISCUSSION

Two different types of bread produced for gluten-free bread production. In the first group of bread, only corn flour was used and in the second group, corn starch was used in addition to corn flour. The amount of water on organoleptic properties of bread made with corn flour is shown in Table 1.

Table 1. The amount of water on organoleptic properties of bread made with corn flour

Properties of bread	**Corn flour**	
	Low amount of water	*High amount of water*
Crust formation on the outer surface	++	+
Inner part of bread		
Spongy	-	++
Stickiness	-	-
Tough and tight	-	-
Porosity	+	++
Chewiness	+	++
Voluminous	+	++
Flexibility	+	++
Brittleness	+	+

-: Not detected / weak

+: middle

++: good

The amount of water on the organoleptic properties of bread made with corn flour and corn starch is shown in Table 2.

In Tables 1 and 2, the increase in the amount of water in both groups of bread made with corn flour and corn flour-corn starch has a positive effect on the quality of the bread. The small amount of water only affected the crust formation positively.

Table 2. The amount of water on the organoleptic properties of bread made with corn flour and corn starch

Properties of bread	**Corn flour and corn starch**	
	Low amount of water	*High amount of water*
Crust formation on the outer surface	++	+
Inner part of bread		
Spongy	-	++
Stickiness	-	-
Tough and tight	-	-
Pore formation	+	++
Chewiness	+	+
Voluminous	+	++
Flexibility	+	++
Brittleness	+	+

The definition of bread is given below according to the Turkish Food Codex Committee on Bread and Bread varieties **[10]**. Bread to wheat flour; water, salt, yeast (*Saccharomyces cerevisiae*) is defined as a product made by adding sugar, enzymes, malt flour as a source of enzymes, gluten and permitted additives and kneading, shaping, fermentation and cooking according to the technique of this mixture. Gluten-free bread is described in two sections **[11]**; Gluten content should not exceed 200 mg/kg in dry matter in foodstuffs defined as "gluten-reduced" and gluten content in foodstuffs

defined as "gluten-free" should not exceed 20 mg/kg in dry matter. Gluten-free foods that replace important basic foods such as flour or bread contain the same amount of vitamins and minerals as the foods they replace **[11].**

In cereal bread, gluten, the main source of protein, has many positive effects on dough and bread quality. When gluten is not used, various quality defects occurred. These deficiencies are eliminated in gluten-free bread production by using various hydrocolloids, emulsifiers and enzymes. In addition to structural deficiencies in gluten-free bread, it is also undesirable in sensory features. While the bread is crumbly, colorless and firm, the taste is smooth and flavorless. Some positive properties obtained after cooking change after a day or two. For example, the crumb, which is wet after baking and sticks together, the next day becomes dry, rough and crumbly **[6]**.

Corn is an important raw material that can be used in bread production as wheat. In our country, especially in the Black Sea region where corn production is common, bread is mostly produced from corn. Corn has low molecular weight protein. 60% of these proteins are made of zein **[12]**. Zein does not have a long polymeric structure like wheat gluten **[13]**. Corn flour contains 75-87% starch and 6-8% protein **[14]**. Corn contains bioactive compounds such as carotenoids, ferulic acid and anthocyanins with many therapeutic properties, as well. Corn seeds with blue, purple and red pigment are rich in anthocyanins with antioxidants and bioactive properties **[15, 16]**. In Table 3, evaluations made in terms of taste and flavor by panelists in bread made with corn flour and bread made with corn flour and corn starch are given.

Table 3. The points given by the panelists to the taste and flavor of bread

Panel-ists	**Bread (corn flour)**	**Bread (corn flour and corn starch)**
1	4	4
2	2	3
3	3	3
4	2	3
5	2	4
6	2	3
7	2	3
8	1	3
9	2	4
10	2	3
11	3	2
12	2	4
13	1	2
14	1	3
15	2	4
16	2	2
17	1	3
18	2	3
19	1	4
20	1	3
Total	**38**	**63**

In this table (Table 3), the breads are evaluated only in terms of taste and flavor.

CONCLUSION

The total score of bread made from corn flour and cornstarch is approximately 2 times higher than the score of bread made from corn flour alone. As a result, bread made with corn flour and corn starch is a product that can be consumed by celiac patients as an alternative to wheat and other gluten-containing breads. However, more studies are needed to improve both the sensory and structural features of cornbread.

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