Hydrocolloids to The Effects of Gluten Free Bakery Products

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Abstract
The technology of the gluten free production process has begun to be studied in order to prevent the occurrence of celiac disease or inflammation of the digestive tract. The absence of gluten which can increase the viscosity and extension characteristics of bakery products is needed to improve the quality of bakery products. Hydrocolloid is a food additive that is known to have characteristics that can increase the viscosity of the dough and improve the quality of gluten free bakery products. In this paper try to examine the opportunities of several hydrocolloids and their characteristics on the quality of gluten free bakery products produced. The study in this paper is expected to provide benefits in the development of gluten free bakery products in general.

Key Words: effect, gluten free, bakery, hydrocolloid

1. Introduction

The technology of gluten free production process has begun to be studied in order to prevent the occurrence of celiac disease or inflammation of the digestive tract. The absence of gluten which can increase the viscosity and extension characteristics of bakery products is needed to improve the quality of bakery products. Hydrocolloid is a food additive that is known to have characteristics that can increase the viscosity of the dough and improve the quality of gluten free bakery products.

Some of the characteristics of bakery products including bread and cake have special characteristics that are quite difficult to repair without the presence of gluten in the dough. The product becomes stalling and has a hard texture, an important point that must be optimized related to the development of gluten free bakery products. Some studies can use the main raw material of gluten free flour such as rice flour, corn flour [1,2,3,4,5,6] and potato flour [7]. The use of the main raw material source is adjusted to the potential that develop in an broaden area.

Some hydrocolloids have the ability to increase the viscosity of the dough and form a good texture, during proofing and baking. The combination of the use of HPMC (Hydroxy Propyl Methyl Cellulose) and CMC (Carboxy Methyl Cellulose) can be more hydrophobic. While the use of a combination of guar gum and 2-4% locus gum can prevent stalling [8,9]. Other types of hydrocolloid that can be used include xanthan gum, guar gum, locus bean gum, HPMC, pectin, a combination of xanthan gum and guar gum also xanthan gum with locus bean gum [10].

The characteristic properties of hydrocolloid such as ability can increase the dough viscosity, increase volume, reduce the level of structural hardness, reduced the stall, into several parameters which are usually analyzed, in addition to sensory properties and all acceptance by consumers. In this paper, the effect of hydrocolloid on the characteristics of bakery products is in the form of bread and cake. Based on the results of the study, it is expected to be able to provide information and open up opportunities for the development of a wider range of gluten free products.

2. Hydrocolloid

Some technology studies of bread production and gluten free cake use hydrocolloid as a food additive to improve the quality of the final product. Estiasih [11] states that hydrocolloid can make dimensional tissue structures such as gluten but in a weak gel form.
This ability is strongly influenced by the type and concentration of hydrocolloid use. There are several types of hydrocolloid as well as later chances of using them related to the source of the raw material. The type of hydrocolloids as well as the source of raw materials as shown in the table 1 below.

| No | Hydrocolloid        | Sourced Raw Based Material        | Reference     |
|----|---------------------|----------------------------------|---------------|
| 1  | Xanthan Gum         | Microbial Metabolite              | [12]          |
| 2  | Guar Gum            | Seed                             | [13]          |
| 3  | Carboxy Methyl Cellulose | Pulp                     | [14]          |
| 4  | Alginate            | Brown Seaweed                    | [15]          |
| 5  | Pektin              | Fruit Peel, Fruit, Vegetable     | [16,17,18,19] |
| 6  | Glucomannan         | Tuber                            | [16]          |

The source of hydrocolloid raw materials is very diverse, such as microbial metabolites, seeds, pulp, sea agar, fruits, vegetables and plant tubers. The source of the raw material becomes an alternative for developing the potential of local raw materials in accordance with the resources in each region. Each hydrocolloid has a certain specific characteristic so that when implemented in bakery products can give a good influence during the process of kneading, proofing or baking process.

3. Bakery Technology Implementation

Some of the characteristics of bakery products including bread and cake have special characteristics that are quite difficult to repair without the presence of gluten in the dough. The product becomes stalling and has a hard texture, an important point that must be optimized related to the development of gluten free bakery products.

In the technology of making bread and cake there are two principles that are quite different, namely in bread-making technology requires fermentation techniques with the help of microbes. While the cake processing technology only requires the accuracy of stirring techniques in the absence of a fermentation process using assistance from microbes. Gluten free flour used as the main raw material and type and concentration of hydrocolloid used as food ingredient as shown in the table 2 below.

| No | Main Based Material     | Hydrocolloid                              | Reference |
|----|-------------------------|-------------------------------------------|-----------|
| 1  | Rice and Corn Flour     | 1% Xanthan Gum and 1% Carragenan           | [1]       |
| 2  | Corn Flour              | 3% Guar Gum                               | [2]       |
| 3  | White Rice Flour        | HPMC                                      | [6]       |
| 4  | Corn Starch             | Xanthan Gum, HPMC                         | [4]       |
| 5  | Potato Flour            | Pectin, Xanthan Gum, CMC, HPMC            | [7]       |
| 6  | Potato Starch, Corn Starch | Pectin, Guar Gum, Xanthan Gum             | [20]      |
| 7  | Rice Flour              | Xanthan Gum, CMC                          | [5]       |

The combination of the use of HPMC (Hydroxy Propyl Methyl Cellulose) and CMC (Carboxy Methyl Cellulose) can be more hydrophobic. While the use of a combination of guar gum and 2-4% locus gum can prevent stalling [8]. Other types of hydrocolloid that can be used include xanthan gum,
The use of guar gum, locust bean gum, HPMC, pectin, a combination of xanthan gum and guar gum also xanthan gum with locust bean gum [10].

The use of starch, gum and hydrocolloid as well as process methods greatly affect the structure of gluten free bakery products [21]. The combination of the use of flour and starch is two different things. Flour contains high fiber content compared to the starch composition. Characteristics of the type of flour as the main raw material also determine the quality of the end product of gluten free bakery. The combination of the use of two types of flour, in addition to substituting each other for the physical characteristics of each flour, also affects starch granules and the ability to form the rheological profile of the resulting dough.

The use of one type of hydrocolloid and a combination of several hydrocolloids also affects the quality of gluten free bakery products. The synergy between hydrocolloid becomes an important factor of consideration before implementing the process of making gluten free bakery. This synergy can not only be observed in the dough making process, but also the final characteristic after baking and general acceptance when consumed.

One important key in making gluten free bread is the occurrence of stalling. Herawati [8] stated that stalling occurs as a result of starch events contained in bakery products undergoing a process of retrogradation. Retrogradation is a phenomenon of the amylose fraction re-bonding together so that the crystalline phase is strong and ultimately results in the bread becoming buffered.

Unlike the case with bread, in the process of making cake without involving the process of fractionation so that the dough is not expected to form a good sheet so that it can trap CO₂ gas produced by microbes.

| No | Main Based Material          | Hydrocolloid                          | Reference |
|----|------------------------------|---------------------------------------|-----------|
| 1  | Rice Flour                   | Xanthan gum, Methyl cellulose         | [22]      |
| 2  | Waxy Rice Flour              | Xanthan Gum, Guar Gum, HPMC, Carrageenan | [23]     |
| 3  | Corn flour                   | Xanthan Gum, Pectin                   | [24]      |
| 4  | Rice flour, Corn flour       | Xanthan Gum                           | [25]      |
| 5  | Chickpea flour, barnyard millet flour, Corn Flour | Xanthan Gum | [26] |
| 6  | Rice flour, Flaxeed flour    | Xanthan Gum                           | [27]      |
| 7  | Rice flour                   | Tragacant, Xanthan Gum                | [28]      |

Based on several studies, gluten free cake can be processed using rice flour, corn flour, flaxseed, barnyard millet and so on. To improve the quality of the dough and the final product can be added some hydrocolloid such as xanthan gum, guar gum, HPMC, MC, pectin, tragacant. The hydrocolloid can be added individually or a combination of several types of hydrocolloid.

4. Characteristics of Product

Gluten is important to retain gas to obtain the desired volume and texture in a dough system. It is essential to form a strong protein network required for the desired viscoelasticity. Glutenin and prolamin are the major fractions of the gluten. While prolamin provides viscosity and extensibility in a dough system, glutenin is responsible for elastic and cohesive properties of dough [29].

Some characteristics of bakery products from gluten free affect the quality of bread and cake products. Characteristics related to the physical quality of bakery products include porosity, developing power, texture, elasticity and overall sensory properties. The functional effects of
hydrocolloids stem from their ability to modify dough rheology and keep qualities of baked products [30, 31, 3].

Demirkesen [32] reported higher consumer preference, by adding xanthan, guar gum, locust bean, HPMC, pectin, xanthan-guar and xanthan-locust bean compared with the control, with xanthan producing the better values. Furthermore, the physical characteristics of gluten free products can be observed from the ability to form porosity, sensory evaluation results, texture, dough elasticity, dough characteristics, volume, and the ability to reduce stalling levels. Related to the type of hydrocolloid and its ability to improve the physical quality of gluten free bread can be seen in Table 4 below.

| Table 4. Physical Analysis of Gluten Free Bread |
|-----------------------------------------------|
| **No** | Hydrocolloid Best Formula | Analysis Parameter | References |
|-------|---------------------------|--------------------|------------|
| 1     | CMC                       | Porosity           | [33]       |
| 2     | Xanthan Gum               | Sensory Evaluation | [32]       |
| 3     | Xanthan Gum               | Decreased Hardness, Increased Elasticity | [33] |
| 4     | Xanthan and Carragenan    | Dough Development and Stability | [1] |
| 5     | HPMC and Guar Gum         | Decreased Hardness and Increased Volume | [31] |
| 6     | CMC                       | Dough Development  | [5]        |
| 7     | Xanthan Gum and CMC       | Decreased Stalling  | [5]        |

Based on the results of a study by [33], the formula of gluten free bread added by BTP hydrocolloid showed better results than controls that were not added to hircocolloid. The porosity of gluten free bread observed that gas cells in the breads containing CMC are bigger than those in breads containing xanthan, which had compacted crumbs. In the breads including both gums, porosity improved by increasing the CMC level [34].

Cellulose derivatives such as CMC, HPMC and MC contain hydrophilic and hydrophobic groups, which provoke other properties, including interfacial activity inside the dough structure during proofing and construction of gel networks during the bread making procedure. Such complex structures increase viscosity and reinforce the boundaries of the gas cells growing in the dough and subsequently increase the gas retention throughout baking [34]. It has been suggested that Xanthan Gum addition makes the dough too rigid and stiff for gases to slip in and produce voluminous breads [34].

Several studies have shown that the use of xanthan gum can reduce the level of hardness and improve the elasticity of the mixture in both fresh and after storage. In addition, the addition of xanthan gum can also improve the brightness (L value) of the gluten free bread product [33]. Based on the characteristic, Xanthan gum not only improves the quality of the dough, texture, but also improves the color quality of the bread produced.

The addition of xanthan gum improved the quality of gluten free cakes. The physical and sensory characteristics of the cakes increased the specific volume, making them softer and retarding their staling. The concentrations of 0.3% and 0.4% of xanthan gum produced cakes with desirable sensory characteristics with high acceptance by the consumers [25].

The synergy between the raw material of flour sources and the type of hydrocolloid is an important point to produce optimal quality bakery products. Based on the results of [28] research, the incorporation of flaxseed flour (20-40%) and xanthan gum (0.8%) into the formulations of gluten-free layer cakes could be a great improvement for the height, volume symmetry and uniformity index and flaxseed flour supplement. It decreased the hardness of gluten free cake.

Several studies have examined the effect of hydrocolloid on the determination of bulk density and porosity in cake products. The uniform distribution of bubble formation and not too large, will produce a soft texture on the gluten free cake products produced. Hojjatoleslami and Azizi [28]
conducted a study on the manufacture of gluten free cake by producing optimum bulk density and porosity with the use of 1% tragacant and 1% xanthan gum.

Furthermore, Ziobro et al. [35] stated that due to having more volume of the cake samples prepared with different percentages of xanthan and tragacanth, higher porosity in these samples compared to the control seems logical. The increase in porosity amount is due to increase in the size and number of gas cells or bubbles and their uniform distribution in the product’s texture. Thus the accuracy of the use of the main raw material types, the synergy of the added hydrocolloid as well as the characteristics of gluten free bakery products need to be considered in order to produce optimal quality both in terms of color, texture and unstalling as well as bread and cake from wheat flour raw materials.

5. Conclusion

Several types of hydrocolloid can be added to improve the characteristics of gluten free bread and cake. The synergy between hydrocolloids is an important consideration before implementation for the optimization of the quality of gluten free bakery products. Physical parameters become a reference in optimizing the quality of gluten free bakery products. Hydrocolloid with certain kinds and concentrations can affect dough, proofing and baking parameters and gluten free bakery end products. In further development, the presentation of this paper is important to be further developed before the optimization of gluten free bakery products.

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