PROCEEDINGS

Starch Update 2011

The 6th International Conference on Starch Technology

13-14 February 2012

Centara Grand at Central Plaza Ladprao
Bangkok, Thailand

Starch Update 2011

The 6th International Conference on Starch Technology

13 - 14 February 2012

Centara Grand at Central Plaza Ladprao Bangkok, Thailand

Organized by

National Center for Genetic Engineering and Biotechnology (BIOTEC)
National Science and Technology Development Agency (NSTDA)
Ministry of Science and Technology (MOST)
Kasetsart Agricultural and Agro-Industrial Product Improvement Institute (KAPI)
Kasetsart University (KU)

Published by:
National Center for Genetic Engineering and Biotechology (BIOTEC)
113 Thailand Science Park, Phahonyothin Road, Klong 1,
Klong Luang, Pathumthani 12120 THAILAND
Tel. +662-564-6700, Fax. +662-564-6701-5
http://www.biotec.or.th

O-STARCH-17

The effects of additives and white egg on composite cassava – wheat bread

Judy R. Witono and Ryan Supomo

Chemical Engineering Dept. - Parahyangan Catholic University, Jl. Ciumbuleuit no.94, Bandung-Indonesia

Abstract

The increasing of bread consumption leads to the increasing demand of wheat flour. The availability of wheat floursometimes is not parallelwith the demand especially in Asia. The problem which arises by substituting wheat flour in bread is the loss of network structure to retain CO_2 gas. This research is intended todevelop a composite white bread which contains cassava starch with XG (xanthan gum)/CMC (carboxymethylcellulose) (2% and 3%) and egg white as a gluten substitute. The properties of bread which was observed are bread hardness, density, extensibility, crumb firming and crust colour. The research was started by determining the optimum time on mixing, 1st and 2nd fermentation. And then was followed by making bread dough with the mass ratio of wheat to cassava flour are 2:1 and 1:1 and adding gluten substitute. The variations are also conducted with and without the addition of 10% of white egg. The analysis result of crumb hardness tested by Texture Analyzer CT3-Brookfield shows a range between 41 – 465.5 g. The bread which shows the best properties in term of the low hardness value, the high extensibility and has acceptable crust colour and crumb firming is the bread with the ratio of wheat to cassava flour = 2:1, with the addition of 10% egg white and 2% CMC.

Keywords: Wheat bread, cassava starch, xanthan gum, carboxymethylcellulose

1. Introduction

Bread originally is made from wheat flour. But with the lack of wheat in some area including Indonesia and also some drawbacks of wheat in the food especially for gluten intolerance people the research of the use of non-wheat flour in bread has been developed. In some country even their government appealed the use of other flour like corn - in Egypt [1] and cassava – in Nigeria [2].

The mixture of wheat and non-wheat is usually called composite flour. The substitute of wheat flour start from 10% up to 90%, but most of the results showed that the viscoelastic properties of dough, gas retention characteristics, crumb & crust structure and extensibility of bread were still can be accepted only around 20% wheat replacement [2-6].

The main problem arise from the substitute of wheat in bread is no-formation of three-dimensional matrix network which can retain the CO_2. The additives which are widely used in food to modify its rheology are hydrocolloids. It is a colloids particle which can spread throughout the water form a gel state. It has also an ability to modify dough in such a way and keeping qualities of finished baked products. Several hydrocolloids which are widely used in baking product as a bread improver are vegetable gum (Arabic gum, xanthan gum, guar gum),CMC(carboxymethylcellulose) and HPMC (hydroxypropylmethylcellulose).

According toMichelle M. Moore et al [7], bread dough with raw materials consists of rice flour, potato starch, corn flour, and soy flour, supplemented with 1% xanthan gum and transglutaminase enzyme will produce gluten-free bread with a larger volume of flowers, good quality from visual observation test, and has the characteristics of a good crumb. This was confirmed also by Shittu et.al [8] who worked on composite cassava-wheat bread. E. Mettler [9] who worked with rye flour found that with the addition of 0.3 % guar gum, 0.6% CMC and 0.8% mono-diglyceride (MDG)individually, the specific volume, porous structure of the crumb and the shelf life could be improved.

This study was conducted to improve the amount of wheat which can replace by cassava flour without reduce the characteristics and sensory acceptability of the bread itself. To support it, the effect of xanthan gum/CMC and egg white as a gluten substitute in that composite flour was also investigated.

2. Materials and Methods

2.1. Materials

Commercial wheat flour was purchased from PT. ISM Bogasari Flour Mills, Jakarta, Indonesia and cassava flour from PT. Sungai Budi, Bandung, Indonesia The ingredients used in the formulation of the product were xanthangum andCMC (Sigma Aldrich), Fermipan dry baking yeast(Route de la Centrale Wavrin - France), salt (PT. Unichem Candi Industri, Riau, Indonesia), sugar (PT. Sugar Group Company, Jakarta, Indonesia), water, shortening(butter) (Meadow Lee Foods Ltd, Macquarie Park, NSW), breadimprover (PT. Gunacipta Multirasa, Jakarta, Indonesia)andeggs from local market in Bandung. All ingredients are of food grades.

2.2. Methods

Dough was produced following the composition presented in table 1. The varieties are made between wheatflour: cassavaflour (2:1; 1:1), the addition ofeggs, and also theuse ofglutensubstitute (xanthan gum; CMC).

Table 1. Dough formulation used

Material	Percentage (%)	Quantity (gram)
flour	100	159.5
Yeast	3	3.19
Water	60.5	96.5
Sugar	5	7.978
Salt	2	2.12
Skim Milk	3	3.19
Shortening	4	6.38
Bread Improver	1	1.59
*egg white (variation)	10	15.95
Total	188.5	296.398

2.3. Analysis

The determination of the optimum time on mixing and during 1st and 2nd fermentation was done visually. The bread density was determined by cutting the product in a size of 2.5 cm x 2.5 cm x 2.5 cm. The fragments were then weighed. Density calculation is done by dividing the weight of bread with the volume.

The crust hardness was determined by Texture Analyzer CT3-Brookfield which is connected to the computer.The pieces of bread with a thickness of 2.5 cmwas be placed under the probe (38.1 mm Ø Perspex Cylinder) and then press with a particular method (Mode: measure force in compression, plot: peak, speed: 1 mm/sec, distance: 3 mm , option: normal, trigger: auto 4 g). Measurements were made every day during three days, to observe the increase in the level of bread violence. The bread extensibility was compared using large-scale paper size 1.5 x 1.5 cm square. Whereas the porosity of the crumb and crust colour were observed visually.

3. Result and Discussion

3.1. Time of mixing

The composite flour and all ingredients excluding salt and shortening were stirred in the mixer. The time needed until the surface of the dough elastic was observed, this condition was known as half-dull. In this experiment, it was found that the time required is 5 minutes. After that the process was followed by the addition of salt and shortening, and stirred again until the surface of dough looks smooth, dull and dry. This stage was carried out for 3 minutes. After that stirring should be stopped, otherwise the dough will be wet, sticky and watery.

3.2. The time of 1st amd 2nd fermentation

First fermentation was carried out until the volume of dough expands 2 times from its original volume. Based on the observations it was obtained that the optimum fermentation time is 20 minutes. Fermentation should not be too long, because it will cause the dough becomes soft and watery. If the fermentation too short it will cause the bread becomes hard and the pores are coarse.

The dough was deflated again to remove CO_2 formed. It was followed by cutting and weighing. The 2nd fermentation was performed to get the maximum expansion of the dough. The optimum time was found 55 minutes because after 55 minutes, there was no significant change in height again.

3.3. Density of Bread

Based on figure 1 below, it can be seen that the density of bread which comes from the ratio of wheat flour to cassava flour 2:1 (with CMC and egg white addition) is lower than the standard bread (fully wheat flour). It means that the hydrocolloids cooperate with gluten lead to the more flexible dough, so that more air cavities can be retained. The total amount of hydrocolloids and gluten in the composite flour 2:1 is higher than in 1:1, so the network matrix formed becomes stronger. This result is similar with the work of Mettler and Seibel on the whole wheat bread which produced a better dough elasticity and height with the addition of CMC [9].

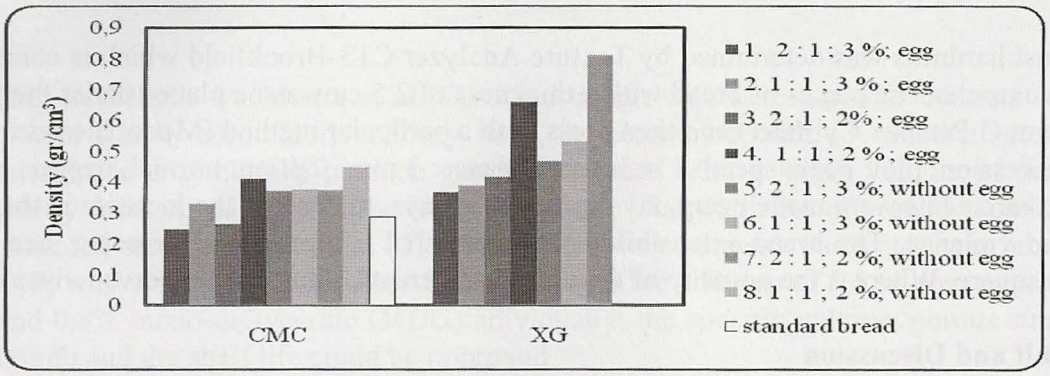


Figure 1 Density measurement

Basically, the molecule structure of CMC and XG was similar, i.e. a polysaccharide complex network of rod-shaped which can be entangled each other. But the products that use xanthan gum produce a higher density than CMC. The molecule chains of xanthan gum is stiffer than CMC, it is caused on alternate glucose units a trisaccharide chain containing one glucuronic acid and two mannose residues is fixed to the 3-position[10].

The products with the addition of egg white produce lower density compared to the products without egg white addition. The liquid egg white is mainly a mixture of water (around 80%) and globular proteins (albumen) form a globular-shaped 3 dimensional network [11]. It can contribute to the physical strength of the dough, although the network is not as strong as gluten. The 2% or 3% addition of XG and CMC do not show significant differences on density.

3.4. Extensibility of Bread

From the figure 2 can be seen that the value of bread extensibility is reversely of the value of bread density. The stronger network will produce bread dough with a larger volume, it means a lower density. Because no CO_2 is released as a result of rupture or tear the dough during fermentation and baking.

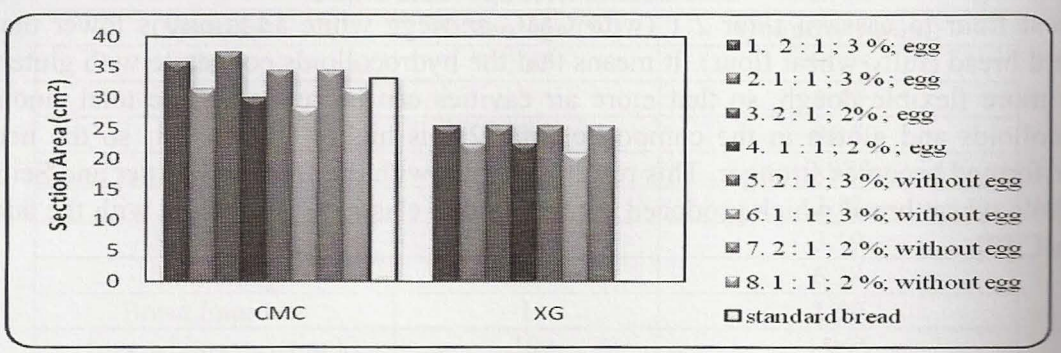


Figure 2 Extensibility of bread

3.5. Bread Hardness

Bread hardness is measured based on its resistance toward 4 gram load with the speed of penetration 1 mm/sec using Texture Analyzer instrument. The results on figures 3 and 4 show, that all products using CMC have a smaller hardness value. This indicates that bread with CMC produces more tender bread compared to bread using XG. There is a directly

proportional relation between density and hardness of the bread, if the density is high, the hardness will be high as well.

Most of the products with the ratio of wheat flour: cassava flour = 1:1 have a higher level of hardness. Network formed by cassava flour is not elastic but tough. Besides no gluten on the cassava flour, higher amylopectin in it stimulate gum properties on cassava flour.

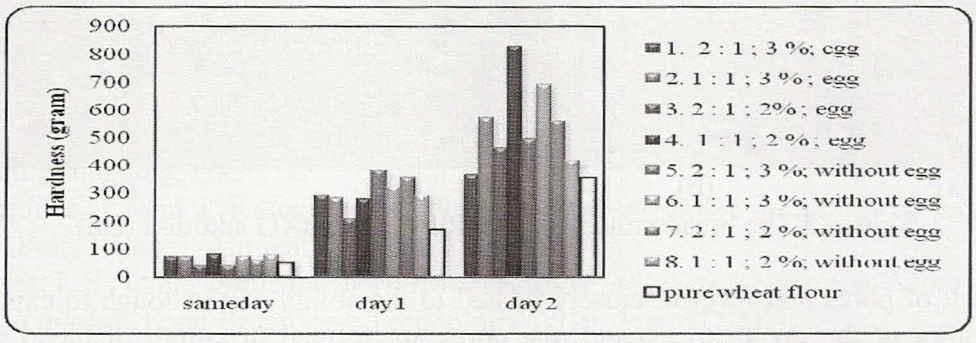


Figure 3 Bread Hardness with CMC addition

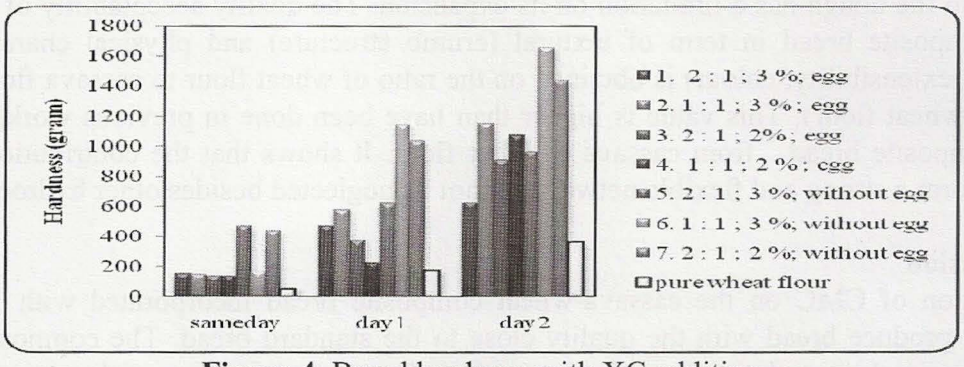


Figure 4 Bread hardness with XG addition

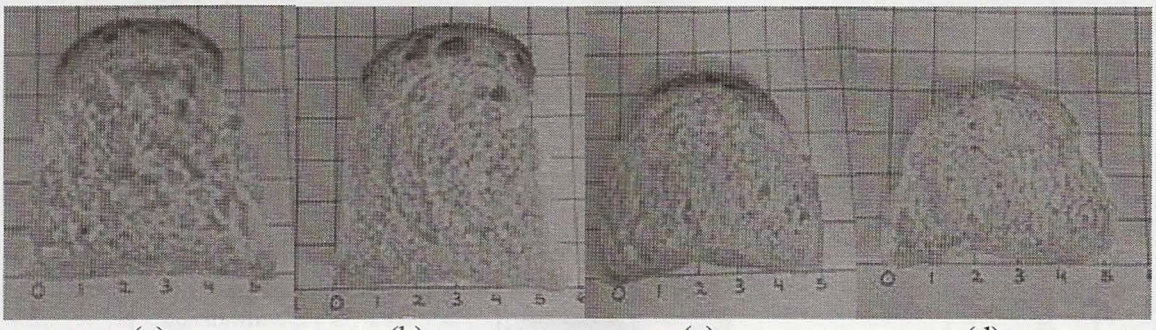
The hardness observation during 3 days showed that the hardness increase with the time. It is valid not only for the bread from composite flour, but also for the bread from pure wheat flour.

3.6. Crust Colours

Ratioof flouristhe mainfactorthataffects thecrust colour. The result showedbreadwithfully wheat flourhasadarkercolourthan theproductfrom composite cassava-wheat flour. It seems that the Maillard reaction is more dominant compared to the caramelization during baking. The amino acid content in the wheat flour reacts with a reducing sugar is forming a melanoid brown, whereas the amino acid in cassava flour is hardly detectable.

3.7. Crumbstructure (crumb firmness)

The crumb structure is determined by its porosity. Based on the figure 5, it can be seen that the bread with CMC addition has more and greater pores than those with XG addition.



(a) (b) (c) (d)

Figure 5 The breadwithCMC addition (a,b) andXG addition (c,d)

The amount of pores that formed, closely related to the ability of the dough to expand. The greater ability of the dough to expand, the pores are formed in crumb of bread will also increase. To obtain a good texture from bread, this should be also supported by the ability of the dough to form strong network. But the network formed by the molecule chain of XG is too stiff, so the dough has a limitation on its expansion. The quality acceptability of cassava-wheat composite bread in term of textural (crumb structure) and physical characteristics (hardness, extensibility, colour) is obtained on the ratio of wheat flour to cassava flour 2:1 (≈ 33% non-wheat flour). This value is higher than have been done in previous work[3, 4, 12, 13]on composite bread from cassava or other flour. It shows that the contribution of egg white in form a strong and flexible network cannot be neglected besides other hydrocolloid.

4. Conclusion

The addition of CMC on the cassava-wheat composite bread incorporated with 10% egg white can produce bread with the quality close to the standard bread. The composite bread that produce a characteristic resembles pure wheat flour bread consists of the ratio of wheat flour: cassava flour= 2:1 with the addition of CMC and egg white, 2% and 10% of the total dough consecutively.

References

1. Yasseen, A.A., A.A. Shouk, and M.T. Ramadan, *Corn-wheat pan bread quality as affected by hydrocolloids.* Journal of American Science, 2010. **6**(10): p. 684-690.
2. Shittu, T.A., A.O. Raji, and L.O. Sanni, *Bread from composite cassava-wheat flour: I. Effect of baking time and temperature on some physical properties of bread loaf.* Food Research International, 2007. **40**(2): p. 280-290.
3. Abdelghafor, R.F., et al., *Quality of bread from composite flour of sorghum and hard white winter wheat.* Advance Journal of Food Science and Technology, 2011. **3**(1): p. 9-15.
4. Afolabi, W.A.O., C.R.B. Oguntona, and B.B. Fakunmoju, *Acceptability and Chemical Composition of Bread from Beniseed Composite Flour.* . Nutrition & Food Science, 2001. **31**(6): p. 310-313.
5. Khalil, A.H., E.H. Mansour, and F.M. Dawoud, *Influence of malt on rheological and baking properties of wheat-cassava composite flours.* LWT - Food Science and Technology, 2000. **33**: p. 159-164.

6. Mepba, H., *Chemical composition, funtional and baking properties of wheat-plantain composite flours.* Africal Journal of Food Agriculture Nutrition and Development, 2007. **7**(1): p. 1-22.
7. Moore, M.M., et al., *Textural comparisons of gluten-free and wheat-based doughs, batters, and bread.* Cereal Chemistry, 2004. **81**(5): p. 567-575.
8. Shittu, T.A., R.A. Aminu, and E.O. Abulude, *Functional effects of xanthan gum on composite cassav-wheat dough and bread.* Food Hydrocolloids, 2009. **23**: p. 2254-2260.
9. Mettler, E. and W. Seibel, *Effects of Emulsifiers and Hydrocolloids on Whole Wheat Bread Quality: A Response Surface Methodology Study.* Cereal Chemistry, 1993. **70**(4): p. 373-377.
10.Edwards, W.P.e., *The Science of Bakrey Products*. 2007: RSC Publishing.
11.Cauvain, S.P. and L.S. Young, *Baked Products: Science, Technology and Practice.* 2006: Blackwell Publishing. UK.
12.Kohajdová, Z. and J. Karovičová, *Influence of hydrocolloids on quality of baked goods.* Acta Sci.Pol., Technol. Aliment., 2008. **7**(2): p. 43-49.
13.Sciarini, L.S., et al., *Influence of gluten-free flours and their mixtures on batter properties and bread quality.* Food Bioprocess Technology, 2010. **3**: p. 577-585.