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Content

O-STARCH-1

The Effects of Varying Weight Ratios of Reconstituted Flour (Wheat, Cassava, Corn, Fermented Cassava) on Characteristics of White Bread.

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Abstract

Lack of food is often more on the limited utilization of the variety of resources rather than the resources shortage. Therefore, it is essential to develop food (like bread) from other flour besides wheat flour, especially in tropical area. Since the texture of the bread comes from the gluten mainly contained in wheat flour, the use of starches other than wheat flour is still an interesting study. The objective of this research is to investigate the effect of the reconstituted flour (cassava, corn and fermented cassava flour) to white bread characteristics. First, the yeast activities (1%, 2% and 3% respectively, in the mix flour) was analyzed to determine the optimal amount needed. The variation of starch mixtures selected was (1) the weight ratio of wheat flour to corn flour is 1:1, 1:2, 0:1 respectively; (2) the weight ratio of wheat flour to mix flour (fermented cassava and corn flour in the ratio 1:1, 1:2, 2:1 respectively) is 1:1. The variation amount of gluten added is 10 %, 15 % and 20 % of starch mixture. The product was determined from its protein content, crumb moisture, specific volume, crumb hardness, loaf expansion and shelf life. The results showed that corn flour slightly inhibited yeast activity, whereas fermented cassava contributed to the yeast needed. Therefore, the optimal yeast used on dough which contains corn flour was 3% and 1.5% for dough which contains fermented cassava. With the condition selected, the publicly consumed white bread characteristic only gained 50% of the non-reconstituted flour.

1. Introduction

Bread has become the most widely consumed food products in the world. From its earliest stage up to now, bread has always been associated with wheat as its major component. Since not every area in the world can produce wheat; the price of wheat fluctuates depending on supply, the availability, even politics. This situation stimulates the utilization of different kind of carbohydrate sources in bread making, like lupin [1], sorghum [2], barley flour [3, 4], rice flour, corn [5] and cassava flour [6-9]. Based on Whistler [10], corn starch and cassava starch have a first and second rank of world starch production in 2003, respectively. The weakness in using other starches rather than wheat starch is the gluten nonexistence, which prevent it from forming permanent network, weaken the dough strength, and reduce gas retention capacity. They generally observed reduction in loaf volume and sensory qualities (e.g. appearance, texture, and flavor). The absent of gluten in flour also reduce the protein content in bread. Singh et al [11] has proved that the addition of wet gluten improved bread properties and increased protein in bread [12].

Hugo et al. [2] who used a fermented sorghum flour (natural lactic acid fermentation) in composite bread reported that by using this flour, the bread volume increased and the crumb firmness decreased. Meanwhile, the utmost goal was to improve the protein

digestibility of the bread product. The objectives of this research were to study the effect of binary mixture (wheat and corn) and ternary mixture (wheat, cassava and fermented cassava) of flours in different ratio with respect to the sensory analysis and physical properties of the white bread. The optimum amount of gluten added into the composite flours and the amount of yeast used in composite dough were also determined.

2. Materials and Methods

2.1. Materials

Commercially all-purpose wheat flour (Cakra-Bogasari Flour Mill), cassava flour (Rose Brand) and corn flour (Maizena) was used as a composite flour in varied weight ratio. The fresh fermented cassava (one of the Indonesian traditional food) was used after cleaning and blanching. The first mixture flours were wheat flour and corn flour with the weight ratio 1:1, 1:2, 0:1. The second mixture flours were wheat flour, cassava flour and fermented cassava with weight ratio between wheat and total cassava flour (native and fermented) was made constant 1:1 whereas the weight ratio of fermented cassava to cassava flour varied in the range 1:2; 1:1 and 2;1. The gluten used varied from 10%, 15% and 20% for every different weight ratio of flour. A food grade *Saccharomyces cereviciae* yeast (Fermipan), dry gluten (Vital), salt and sugar were obtained from local market.

Yeast activities

The activities of yeast were determined by measuring the increasing volume of mixed starch during fermentation periodically. The process was done in a volume jar until the volume of mixed starch started to decrease.

Bread Making Procedure

The procedure of bread making used is a straight-dough method with 500g total weight of dough The mixture flours (282g) containing wheat flour and corn flour (1:1, 1:2, 0:1 w/w), dry gluten (10%, 15% and 20% w/w) along with 5 g compressed yeast, 5 w% sugar, 2 w% skimmed milk and 0.3 w% bread improver were mixed for several minutes in a bread mixer with low speed to get a homogeneous mixture. Then 62 w% of water was added and the mixer speed was increased to a moderate speed. When the dough has a moderate stiff consistency, 2 w% salts and 4 w% shortening was added. The dough was remixed with a high speed mixer for 20 minutes, rested for 10 minutes, molded and placed in baking pans. Baking was done for 25 min., at 220^0C. Bread loaves were cooled for 1 h and then sliced into 1 cm thick slices, packed in polyethylene bag and stored at room temperature (25^0C) for further shelf life studies.

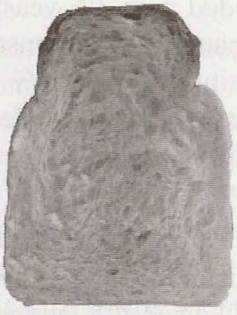
Analysis

The characterization of the product was done on chemical composition, crumb firmness using penetrometer, crumb hardness through the density measurement, and gas retention capacity through the height of loaf measurement. The characteristic of the wheat bread used as the standard was showed in Table 1 below. It was determined by the experiment.

3. Results and Discussion

3.1. Yeast Activity

From the observation of the increasing volume of mixed starch during fermentation, it can be seen that at 3 w%, yeast gives maximal volume, reaching the same level as pure wheat bread.



Parameter	Nilai
% Protein	8,163 %
Tekstur / kekerasan	16,46 mm/s/gr
Densitas	0,29 gr/cm^3
% Kadar air	39,54 %
Tinggi roti	± 12 cm
Kadaluwarsa	3,5 hari

Table 1. The standard properties of wheat bread

3.2. Sensory and Physical Properties of Wheat-corn Bread

The results of wheat-corn bread are shown in Table 2.

Run	Variation			Protein (%)	Moisture (%)	Density (gr/cm^3)	Crumb Firmness (mm/s/g)	Height Loaves (cm)
	Wheat : Corn	Yeast	Gluten					
1	1 : 2	1 %	10 %	7,541	38,42	0,241	11,33	10
2			15 %	7,944	38,11	0,222	15,64	10,5
3			20 %	9,106	35,99	0,332	15,67	11
4		2 %	10 %	7,234	38,25	0,341	8,35	8
5			15 %	8,069	38,09	0,318	14,23	12,5
6			20 %	8,311	37,34	0,243	8,28	8
7		3 %	10 %	7,631	39,04	0,333	10,59	10
8			15 %	8,194	33,52	0,323	11,11	12
9			20 %	9,662	37,04	0,304	14,99	11
10	1 : 1	1 %	10 %	7,763	37,78	0,307	16,26	9,5
11			15 %	7,905	36,65	0,289	14,6	12
12			20 %	8,413	39,08	0,216	15,04	11
13		2 %	10 %	7,417	37,12	0,289	7,14	11
14			15 %	7,706	35,08	0,284	9,97	9,5
15			20 %	9,094	39,21	0,191	12,16	10
16		3 %	10 %	7,138	38,24	0,279	10,41	12
17			15 %	8,023	37,27	0,25	11,98	10
18			20 %	9,519	36,77	0,346	12,89	11
19	2 : 1	1 %	10 %	7,367	37,23	0,473	3,73	5
20			15 %	7,488	36,11	0,466	4,68	7
21			20 %	9,112	38,12	0,386	11,23	11
22		2 %	10 %	7,333	34,06	0,35	5,83	7
23			15 %	7,512	33,82	0,363	4,57	6,5
24			20 %	8,556	32,93	0,344	12,08	10
25		3 %	10 %	7,049	37,63	0,464	3,96	5
26			15 %	8,432	35,27	0,496	5,29	6
27			20 %	8,677	38,71	0,33	9,08	11

Table 2. The wheat-corn composite bread properties

The table above shows that the wheat-corn bread, which is the closest to the wheat bread properties is achieved at weight ratio wheat to corn 1:1 added with 3% yeast and 20% gluten. The sensory evaluation, which was tested from 20 panelists, demonstrated that acceptable quality of this bread could be made with corn substitution at ≤ 50%. The only difference lies on the color of the crumb, which becomes more yellow. No difference was observed for the sensory attributes of aroma, firmness and mouthfeel. Beyond the mentioned figure, the taste of the bread changes, the crumb become very dry, and the crust is very hard. Compared to the result obtained by Siddiq et al..[5], who substituted wheat bread with defatted maize germ flour, the result from this experiment has improved. The acceptable quality of the mixed flour bread only gained up to 15g DMG/100 g (≈ 20%). And also corn in the white bread extends its shelf life which can reaches up to 4.5 days, longer than the standard wheat bread of 3.5 days.

3.3. Sensory and Physical Properties of Wheat-cassava (native and fermented) Bread

Run	Variation		Protein (%)	Moisture (%)	Density (g/cm^3)	Crumb firmness (mm/s/g)	Height loaves (cm)
	Cassava *) (fermented:native) (w/w)	Gluten (w%)					
1	1 : 2	10	20.381	24.47	0.356	8.69	7.5
2			17.296	27.27	0.383	16.03	8
3		15	14.274	30.31	0.418	7.54	7
4			27.425	21.05	0.353	8.25	6.5
5		20	17.067	31.11	0.640	6.37	5
6			13.82	31.37	0.315	10.1	9.8
7	1 : 1	10	19.776	29.08	0.517	7.4	5.5
8			23.214	32.58	0.341	10.89	9
9		15	12.686	25.76	0.509	16.64	10
10			24.571	25.98	0.385	9.04	10
11		20	30.507	26.87	0.449	16.56	14.5
12			20.897	26.92	0.422	17.95	16
13	2 :1	10	16.754	25.86	0.413	12.11	9
14			17.521	29.57	0.370	15.16	10
15		15	18.665	25.58	0.473	11.31	12

*) weight ratio of total cassava to wheat = 1: 1 (constant)

Table 3. The wheat-cassava (native-fermented) composite bread properties

Table 3 shows the result of breadmaking from the ternary mixtures flours. The weight of fermented cassava flour was calculated based on its dry weight. The water content of the fermented flour was considered in the amount of water used in the formulation. The result which closed to the standard wheat bread was at the weight ratio fermented cassava to cassava flour = 1:1 with the gluten addition of 20%. This bread gives a unique aroma which is favorable, but its shelf life is reduced compared to the wheat bread. Apparently, the *Saccharomyces cereviciae* from the fermented cassava gives contribution to the perishable bread.

4. Conclusions

The composite flours have considerable potential for breadmaking. Natural fermentation of cassava roots improves the protein content of white bread, but decreases the crumb firmness and shelf life. To gain good texture, the added gluten should be proportional with the substituted wheat flour. Further research will be more concentrated on the molecular properties of the flour and the effect of the microorganism from the fermented roots.

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