

CHAPTER V

INFLUENCE OF BREAD PREPARATION AND IMPROVERS ON PHYSICAL AND ORGANOLEPTIC QUALITY OF BREAD

5.1 INTRODUCTION

The baking process exposes flour baking characteristics and the first important stage in baking process is mixing in dough preparation. Gluten development, oxidation and expansion occur during this process. During mixing gliadin and glutenin combined to form gluten which holds the cell during gas formation by yeast. The amount of gluten produced depends on the protein quantity of flour; therefore, protein is responsible for the expansion of the retained gas and the amount of protein present dictates the expansion length and subsequent loaf volume and bread texture (Dennis, 2012; Upadhyay et al, 2012).

Bread ingredients mainly flour, water, salt and yeast are important in the mixing process. As the ingredients affect the chemical and physical processes so also the processing. Producing quality bread therefore demands not only the right ingredients but also suitable technique (Gallagher et al, 2005; Svec and Hruskova, 2010). Therefore, monitoring should cover both material and processing technique involved to achieve a quality bread at minimal cost.

The consumers' preference is essential when monitoring food quality to ensure marketability and avoid product rejection. Dough preparation is an important stage of bread

production technology with a significant effect on quality of product. The significant of salt in food preparation are numerous. Salt are used for flavour development, preservation, improving taste as well as controlling leavening in yeast bread. Two basic mixing techniques are developed for yeast products; the Straight dough and the sponge method.

Straight Dough Method involves combining all ingredients in the mixing bowl and mix. It is the initial method used in commercial production and has been adopted by researcher as well while the sponge dough is prepared in two stages. The sponge is prepared first from water, flour, and yeast and allowed to ferment. This process reduces fermentation time and improved flavour (Dennis, 2012; Ishida and Steel, 2014).

The problem emanating from the development in milling technology introduced into bakery industry pushed research to the Autolyse technique. Autolyse is an improved sponge method; flour and water are first prepared and allowed to rest before the addition of other ingredients. It prevents long mixing, activates flour enzymes and improves baking output.

Calvel has introduced Autolyse since 1960 with the concern of preparing quality bread at less cost for the satisfaction of both producers and consumers of bread (Gisslen, 2013; Raymond 2001). Research work to investigate into this method is very scanty therefore this study aims to assess bread making and sensory qualities of bread produced from Straight dough and Autolyse technique of mixing under the influence of the three brands of commercial improver.

5.2 Materials and Method

Diamond brand high gluten flour with protein content of 12% was selected for this study, CBI under test were Kijang (1st brand), Nona (2nd brand) and YNS (3rd brand), other ingredients include baker's yeast, salt, shortening and sugar. All materials were supplied by Food Biotechnology Department, Universiti Sains Islam, Malaysia (USIM).

Straight dough and Autolyse mixing technique was employed. Bread samples produced and labelled according to their preparatory method and improver brand combination. A1, A2, A3 (Autolyse samples with the first, second and third brand of improver respectively) and S1, S2, S3 (Straight dough samples with the first, second and third brand of improver respectively).

5.2.1 Baking Procedure

5.2.1.1 Straight Dough Method

Straight dough mixing was prepared as described in chapter three.

5.2.1.2 Autolyse Technique:

The baking recipe for each sample of this study in baker's percentage in proportion of flour was 100% flour, 2.25% salt, 60% water, 3.75% instant dry yeast, 3.75% sugar and 1.0% improver based on manufacturer recommendation. The flour and water were mixed and allowed to rest in the mixer for 40 minutes before adding other ingredients.

This second mixing was done for 15 minutes at low speed. The dough was then transferred to proofer at 30 °C, and 70% relative humidity until it doubled in size, kneading was done manually and the kneaded dough was transferred into baking pans greased with fat and returned to proofer for second proofing before transferring into oven. Baking was done for 30 minutes at the temperature of 200 °C. The bread was allowed to cool for a minimum of two hours before further analysis.

5.3 Bread Characteristics

5.3.1 Physical Measurement

The measurement of bread volume, weight, specific volume, loaf height, weight loss, crust-crumbs colour, and textural analysis were performed as described in previous chapter. Image of breadcrumb was acquired by capturing images on the crumb grain of the sliced bread. This was achieved by scanning slices from the center of each bread with a scanner (Canon Scan Lide 700F, Canon) as described by Skendi et al. (2010). Textural analysis was performed as described in the previous chapter; analyses were conducted 24 hours, 5 days and 10 days after baking.

5.3.2 Moisture Content

Moisture content was determined as described in chapter three. Analyses were conducted 24 hours, 5 days and 10 days after baking.

5.3.3 Crumb Structure

Breads crumbs were assessed as described in chapter three.

5.3.4 Crumb and Crust Colour

The parameter of crumb and crust was measured with Hunterlab Lab scan XE colourimeter as described in previous chapter. Images of crumb obtained through scanner as described in chapter three.

5.3.5 Texture Profile Analysis

Crumb texture profile analysis was performed using a TA.XT^{plus} TA XT Express texture analyzer (Stable Micro Systems Ltd., Surrey, UK) according to the AACC (2010) approved method. Firmness testing was performed on bread loaves that were stored for 4 days. About 25 mm thickness sliced crumb samples were cut from the center of each loaf using a kitchen knife, samples were analyzed immediately after extracting to prevent excess moisture loss.

Samples were compressed in dual cycle using a 36 mm cylinder probe with the maximum compression of 40% at a crosshead speed of 1.7 mm/s. The analysis was performed in triplicate for each treatment and average values were reported.

5.3.6 Organoleptic Properties

The sensory evaluation of the fresh bread was conducted by 12 panelists from the department of Food Science and Technology, USIM, Malaysia. The bread samples were

prepared and coded with 3-digit random numbers and each sample was presented with different number.

Evaluation was done four hours post baking. Samples were randomly assigned to each panelist. Panelists were asked to evaluate the coded bread samples for each sensorial parameter including appearance, colour, aroma, crumb texture, taste, and overall acceptance based on their degree of liking using 9-point hedonic scale, from “dislike extremely to like extremely” (Ishida and Steel, 2014).

5.3.7 Statistical Analysis

The result obtained was reported as the means of three loaf replicates and analyzed by analysis of variance (ANOVA) using Minitab 16.2.1 version software. Significant differences between the mean values were determined using Fisher's test at a significance level of $P < 0.05$.

5.4 Result and Discussion

5.4.1 Physical Properties

Table 5.1 shows the result for the analysis of the physical properties of the bread samples.

5.4.1.1 Volume

The average volume of samples vary from 1983.30 to 2016.70 and 1733.33 to 1816.67 cm^3 for the Autolyse and Straight dough baked bread respectively. All samples differ statistically, sample A1 and S3 had the highest and lowest volume respectively. Autolyse samples were lighter compare to the Straight dough samples with weight value in range of

489.43 to 499.80 g and 605.93 to 609.57 g for Autolyse and Straight dough baked loaves respectively.

Table 5.1: Physical Characteristic of Autolyse and Straight Dough Bread Samples

Sample	Volume (cm ³)	Weight (g)	Loaf Height (cm)	Specific volume (cm ³ /g)	Weight loss (%)
A1	2016.70 ^a ±76.4	499.80 ^b ±18.6	11.61 ^a ±0.1	4.03 ^a ±0.1	13.37 ^a ±0.3
A2	1933.30 ^{ab} ±76.4	489.43 ^b ±26.1	11.27 ^a ±1.0	3.96 ^a ±0.3	12.66 ^a ±0.8
A3	1983.30 ^a ±28.9	493.77 ^b ±14.6	12.00±0.5	4.02 ^a ±0.3	13.18±0.6
S1	1766.67 ^c ±125.8	607.40 ^a ±11.5	10.89 ^a ±1.0	2.91 ^b ±0.2	10.25 ^a ±2.2
S2	1816.67 ^{bc} ±28.9	605.93 ^a ±17.2	10.71 ^a ±1.1	3.00 ^b ±0.1	10.38 ^a ±2.9
S3	1733.33 ^c ±76.4	609.57 ^a ±17.8	10.61 ^a ±1.2	2.85 ^b ±0.2	10.12 ^a ±2.5

Means with different alphabet are statistically different (P<0.05)

5.4.1.2 Weight and Weight Loss

Weight of samples were not differ in terms of improver group, that is Autolyse samples were not statistically differ (P<0.05) among themselves, the Straight dough samples follow this same trend. There was no significant difference between loaf weight and weight loss of samples. Specific volume of the Autolyse samples were higher compare to the Straight dough samples. Samples within a particular mixing method were not differentiated statistically.

Summarily, Autolyse samples exhibited higher volume, specific volume (3.96-4.03cm³/g) and lower weight while Straight dough samples showed larger weight, lower value of volume and specific volume (2.85-3.0 cm³/g). The mean specific volume found in

this study is consistent with those reported by Ndife et al (2013), he obtained an average value of 4.38 cm³/g and a range of 2.15 to 3.14 cm³/g for white and whole wheat bread respectively.

Ishida and Steel (2014) found higher value for white and whole wheat, 4.72 and 4.70 cm³/g respectively. A recent study on composite bread by Julianti and others (2015) found a lower specific volume between 1.45 to 1.59 cm³/g. The specific loaves ranged from 2.59 to 3.45 cm³/g was recorded by Coelho and Salas-Mellado (2015).

5.4.2 Moisture Content

The moisture contents of samples vary between 34.07% and 39.13% (Table 5.2).

Table 5.2: Moisture Content of Bread Samples on Days 1, 5 and 10 after Baking

Sample	Moisture 1	Moisture 5	Moisture 10
A1	35.73 ^a ±4.75	34.14 ^{ab} ±0.19	31.93 ^a ±0.07
A2	39.13 ^a ±3.17	35.16 ^a ±1.82	31.37 ^a ±1.15
A3	37.16 ^a ±3.09	33.14 ^{bc} ±0.68	28.96 ^b ±0.56
S1	34.07 ^a ±1.27	33.40 ^{bc} ±0.20	32.19 ^a ±1.19
S2	34.12 ^a ±1.25	31.82 ^c ±0.94	31.20 ^a ±1.34
S3	34.09 ^a ±3.40	32.24 ^c ±0.54	30.48 ^{ab} ±0.88

Means with different alphabet are statistically different (P<0.05)

For the first day of analysis, the moisture content of all samples were not statistically different (P<0.05). White bread has been regulated to have moisture content not more than

45% in Malaysia (Food regulations, 1985). Therefore, the values obtained in this work are within the accepted values.

There is similarity of moisture content values with what has been reported. Olaoye et al (2006) obtained 30.98%, and 34-35.59% moisture for white and composite bread sample, recent work by Coelho and Salas-Mellado (2015) obtained moisture content values of 37.2 and 37.2-37.38.2 for white and composite bread respectively.

Moisture content of all samples decreased during the period of analysis (Figure 5.1) and the Autolyse bread samples had higher moisture on day five of analysis. This happened because the flour had been allowed to absorb enough water during mixing (Ishida and Steel, 2014) and the unavailability of salt during the process to compete with flour favours water retention.

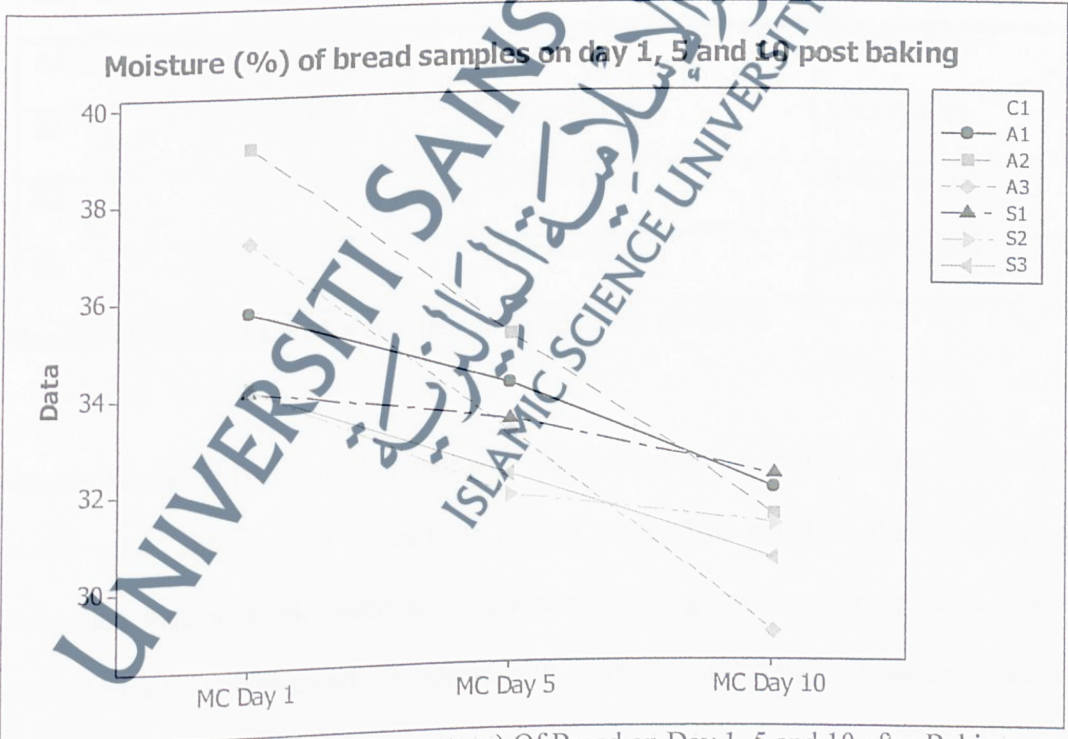


Figure 5.1: Moisture Content (Percentage) Of Bread on Day 1, 5 and 10 after Baking

5.4.3 Water Activity

The result of the water activity (A_w) of bread samples is presented in Table 5.3 and Figure 5.2.

The average water activity values (A_w) on the first day of analysis were not statistically different among samples ($P<0.05$). Higher and similar values obtained by samples A1, A2 and S3 on the fifth day while sample A3 had the lowest values.

Table 5.3: Water Activity of Bread Samples on Days 1, 5 and 10 after Baking

Sample	H ₂ O activity-Day1	H ₂ O activity-Day5	H ₂ O activity-Day10
A1	0.950 ^a ±0.01	0.944 ^a ±0.00	0.925 ^{ab} ±0.00
A2	0.951 ^a ±0.01	0.948 ^a ±0.00	0.930 ^{ab} ±0.01
A3	0.942 ^a ±0.00	0.929 ^c ±0.01	0.922 ^b ±0.01
S1	0.942 ^a ±0.01	0.939 ^{ab} ±0.01	0.935 ^a ±0.01
S2	0.942 ^a ±0.01	0.939 ^{ab} ±0.00	0.934 ^{ab} ±0.01
S3	0.947 ^a ±0.01	0.945 ^a ±0.01	0.926 ^{ab} ±0.00

Means with different alphabet are statistically different ($P<0.05$)

Sample A3 and S3 (with brand C improver) showed conflicting result, sample A3 had the lowest value while sample S3 had the highest value. This could be due to different processing method used, Autolyse dough retains enough water making lesser water available for microbial growth. Products with more free water will release moisture to surrounding to attain equilibrium.

The tenth day showed that samples A1, A2, S2 and S3 had similar Aw. Sample A3 and S1 had the lowest and highest values respectively. All samples had reduced Aw during shelf life. This result suggests that Aw was not only affected by CBI but also influenced by processing.

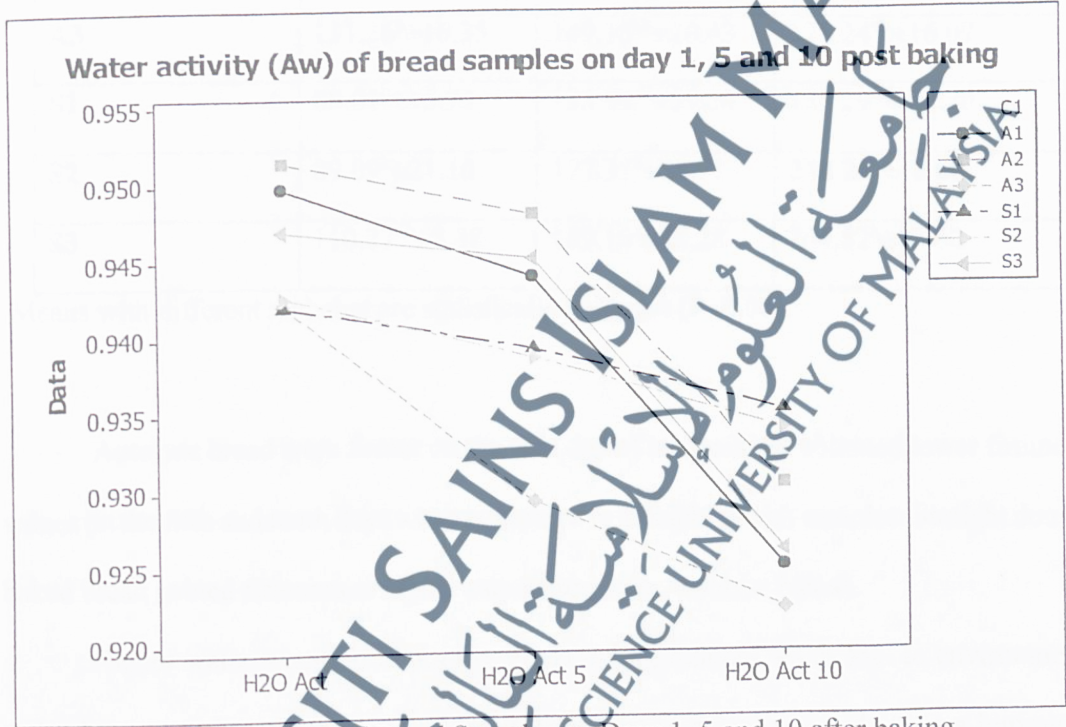


Figure 5.2: Water activity of Bread Samples on Days 1, 5 and 10 after baking

5.4.4 Textural Properties of Bread.

The average firmness values of the bread samples is depicted in Table 5.4.

Table 5.4: Firmness of Bread Samples on Days 1, 5 and 10 after Baking

Sample	Firmness 1	Firmness 5	Firmness 10
A1	106.46 ^{ab} ±3.75	115.67 ^b ±5.24	149.72 ^b ±61.57
A2	129.79 ^a ±21.15	140.09 ^{ab} ±4.87	173.90 ^{ab} ±5.67
A3	131.36 ^a ±16.35	149.16 ^{ab} ±20.43	173.24 ^{ab} ±16.07
S1	88.01 ^b ±15.93	133.64 ^{ab} ±59.34	187.29 ^{ab} ±82.70
S2	89.09 ^b ±21.10	177.33 ^a ±34.71	248.26 ^a ±48.60
S3	110.27 ^{ab} ±8.38	189.16 ^a ±38.28	264.82 ^a ±53.60

Means with different alphabet are statistically different (P<0.05)

Autolyse bread were firmer on the first day of analysis but obtained lower firmness values on the fifth and tenth days when compared to Straight dough samples. Straight dough baked bread gained firmness at higher rate compare to Autolyse baked.

Higher water retention of Autolyse processing reduces water loss to environment and subsequently lessen hardness of bread. Firmness of samples vary based on improver group. This result suggest that improver enhance bread textures. All samples showed increase in firmness during storage as observed in Figure 5.3. This is probably due to starch retrogradation and water loss.

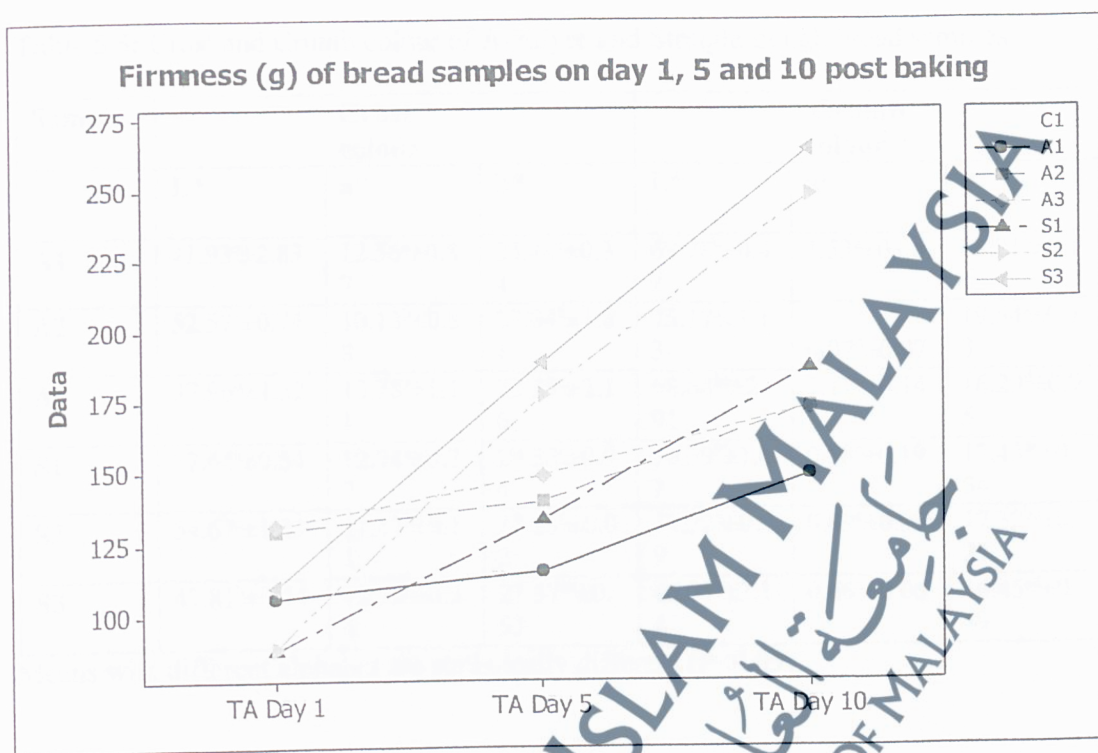


Figure 5.3: Firmness of Bread Samples on Days 1, 5 and 10 after Baking

5.4.5 Colour Measurement

The lightness (L^*) values (crust) of the Autolyse samples range from 37.96 to 52.57 and Straight dough from 47.81 to 54.67 (Table 5.5). Lower L^* value of Autolyse implies a more brownish crust than other samples. Samples A3 (with brand C improver) and A2 (with brand B improver) had the lowest and highest L^* values respectively in the Autolyse sample.

As for the Straight dough, sample S3 (with brand C) had the lowest value and statistically different from others. Thus there is an indication that brand C influences colour parameter of the sample. The b^* values vary from 22.29 to 29.52. Straight dough samples had higher b^* values (27.23-29.52) indicating that they were more yellowish than the Autolyse samples.

Table 5.5: Crust and Crumb colour of Autolyse and Straight dough bread samples

Sample	Crust colour			Crumb colour		
	L*	a*	b*	L*	a*	b*
A1	41.93 ^c ±2.83	12.56 ^a ±0.87	23.44 ^c ±0.34	69.78 ^b ±0.42	1.53 ^a ±0.06	18.21 ^b ±0.14
A2	52.57 ^a ±0.74	10.13 ^b ±0.88	27.04 ^b ±1.81	75.17 ^a ±1.13	-0.07 ^d ±0.07	19.54 ^a ±0.53
A3	37.96 ^d ±1.32	13.78 ^a ±1.11	22.29 ^c ±2.10	68.64 ^{bc} ±2.91	1.12 ^b ±0.14	16.29 ^d ±0.95
S1	52.44 ^a ±0.54	12.94 ^a ±0.27	29.52 ^a ±0.94	70.59 ^b ±1.47	0.58 ^c ±0.19	17.43 ^{bc} ±0.54
S2	54.67 ^a ±1.23	11.17 ^b ±0.11	27.23 ^b ±0.02	71.22 ^b ±0.09	0.49 ^c ±0.09	17.32 ^{bc} ±0.29
S3	47.81 ^b ±0.74	12.92 ^a ±0.34	27.57 ^{ab} ±0.53	65.77 ^c ±2.14	0.66 ^c ±0.06	16.45 ^{cd} ±0.49

Means with different alphabet are statistically different (P<0.05)

For the crumb measurement, Autolyse samples L* values were in the range of 68.64 to 75.17 and Straight dough prepared samples had L* values range of 65.77 to 71.22. This shows that Autolyse samples were whiter than the other samples. The average a* range for Autolyse and Straight dough samples were - 0.07 to 1.53 and 0.49 to 0.66 respectively, with the lowest score in sample with brand B improver in the two processing methods.

This indicates that Autolyse samples with the exception of sample A2 were more reddish than other samples. The b* values range were 16.29 to 19.54 and 16.45 to 17.43 for the Autolyse and Straight dough bread samples respectively, indicating Autolyse samples to be more yellowish than bread from Straight dough.

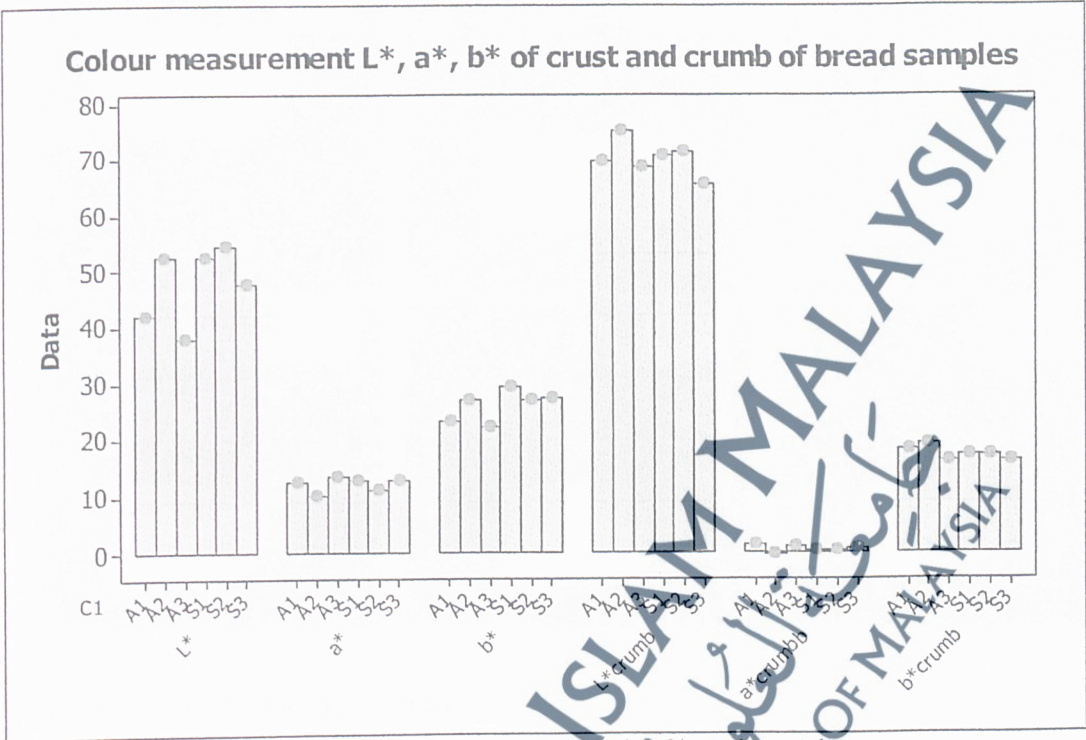


Figure 5.4: Colour measurement of crust and crumb of bread samples

5.4.6 Crumb Structure

The crumb structure of bread samples were presented in Figure 5.5, a significant influence of processing method on cells size was noticed, while the crumb porosity was similar among samples. Autolyse technique of mixing had positive effect on flour irrespective of improver in usage.

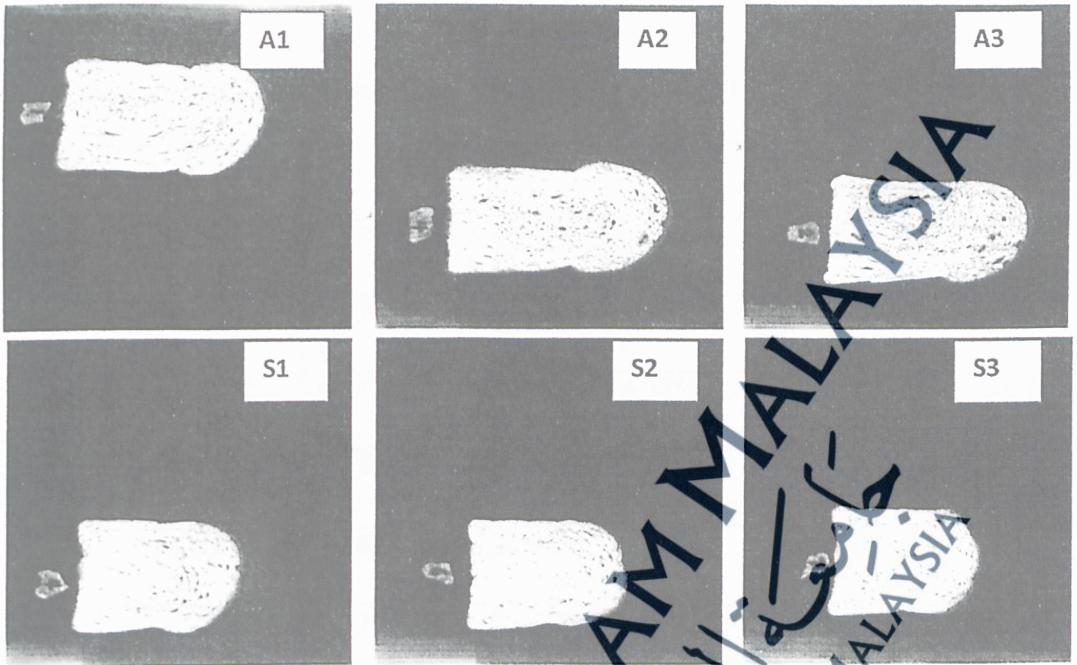


Figure 5.5: Crumb Structure of Bread.

A1, A2 and **A3** are Autolyse samples with first, second and third brand of improver respectively.

S1, S2 and **S3** are Straight dough samples with first, second and third brand of improver respectively.

5.4.7 Organoleptic Analysis

Table 5.6: Organoleptic Assessment of Autolyse and Straight Dough Samples

Sample	A1	A2	A3	S1	S2	S3
Appearance	6.00 ^{ab} ±0.0	5.67 ^b ±0.6	6.00 ^{ab} ±0.0	6.33 ^{ab} ±0.6	6.00 ^{ab} ±0.0	6.67 ^a ±0.6
Taste	5.67 ^{ab} ±0.6	5.67 ^{ab} ±0.6	6.67 ^a ±0.6	5.67 ^{ab} ±0.6	5.33 ^b ±0.6	6.67 ^a ±0.6
Colour	6.33 ^a ±0.6	6.67 ^a ±0.6	6.33 ^a ±0.6	6.33 ^a ±0.6	6.33 ^a ±0.6	6.67 ^a ±0.6
Aroma	6.67 ^a ±0.6	6.33 ^{ab} ±0.6	6.33 ^{ab} ±0.6	6.00 ^{ab} ±0.0	5.67 ^b ±0.6	5.67 ^b ±0.6
Texture	6.00 ^{ab} ±0.0	6.00 ^{ab} ±0.0	6.33 ^a ±0.6	5.67 ^{ab} ±0.6	5.33 ^b ±0.6	5.67 ^{ab} ±0.6
Overall acceptability	6.33 ^a ±0.6	6.33 ^a ±0.6	6.33 ^a ±0.6	6.00 ^a ±1.0	5.67 ^a ±0.6	6.00 ^a ±1.0
IA (%)	68.52	67.91	70.35	66.67	63.57	69.17

Means with different alphabet are statistically different ($P < 0.05$)

Table 5.6 shows the average scores obtained by each sample in the sensory test.

Samples from both method differed slightly regarding appearance and taste. For the appearance sample S3 was rated higher, samples A3 and S3 were rated best and compete with the control in terms of taste ($P < 0.05$). Regarding the attribute aroma, Autolyse samples were more acceptable than Straight dough samples, this higher score can be associated to the method employed (Ishida and Steel, 2014). Samples differed slightly regarding texture.

The overall impression and colour attributes were not statistically differentiated from the control ($P < 0.05$), however the outcome of the index of acceptability revealed score between 67.91 to 70.35% and 63.57 to 69.17% (table 19) for Autolyse and Straight dough samples respectively.

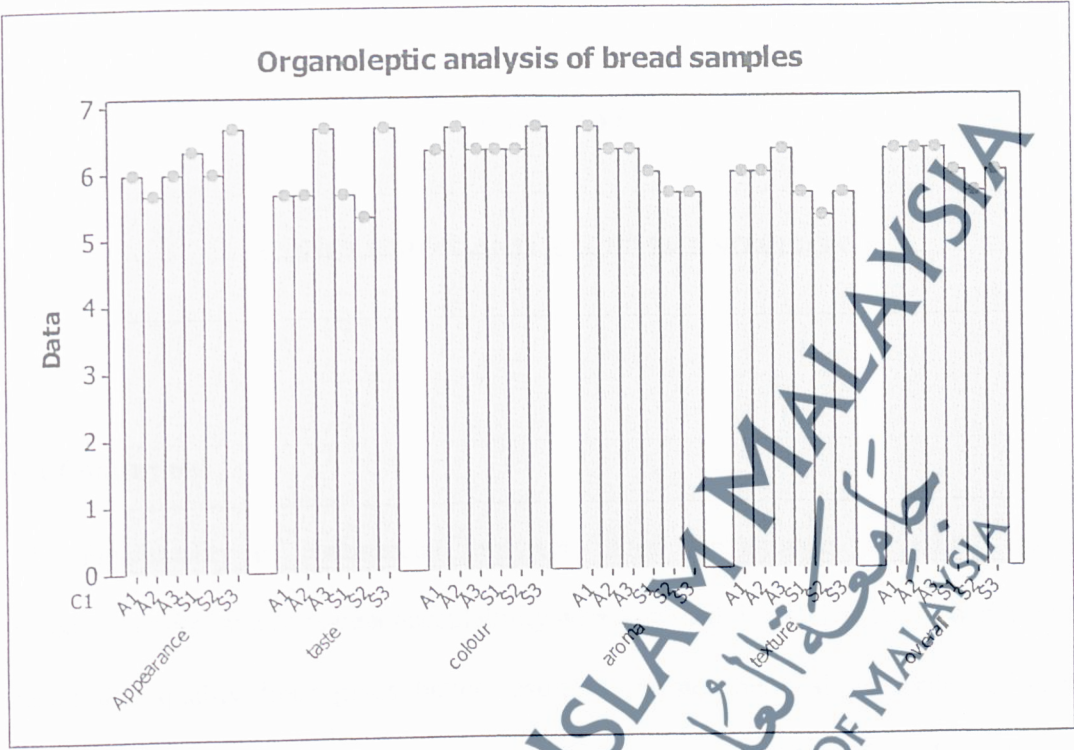


Figure 5.6: Consumer acceptability of bread samples prepared using Autolyse and Straight dough method

5.5 Conclusion

Processing method greatly influenced bread quality. Autolyse samples had higher volume, higher specific value, and better textural attributes that improve bread storability. Consumer test indicated higher acceptance of Autolyse samples. The samples scored higher on aroma, texture and the overall impression of attribute tested. Though the effect of processing method is more pronounced, variability of improvers affects bread features.