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# Effect of processing techniques on pasting properties, colour and consumer acceptability of Ogi produced from four varieties of maize

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**Abstract**

This study was aimed at investigating the common processing techniques and the effect on consumers' concerns (pasting, colour and sensory parameters) for ogi produced from four varieties of maize (TZL COM4(A4W), ACR9931DMRSRY (C3Y), BR9928DMRSRY, (B2Y) and ACR97COM1 (E9W). Ogi was produced during the soaking period in the range of 12 to 96 hrs at an average soaking temperature of 28 and 65°C, respectively. The result revealed that there were significant differences ($p<0.05$) in the pasting properties. The peak viscosities ranged from 165.01-184.174 RVU and 165.01-188.94 RVU for C3Y, 161.889-184.60 and 162.35-199.42 RVU for B2Y, 165.48- 187.86 and 165.811.202.62 RVU E9W soaked at 28 and 65°C, respectively. Higher values of Breakdown viscosity were recorded for ogi produced at 60, 72, 84 and 96th hrs of soaking for maize varieties B2Y and C3Y. The cooking time obtained was all less than 7 mins, while the pasting temperature ranged from 75-84°C. There were significant differences ($p<0.05$) in the sensory parameters evaluated. Ogi from A4W at the soaking period of 12 hrs was favourably scored 6.90 and 7.40 for sourness. Ogi soaked at 28 and 65°C was scored higher for colour at 12th hr for all the varieties. The result indicated that the soaking period and method prompted the lightness of Ogi produced from maize grains. The colour changes were significantly higher in the yellow maize varieties B2Y and C3Y.

## 1. Introduction

Ogi slurry is one of the products widely produced from cereals. It is a popular breakfast and infant weaning food in Nigeria and West Africa (Igbedioh *et al.,*1996; Bolaji *et al.,* 2011). Ogi is usually consumed alone or sometimes, fortified with legumes as weaning food (Akingbala *et al.,* 1981). The pap or the stiff gel (Eko) is often eaten along with meat, stew, vegetable soup, steamed bean's cake (moin-moin) or fried bean cake (Akara) (Akingbala *et al.,* 1981; Onyekwere *et al.,* 1989; Igbedioh *et al.,* 1996). The production of ogi reported by most researchers is characterised by soaking of 24-72 hrs (Onyekwere *et al.,* 1989; Igbedioh *et al.,* 1996; Bolaji *et al*., 2011) wet milling, filtration and sedimentation of the filtrate for 12–48 hrs to obtain sour ogi (Onyekwere *et al.,* 1989; Bolaji, Adenuga-Ogunji and Abegunde, 2017). Nago *et al.* (1998) reported boiling at 95-100°C for a few minutes before soaking for 12-48 hrs at an ambient temperature of 25-35°C in Benin. In some cases, soaking is done in cold water at room temperature for 72 to 120 hrs with regular changing of the steep water every day (Teniola and Odunfa, 2002; Bolaji, Abegunde, Praise-Ofuani-Oyinloye *et al.,* 2017).

Pasting properties and tartness are important to most consumers (Bolaji, Adenuga-Ogunji and Abegunde, 2017; Bolaji, Abegunde, Praise-Ofuani-Oyinloye *et al.,* 2017). Pasting properties are an indicator of amylose leaching and are necessary to establish the effect of viscous load required during processing and handling (Miles *et al.,* 1985; Ring *et al.,* 1987; Atwell *et al.,*1988; Da Silva *et al.,* 1997; Shimelis *et al.,* 2006; Bolaji, Adenuga-Ogunji and Abegunde, 2017). Changes in final viscosity and setback were linked to the degree of re-ordering of leached amylose chains (Atwell *et al.,*1988; Da Silva *et al.,* 1997; Bolaji, Abegunde, Praise-Ofuani-Oyinloye *et al.,* 2017). Pasting properties are dependent on the botanic sources and molecular degradation of starch (Nemtanu *et al.,* 2007; Seetharaman *et al.* 2001). Several researchers characterised pasting properties of starches from different corn types (Yamin *et al.,* 1999; Seetharaman *et al.,* 2001; Ji *et al.,* 2003; Sandhu *et al*. 2004; Sandhu and Singh, 2007).

Many areas have been explored in the production of ogi, but the survey of processing techniques (soaking period, methods and temperature) and their effect on the

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pasting properties and colour of wet ogi is scanty in the literature, most especially on the varieties of maize used in this work (Bolaji *et al.,* 2016; Bolaji, Awonorin, Shittu *et al*., 2017; Bolaji, Awonorin, Shittu *et al*., 2017). Mechanical properties at critical processing conditions (Bolaji *et al.,* 2018a) and water absorption kinetics (Bolaji *et al.,* 2018b) of the varieties of maize used in the research have been extensively studied, however, the effect of processing techniques on consumers' concerns, even though of commercial importance is yet to be explored, but addressed in this work.

## 2. Materials and methods

### *2.1 Preliminary study*

A preliminary study was conducted with the aid of a questionnaire. The information obtained from a questionnaire and statistically analysed are reflected in Table 1.

### *2.2 Production of the Ogi*

Four varieties of maize (A4W -TZL COM4, C3Y-ACR9931DMRSRY, B2Y-BR9928DMRSRY and E9W-ACR97COM1) were obtained from IITA for this study. These maize varieties were soaked for 12, 24, 36, 48, 60, 72, 84 and 96 hrs, within the range reported in the literature (Onyekwere *et al.,* 1989; Bolaji *et al*., 2011; Bolaji, Adenuga-Ogunji and Abegunde, 2017) and soaking methods of ambient temperature (28°C) and average 65°C, respectively and ogi slurry was produced by wet milling, filtration and allowed to sediment. An average 65°C was obtained as a result of common practices of hot water soaking ranging from boiled water. The general practice indicated that the boiled water is not kept constant in the process and soon equilibrate with the environment at about 3-4 hrs depending on the rate of heat loss. The average temperature within hrs was recorded for hot soaking.

### *2.3 Determination of pasting properties and colour of Ogi*

The pasting properties were determined using Rapid Visco Analyser (RVA). The values obtained were conveniently determined using the software provided (Thermokin software) in the instrument. The colour of the Ogi sample was determined quantitatively with the aid of a handheld ColorTec-PCM/PSMTM1 meter, manufactured by Color-Tec. Clinton, NJ 08809, USA. The colourimeter was calibrated and this process was repeated each time the instrument was used based on manufacturers' guidelines. The reading was taken directly for L*. The instrument displayed three-dimensional colour difference in uniform colour space (Lab) coordinates. Total colour difference ($\Delta E^*$) was calculated using the equation (1):

$$\Delta E^* = \sqrt{(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2} \quad (1)$$

### *2.4 Sensory evaluation*

A total of sixty member panels consisting of adults (18 years and above) helped to evaluate the pap produced from ogi slurry from these varieties. The panel was untrained but consisted of ogi consumers. The selection was based on familiarity, interest and availability. Ogi porridge was prepared by mixing 100 g of ogi slurry with 50 mL in a transparent 1000 mL plastic bowl and 400 mL of boiled water at 100°C was used to gelatinize the sample (Bolaji *et al.,* 2011). The Responses obtained from the panellist were subjected to statistical analysis.

### *2.5 Data analysis*

The SPSS version 17 was used for statistical analysis of data obtained. Analysis of variance was determined, where significant difference existed, Duncan, multiple range tests were conducted to separate the means.

## 3. Results and discussion

### *3.1 Survey study*

The result obtained from the survey study of Ogi production from 230 respondents comprising the consumer, producer and marketer is shown in Table 1. The result revealed that there were 77.83% and 22.17% of female and male respondents, respectively. About 42 civil servants, 65 traders, 44 self-employees and 79 falls to other groups. About 56.96% of the respondents were consumers, 23.48% were marketers and 19.58 % were producers. About 116 of the respondents buy ogi, 94 self -produced and 19 contract it out. 181 respondents reported that they use maize as major raw material in the production of ogi. About 105 of these preferred the use of white maize and 81 respondents used yellow maize. About 172 of the respondents used the cold-soaking method while 51 respondents used hot soaking (pour boiled water at the beginning of soaking). The attrition mill was mostly used by the 171 respondents. Most of the respondents cannot ascertain if the hot or cold soaking will aid gelling, or colour changes and a majority indicated that ogi is usually left to ferment for at least one day.

### *3.2 Pasting properties*

The result of pasting properties of ogi produced from these four varieties of maize at different soaking periods and methods were as shown in Tables 2 and 3. The result revealed that there was a significant difference ($p< 0.05$) in the pasting properties. The Peak viscosity ranged from

 

Table 1. The survey responses of Ogi production

| Parameters | Frequency | Percentage (%) | | Frequency | Percentage (%) |
|---|---|---|---|---|---|
| **Sex** | | | **Period of soaking** | | |
| Male | 51 | 22.17 | 1 day | 47 | 20.43 |
| Female | 179 | 77.83 | 2 days | 78 | 33.91 |
| **Occupation** | | | 3 days | 66 | 28.69 |
| Civil Servant | 42 | 18.26 | 4 days | 34 | 14.78 |
| Trader | 65 | 28.26 | 5 days | 5 | 2.17 |
| Self Employed | 44 | 19.13 | **Milling after soaked maize is done through** | | |
| Others | 79 | 34.35 | Attrition mill | 171 | 74.35 |
| **Categories** | | | Hammer mill | 49 | 21.30 |
| Consumer | 131 | 56.96 | | 10 | 4.35 |
| Producer | 45 | 19.57 | **Is milled ogi sieved before consumption?** | | |
| Marketer | 54 | 23.48 | Yes | 195 | 84.78 |
| **As a consumer, how do you get your ogi?** | | | No | 31 | 13.48 |
| Buy | 116 | 50.44 | 3 | 4 | 1.739 |
| Self-Produced | 94 | 40.87 | **After sieving ogi is left to ferment before consumption for** | | |
| Contract out | 19 | 8.26 | 0 day | 44 | 19.13 |
| Buy and self produced | 1 | 0.44 | 1 day | 88 | 38.26 |
| **Type of raw material** | | | 2 days | 69 | 30.00 |
| Maize | 181 | 78.69 | 3 days | 23 | 10.00 |
| Millet | 17 | 7.39 | 4 days | 6 | 2.61 |
| Guinea Corn | 22 | 9.57 | **Ogi soaked with Hot water will gelled better than those soaked with cold water?** | | |
| Maize millet and guinea corn | 10 | 4.35 | Yes | 76 | 33.04 |
| **If maize, types of maize** | | | No | 80 | 34.78 |
| Yellow maize | 81 | 35.22 | I don't know | 74 | 32.17 |
| White maize | 105 | 45.66 | **Ogi soaked with boiled water will maintain initial colour** | | |
| Yellow and white maize | 14 | 6.09 | Yes | 134 | 58.26 |
| **Method of soaking** | | | No | 53 | 23.04 |
| Hot water | 51 | 22.18 | I don't know | 43 | 18.69 |
| Cold water soaking | 172 | 74.77 | **Ogi soaked with cold water will maintain initial colour** | | |
| | | | Yes | 140 | 60.87 |
| | | | No | 46 | 20.00 |
| | | | I don't know | 43 | 18.69 |

Table 2. Pasting properties of ogi produced from maize variety B2Y soaked at 28°C

| Soaking time (hrs) | Peak viscosity (RVU) | Trough Viscosity (RVU) | Break down viscosity (RVU) | Final viscosity (RVU) | Setback viscosity (RVU) | Pasting time (min) | Pasting temperature (°C) |
|---|---|---|---|---|---|---|---|
| 0 | $161.89^{o}$ | $142.92^{d}$ | $18.98^{o}$ | $189.62^{h}$ | $46.70^{l}$ | $7.63^{a}$ | $81.78^{bc}$ |
| 12 | $166.31^{l}$ | $140.38^{de}$ | $25.93^{n}$ | $193.96^{fg}$ | $53.58^{i}$ | $7.44^{b}$ | $76.97^{cd}$ |
| 24 | $169.19^{k}$ | $143.84^{d}$ | $25.34^{n}$ | $201.03^{c}$ | $57.19^{g}$ | 6.95d | $77.14^{cd}$ |
| 36 | $166.99^{l}$ | $141.63^{de}$ | $25.36^{n}$ | $196.99^{e}$ | $55.36^{h}$ | $7.05^{c}$ | $76.72^{cd}$ |
| 48 | $154.59^{p}$ | $148.81^{c}$ | $5.77^{r}$ | $183.00^{n}$ | $34.19^{l}$ | $7.43^{b}$ | $76.22^{cd}$ |
| 60 | $161.23^{o}$ | $131.73^{i}$ | $29.50^{l}$ | $177.89^{p}$ | $26.16^{m}$ | $6.17^{g}$ | $76.15^{cd}$ |
| 72 | $179.21^{de}$ | $130.49^{i}$ | $48.74^{g}$ | $202.27^{c}$ | $71.77^{c}$ | $5.78^{h}$ | $76.88^{cd}$ |
| 84 | $170.29^{ij}$ | $127.85^{k}$ | $42.45^{i}$ | $199.54^{cd}$ | $71.69^{c}$ | $5.77^{h}$ | $74.73^{d}$ |
| 96 | $184.61^{cd}$ | $119.68^{o}$ | $64.93^{e}$ | $198.86^{d}$ | $79.18^{a}$ | $5.53^{k}$ | $77.89^{cd}$ |
| **B2Y soaked at 65°C** | | | | | | | |
| 0 | $161.89^{o}$ | $142.93^{c}$ | 18.98 | $189.63^{h}$ | $46.70^{i}$ | $7.63^{a}$ | $81.77^{bc}$ |
| 12 | $160.14^{o}$ | $125.08^{l}$ | $35.06^{e}$ | $172.83^{q}$ | $47.75^{i}$ | $7.00^{c}$ | $75.44^{d}$ |
| 24 | $162.14^{o}$ | $129.49^{ij}$ | $32.66^{f}$ | $175.41^{o}$ | $45.93^{j}$ | $7.34^{b}$ | $74.75^{d}$ |
| 36 | $165.35^{m}$ | $132.15^{hi}$ | $33.19^{f}$ | $182.76^{n}$ | $50.60^{h}$ | $7.16^{c}$ | $77.06^{cd}$ |
| 48 | $167.04^{l}$ | $130.17^{i}$ | $36.88^{e}$ | $187.44^{i}$ | $57.28^{g}$ | $6.39^{d}$ | $75.31^{d}$ |
| 60 | $164.85^{mn}$ | $115.90^{qr}$ | $48.95^{cd}$ | $185.54^{j}$ | $69.64^{c}$ | $5.38^{g}$ | $74.92^{d}$ |
| 72 | $171.62^{ij}$ | $108.27^{t}$ | $63.34^{b}$ | $186.19^{j}$ | $77.92^{b}$ | $5.15^{h}$ | $76.04^{cd}$ |
| 84 | $189.58^{c}$ | $137.72^{f}$ | $51.85^{c}$ | $202.68^{c}$ | $64.95^{e}$ | 5.86f | $75.85^{d}$ |
| 96 | $182.00^{d}$ | $115.78^{qr}$ | $66.22^{bc}$ | $180.98^{l}$ | $65.19^{e}$ | $5.30^{h}$ | $74.55^{d}$ |

Values are means of two replications. Values with different superscripts within the same row are significantly different ($p<0.05$).

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Table 3. Pasting properties of ogi produced from maize variety A4W soaked at 28**°**C

| Soaking time (hrs) | Peak viscosity (RVU) | Trough Viscosity (RVU) | Break down viscosity (RVU) | Final viscosity (RVU) | Setback viscosity (RVU) | Pasting time (min) | Pasting temperature (ºC) |
|---|---|---|---|---|---|---|---|
| 0 | 167.52$^{l}$ | 129.34$^{ij}$ | 38.17$^{g}$ | 182.95$^{n}$ | 53.61$^{g}$ | 6.76$^{d}$ | 79.645 |
| 12 | 165.94$^{m}$ | 129.29$^{ij}$ | 36.65$^{h}$ | 194.69$^{e}$ | 65.39$^{d}$ | 6.98$^{c}$ | 84.29$^{ab}$ |
| 24 | 172.86$^{g}$ | 134.51$^{g}$ | 38.35$^{g}$ | 214.44$^{b}$ | 79.93$^{b}$ | 6.65$^{d}$ | 76.18$^{cd}$ |
| 36 | 170.69$^{i}$ | 131.68$^{hi}$ | 39.02$^{g}$ | 196.17$^{e}$ | 64.49$^{d}$ | 6.67$^{e}$ | 81.83$^{b}$ |
| 48 | 175.58$^{f}$ | 119.76$^{o}$ | 55.82$^{e}$ | 190.79$^{g}$ | 71.04$^{c}$ | 5.43$^{i}$ | 77.20$^{cd}$ |
| 60 | 175.06$^{f}$ | 133.39$^{h}$ | 41.67$^{g}$ | 197.49$^{d}$ | 64.11$^{d}$ | 5.96$^{f}$ | 73.94$^{e}$ |
| 72 | 183.80$^{d}$ | 129.87$^{i}$ | 53.93$^{e}$ | 211.52$^{b}$ | 81.65$^{a}$ | 5.59$^{g}$ | 76.74$^{cd}$ |
| 84 | 177.28$^{ef}$ | 118.93$^{o}$ | 48.35$^{f}$ | 190.05$^{g}$ | 71.12$^{c}$ | 5.51$^{h}$ | 75.29$^{d}$ |
| E9W soaked at 65°C | | | | | | | |
| 0 | 167.52$^{l}$ | 129.34$^{ij}$ | 38.176$^{g}$ | 182.95$^{n}$ | 53.60$^{f}$ | 6.76$^{b}$ | 79.65$^{b}$ |
| 12 | 170.46$^{ij}$ | 129.92$^{ij}$ | 40.54$^{g}$ | 190.48$^{fg}$ | 60.56$^{c}$ | 6.54$^{c}$ | 83.84$^{a}$ |
| 24 | 173.13$^{g}$ | 125.79$^{l}$ | 37.42$^{gh}$ | 192.15$^{f}$ | 66.44$^{b}$ | 7.404 | 72.77$^{e}$ |
| 36 | 175.29$^{f}$ | 135.59$^{g}$ | 39.69 | 205.31$^{c}$ | 69.718$^{b}$ | 6.74$^{b}$ | 83.90$^{b}$ |
| 48 | 168.68$^{l}$ | 130.12$^{i}$ | 38.56$^{g}$ | 192.41$^{f}$ | 62.29$^{cb}$ | 6.69$^{b}$ | 69.96$^{f}$ |
| 60 | 186.31$^{d}$ | 146.08$^{e}$ | 40.23$^{g}$ | 203.77$^{c}$ | 57.69$^{d}$ | 6.09$^{c}$ | 84.93$^{ab}$ |
| 72 | 179.15$^{f}$ | 132.35$^{g}$ | 36.79$^{i}$ | 207.26$^{c}$ | 74.90$^{a}$ | 5.862$^{d}$ | 73.98$^{e}$ |
| 84 | 170.69$^{ij}$ | 141.76$^{d}$ | 28.93$^{k}$ | 196.89$^{e}$ | 55.13 | 6.38$^{c}$ | 86.12$^{a}$ |
| 96 | 193.75$^{b}$ | 145.03$^{c}$ | 48.72$^{f}$ | 209.77$^{c}$ | 64.73$^{b}$ | 5.78$^{d}$ | 73.04$^{e}$ |

Values are means of two replications. Values with different superscripts within the same row are significantly different ($p<0.05$).

165.01-184.174 RVU and 165.01- 188.94 RVU for ogi produced from maize soaked at 28 and 65ºC, respectively. The values obtained for peak viscosity were lower compared with the values reported by Ashogbon and Akintayo (2012). According to Adebowale *et al.* (2005), the higher the breakdown viscosity, the lower the ability of the starch sample to withstand heating and shear stress during cooking. The breakdown varies significantly, and these lower values of breakdown viscosity might suggest an ability to withstand more heating and shear stress compared with those of higher values (Adebowale *et al.,* 2005; Ashogbon and Akintayo, 2012). Lower break down viscosity was recorded for unsoaked maize varieties B2Y and C3Y. Higher values of break down viscosity were recorded for ogi produced at 60, 72, 84 and 96$^{th}$ hr soaking for ogi produced from B2Y and C3Y, respectively. The least values of breakdown were reported for ogi produced at the 48$^{th}$ hr of soaking for C3Y (8.23RVU) and B2Y (5.77 RVU) at ambient temperature. There was a significant difference ($p<0.05$) in final and setback viscosity. There were significant differences ($p<0.05$) in the values of setback viscosity. The difference in setback among different ogi pastes may be due to the amount of Amylose leached from the granules (Chang and Liu 1991; Loh, 1992; Gudmundsson, 1994). According to Adebowale and Lawal (2003), there is a strong connection between amylose content to syneresis and retrogradation. The cooking time for all the maize varieties at varying soaking times and methods were all less than 7 min, while some researchers reported pasting temperatures ranging from 77-80°C (Oladele and Aina 2007; Fasasi *et al.,* 2007; Rungnaphar and Suwapat 2008; Bolaji *et al*., 2011; Bolaji, Abegunde, Praise-Ofuani-Oyinloye *et al.,* 2017). Varietal differences in pasting characteristics of ogi may be attributed to the differences in amylopectin molecular structure (Adebowale and Lawal 2003; Adebowale *et al.,* 2005; Shimelis *et al.,* 2006).

### *3.3 Colour of Ogi produced from maize soaked at varying time*

The colour obtained for this work is shown in Table 4. The result revealed that there was a significant difference ($p<0.05$) in the degree of L*, a* and b*. The value of L* obtained for ogi produced from C3Y maize variety increased from 74.1-80.26 and 74.78-81.82 for ogi produced at ambient temperature. A similar observation was noted for b* B2Y, where the value recorded for L* also increased from 72 to 83.91 (0-96 hrs of ambient soaking). These indicated that the soaking period and method promoted the lightness of Ogi produced from maize grains. The value of a* was higher in the maize varieties C3Y and B2Y. The value of L* in ogi produced from A4W was more affected by hot soaking (79.55-82.57). The value of a* for Variety C3Y and B2Y were significantly higher than the values obtained for E9W and A4W. (1.51), at 24 hrs of soaking at 65°C (1.79) and 36 hrs soaking at 65°C (1.30). Generally, the value for b* decreased with an increase in the soaking period for E9W at both soaking methods. The same trend was recorded for A4W. The values obtained in this work for L*, a* and b* were in the range reported for cassava starch salad creams of different varieties (Moreira, *et al*., 2011). The changes in ΔL, Δa,

 

Table 4. The colour of Ogi produced from C3Y, B2Y, E9W and A4W at varying soaking conditions at varying soaking conditions

| Soaking time (hr) | L* | a* | b* | L* | a* | b* |
|---|---|---|---|---|---|---|
| | C3Y (28°C) | | | B2Y(28°C) | | |
| 0 | 74.36$^{a}$ | 4.52$^{cd}$ | 31.47$^{bc}$ | 72.02$^{a}$ | 4.48$^{d}$ | 31.29$^{c}$ |
| 12 | 77.70$^{ab}$ | 3.43$^{c}$ | 28.89$^{b}$ | 76.19$^{a}$ | 3.99$^{c}$ | 31.12$^{c}$ |
| 24 | 81.77$^{b}$ | 3.10$^{c}$ | 30.04$^{b}$ | 77.59$^{ab}$ | 4.22$^{c}$ | 32.58$^{d}$ |
| 36 | 78.26$^{b}$ | 3.59$^{c}$ | 29.91$^{b}$ | 78.19$^{b}$ | 4.25$^{d}$ | 32.07d |
| 48 | 78.61$^{b}$ | 3.95$^{c}$ | 30.6$^{b}$ | 78.91$^{b}$ | 4.81$^{d}$ | 33.02$^{d}$ |
| 60 | 80.92$^{b}$ | 3.59$^{c}$ | 25.06$^{b}$ | 83.19$^{bc}$ | 2.25b | 26.24$^{b}$ |
| 84 | 78.22$^{b}$ | 4.85$^{d}$ | 31.26$^{c}$ | 81.35$^{b}$ | 2.96$^{b}$ | 28.37$^{bc}$ |
| 96 | 80.38$^{b}$ | 3.73$^{c}$ | 26.77$^{b}$ | 82.33$^{b}$ | 2.15$^{b}$ | 27.09$^{b}$ |
| | C3Y(65°C) | | | B2Y(65°C) | | |
| 12 | 79.99$^{b}$ | 3.75$^{c}$ | 29.70$^{b}$ | 78.43$^{b}$ | 3.42$^{c}$ | 28.59$^{c}$ |
| 24 | 79.83$^{b}$ | 3.45c | 28.43$^{b}$ | 79.83$^{b}$ | 2.45$^{b}$ | 28.24$^{bc}$ |
| 36 | 79.77$^{b}$ | 3.82c | 32.44$^{b}$ | 77.24$^{ab}$ | 4.64$^{d}$ | 29.11$^{bc}$ |
| 48 | 78.67b | 4.73d | 31.21$^{b}$ | 77.95$^{ab}$ | 2.2 | 32.18$^{d}$ |
| 60 | 84.39$^{b}$ | 4.62d | 29.84$^{b}$ | 84.36$^{bc}$ | 1.64$^{b}$ | 26.24$^{b}$ |
| 84 | 81.09$^{b}$ | 4.40$^{d}$ | 27.45$^{ab}$ | 81.35$^{b}$ | 2.96$^{bc}$ | 28.37$^{bc}$ |
| 96 | 80.99$^{b}$ | 4.53$^{d}$ | 29.64$^{b}$ | 82.33$^{b}$ | 2.15$^{b}$ | 27.09$^{b}$ |
| The colour of Ogi produced from E9W and A4W at varying soaking conditions | | | | | | |
| | E9W (28°C) | | | A4W(28°C) | | |
| 0 | 78.12$^{b}$ | 2.43$^{b}$ | 25.56$^{b}$ | 79.55$^{b}$ | 1.74$^{ab}$ | 24.06$^{b}$ |
| 12 | 82.50$^{b}$ | 1.85$^{ab}$ | 24.29$^{a}$ | 82.42$^{b}$ | 1.89$^{ab}$ | 23.85 |
| 24 | 80.64$^{b}$ | 1.51$^{a}$ | 24.16$^{b}$ | 78.16$^{b}$ | 1.81$^{ab}$ | 23.93$^{b}$ |
| 36 | 82.94$^{b}$ | 0.51$^{a}$ | 21.15$^{a}$ | 83.86$^{c}$ | 0.52$^{a}$ | 21.28$^{a}$ |
| 48 | 80.13$^{b}$ | 1.30$^{a}$ | 22.75$^{a}$ | 78.88$^{b}$ | 1.69$^{a}$ | 23.15$^{b}$ |
| 60 | 84.83$^{c}$ | 1.96$^{ab}$ | 25.34$^{b}$ | 85.28c$^{d}$ | 1.26$^{a}$ | 19.65$^{a}$ |
| 84 | 86.25$^{cd}$ | 0.89$^{a}$ | 19.64$^{a}$ | 85.61$^{cd}$ | 0.87$^{a}$ | 19.02$^{a}$ |
| 96 | 83.57$^{c}$ | 1.40$^{a}$ | 20.88$^{a}$ | 84.33$^{c}$ | 1.63$^{a}$ | 19.14$^{a}$ |
| | E9W (65°C) | | | A4W (65°C) | | |
| 12 | 82.50$^{b}$ | 1.85$^{a}$ | 24.29 | 82.57 | 1.51$^{a}$ | 23.59$^{b}$ |
| 24 | 85.82$^{cd}$ | 1.02$^{a}$ | 20.48 | 80.79 | 1.79$^{ab}$ | 24.98$^{b}$ |
| 36 | 80.76$^{b}$ | 1.30$^{a}$ | 22.95 | 80.76 | 1.30$^{a}$ | 22.95$^{ab}$ |
| 48 | 81.03$^{b}$ | 1.49$^{a}$ | 22.88 | 78.88 | 1.69$^{a}$ | 23.15$^{b}$ |
| 60 | 83.43$^{bc}$ | 1.79$^{a}$ | 20.53 | 82.99 | 3.20$^{c}$ | 26.67$^{b}$ |
| 84 | 84.58$^{c}$ | 0.64$^{a}$ | 20.87 | 81.09 | 4.40$^{d}$ | 27.45$^{bc}$ |
| 96 | 84.83$^{c}$ | 0.71$^{a}$ | 19.88 | 84.17 | 0.830$^{a}$ | 20.03$^{a}$ |

Values are means of two replications. Values with different superscripts within the same row are significantly different ($p<0.05$).

Δb and ΔE revealed that there was a significant difference ($p<0.05$) as a result of the soaking period and soaking method. The ΔL (7.67) in C3Y was highest at 24 hrs of soaking and ΔE was 7.71 and the ΔL for corresponding soaking at 65°C at 12 and 24 hrs were 5.89 and 5.72 and ΔE 5.93 and 5.94. The ΔL increased linearly from 4.18 – 6.89 for soaking at 28°C of B2Y. The ΔE also increased linearly from 12-48 hrs of soaking (4.19-6.93). The observation in B2Y was not similar to values obtained for A4W and E9W.

There were colour changes (ΔE) calculated from colour parameters L*, a* and b* of ogi produced from soaked maize compared with unsoaked maize grain. According to the description of Silva and Silva (1999), the smaller the values of ΔE, the closer the samples in colour to unsoaked maize. Values of ΔE between 0 and 0.2 indicated an imperceptible colour difference, 0.2–0.5 for a very small difference, 0.5–1.5 for a small difference, 1.5–3.0. The results in this work showed that the soaking period had a significant influence on the colour change. The colour changes increased with the increase in the soaking period and this was reflected in all the maize varieties. The colour changes were higher in the yellow maize varieties B2Y and C3Y.

 

*3.4 Sensory evaluation*

The result obtained for sensory evaluation and the correlation effect among sensory parameters is shown in Figure 1. There were significant differences ($p<0.05$) in the parameters evaluated. There was a significant correlation between sensory parameters evaluated on ogi produced from all the maize varieties at initial hot water soaking and soaking at 28°C, respectively, for the period of 12-96 hrs. The ogi produced at the soaking period of 12 hrs recorded an average score of 6.90 and 7.40, respectively for the sourness of ogi produced from maize variety A4W. This trend was similar to that obtained for other ogi produced from E9W, B3Y and C3Y at hot and ambient soaking at 28°C, respectively. Ogi soaked with initial hot water and soaking at 28°C recorded the highest values for colour attributes at 12$^{th}$ hr of soaking for all the varieties E9W (7.40 and 7.30), B2Y (6.0 and 7.10, A4W (7.40 and 6.90) and C3Y (6.40 and 6.40). The score for consistency showed that there was no significant difference ($p>0.05$). The overall acceptability result showed that ogi produced at 12$^{th}$ hr of a soaking period of both hot water and soaking at 28°C were most preferred by the panellist. Ogi produced from E9W (7.10 and 7.53), A4W (6.76 and 6.93), B2Y (6.75 and 6.95) .and C3Y, and (6.97 and 7.03). The result revealed that the sedimentation time after filtration count significantly in the values recorded for sourness compared with the long duration of soaking maize.

## 4. Conclusion

This study showed that the duration of soaking may affect pasting properties. Also, the initially hot water soaking did not have a significant difference in the pasting properties of ogi. More so, the temperature usually falls to room condition in less than 3-4 hrs of soaking. Varietal differences in pasting characteristics of ogi may be attributed to the differences in amylose leaching during swelling that could have been affected

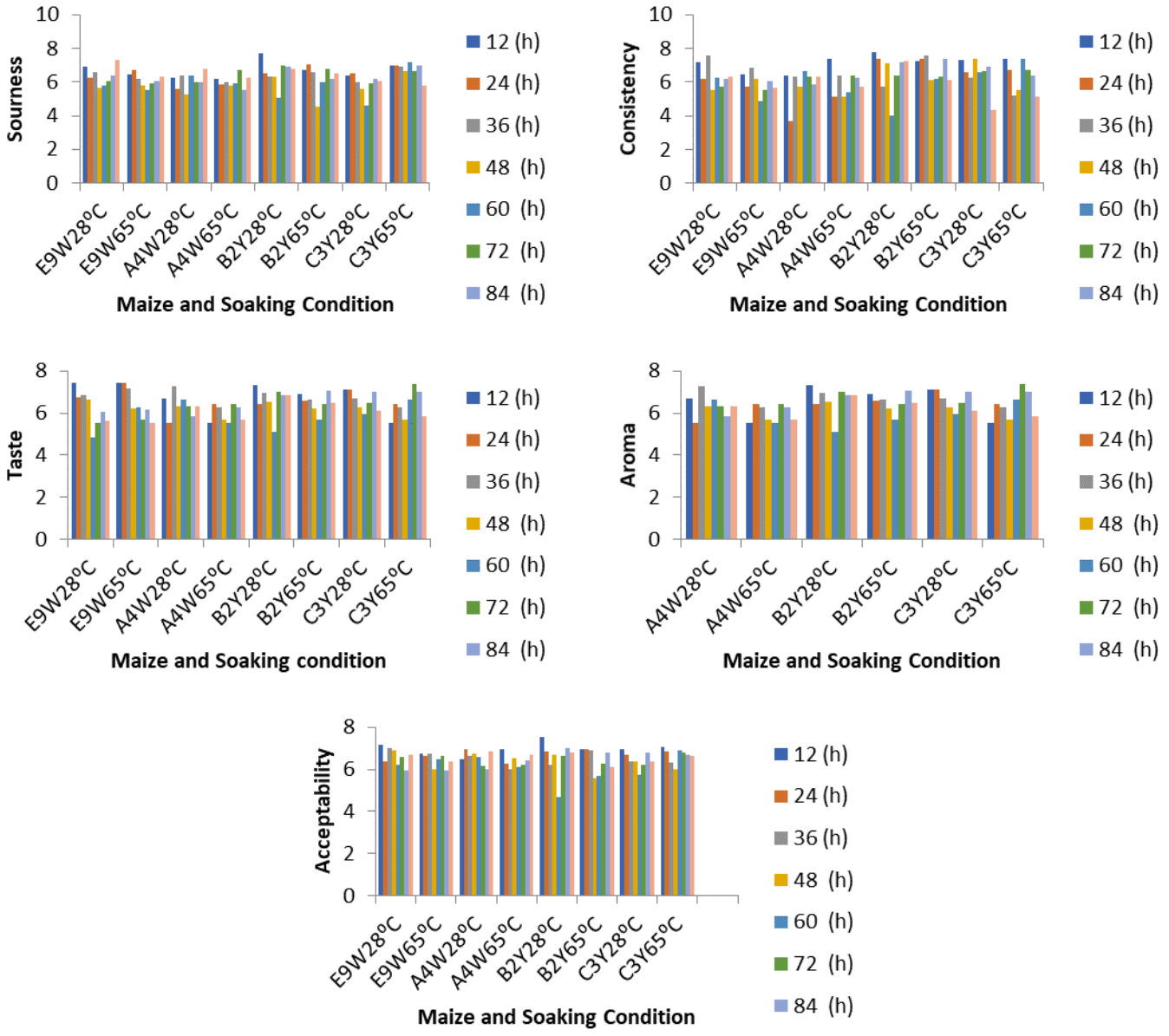


Figure 1. Sensory evaluation results for Ogi at varying soaking conditions

 

by the soaking period. The result revealed that the sedimentation time significantly affected the values recorded for sourness compared with the long duration of soaking maize. The overall result indicated that the soaking period and method prompted the lightness of Ogi.

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