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Impact of Soaking Period and Drying Temperature on the Pasting Properties of Ogi Produced from Some Selected Maize Varieties

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Abstract Impact of some processing conditions on pasting behaviour of ogi from six maize varieties soaked for 12, 24 and 36 hours and dried at 40, 50 and 60°C, respectively was evaluated. There were significant differences ($p<0.05$) in the pH and pasting values of ogi from all the maize varieties. High values of peak viscosities were recorded for ogi dried at 50°C irrespective of the soaking periods. Ogi from S7Y at 12th hour of soaking had it peak viscosities increased with increase in drying temperature. Similar trend was recorded for trough viscosity of ogi from A5W at 36th hour of soaking while a contrary trend was observed for breakdown viscosity of ogi at 24 and 36th hours of soaking, respectively. Highest setback viscosity of 1110.00cp was obtained at 12th hour of soaking and drying temperature of 40°C. The impact of drying temperature and starch components were more evident compared with varying soaking period of maize on ogi.

Keywords: *ogi, soaking period, drying, pasting, viscosity*

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1. Introduction

Ogi is one of the staple foods for infants in West African countries [1]. Ogi may be prepared from maize, sorghum or millet. There are different traditional names given to these semi-solid foods such as Eko, Agidi, Akamu [2,3]. Some researchers reported that physical and biochemical qualities of ogi may be influenced by the type of cereal grain, fermentation or souring periods and the milling method [2,4]. Ogi fermentation by traditional methods was observed to have shelf life of 40 days if frequent and decantation of water is carried out [5]. This is definitely below the duration obtainable with dried ogi flour. Some researchers successfully attempted drying ogi [4,6,7,8,9]. Dry milling was considered more convenient than wet milling process, since the flour could be dispensed and packaged to consumers for subsequent reconstitution and preparation into any secondary product. In an attempt to prolong the shelf life of ogi, dried powdered still stand out relevant. However, its important functional and pasting properties during the process of achieving this may be affected [7,10].

Pasting properties are indicator of swelling of starch granules with amylose leaching [11]. It is a degree of intactness of product, source, granule size, concentration and amylose/amylopectin ratio in food materials [11,12]. Pasting properties are dependent on the botanic sources and molecular degradation of starch [12,14,15,16]. Starch contain amylose and amylopectin and they are capable of retrograding [15,16]. Starches have tendency to swell and their volume fraction and morphology, have been reported to play important roles in the rheological behaviour of starch dispersions [17].

Athough, many areas have been explored in the production of ogi. However, the impact varying soaking period and drying temperature on pasting properties are rare in the litreature. These information may be needed by prospective small-scale food processors who intend to employ drying operation or Ogi flour instead of wet ogi product to standardise the production process.

2. Materials and Methods

Six maize varieties (D1Y, D2Y, T3W, A4Y, A5W and S7Y) were obtained from Institute of Agricultural Research and Training, Ibadan, Oyo state, Nigeria. The maize grains were thoroughly cleaned. Each sample was soaked for 12, 24 and 36 hours at room temperature. Decanted and wet milled with attrition milling machine model M230 Watts and filtered with muslin clothe. The water was squeezed out and dried in a Genlabl drying cabinet drier. (Model DC 125) at 40, 50 and 60°C, respectively. The dried samples were milled with kenwood blender, sieved (212) and packaged for Pasting properties determination using Rapi visco analyser (RVA).

The varieties are

D1Y- DMR-LSR-Y
D2Y- DMR-ESR-Y
T3W- TZPB-SR-W
A4Y- ART/98/SW1-SR-Y
A5W- ART/98/SW5-OB-W
S7Y- SUWAN-SR-Y

2.1. Determination of Moisture Content

The moisture content was carried out using a calibrated moisture meter (Model MD 215) and pH with the aid of standardised pH meter (MODEL HANNA – COMBO M - 27433).

2.2. Determination of Pasting Properties

The Pasting Properties of the samples were carried out using a Rapid Visco Analyser (Model: RVA-4, Newport Scientific Pty. Ltd., Sydney, Australia. Ogi suspension was prepared by adding 25 ml of distilled water to 3g of ogi flour to make slurry in a RVA sample container. The RVA sample container was inserted into the RVA machine. The rate of viscosity of the sample was graphically displayed on the monitor in about 30 minutes.

2.3. Statistical Analysis

Data obtained were subjected to analysis of variance (ANOVA) using Statistical Package for Social Sciences (SPSS) version 17.0 and where significant difference existed, mean were separated with Duncan Multiple Range Test (DMRT). Sigma plot version 10 was used determine the interaction effect.

3. Results and Discussion

3.1. pH and Moisture Content

The result obtained for pH and Moisture content between 13 and 17 hours of drying are shown in Table 1, while the moisture behaviour during drying is as shown in Figure 1. There was significant difference ($p<0.05$) in the pH values obtained for ogi produced from all the maize varieties at varying soaking period and drying temperature. The pH values ranged from 4.00 to 5.00 for ogi produced from A5W, 4.00 to 5.00 for A4Y, 4.00 to 5.00, 4.00 to 5.33, 4.00 to 5.00 and 4.00 to 5.33 for D1Y, D2Y, S7Y and T3W, respectively. The pH of ogi produced from A5W and S7Y decreased with increase in drying temperature. Ogi produced from T3W at 12th hour of soaking followed similar trend. This followed a contrary trend to the report of Afoakwa *et al.* [18] about the changes during drying of pulp pre-conditioned and fermented cocoa. The pH values obtained for all the dried ogi were higher compared with values reported for wet ogi at varying storage conditions [19,20]. Obviously, moisture content of the Ogi produced from all the maize varieties decreased significantly ($p<0.05$) with increase in drying time and temperature. The moisture behaviour may be connected with the migration of water within the Ogi and evaporation of moisture from Ogi surfaces into the air. Some researcher reported that solid content in a food material may affect the drying behaviour [21,22]. According to Saravacos *et al.* [23]. The porous nature of dehydrating materials could affect the transport properties during heat application and subsequently affect the moisture removal pattern. It was observed that the total drying time decreased with increase in drying temperature. Similar results were reported in the literature for various fruits and vegetables [24,25].

Table 1. The pH and moisture content of Ogi produced from six varieties at varying soaking period and drying temperature.

Soaking period (hr)	Drying temperature (^oC)	A5W	D1Y	A4W	D2Y	S7Y	T2W
12	40	5.00^{cd}	4.00^{a}	4.67^{bc}	4.00^{a}	4.00^{a}	5.33^{d}
	50	4.33^{ab}	5.00^{cd}	5.00^{cd}	4.00^{a}	4.00^{a}	5.00^{cd}
	60	4.00^{a}	4.00^{a}	4.00^{a}	5.00^{cd}	4.00^{a}	4.33^{ab}
24	40	5.00^{cd}	4.00^{a}	5.00^{cd}	5.00^{cd}	5.00^{cd}	5.00^{cd}
	50	4.00^{a}	5.00^{cd}	5.00^{cd}	4.33^{ab}	4.33^{ab}	4.00^{a}
	60	4.00^{a}	5.00^{cd}	5.00^{cd}	5.00^{cd}	4.00^{a}	4.67^{bc}
36	40	5.00^{cd}	5.00^{cd}	5.00^{cd}	5.33^{ab}	5.00^{cd}	4.00^{a}
	50	4.33^{ab}	5.00^{cd}	5.00^{cd}	4.33^{ab}	4.33^{ab}	4.00^{a}
	60	4.00^{a}	5.00^{cd}	4.33^{ab}	5.00^{cd}	4.00^{a}	5.00^{cd}
				Moisture content			
12	40	10.62	10.5	10.39	11.49	9.49	11.26
	50	10.18	10.79	10.65	10.37	10.95	9.83
	60	10.36	10.12	10.12	10.7	9.64	10.6
24	40	10.48	10.62	11.63	11.91	11.65	11.31
	50	10.53	10.47	11.37	11.1	10.55	10.27
	60	10.57	9.8	10.39	9.61	10.7	10.7
36	40	11.07	10.68	10.48	12.75	10.45	11.56
	50	10.43	9.95	11.33	11.87	10.37	9.89
	60	10.04	9.34	9.8	9.82	9.74	10.47

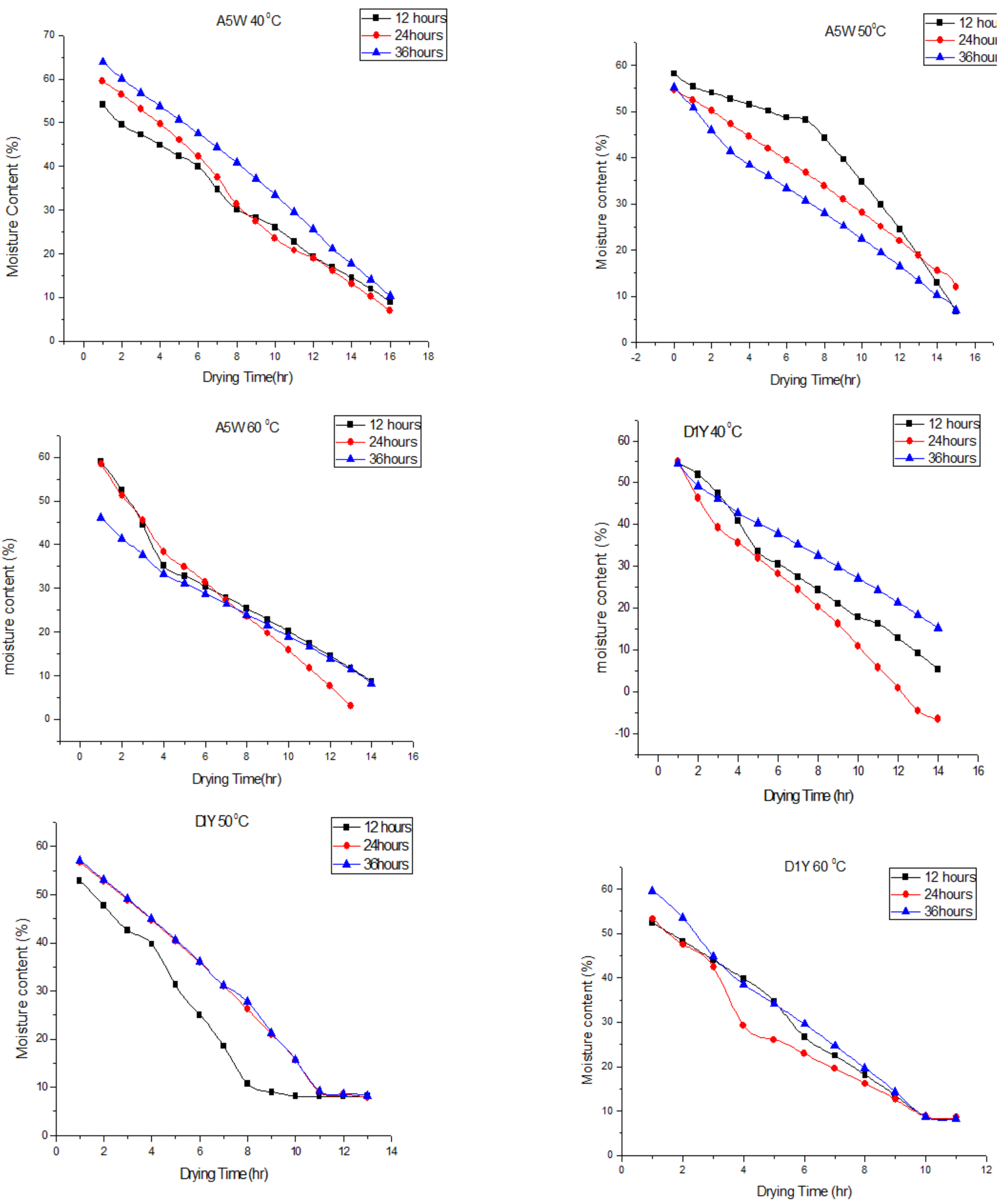

Figure 1. Moisture pattern with respect to drying time of Ogi produced from six maize varieties

3.2. Pasting Properties

3.2.1. Peak Viscosity

Although, there was no specific pattern in the values obtained for the peak viscosity, however, there were significant differences ($p<0.05$) in the values as shown in Table 2, Table 3 and Table 4. Higher values of peak viscosities were obtained for ogi produced from all the maize varieties at all the soaking periods and drying temperature of 50°C except ogi produced from A5W, D2Y, S7Y and T3W at 36th hour of soaking. These recorded high peak viscosities of 3132.00, 2622.00, 2042.00 and 2170.00cp, respectively at drying temperature of 40°C. Similarly, ogi produced from A4Y, D2Y and T3W at 24th hour of soaking and drying temperature of 40°C had peak viscosities of 1833.00, 2001.00 and 3059 cp, respectively. Ogi produced at 12th hour of soaking and dried at 60°C recorded 2188.00cp for A4Y contrary to

2181.00cp recorded for ogi produced at 36^{th} hour of soaking and drying temperature of 50°C. While ogi produced from D1Y at 24^{th} and 36^{th} hour of soaking and dried at 60 and 50°C had peak viscosities of 3247.00 and 2102cp, respectively. Ogi produced from S7Y at 12^{th} hour of soaking had an increase in peak viscosity with increase in drying temperature. The value of peak viscosity A5W at 36^{th} soaking hour and drying temperature of 40°C and D1Y at 24^{th} hour of soaking and drying temperature of 60°C were higher compared with values reported for kiwi fruit starch [26,27]. The difference in peak viscosity among different ogi samples may be due to the amount and the molecular weight of Amylose leached from the granules [28,29,30,31]).

Table 2. The effect of drying periods on the pasting properties of Ogi produced from A4Y and A5W

Soaking period (Hr)	Drying temperature (⁰C)	Peak Viscosity(cp)	Trough viscosity (cp)	Breakdown viscosity (cp)	Final viscosity (cp)	Set back viscosity (cp)	Peak time (Minutes)	Pasting temperature (⁰C)
			A5W					
12	40	1831.00^{q}	674.00^{bcd}	824.00^{o}	1966.00^{pq}	959.00^{u}	4.80^{gh}	77.55^{d}
	50	2383.00^{y}	1058.00^{lmno}	1325.00^{z}	2031.00^{q}	973.00^{u}	4.53^{cd}	77.45^{d}
	60	2232.00^{x}	991.00^{ijklm}	1241.00^{y}	2033.00^{q}	1042.00^{x}	4.67^{ef}	77.45^{d}
24	40	2052.00^{w}	800.00^{cdef}	1252.00^{y}	1854.00^{lm}	1054.00^{x}	4.00^{a}	75.00^{a}
	50	2160.00^{x}	896.00^{efg}	1264.00^{y}	1655.00^{j}	759.00^{l}	4.60^{de}	77.45^{d}
	60	1813.00^{q}	852.00^{defg}	961.00^{s}	1588.00^{i}	736.00^{j}	4.80^{gh}	78.25^{e}
36	40	3132.00^{z}	1943.67^{t}	1183.00^{x}	3545.00^{y}	1596.00^{z}	4.87^{hi}	77.50^{d}
	50	1443.00^{e}	471.00^{a}	972.00^{t}	826.0^{0a}	355.00^{a}	4.53^{cd}	78.10^{e}
	60	2271.00^{x}	$759.^{cde}$	1513.00^{z}	1462.00^{fg}	703.00^{l}	4.40^{a}	$77.40^{d``}$
			A4Y					
12	40	1791.00^{j}	1069.00^{lmno}	722^{l}	1985.00^{pq}	916.00^{s}	5.13^{m}	79.95^{g}
	50	1218.00^{a}	787.00^{cdef}	431^{a}	1498.00^{fg}	711.00^{l}	5.07^{m}	79.80^{h}
	60	2188.00^{x}	1031.00^{klmno}	1157^{x}	1937.00^{no}	904.00^{r}	4.73^{fg}	78.25^{ef}
24	40	1833.00^{q}	1070.00^{klmno}	763.00^{m}	1934.00^{no}	864.00^{q}	5.07^{m}	79.05^{g}
	50	1645.00^{h}	980.00^{hijkl}	665.00^{i}	1919.00^{mno}	939.00^{t}	5.20^{n}	79.95^{h}
	60	1322.67^{b}	761.00^{cdef}	563^{e}	1420.00^{e}	659.00^{l}	5.00^{jk}	79.90^{h}
36	40	1969.00^{u}	1213.00^{qr}	756.00^{m}	2146.00^{s}	933.00^{t}	5.07^{m}	79.85^{h}
	50	2181.00^{x}	1161.00^{pqr}	1020.00^{u}	2127.00^{t}	966.00^{u}	4.93^{jk}	79.15^{g}
	60	1870.00^{q}	954.00^{hijkl}	916.00^{p}	1817.00^{kl}	863.00^{q}	4.80^{gh}	79.10^{g}

Values are means of two replications. Superscript of different alphabet are significantly different ($p<0.05$).

Table 3. The effect of drying periods on the pasting properties of Ogi produced from D1Y and D2Y

Soaking period (Hr)	Drying temperature (°C)	Peak Viscosity(cp)	Trough viscosity (cp)	Breakdown viscosity(cp)	Final viscosity(cp)	Set back viscosity(cp)	Peak time (Minutes)	Pasting temperature (⁰C)
				D1Y				
12	40	1528.00^{g}	812.0^{cdefg}	716.00^{k}	1465.00^{fg}	653.00^{f}	4.87^{hi}	77.40^{d}
	50	1472.00^{ef}	828.00^{cdefg}	644.00^{h}	1499.00^{fg}	671.00^{g}	5.00^{jk}	79.85^{h}
	60	1408.00^{d}	802^{cdefg}	606.00^{g}	1508.00^{g}	706.00^{l}	4.87^{hi}	78.20^{ef}
24	40	1648.00^{h}	941.00^{hjklm}	707.00^{j}	1778.00^{k}	837.00^{p}	4.93^{ij}	79.05^{g}
	50	1898.00^{q}	$1174.^{nopqr}$	724.00^{l}	2165.00^{t}	991.00^{w}	5.07^{m}	79.05^{g}
	60	3267.00^{z}	1493.00^{s}	1774.00^{z}	2578.00^{v}	1085.00^{z}	4.40^{b}	77.65^{d}
36	40	1948.00^{t}	855.00^{hijk}	1093.00^{x}	1564.00^{i}	709.00^{l}	4.73^{fg}	77.50^{d}
	50	2102.00^{x}	1199.00^{pqr}	903.00^{p}	2200.00^{t}	1001.00^{w}	4.87^{hi}	77.50^{d}
	60	1768.00^{k}	828.00^{cdefg}	940.00^{r}	1468.00^{fg}	637.00^{e}	4.67^{e}	77.45^{d}
				D2Y				
12	40	1984.00^{u}	1189.00^{opqr}	795.00^{n}	2299.00^{u}	1110.00^{z}	4.73^{fg}	75.05^{a}
	50	1485.00^{f}	972.00^{hijkl}	513.00^{b}	1774.00^{k}	802.00^{m}	5.20^{n}	76.65^{c}
	60	1719.00^{j}	1170.00^{nopqr}	549.00^{c}	2078.00^{rs}	908.00^{s}	5.20^{n}	75.80^{b}
24	40	2001.00^{w}	940.00^{hijkl}	1061.00^{w}	1773.00^{k}	833.00^{p}	4.53^{cd}	75.30^{a}
	50	1922.00^{s}	1163.00^{nopqr}	759.00^{m}	1989.00^{p}	826.00^{o}	4.93^{jk}	77.50^{d}
	60	1652.00^{h}	1093.00^{lmnop}	559.00^{d}	1847.00^{klm}	747.33^{k}	5.20^{n}	77.40^{d}
36	40	2622.00^{y}	1303.00^{r}	1319.00^{z}	2341.00^{u}	1038.00^{x}	4.53^{cd}	75.85^{b}
	50	1704.00^{j}	1066.00^{lmnop}	638.00^{f}	1890.00^{lmno}	824.00^{o}	4.93^{jk}	77.45^{d}
	60	1672.00^{h}	1087.00^{lmnop}	585.00^{e}	1901.00^{0}	814.00^{n}	5.07^{m}	77.65^{d}

Values are means of two replications. Superscript of different alphabet are significantly different ($p<0.05$).

Table 4. The effect of drying periods on the pasting properties of Ogi produced from S7Y and T3W

Soaking period (Hr)	Drying temperature (0C)	Peak Viscosity(cp)	Trough viscosity (cp)	Breakdown viscosity(cp)	Final viscosity(cp)	Set back viscosity(cp)	Peak time (Minutes)	Pasting temperature (^{0}C)
				S7Y				
12	40	1368.00^{c}	665.00^{bc}	703.00^{j}	1328.00^{cd}	663.00^{fg}	5.07^{l}	79.05^{g}
	50	1385.00^{c}	659.33^{bc}	709.00^{j}	1286.00^{c}	610.00^{d}	4.73^{fg}	77.45^{d}
	60	1509.00^{f}	800.00^{cde}	709.00^{j}	1415.00^{ef}	615.00^{d}	4.00^{a}	75.00^{a}
24	40	1469.00^{e}	540.00^{ab}	929.00^{q}	985.00^{b}	445.00^{b}	4.60^{de}	76.70^{c}
	50	1696.00^{i}	763.00^{cdef}	933.00^{q}	1449.00^{e}	686.00^{h}	4.73^{fg}	77.50^{d}
	60	1458.00^{e}	552.00^{ab}	906.00^{p}	993.00^{b}	441.00^{ab}	4.60^{de}	77.45^{d}
36	40	2042.00^{w}	1013	1029.00^{v}	1871.00^{lmn}	858.00^{q}	4.80^{gh}	77.55^{d}
	50	1767.00^{k}	757.00^{cde}	1010.00^{u}	1341.00^{cd}	584.00^{c}	4.60^{de}	77.50^{d}
	60	2014.00^{w}	788.00^{cdefj}	1226.00^{y}	1381.00^{de}	593.00^{c}	4.47^{bc}	76.60^{c}
				T3W				
12	40	1787.00^{k}	995.00^{jklm}	792.00^{n}	1887.^{lmn}	892.00^{r}	4.93^{ij}	77.40^{d}
	50	1580^{gh}	757.00^{cde}	823.00	1283.00^{c}	526^{bc}	4.53^{cd}	75.80^{a}
	60	1651.00^{h}	718.00^{cde}	933.00^{q}	1262.00^{cd}	544^{c}	4.60^{de}	76.70^{c}
24	40	3059.00^{z}	2004.00^{t}	1055.00^{w}	4151.00^{z}	2147.00^{z}	5.13^{m}	76.60^{c}
	50	1708.00^{j}	788.00^{cdef}	920.00^{q}	1316.00^{cd}	528.00^{bc}	4.60^{de}	77.50^{d}
	60	2605.00^{y}	995.00^{klm}	1610.00^{z}	1800.00^{kl}	805.00^{m}	4.33^{b}	76.70^{c}
36	40	2170.00^{x}	1215.00^{r}	955.00^{s}	2121.00st	906.00^{r}	4.87^{hi}	78.25^{ef}
	50	1446.00^{e}	524.00^{a}	922.00^{q}	870.00^{ab}	346.00^{a}	4.53^{cd}	77.55^{d}
	60	1543.00^{gh}	420.00^{a}	1123.00^{y}	730.00^{a}	310.00^{a}	4.40^{b}	77.45^{d}

Values are means of two replications. Superscript of different alphabet are significantly different ($p<0.05$).

3.2.2. Trough Viscosity

There was significant difference ($p<0.05$) in trough viscosities. The trough viscosities followed similar pattern of the peak viscosities. Values ranged from 471.00 to 1943cp for A5W, 761.00 to 1213cp for A4Y, 941 to 1493 cp for D2Y, 540 to 1013cp, 972 to 1303cp and 524 to 1215cp for S7Y, D2Y and T3W, respectively. The break down viscosity of A4W ranged from 431-1020cp, 606-1774cp (D1Y), 513-1319CP (D2Y), and 972-1325CP (A5W), 703-1225cp (S7W), and 792.00-1123cp (T3W). The highest value recorded was 1943.00cp. The trough viscosity of ogi produced from A4Y at 24 and 36th hour of soaking decreased with increase in drying temperature. Ogi produced at 12th hour of soaking were 1069.00, 787.00 and 1031.00cp at drying temperature 40, 50 and 60°C, respectively. The highest value of trough viscosity of ogi produced from A4Y was recorded at 36th hour of soaking and drying temperature of 40°C. Ogi produced at 24th hour of soaking decreased with increase in drying temperature with the highest value recorded at 1493.00cp. Generally, smaller values were recorded for ogi produced from S7Y at all the soaking period and drying temperature. The trough viscosity of ogi produced from T3W at 12 and 36th of soaking period decreased with increase in drying temperature. Ogi produced at 24th hour of soaking followed the same pattern of ogi produced from A4Y at 12th of soaking. The highest trough viscosity was 2004.00cp at drying temperature of 40°C. This was higher than values reported for kiwi fruit starch [26].

3.2.3. Breakdown Viscosity

The breakdown viscosities of ogi produced at 24 and 36th hour of soaking decreased with increase in drying temperature. Ogi produced at 36th hour of soaking and dried at 60°C had 1513.00cp for A4W, 1774.00CP at 24th of soaking and drying temperature of 60°C for D1Y. This was similar to observation recorded for ogi produced at 36th hour of soaking from D1Y. The break down viscosities of ogi produced at 12, 24 and 36 hour of soaking from D2Y decreased with increase drying temperature. This was contrary to values obtained for T3W and S7Y. Generally, the break down viscosities obtained for all the ogi produced in this work were significantly higher compared with values obtained by Osungbaro *et al.*, [31]. According to Adebowale *et al.*, [32], the higher the breakdown in viscosity, the lower the ability of the starch sample to withstand heating and shear stress during cooking. Starches with high breakdown are likely to produce unstable pastes [31,33].

3.2.4. Final Viscosity

Final viscosity of ogi produced from D2Y at 12 and 24th hour of soaking increased with increase in drying temperature. Lower values of final viscosities were obtained for ogi produced at all the soaking period and drying temperature produced from S7Y. The final viscosity of 1415cp at 12th hour, 1449 at 24th hour and 1871 at 36th hour of soaking and drying temperate of 60, 50 and 40 ^{0}C, respectively were measured for S7Y. The final viscosity of ogi from A4Y at 24 and 36th hour of soaking decreased with increase in drying temperature. The peak viscosity obtained for ogi produced from A5W and T3W at 24 and 36th hour of soaking and drying temperature 40°C, respectively were higher than values obtained for 100% cassava (284.08 RVU); while 1 RVU is equal to 12 cp [31]. The interaction effect of final viscosities, soaking time and drying temperature are as shown in Figure 2. Drying temperature alongside the botanical constituent of maize grains and varieties used in producing the ogi showed noticeable effect than the soaking period. Values obtained for final viscosities for all the six varieties and at varying soaking conditions were lower compared with the values reported by some researchers [26,29,31]. According to Osungbaro *et al.* [31], the final viscosity is the most commonly used parameters to determine a particular starch-based sample quality. The increase in final viscosity recorded was consistent with the values obtained by some researchers [4,31].

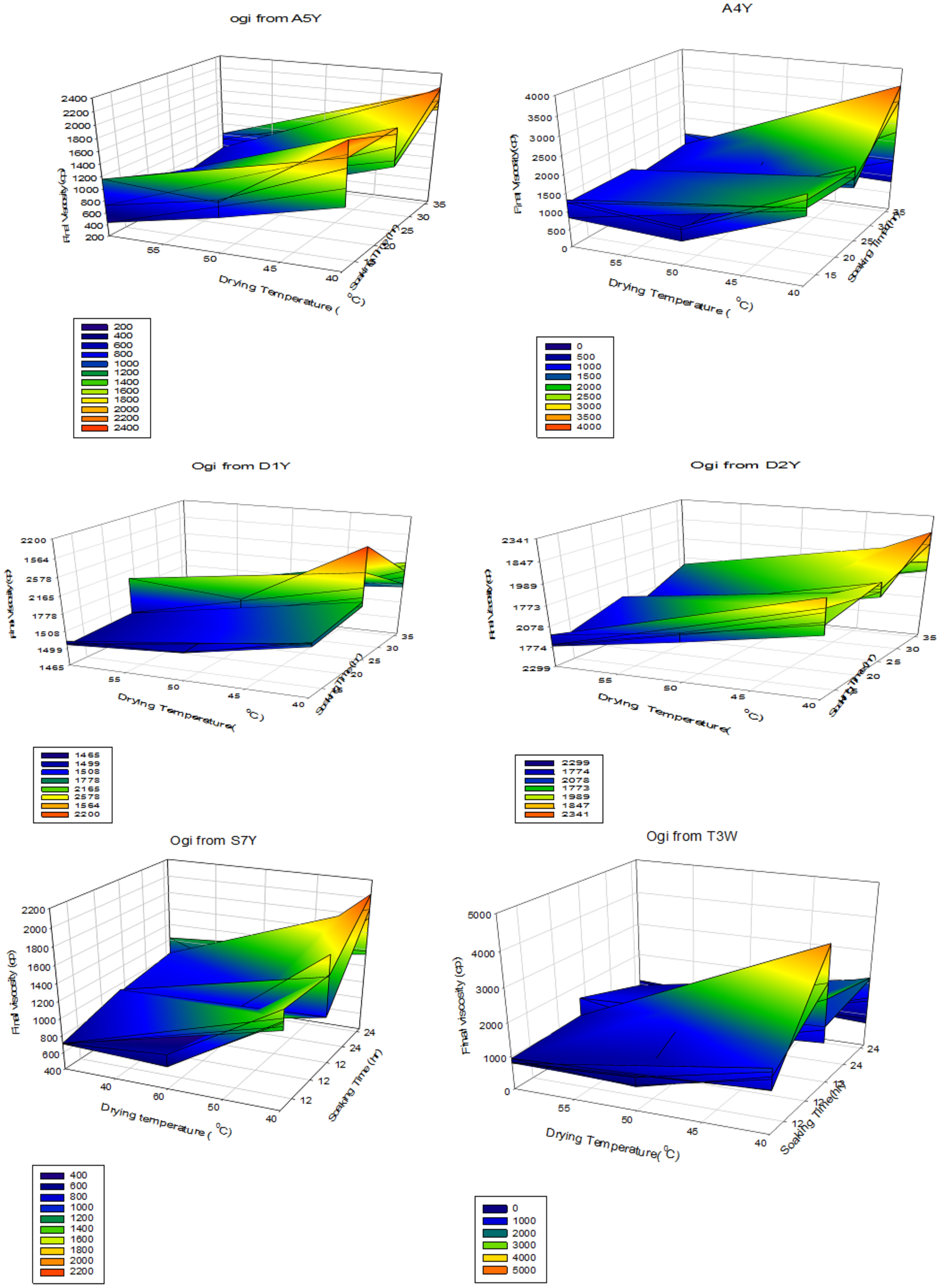

Figure 2. Interaction effect of final viscosity with soaking time and drying temperature

3.2.5. Setback Viscosity

The set back viscosity revealed that ogi produced from D2Y at 24th hour of soaking decreased with increase in drying temperature. The setback viscosity of 1110.00 was obtained at 12th hour of soaking and drying temperature of 40°C. This value was higher than all the values obtained for setback viscosities of ogi produced from A4Y, S7Y, T3W and D1Y. Setback is a measure of recrystallization of gelatinized starch during cooling [28,30,31,33,34]. The difference in setback among different ogi samples may be due to the amount and the molecular weight of Amylose leached from the granules [27]. The kinetics of crystallization of amylose and recrystallization of amylopectin are mechanisms with tendencies to affect retrogration of gels from starch [27].

3.3. Peak Time and Temperature

The peak time for the ogi samples were in the range of 4.00 to 4.87 min. (A5W), 4.73-5.13(A4Y), 4.00 to 5.07 min. (S7Y), 4.33-5.13min. (T3W), 4.40 to 5.07 min. (D1Y) and 4.73 to 5.20 min.(D2Y). It was observed that in some cases, samples with high cooking time had high peak and final viscosities. The pasting time obtained in this research work were significantly lower compared with values reported by Osungbaro *et al.* [31]. The pasting time values were higher when compared with the values reported by some researchers [19,20,29]). Pasting temperature marks the gelatinization or initial increase in viscosity. The pasting temperature of the ogi was in the range of 75.05 to 77.50°C (D2Y), 75.00 to 78.10°C. A5W, 77.40 to 79.85°C (D1Y), 78.25 to 79.95 (A4Y), 75.00 to 79.05 (S7Y) and 75.45 to 78.25 (T3W). The pasting temperature in ogi produced from maize varieties A4Y were consistently and significantly higher compared with ogi produced from other maize varieties. The pasting temperature recorded for all the ogi produced from all the maize varieties were higher compared with the values reported by some researchers [26,29,31,34]. The results obtained for this research work were lower when compared with other research works [35,36], however, within the range of values obtained by Bolaji *et al.* [20] and Bolaji *et al.,* [19] for ogi at varying storage conditions.

3.4. Correlation Effect of Pasting Properties

Significant positive correlation was observed between Peak viscosity and other pasting properties. The significant positive correlation between peak viscosity and breakdown, indicated that ogi paste with high Peak viscosity have tendencies of high breakdown values [32,33,37]. This implies that weak gels may be formed and may not be able to withstand or disintegrate under shear and heat [33]. Varietal differences in pasting characteristics of ogi may be attributed to the differences in amylopectin molecular structure [38]. Also, the degree of randomly limited branching in Amylose content may have contributed to varying pasting values [30]. It was also reported that free amylase complexes with lipids may affect the pasting behaviour [28]. Mason and Hoseney, [39] reported that hot paste viscosity was affected by die temperature and an interaction between screw speed and barrel temperature while cold paste viscosity was affected by an interaction between moisture of the feed and throughput rate. This implies that temperature have strong tendency to affect properties of starch. According to Almei-Dominguez *et al.,* [40], higher solids content may increase peak viscosity. A low heating rate may produce the highest peak viscosities [27,28]. Also, the amount of amylose that is free and molecular weight distribution was reported to have possible effect on pasting properties [28]. Hot water soluble component was reported to have a postive influence on retrgration compared with lower moleculaur weight component. [12,28,39,41]. According Nur and Purwiyatno, [42] Maize-starch in conventional form is limited in use because of it's physically properties, e.g. highly retrogration properties, syneresis pasta, and low stability of pasta at high temperature. According to Singh *et al.,* [33] quick amylose leaching out into the aqueous phase has tendency of reassociation thereby leads to higher hot paste viscosities. Short peak-paste time of starches have been found to have low resistance to swelling and they would be expected to swell rapidly and become susceptible to concurrent shear induced disintegration while a long paste-peak time are associated with gradual swelling of granules. They may not be susceptible to mechanical damage [43].

4. Conclusion

The peak, break down and set back viscosities of ogi produced from D2Y decreased with increase in drying temperature at 24th hour of soaking. The final and set back viscosities of ogi produced from A5W and D1Y at 12th hour of soaking decreased with increase in drying temperature. There was increase in peak, trough, breakdown, final and set back viscosities with increase in drying temperature for ogi produced from D1Y at 24th hour of soaking. Pasting time and temperature of ogi produced from S7Y and A4Y at 12 and 36th hour of soaking decreased with increase in drying temperature. Findings in this work suggested that drying temperature is of significant importance to the behaviour noticed and evident in this work unlike the soaking period. The significant differences noticed in the pasting properties were easily traceable to varying temperature of drying than to soaking period. Varietal differences also had evident impact on the pasting properties of ogi produced from the six maize varieties used in this work. Varietal differences which were influenced by major components of the starches in ogi produced from all the maize may have dictated the pasting behaviour and responses to varying drying temperature.

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