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Studies on the Rheological Properties of Ogi Produced from Different Pearl Millet Varieties

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Abstract: In the present study viscosity characteristics and pasting properties of ogi produced from six pearl (both local and improved) cultivars was studied. The ogi produced from the pearl cultivars exhibited varying degrees of rheological characteristic. The viscosity data recorded at the share rates were significantly ($p<0.05$) different for the ogi's. While the amylograph hot past viscosities for the individual ogi's recorded significant ($p<0.05$) differences in the parameters assessed. None of the ogi samples had a characteristic peak except ogi from Gwagwa pearl millet cultivar. The excellent stabilities exhibited by the ogi samples from LCIC-9702, SOSAT-C 88 (improved cultivars) and Zango and Ex-Borno (local cultivars) is desirable for instant ogi. There were non significant differences in the water absorption capacity of the ogi from the pearl millet varieties. SOSAT-C88 and Zango recorded the highest percent water absorption of 76 and 74%, respectively, while Ex-Borno was the least.

Key words: Rheology, ogi, pearl millet

INTRODUCTION

Ogi a fermented thick porridge is fed to infants and also used as breakfast item in many West African countries including Nigeria. It is prepared from maize, sorghum and millet. Akingbala *et al.*[1] reported on the pasting properties of ogi from different sorghum cultivars. They reported that the six sorghum varieties had different pasting properties especially the waxy sorghum. The greatest difference was in their reduced set back and low initial pasting temperature especially for ogi from waxy sorghum cultivar. Low peak viscosity, poor stability and low set back reduces the desirability of waxy sorghum fro ogi production. It has been reported that when the amylograph of ogi is associated with a high peak, the ogi will not be suitable for instance porridge. If the peak viscosity is reasonably low, the ogi can use as an instant ogi.

In breeding programmes, varieties to be selected and released for increased commercial cultivation must be evaluated for its agronomic characteristics, disease resistance and end use quality. These factors combined determine the desirability of a variety for release to the farmers. Therefore understanding the pasting properties of pearl millet varieties for release to farmers becomes very important[2].

There are various factors, which affect the pasting properties of starch or flour. These include the followings, presence of chemical compounds, enzymes (Amylase), lipids, cell wall components, sugars and non-denatured proteins as well as the variety or grain type.

It is known that many chemical compounds influence the viscosity characteristics of starch-based solutions. Inorganic ions especially influence the gelatinization process and also the cold gel viscosity, probably as a result of bonding with phosphate ester groups with subsequent restriction to swelling[3,4]. Therefore, when comparing or accounting for the functional properties of different starch, flour or meal the presence of certain ions must be accounted for. The viscosity curves are also influenced by lipids, especially neutral and phospholipids[3,4]. However, the extent of their influence remains uncertain. Addition of phospholipids to potato starch was found to reduce peak viscosities; monoglycerides present also have considerable influence on viscosity curves as a result of complex formation with amylose. The fairly high amount of lipid in akamu (ogi) from millet may have some influence in their viscosities.

Cell wall compounds have been shown to influence the viscosity properties of starch, flour or meal suspensions, pentosan reduce the rate of set back, but not the on set of getalinization and also the presence of sugar and non denatured proteins as in akamu (ogi could change the amylograph. The non starch compounds in ogi and the proportions in which they occur may influence the viscosity either by restricting the swelling at gelatinization, stabilizing the hot paste viscosity against heat and mechanical breakdown and by increasing the paste viscosities after gelatinization peak[4].

The presence of impurities is not able to influence the acid stability of starch suspension to any great extent.

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Reduction in water extractable (compounds) components may increase viscosity. Stability and high viscosities may increase viscosity. Stability and high viscosities may also be attributable to the presence of tightly bound or insoluble compounds. Decreased peak viscosity of starch or meal may be attributed to water soluble compounds.

The acid stability of starch suspensions is important in acid foods. The differences in the pasting properties of some starch may or could be as a result of varying pH and acidity values. It is however reported that the hot paste and cold paste viscosities are only influenced slightly by reduction in pH. However, at pH 3.2 and acid values 2 and below starch based products are unstable to heat and mechanical) may of interest in choosing for Viscosity of ogi from the six pearl millet varieties. This study was aimed at comparing the pasting characteristics of the individual ogi produced from the pearl millet cultivars.

MATERIALS AND METHODS

The six pearl millet varieties used in this was study are Ex-Borno, Zango, Gwagwa (local) and SOSAT-C88, GB-8735 and LCIC-9702 (improved varieties) were collected from Lake Chad Research Institutes Maiduguri, Borno State, Nigeria. Grain samples were clean and stored at 0°C until used.

The hot past viscosity of ogi (10% w/v) were determined using Brookfield viscometer. The amylograph characteristics of ogi were determined as by Lorenz and Dilssaver[5].

Analysis of variance (ANOVA) was used to determine the differences with the groups and Duncan Multiple Range Test was used to determined the differences within the varieties at 95% confidence level ($p<0.05$).

RESULTS

Table 1 shows the hot past viscosities (BU) for ogi produced from six pearl millet varieties. There were statistically significant ($p<0.05$) differences in viscosities of ogi from the varieties at the different shear rates used. At shear rate 10 (rev/min) LCIC-9702 has the highest viscosity and Gwagwa the least, while at shear rates 20 (rev/min), LCIC-9702 has the highest viscosity and Gwagwa the least and at shear rate 50 (rev/min) LCIC-9702 recorded the highest viscosity and Gwagwa the least.

LCIC-9702 an improved variety exhibited a consistently higher viscosity values at all the shear rates compared to the other varieties, followed by Ex-Borno, Zango, GB-8735, SOSAT-C88 and Gwagwa at all the shear rates, respectively.

The cold paste viscosity for all the ogi samples from the different varieties was similar. However, the point (time) at which swelling or increase in viscosity started was different for ogi from Zango and Gwagwa pearl millet varieties. Both Zango and Gwagwa are local varieties. The point at which swelling was initiated for the remaining ogi samples from the other varieties (Ex-Borno, SOSAT-C88, GB-8735 and LCIC-9702) as heating progressed were similar; these pearl millet samples are improved varieties. It could be stated that the initial pasting temperatures for these four samples were similar. All samples of ogi showed increases in viscosity as cooking progressed. The gelatinization temperature of all the ogi samples varied slightly (Table 2) and ranged from 84.9-89.1.

None of the ogi samples had a characteristics peak except ogi from Gwagwa pearl millet variety. Ogi from GB-8735 pearl millet variety had a peak viscosity, which was lower than that of Gwagwa. The viscosity at peak for ogi from Gwagwa was 690 BU, while that of GB-8735 pearl millet variety was 390BU. All the other ogi samples had no noticeable peak viscosity (Table 2).

Holding the temperature at 95°C for 20 min produced increased viscosity for ogi from LCIC-9702 pearl millet up to about 450 BU. Ogi from SOSAT-C88, Ex-Borno and GB-8735 pearl millet varieties showed no measurable increases in viscosity on holding at 95°C for 20 min. But on holding at 95°C for 20 min ogi from Zango showed an excellent stability. Also ogi from SOSAT-C88, GB-8735 and Ex-Borno showed good stability on holding at 95°C for 20 min even though the highest viscosity on holding was around 320 BU for these samples. On cooling to 50°C a significant increase in the viscosity for all ogi samples was noticed (set back or retrograde). On cooling to 50°C, for 20 min all the ogi samples arrived at almost similar viscosities even though the time to reach this value varied from one ogi sample to another. The point (time in min) for the initiation of set back also varied for the ogi samples from Zango, LCIC-9702 and Gwagwa pearl millets (Table 2). The percent water absorption for the individual ogi produced from different pearl millet varieties is shown in Table 3. The values ranged from 61.83 for Ex-Borno and 76.50 SOSAT-C88. The differences observed within the ogi are statistically significant ($p<0.05$).

Table 1: Viscosity (centipoise) of ogi produced from six pearl millet varieties

	Viscosity (BU)		
	Share rate (rpm)		
Varieties	10	20	50
EX-BORNO	2906.0^{a}	3223.00^{a}	4035.00^{a}
SOSAT-C88	496.0^{b}	686.30^{b}	1111.00^{b}
GWAGWA	482.7^{b}	647.30^{b}	1095.00^{b}
GB-8735	1023.0^{c}	1213.00^{c}	1443.00^{c}
ZANGO	1604.0^{d}	1763.00^{d}	2056.00^{d}
LCIC-9702	4237.0^{e}	5263.00^{e}	5376.00^{e}
LSD 5%	30.79	70.54	35.76

Values are means of triplicate determination, Values with different superscript vertically along a column are statistically significant ($p<0.05$)

Table 2: Amylograph viscosity (BU) characteristics of ogi from six pearl millet varieties

Varieties	G T (°C)	PV (BU)	TPV (°C)	VH (95°C) (BU)	VC (BU)	GTT (Min)	PVT (Min)	SBV (BU)
LCIC-9702	88.4		93.3	552	990	67		900
SOSAT-C88	87.4		94.3	260	975	76		900
GB-8735	85.6	390	93.5	315	990	78	87	900
EX-BORNO	84.9		89.6	278	990	77		800
GWAGWA	89.1	690	92.7	318	990	58	64	700
ZANGO	87.2		85.9	580	990	70		990

GT = Gelatinasation temperature (°C)
TPV = Temperature to reach peak viscosity (°C)
VC = Viscosity on cooling to (50°C) BU
PVT = Time to reach peak viscosity (min)
PV = Peak viscosity (BU)
VH = Viscosity at holding 93-95°C (BU)
GTT = Time to reach geletinisation temperature (min)
SBV = Set back viscosity BU

Table 3: Water absorption capacity of *ogi* produced from six pearl millet varieties

Varieties	Water absorbed (mL)	% Water absorbed
EX-BORNO	3.263 ± 0.19^{a}	61.83 ± 9.52^{a}
LCIC-9702	3.300 ± 0.40^{a}	65.00 ± 10.01^{b}
SOSAT-C 88	3.530 ± 0.30^{b}	76.50 ± 10.0^{c}
GB-8735	3.437 ± 0.42^{c}	71.83 ± 11.0^{d}
ZANGO	3.483 ± 0.27^{d}	74.17 ± 10.3^{e}
GWAGWA	3.400 ± 0.27^{e}	70.00 ± 10.2^{f}
LSD (5%)	0.280	0.14

Values are means of triplicate determinations
Values with different superscript vertically along a column are statistically significant ($p<0.05$)

DISCUSSION

The differences recorded in viscosities within the ogi from pearl millet varieties might be due to varietal difference and of differences in the levels of amylose and amylopectin or degree of starch damage due mainly to amylase activity or due to grinding. Activities of microorganism during fermentation can also lead to such observed differences in rheological behavior as reported in this study. This result is consistent with earlier reported by Akingbala *et al.*[1] where ogi from six sorghum varieties exhibited similar rheological behaviors. This result is however, not in agreement with the preliminary result by Nkama *et al.*[6].

The factors which may have influenced the noticeable differences in pasting characteristics of these ogi may include varietal differences, the extent of starch damage during grinding and changes that may have occurred in the starch properties during fermentation of pearl millet for ogi production[7]. Similar viscosity patterns as exhibited by these ogi samples have been reported by other workers for ogi from sorghum and maize[1] and air classified potato starch[4] containing non-starch components proteins and sugar.

The presence of neutral and phospholipid greatly reduces the viscosity of starch flour. This is because the rate at which water penetrates into the starch molecules is decreased. Defatted corn and wheat starches have been reported by Madeleine[3] to increase (facilitate) penetration of water molecules, resulting in an increase peak width. The excellent stability for ogi samples from LCIC-9702, SOSAT-C88, Zango and Ex-Borno pearl millet varieties is a good indication that these cultivars would be desirable for instant ogi. Nkama *et al.*[6] reported that ogi from SOSAT-C88 and Zango were the most acceptable.

REFERENCES

1. Akingbala, J.O.L.W, Rooney and J.M. Faubion, 1981. A laboratory procedure for the preparation of ogi, a Nigerian fermented food. J. Food Sci., 46: 1523.
2. Nkama, I. and M.I.C. Ikwelle, 1997. Assessment of Food Quality of Millet Grain. In: Pearl Millet in Nigerian Agriculture, Production, Utilization and Research Priorities. Proceedings of the Pre-season National Co-ordination and Planning Meeting of the National Coordinated Research Programme of Pearl Millet (Emechebe, A.M., M.C. Ikwelle, O. Ajayi, M. Aminu Kano and A.B. Anaso, Eds.), Maiduguri, 21-24th April, 1997, pp: 171-178.
3. Madeleine, A.M., 1979. The effect of extractable lipids on the viscosity characteristics of corn and wheat starches. J. Sci. Food Agric., 30: 731-738.
4. Holms, F., 1981. Physical characteristics of an air classified potato starch. J. Food Technol., 16: 101-113.
5. Lorenz and W. Dilssaver, 1980. Rheological properties and food applications of proso millet flours. Cereal Chem., 57: 21-24.
6. Nkama, I., S. Dappiya, S. Modu and W. Ndah, 2000. Physical, chemical, Rheological and sensory properties of Akamu (ogi) from different pearl millet cultures. J. Arid Agric., 10: 145-149.
7. El-Tinary, A.H., G.A.M. Abdel and M. EL-Hidai, 1979. Sorghum fermented Kisra bread. I. Nutritive value of Kisra. J. Sci. Food Agric., 30: 859.