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Effect of Processing Time and Some Additives on the Apparent Viscosity of 'Achi' *Brachystegia eurycoma* Flour

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Abstract: The effect of processing time and some additives on the apparent viscosity of 'achi' *Brachystegia eurycoma* flour a traditional food thickener with extensive domestic use in Eastern part of Nigeria was evaluated. The additives include, flour concentration, palm oil and salt concentrations. Achi dispersions at 2% (w v^{-1}) achi flours and various concentrations of palm oil and NaCl were prepared by mixing measured amounts of flour in water with adequate amounts of palm oil and NaCl, respectively at room temperature (28±2°C). Dispersions were held with continuous stirring for 30 min before shearing in a digital display viscometer (NDJ-85) at 25±0.5°C. The apparent viscosity (at 0.5 s^1) increased with increased toasting time, flour and palm oil concentrations, but decreased with increased NaCl concentration.

Key words: Brachystegia eurycoma flour, viscosity, toasting time, palm concentration

INTRODUCTION

There are many local food crops used in different food formulations in Nigeria. *Brachystegia eurycoma* commonly called 'achi' in Eastern parts of Nigeria, a legume belonging to the family leguminosae has been widely used in Nigeria and some African countries as emulsifiers and thickners in traditional soups (Keay *et al*., 1974; Onweluzo *et al*., 1994). The use of this legume has been limited to local traditional culinary practices, which makes them under exploited and has also received little attention and recognition from researchers unlike other legumes such as soybeans, cowpea and great Northern bean. This is evident from the dearth of scientific reports on them.

The popularity of convenience foods places great emphasis on the reliability of functional properties of the ingredients. Novel foods and food ingredients must be functionally reliable if they are to be accepted for use. Functionality can be defined as any property of a food or food ingredient other than the nutritional ones that affects it utilization.

'Achi' when in powdery form, swell in water, thus increasing the viscosity in traditional soup. It may also, be used to impact textural and functional properties to other foods especially, the convenience foods (Uzomah and Ahiligwe, 1995). In soup making, viscosity is an index of thickness. Soups are preferred by consumers based on their thickness in Nigeria. This and the taste of the soup may however, be influenced by processing conditions of the thickening agent.

The utilization of this legume can be increased by evaluating its stability to processing parameters, the effects of added ingredients as they affect the viscosity of 'achi' flour as been done for other legumes. Uzomah and Ahiligwe (1995) have studied the rheological properties and functional potentials of 'achi' and 'ogbono'; Onweluzo *et al*. (1994) studied the viscosity studies on the flour of 'achi' but they did not consider the effect of processing time and some additives such as palm oil and salt concentrations on the viscosity of the 'achi' flour.

The objective of this study, is to investigate the effect of processing time and some added ingredients on the apparent viscosity of 'achi' flour. The data generated from this study would be useful in guiding food processors on their choice of processing condition and design of pumps.

MATERIALS AND METHODS

Source and preparation of sample: Samples of *Brachystegia eurycoma* 'achi' seeds were purchased from Eke-Aba market in Abakaliki, Ebonyi State, Nigeria. The seeds were screened to eliminate the bad ones. Cleaned seeds were divided into 2 parts of about 1kg each. One part was conditioned to 25% moisture content by the addition of distilled water and held for 1 h with occasional stirring. The conditioned sample was sun dried to a final moisture of approximately 10%. The dry seeds were

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dehulled for 2 min using disc attrition mill (No1A Premier). The dehulled seeds were milled in an attrition mill and sieved with American standard sieve number 40, with aperture of 435 μm, packaged, labeled and stored at room temperature (28±2°C) in water and airtight polyethylene bag until used.

The second part of the cleaned seeds were toasted in an oven at 120°C for 6,9,12 and 15 min, respectively and dehulled while, hot with stone. The dehulled seeds were milled in an attrition mill, sieved and packaged.

Viscosity measurements: The viscosities of the 'achi' samples were determined at 25±0.5°C using a digital display viscometer (NDJ-85). 'Achi' dispersions with concentration ranging from 0.4-2.0% (w v^{-1}) were prepared with distilled water in a 300 mL glass beaker at room temperature under continuous stirring using a magnetic stirrer for 30 min for complete dispersion. The viscosity values of the hydrated dispersions were obtained by multiplying dial reading by appropriate factors (supplied by the viscometer manufacturer).

Effect of toasting time on apparent viscosity: A 2% (w v^{-1}) dispersion of each 'achi' flour was prepared with distilled water in a 300 mL glass beaker. The dispersions were continuously stirred for 20 min using a magnetic stirrer. Apparent viscosity of each dispersion was measured as in 2.2.

Effect of palm oil concentration on apparent viscosity: A 2% (w v^{-1}) of 'achi' flour was prepared with distilled water and palm oil in concentrations between 0-25% (w w^{-1}) was added. The mixtures were stirred for 30 min continuously with a magnetic stirrer for uniformity. Apparent viscosity of the mixtures was measured as in 2.2.

Effect of sodium chloride (NaCl) concentration on apparent viscosity: Dispersion 2% (w v^{-1}) of 'achi' flour was prepared with sodium chloride solution in concentration between 0-1.0 M. The dispersions were stirred for 30 min using magnetic stirrer for homogeneity. Apparent viscosity of dispersions was measured as in 2.2.

In all cases, temperature was controlled to 25±0.5°C using an Ambassador circulating water bath and monitored by a thermocouple in contact with the stationary element.

RESULTS AND DISCUSSION

Figure 1 shows the influence of flour concentrations on viscosity of 'achi' flour. The viscosity values ranged

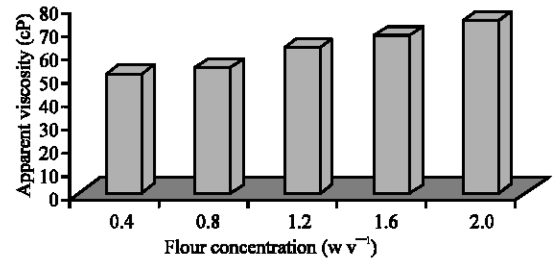

Fig. 1: The effect of flour concentration on the apparent viscosity (cP) of 'achi' flour at 0.5 s^{-1} and 25±0.5°C

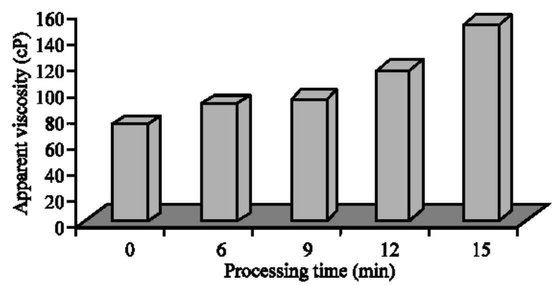

Fig. 2: The effect of processing time on the apparent viscosity (cP) of 2% (w v^{-1}) 'achi' flour dispersion at 0.5 s^{-1} and 25±0.5°C

from 50-73 cP, with 2% (w v^{-1}) flour dispersion having the highest viscosity and that from 0.4% (w v^{-1}) had the lowest. From Fig. 1, it was observed that viscosity increased with increase in flour concentration. The observed increase could be attributed to solubility and swelling properties of the flour. A possible explanation is that the polysaccharide has a strong tendency to self-association with the extent of aggregation increasing with increasing concentration. This result is supported by the findings of the following experts Snyder and Kwon (1987), who reported that the more material there is in solution the higher the viscosity; King (2005) found that the viscosity of starch granules in suspension increased depending on starch concentration; Lewis (1987) stated that viscosity rapidly increases due to concentration increase and there is often a transition from Newtonian to non-Newtonian behaviour and the extent of the concentration is governed by the viscosity characteristics of the concentrate.

The effect of processing time on apparent viscosity of 'achi' flour dispersions is presented in Fig. 2. The viscosity values of the flour dispersions as influenced by processing time ranged between 73-150 cP, with flour dispersion from 15 min toasting having the highest (150 cP) and the control (0 min toasting) had the lowest. From Fig. 2, it was observed that viscosity increased with increase in processing time. This may be due to increasing dry matter content. This agrees with the reports of

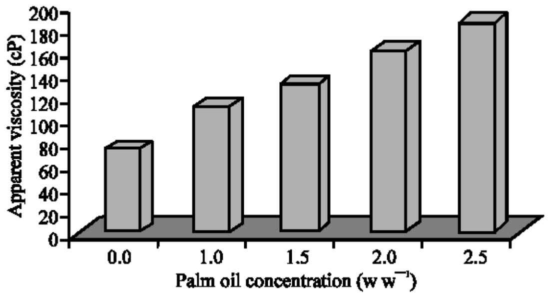

Fig. 3: The effect of palm oil concentration on the apparent viscosity (cP) of 2% (w v^{-1}) 'achi' flour dispersion at 0.5 s^{-1} and 25±0.5°C

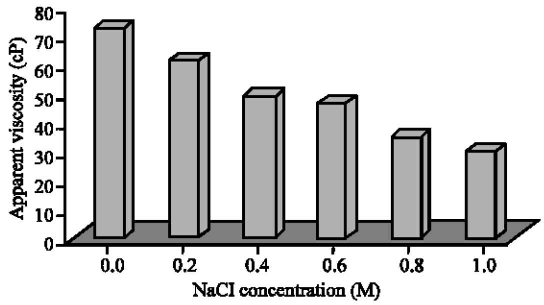

Fig. 4: The effect of salt concentration on the apparent viscosity (cP) of 2% (w v^{-1}) 'achi' flour dispersion at 0.5 s^{-1} and 25±0.5°C

Fennema (1996), Rao (1999) and Jobling (2004) that thermal processing changes the physicochemical properties of starch, such as increased water solubility and viscoelastic behaviour. Iwe (2003) similarly reported that viscosity is often affected by the conditions such as temperature and processing time. It might be interpreted from this study that toasting achi seed for 15 min will result in using small quantity of the flour to achieve the desired consistency and thickness compared to flour from 6 min toasting because of its highest viscosity value.

The results of the effect of palm oil concentration on the apparent viscosity of 'achi' flour dispersions are presented in Fig. 3. The viscosity values ranged between 73-185 cP. Flour dispersion with 2.5 (w w^{-1}) palm oil had the highest viscosity, while the control (zero addition of palm oil had the lowest apparent viscosity value. Fig. 3, revealed that the apparent viscosity of the 'achi' flour dispersion increased with increase in palm oil concentrations. The observed increase might be due to some form of interaction between the palm oil and some constituents of the 'achi' flour, which may be responsible for binding the oil and producing the viscous uniform slurry. The result observed in this study is similar to the reports of Okechukwu (2008) on the influence of peanut oil on cowpea slurry, that the inclusion of oils in the helical strands of amylose component of starch is responsible for the increase in cowpea slurry viscosity on heating. Osman and Dix (1960) in their study on the effect of fat and non-ionic surface-active agents on starch paste reported the same increase in viscosity on fat inclusion.

Figure 4 shows the influence of sodium chloride concentration on the apparent viscosity of 2% (w v^{-1}) dispersions of achi flour. The apparent viscosity values ranged from 30-73 cP. The achi dispersion without salt had the highest (73 cP) and the dispersion with 1.0 M of salt had the lowest (30 cP). It was observed that (Fig. 4) viscosity decreased with increase in salt concentration. The result obtained in this study is similar to the findings of Ndjouenkeu *et al*. (1996) for Dika nut gum, where they reported that the addition of salt screens the repulsions and allows the coils to contract to a more compact conformation, with consequent reduction in viscosity.

CONCLUSION

The study showed that toasting of achi seeds, the addition of palm oil and increased flour concentration increased the apparent viscosity of 'achi' flour dispersions, while NaCl addition decreased the apparent viscosity. Also, the apparent viscosity of flour dispersion increased with increase in toasting time, palm oil and flour concentrations. Of all the conditions given to the 'achi' *Brachystegia eurycoma*, salt addition affected its apparent viscosity negatively.

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