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Research Article

Stiffness of Danwake Measured Using a Squeezing Flow Rheometer

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Abstract

The danwake ingredients (sorghum grains variety Chakalari white flour, cowpea flour, baobab leaves powder and potash) were blended using a metallic pan and a metallic perforated spatula. Samples of danwake were processed following the traditional method of preparation. A squeezing flow rheometer (TA HD and Texture Analyzer Texture Technologies Corp. 18 Favieus Road Scarsdale, New York 10583 USA) was used at strain rates, 10.00, 40.00, 70,00 and 100.00% / sec, to determine the stiffness of danwake. Results showed that the stiffness of danwake decreased as the strain rates increased, a case of pseudoplasticity and a phenomenon observed with most food [1]. Moreover, the stiffness of oily danwake was greater than that of non- oily danwake at all strain rates used. Hence, the addition of oil to danwake increased the stiffness of the product.

Keywords: Stiffness; Sorghum; Danwake; Measure; Squeezing Flow Rheometer

Introduction

Stiff dumplings have anecdotally been used to provide fullness and extended energy in the daily search of fighting hunger throughout the world. This would explain the preferred consumption of stiff dumplings as danwake and tô, in some West African countries as Nigeria and Mali as well as the research work undertaken on these products. Danwake, an indigenous, stiff dumpling food of the people in the northern part of Nigeria is traced to be of the Nupe origin in Niger/ Kogi State. The product is originally prepared from beans flour/ sorghum flour, cassava flour/ beans flour, maize flour/ beans flour. Dry baobab leaves flour and trona ('kanwa') are also added. People believe that the addition of trona reduces flatulence and facilitates cooking of the beans [2]. The choice of cereal grains in danwake processing depends on individual needs and the availability of the desired blend components. The danwake flour blend is mixed with water to obtain dough which is moulded into small balls. The balls are cooked in boiling water for 15 to 30 min. They are thereafter removed from the cooking pan and placed in cold water to remove the mucilaginous foam which is drained off. The product is rinsed again with cold water and served with ground nut oil or any other vegetable oil, salt, magi and locally prepared spices ('yaji') containing ginger and red pepper.

The food material types, the particles size of the flour obtained from the blend of materials as well as the amount of water used during the preparation, contribute largely to the stiffness of the finished product. The objectives of the current study were:

- To produce danwake following the traditional method of preparation.
- To determine the stiffness of danwake using a squeezing flow rheometer.

Materials and Methods

Materials

The materials in the preparation of danwake were composed of sorghum Chakalari white variety and cowpea flours, potash granules and Baobab leaves powder (Kuka). A metallic pan and a metallic perforated spatula were used for blending the different danwake ingredients. A squeezing flow rheometer (TA HD and Texture Analyzer Texture Technologies Corp. 18 Favieus Road Scarsdale, New York 10583 USA) [3] was used to determine the stiffness of danwake.

Methods

Preparation of Danwake

Danwake samples were produced from a blend of sorghum four, cowpea flour, baobab leaves powder and potash following the procedure described by [4,5]. The flour blend was mixed with water to produce dough which pH was adjusted by adding potash solution or trona. The initial pH of the raw danwake without trona is acidic, pH 6 or below whereas that of the finished product ranged between 6 and 8 [6]. The dough was molded into small balls which were cooked in boiling water for 15 to 30 min. During cooking, the balls were stirred using a metallic perforated spatula, to avoid over boiling and their coalescence to form agglomerates. The cooked balls were thereafter removed from the cooking pan, cooled in cold water to remove the mucilaginous foam which was drained off using a colander. Ground nut oil was added to the finished product for oily danwake samples.

Stiffness of Danwake Measured Using a Squeezing Flow Rheometer

The stiffness of danwake was determined using the squeezing flow rheometer (TA HD and Texture Analyzer Texture Technologies Corp. 18 Favieus Road Scarsdale, New York 10583 USA) as follows:

The machine was switched on by clicking on the start sign or drawing on the monitor screen to start. A user name was selected among those programmed and its corresponding pass word typed in to log on. A test was programmed as follows: the pretest speed was set at 1.00 mm /sec., whereas that of the test at 5.00 mm/sec. The post- test speed was 5.00 mm/sec. and the distance between the compressor and the sample prior to compression of sample, was 10.00 mm (depending on the height of the sample). The duration of the compression of the sample: was set at 5.00 sec and the trigger force at 5.00 g. A special test was selected by double clicking it in the Library on the screen of the monitor. Thereafter, the strain rate (in our test, 10.00, 40.00, 70.00 and 100.00%/sec.) was selected. The compressor was lowered to the top of the sample by choosing on the screen of the monitor, move prove. The run test sign was selected to compress the sample and thereafter, the compressor lifted. A figure of the compression of the sample was shown on the screen of another computer connected to the squeezing flow machine. The displayed figure was saved by double clicking on it first and then choosing to save in the file.

Results and Discussions

The results of the stiffness of danwake using the squeezing flow rheometer are presented in Figures 1a to 1d. The viscosity of oily danwake was greater than that of the non-oily one regardless of the strain rate used. From Figures 1a to 1d, the viscosity of danwake could be estimated to 3.50 ± 0.10, 3.80 ± 0.09, 3.80 ± 0.09 and 2.90 ± 0.09 Pas, at strain rate, 10.00, 40.00, 70.00 and 100.00%/sec, respectively. It could also be noted that the viscosity of danwake decreased as the strain rate increased, which is a characteristic of pseudoplastic foods and of most foods (BeMiller, 2007). Figure 1a showed that stifness of danwake increased with increase in strain for oily danwake until it reached a strain value of 102.90 Pa and then decreased sharply.

The stiffness for non-oily danwake, increased sharply and remained flat. The sharp decrease in stiffness is probably due to the lack of gluten in sorghum dough as compared with wheat dough. Gluten elasticity enables wheat dough to extend and produce volumunous bread. Since gluten is missing in sorghum dough, the expendibility of that dough will be limited. The presence of oil, in addition to that of the other danwake ingredienrs as cowpea, and baobab leaves powder which have a thickening and ligant properties, respectively, might have given a better elasticity to the oily danwake than the non-oily danwake, which showed a poor extensibility and remained flat after a short period of rising. The same explanation stands for Figure 1b., except that, the increase in shear rate from 10.00% / sec to 40.00% /sec might have decreased the viscosity (a case of pseudoplasticity) of the danwake particularly, that of the oily danwake. Therefore, oily danwake (Figure 1b) stretched for a short time then dropped gradually up to a strain value of 553.00 Pa, then increased again higher than in the first case before droping. The time during which the viscosity dropped probably gave time to the compressed danwake to rest and recover thereby, enabling it to reach a greater increase in viscosity than that in the first one. Figure 1c had also shown the same phenomenon as that in Figure 1b. However, because of the increase in shear rate from 40.00%/sec to 70.00% / sec the viscosity of both the oily and non-oily danwake, after reaching a strain of 56.00 Pa dropped and increased again but at a lower extent than that of the first increase. The same trend was obtained with Figure 1d in which, oily and non-oily danwake increased in stiffness then dropperd at a strain value of 87.00 Pa. However, while the oily danwake stiffness increased greater in the second increase than in the first one, the increase stiffness in non-oily danwake in its second increase was lower than that in the first.

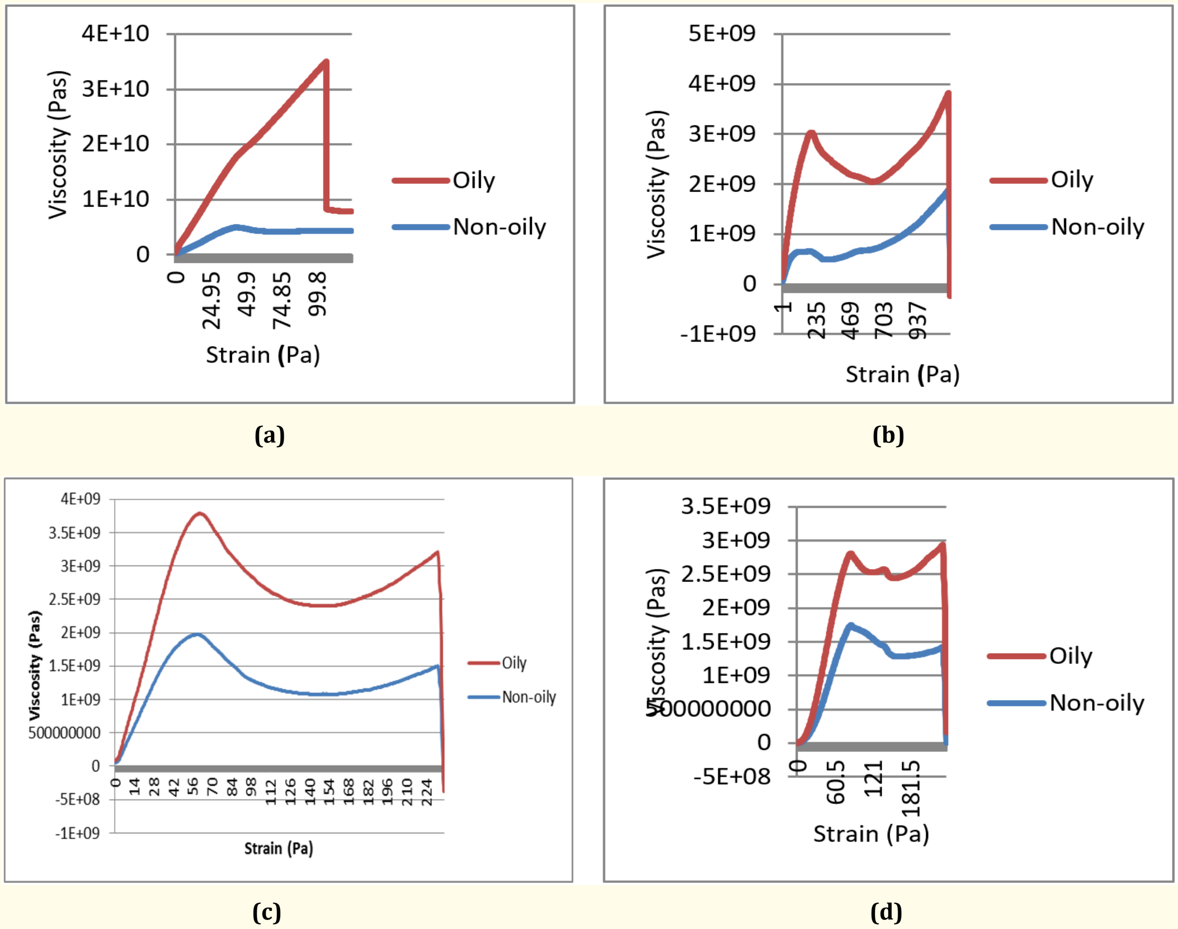

Figure 1: Stiffness of Oily and Non-Oily Danwake at Strain Rates: (a) 10.00 % /sec, (b) 40.00 % /sec, (c) 70.00 % /sec and (d) 100.00 % /sec.

Conclusions

It can be concluded from the study that the viscosity of *danwake* decreased as the strain rate increased, which is a characteristic of pseudoplastic foods and that of most foods. At all strain rates used (10.00, 40.00, 70.00 and 100.00% / sec), the viscosity of the oily danwake is greater than that of the non - oily danwake. Therefore, the addition of oil to danwake enabled the increase in viscosity of the product.

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