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Stiffness of *Danwake* from Sorghum, Wheat and Cassava Bases as Related to their Flour Blends Composition and Particles Sizes

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Abstract

Danwake samples were processed from three (3) different raw material bases, sorghum, wheat and cassava following the traditional method of preparation. The *danwake* ingredients (sorghum flour/wheat flour/cassava flour and cowpea flour, baobab leaves powder and potash) were blended to obtain seven (7) formulations, sorghum containing 5, 7, 11, 16 and 30% cowpea, wheat with 0% cowpea and cassava with 11% cowpea. The particles sizes of the different *danwake* flour blends were determined using a set of 10 sieves of an Alpine air-jet sifter with different mesh aperture (63, 150, 250, 300, 425, 500, 710, 850, 1000 and 2,000 µm). The stiffness of *danwake* was measured using a cone - penetrometer. The effects of raw material types, formulations and particles sizes of the flour blends, on the stiffness of *danwake* were also investigated. Results showed that the addition of cowpea up to 30% did not affect the stiffness of sorghum based *danwake*. However, the stiffness increased with the increase in particles size of the flour blends used to process *danwake*.

Keywords: *Stiffness; Danwake; Sorghum; Flour Blend; Particles Size*

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 to, 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 [1]. 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. Therefore, the current study sought:

1. To produce *danwake* from sorghum, wheat and cassava following the traditional method of preparation;
2. To determine the particles size of the flour blends used to process *danwake* and
3. To determine the effects of raw material types, formulations and particles sizes of the flour blends, on the stiffness of *danwake*.

Materials and Methods

Materials

The materials in *danwake* flour blends formulation and the processing of the product were composed of sorghum *Chakalari white* variety and cowpea grains, potash granules, wheat flour, cassava flour and Baobab leaves powder (Kuka). A metallic pan and a perforated spatula were used for blending the *danwake* flours whereas, a special application, universal and portable penetrometer (model H1252, Humboldt. Mfg. Co. Schiller Park, Illinois 60176, USA) was used to determine its stiffness.

Methods

Formulation of *Danwake* Flour Blends

Sorghum and cowpea grains were thoroughly cleaned manually using a metal tray, a local screen of 2 mm in diameter and the impurities (broken grains, sand, seeds, and metals) removed. The cleaned, non- decorticated grains of sorghum and cowpea were milled separately into flour using an Indian 1A DELMAR\GRINDING MI mill. Potash granules were also milled into powder using the same mill. Baobab leaves powder, wheat and cassava flours, were purchased at Maiduguri Monday Market. The aforementioned ingredients were blended in a metallic pan using a metallic perforated spatula to obtain the seven (7) *danwake* formulations, sorghum containing 5, 7, 11, 16 and 30% cowpea, wheat with 0% cowpea and cassava with 11% cowpea as presented in table 1.

Ingredients	Formulations						
	1	2	3	4	5	6	7
Sorghum	67.75	-	-	76.69	79.92	89.33	90.39
Cowpea	30.00	-	-	16.26	11.34	7.12	5.06
Kuka	1.50	-	-	3.63	4.53	1.47	1.80
Potash	1.75	-	-	4.03	4.20	2.09	2.74
Wheat	-	95.88	-	-	-	-	-
Cowpea	-	0.00	-	-	-	-	-
Kuka	-	2.90	-	-	-	-	-
Potash	-	1.22	-	-	-	-	-
Cassava	-	-		79.92	-	-	-
Cowpea	-	-	11.34	-	-	-	-
Kuka	-	-	4.53	-	-	-	-
Potash	-	-	4.20	-	-	-	-

Table 1: *Formulations of Sorghum, Wheat and Cassava Danwake Flour Blend (g ingredients/100 g of flour blend).*

Particles size determination of *danwake* flour blends

Flour mean particles size of *danwake* flour blends from the seven (7) aforementioned formulations, was determined using the method described by CIRAD [2]. Fifty (50) g of the dry flour of each of the seven formula were weighed. The flour was sifted successively for 5 minutes through a set of 10 sieves of an Alpine air-jet sifter with different mesh aperture (63, 150, 250, 300, 425, 500, 710, 850, 1000 and 2,000 µm). The percentage of flour that does not pass through each sieve was determined. The mean particle size (G50) corresponded to the sieve mesh that retained 50% of the flour i.e. 25g.

Preparation of *danwake* samples

Danwake samples were produced following the procedure described by Bamanga AD [3] and Alkali B [4]. Each of the *danwake* flour blends previously formulated 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 [5]. The dough was molded into small balls which were cooked in boiling water for 15 to 30 minutes. During cooking, the balls were stirred using a metal 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.

Stiffness determination of *danwake* using a cone-penetrometer

Four *danwake* pieces were randomly pulled from a test preparation. They were individually placed on the base of the penetrometer (Universal Portable Penetrometer Humboldt Universal Penetrometer Humboldt Mfg. Co. 3801 North Avenue, Schiller Park, Illinois, 60176 USA Model 2529) on top of a clean paper. The level spirit of the penetrometer was lowered and set in contact with the top of the probe of the instrument after zeroing the dial reading. The cone of the penetrometer was inserted into the probe stick and screwed. The needle of the cone was thereafter brought on top of the sample surface without penetrating it by unscrewing the level screw to lower the system, dial reading, probe and cone. This setting of the system was secured by tightening the security screw underneath. The clutch was then pressed to release the cone which penetrates the sample. Then the spirit level was pushed down with fingers to reconnect with the top of the probe as it was before. A dial reading of this displacement of the dial needle is taken and corresponded to the cone needle depth of penetration which was divided by ten to obtain the measurement given in mm.

Results and Discussion

Particles size of *danwake* flour blends

The particles size of *danwake* flour from the three different bases, sorghum, wheat and cassava are presented in table 2. The values ranged from less than 63 to 500 µm at greater or equal to 20%. The coarsest and the finest particles were encountered with sorghum *danwake* containing 5% cowpea and cassava *danwake* with 11% cowpea, respectively. The coarse size of the flour from sorghum *danwake* is probably due to the fact that this cereal was not dehulled prior to milling. Therefore, the fibrous outer layers of the seed envelops would be incorporated into the flour. Similar range of 53 µm to 425 µm was reported [3] for the particles size of sorghum and cassava *danwake* flours. The cassava *danwake* flour was finer than those from sorghum and wheat.

Type of Danwake Flour	Sieve Diameter (µm)										
	2,000	1,000	850	710	500	425	300	250	150	63	< 63
	Flour Weight Retained on Sieve (g)										
WDFB (0 % cowpea)	0.00	0.02	0.06	0.34	14.39	13.56	10.78	33.71	21.78	4.84	0.30
SDFB (5 % cowpea)	0.00	0.03	0.16	0.09	34.96	9.84	9.59	24.89	16.55	2.78	0.30
SDFB (7 % cowpea)	0.00	0.45	0.08	1.15	34.33	3.04	6.35	27.85	21.64	3.71	2.40
SDFB (11 % cowpea)	0.00	0.18	0.08	1.37	23.14	4.01	34.10	10.20	15.82	9.02	2.06
SDFB (16 % cowpea)	0.00	0.08	0.13	0.33	11.00	5.33	8.70	20.45	25.92	20.92	6.29
SDFB (30 % cowpea)	0.00	1.21	0.06	0.56	29.86	2.76	6.82	36.23	13.21	8.32	0.82
CDFB (11 % cowpea)	0.00	0.02	0.02	0.39	1.62	2.66	4.09	11.25	20.61	29.52	26.99

Table 2: *Particle size of sorghum, wheat and cassava danwake flour.*

[1]*WDFB (0.00 % cowpea) = Wheat danwake flour blend (0.00 % cowpea).*

[2]*SDFB (5.00 % cowpea) = Sorghum danwake flour blend (5.00 % cowpea).*

[3]*SDFB (7.00 % cowpea) = Sorghum danwake flour blend (7.00 % cowpea).*

[4]*SDFB (11.00 % cowpea) = Sorghum danwake flour blend (11.00 % cowpea).*

[5]*SDFB (16.00 % cowpea) = Sorghum danwake flour blend (16.00 % cowpea).*

[6]*SDFB (30.00 % cowpea) = Sorghum danwake flour blend (30.00 % bean).*

[7]*CDFB (11.00 % cowpea) = Cassava danwake flour blend (11.00 % cowpea).*

Effects of raw material type, formulations and particles size of flour blends on the stiffness of *danwake* The results of the texture (stiffness) of *danwake* produced from the seven formulations determined using a penetrometer are given in table 3. As expected, *danwake* from cassava was the softest followed by that from wheat and the stiffest was from sorghum danwake with 5% cowpea. The differences in stiffness may be due to the composition [6,7] as well as the particle size of the flour blend used to process *danwake*. Moreover, sorghum and wheat *danwake* were processed using ground whole grains. This may explain why they appear stiffer than cassava flour based danwake. This difference may also be related to the amount of water added during mixing. Six hundred (600 ml) of water was added to 500g of sorghum flour for sorghum *danwake* containing 30% cowpea, while for all of the other sorghum formulations as well as for those of wheat and cassava, though the amount of water not measured by the processors, was greater than 600 ml for 500g of flour blend.

Sample	Penetrometer Cone Needle Penetration Depth (mm)
Wheat *danwake* (0% cowpea)	12.98 ± 0.51[c]
Sorghum *danwake* (5% cowpea)	9.90 ± 0.74[a]
Sorghum *danwake* (7% cowpea)	10.15 ± 0.77[a]
Sorghum *danwake* (11% cowpea)	10.38 ± 0.26[a]
Sorghum *danwake* (16% cowpea)	10.58 ± 0.26[b]
Sorghum *danwake* (30% cowpea)	10.13 ± 0.25[a]
Cassava *danwake* (11% cowpea)	16.98 ± 0.66[d]

Table 3: *Penetrometer evaluation of danwake stiffness.*

The effect of cowpea inclusion in the stiffness of *danwake* was not clear cut. Addition of cowpea up to 30% did not affect the stiffness of sorghum based *danwake*. The presence of the seed pericarp layer or bran may have influenced the stiffness of sorghum and wheat based *danwake*. Stiffness of *danwake* may also be correlated with the degree of fullness, which may explain why *danwake* from wheat and sorghum may be more preferred to cassava based *danwake*.

Conclusion

The particles size analysis of the 7 *danwake* flour blend formulations, sorghum containing, 5, 7, 11, 16 and 30% cowpea, wheat with 0% cowpea and cassava with 11% cowpea), revealed that sorghum with 5% and cassava with 11% cowpea, had the coarsest and the finest flour blends, respectively. The addition of cowpea up to 30% did not affect the stiffness of sorghum based *danwake*. The presence of the seed pericarp layer or bran may have influenced the stiffness of sorghum and wheat based *danwake*. However, the stiffness increased as the particles size of the flour blends increased.

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