Effects of *Aframomum danielli* (powder and extracts) on the nutritional, physico-chemical and sensory properties of wheat flour bread

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Abstract: The effects of adding different concentrations of *Aframomum danielli* (powder and ethanoic extracts) on nutritional, physico-chemical and sensory properties of wheat flour bread were examined. *A. danielli* powder 2, 4 and 6%, and ethanolic extract (0.1 and 0.2%) were added, respectively, to flour. Using alveograph and consistograph, the physical properties of the dough–water absorption capacity, tenacity, extensibility, strength of flour and peak time were evaluated. As the concentration of *A. danielli* in the dough increased from 0 to 4%, alveograph tenacity increased from 96 to 193 mm H_2O, extensibility decreased from 92 to 27 mm, gluten decreased from 12.21 to 10.56 mm, flour strength decreased from 365 to 255 while consistograph water absorption capacity increased from 56.8 to 58.9%. A 24-member panel familiar with spiced bread found that bread with *A. daniell* flavour and having no quality impairment can be made with 2% *A. danielli* powder and 0.1–0.2% ethanolic extract. The lower the level of *A. danielli* powder addition, the more acceptable the loaf to the taste panellists as the golden brown colour of the crust, texture and uniform crumb grain of spiced bread were similar to those of the control bread sample.

Keywords: *A. danielli*; alveograph; bread; consistograph; sensory evaluation; texture; wheat flour.

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1 Introduction

Bread is one of the very common baked foods found all over the world. While a variety of bread can be found in developed countries, the bread produced is mainly white pan bread (Rao et al., 1991). Thus in most wheat-growing countries, the bakery industry is an important factor in the economy, and the techniques of production and treatment of bakery products continue to witness new changes and development. When it is realised that problems associated with synthetic chemicals in foods have been reported (Miller, 1989), attention can be focussed on the use of vegetables and spices in bread formulation with less use of synthetic adjuncts. Non-toxic food protectants such as potent antioxidant and antimicrobial agents from herbs and spices have been identified (Chatterjee, 1990; Adegoke and Odesola, 1996; Adegoke and Gopalakrishna, 1998). The spice *Aframomum danielli* from where *A. danielli* powder was produced (Adegoke, 2005, 2006) belongs to the family Zingibereacea; it is oval in shape, olive brown in colour with shining appearance and has a sharp pungent taste. The antimicrobial (Adegoke and Skura, 1994), antioxidant (Adegoke and Gopalakrishna, 1998), antibrowning (Adegoke, Fasoriyo and Skura, 2000) and preservative (Adegoke et al., 2002) characterististics of the spice have been documented. Furthermore, *A. danielli* which is non-toxic (Adegoke et al., 2002) reduced the levels of ochratoxin A in spiked cocoa products (Aroyeun and Adegoke, 2007) and of enzymes associated with hepatoxicity (Adegoke et al., 2002) and it has been added to foods to control rancidity (Fasoyiro et al., 2001). The phytochemical components of *A. danielli* have also been reported (Fasoyiro and Adegoke, 2007). This work was therefore, carried out to ascertain the nutritional, chemical and other characteristics of bread to which have been added different concentrations of *A. danielli* powder and ethanoic extracts.

2 Materials and methods

2.1 *Materials*

Commercial, refined wheat flour (Flour mills of Nigeria Plc.), dry yeast, sugar (Dangote Sugar Nigeria Plc.) and salt (Dangote Salt Nigeria Plc.) were procured from a local market in Ibadan, Nigeria.

2.2 *Methods*

2.2.1 *Preparation of A. danielli powder*

Aframomum danielli powder was prepared as described elsewhere (Adegoke, 2005, 2006). After preparation, the powder was allowed to cool and then packaged in polythene bag and sealed to prevent moisture absorption. Samples were drawn from the bag for subsequent analysis (Adegoke, Fasoriyo and Skura, 2000).

2.2.2 *Preparation of ethanoic extract of A. danielli*

The ethanoic extract of *A. danielli* was obtained by soaking *A. danielli* powder in 70% ethanol for 24 hours, followed by careful mixing and evaporation of ethanol to obtain the extract for use.

2.2.3 *Bread preparation*

Table 1 shows the baking ingredients used in the formulation for the various bread samples. For each dough, the ratios of *A. danielli* powder to flour used were 10:500 g (2%); 20:500 g (4%) and 30:500 g (6%) while for the ethanoic extract 0.5:500 g (0.1%) and 1.0:500 g (0.2%) were used, respectively. *A. danielli* powder and ethanoic extracts were excluded from the preparation of the control sample.

Bread preparation was then carried out as described by Godye, Doling and Kingswood (1981) and were coded as follows: A: control (no *A. danielli* powder); B: 2% *A. danielli* powder; C: 4% *A. danielli* powder; D: 6% *A. danielli* powder; E: ethanoic extract of *A. danielli* (0.2%); F: ethanoic extract of *A. danielli* (0.1%)

2.2.4 *Chemical analysis of bread samples*

Moisture contents of bread samples were determined by drying to constant weight at 100 °C in air draught oven for 24 hours (AOAC, 1984). The ash content of samples was determined by igniting each sample in a furnace at 550 °C until a light grey ash was produced (AOAC, 1984). Dry matter was determined according to AOAC method (AOAC, 1984) crude fibre was determined according to AOAC method (AOAC, 1984) and energy values was determined according to AOAC method (AOAC, 1984). Crude protein was determined by the Kjedahl method (AOAC, 1984).

Table 1 Baking ingredients

	Samples (g)					
Ingredients	*A (Control)*	*B*	*C*	*D*	*E*	*F*
Wheat flour	500	500	500	500	500	500
Yeast	2.5	2.5	2.5	2.5	2.5	2.5
Sugar	5	50	50	50	50	50
Salt	10	10	10	10	10	10
A. danielli powder	–	10	20	30	–	–
Ethanoic extract of *A. danielli*	–	–	–	–	0.5	1.0

2.2.5 Dough evaluation

Water absorption capacity, tenacity, extensibility, elasticity, strength of flour and peak time were determined using alveograph and consistograph (AOAC, 1984).

2.2.6 Sensory analysis

A 24-member panel who are regular consumers of spiced bread was used for sensory analysis of the bread. Evaluation was conducted in a climate-controlled sensory evaluation laboratory equipped with individual partitioned booths illuminated with 40-watt incadescent bulbs which provided 473 lux of light at the bread surface. Panellists were comfortably seated in booths and served with separate loaves of bread.The bread samples were coded with 3 digit code numbers and water was provided to panellists to cleanse their palates between samples and covered expectoration cups if they did not wish to swallow the samples.The bread samples were evaluated for crust colour, surface appearance, texture, eating quality, flavour, crumbiness and overall acceptability using the multiple preference test (Larmond, 1977) on a 9-point hedonic scale, where one represented dislike extremely and nine represented like extremely. The result was analysed statistically using analysis of variance.

2.2.7 Statistical analysis

Data obtained were tested for differences using Analysis of Variance and means were separated by Duncan's multiple range tests using SPSS 10.0 package.

3 Results and discussion

3.1 *Chemical characteristics*

Aframomum.danielli powder used in this study had a moisture content of 10.8, 7.96% protein, 12.2% fat, 3.65 crude fibre and 60.99% carbohydrate (calculated by difference) while the wheat flour had 12.9% moisture content, 11.86% protein, 1.2% fat, 1.16% ash content, 1.20% crude fibre and 71.61% carbohydrate (calculated by difference). The chemical compositions of bread fortified with *A. danielli* are shown in Table 2.

Table 2 Chemical composition of bread fortified with *Aframomum danielli*

Samples	*Ash (%)*	*Protein (%N x 5.7)*	*Fat (%)*	*Total solid (%)*	*Moisture content (%)*	*Acid insoluble (%)*	*Crude fibre (%)*	*pH*	*Energy kcal* g^{-1}	*Total sugar (%)*	*Carbohydrate (%)*
A	1.92b	9.10d	1.82d	60.13d	39.83c	0.2c	0.46d	5.52e	2.25c	1.90d	44.93b
B	1.96b	9.26c	2.56a	60.33c	39.67d	0.4ab	0.67b	5.56d	2.28bc	2.22c	44.14c
C	2.03a	9.42b	2.38b	60.50b	39.51e	0.5a	0.72a	5.59d	2.31b	2.53b	43.41d
D	2.07a	9.58a	2.32c	60.66a	39.34f	0.4ab	0.76a	5.64c	2.39a	2.85a	43.08e
E	1.85c	8.62e	2.29c	59.72e	40.28b	0.2c	0.57c	5.74b	2.12d	1.26f	45.14a
F	1.84c	8.30f	2.31c	59.63f	40.37a	0.3bc	0.55d	5.82a	2.09d	1.58e	45.09a

Means in the same column followed by the same letters are not significantly different ($p > 0.05$).

Key to Legend: A, control (no *A. danielli* powder); B, 2% *A. danielli* powder; C, 4% *A. danielli* powder; D, 6% *A. danielli* powder; E, 0.2% ethanoic extract of *A. danielli*; F: 0.1% ethanoic extract of *A. danielli*.

3.2 *Dough characteristics*

Increasing the concentrations of *A. danielli* powder from 0 to 6% and ethanoic extract from 0 to 0.2%, the water absorption capacity of dough increased by 2.7 and 0.8% while dough extensibility decreased by 74 and 3.0 mm, respectively. The increase in water absorption found with wheat flours blends with *A. danielli* can be attributed to increased hydration capacity of the powder and ethanoic extracts of the spice as found with sesame seed protein (El-Adawy, 1995). Dough extensibility decreased with increased supplements of *A. danielli* in wheat flour. As the level of the addition of *A. danielli* extracts in the dough increased, there was reduction in the strength of the dough. This reduction in the dough strength can be attributed to decrease in wheat gluten content as a result of wheat flour supplementation with *A. danielli* powder and extracts, moreso as gliadin is known to provide elasticity of gluten while glutenin provides the strength of the flour (Levine and Slade, 1990). Furthermore, the reduction in dough strength may also be due to competition between the proteins of *A. danielli* and wheat flour for water. The interchange reactions of *A. danielli* constituents with disulphide bonds of wheat flour proteins may have led to the reduction in the strength of dough as thiol compounds in garlic which caused reduction in consistency and strength of dough has been reported (Bloskma, 1971). Dough tenacity, a function of configuration ratio, increased with an increased supplements of *A. danielli* powder and ethanoic extracts in wheat flour for example, in blends with *A. danielli* powder (0–6%) tenacity increased significantly by 117 mm H_2O while in blends with ethanoic extracts (0.1–0.2%) tenacity increased by

3 mm H_2O. Water absorption capacity of flour dough samples treated with *A. danielli* powder ranged between 57.1 and 59.5% (Table 3). According to Okaka (2005) water absorption of flours vary and normal range for good breadmaking flour is 55–61% (flour basis).

Table 3 Dough characteristics of bread samples

Samples	*% moisture content*	*Gluten*	*Tenacity (mmH₂0)*	*Extensibility (mm)*	*Elasticity (%)*	*Strength of flour*	*Configuration ratio*	*Water absorption (%)*
A	13.30a	12.21a	96d	92a	68.4a	365a	1.04f	56.8d
B	12.80c	12.01b	156c	42c	62.0c	317d	3.71c	57.9c
C	12.55d	10.56c	193b	27d	0.0d	255c	7.15b	58.9b
D	12.25e	9.48d	213a	18e	0.0d	209f	10.56a	59.5a
E	13.10b	12.19a	97d	86b	67.1ab	352b	1.13e	57.1d
F	13.04b	12.16a	99d	83b	66.3b	343c	1.20d	57.6c

Means in the same column followed by the same letters are not significantly different ($p > 0.05$).

Key to Legend: A, control (no *A. danielli* powder); B, 2% *A. danielli* powder; C, 4 % *A. danielli* powder; D, 6% *A. danielli* powder; E, 0.2% ethanoic extract of *A. danielli*; F: 0.1% ethanoic extract of *A. danielli*.

3.3 *Baking properties*

Comparable bread characteristics such as specific volume, crust shape, golden brown colour, soft texture, fine and uniform crumb grains were found with both control and *A. danielli* treated bread samples. The specific loaf volume of *A. danielli* treated samples decreased from 3.38 to 2.91 ml g^{-1}. The crust shape of treated bread samples gradually became flat and crumb grains were coarse and non-uniform with the use of *A. danielli* powder from 0 to 6.0%, the crust shape became different from control at 6.0% *A. danielli* powder.

Table 4 Sensory evaluation of bread samples treated with *A. danielli* powder and ethanoic extracts

Samples	*Crust colour*	*Surface appearance*	*Texture*	*Eating quality*	*Flavour*	*Crumbiness*
A	7.50a	7.5a	6.50ab	7.00a	6.92a	6.75a
B	5.92b	6.17c	6.67a	5.17b	5.60b	6.17b
C	4.33d	4.67d	4.92c	4.58c	4.50c	5.17c
D	4.5d	4.08e	3.83d	3.92d	4.25c	4.50d
E	6.92b	7.0ab	6.00b	5.58b	5.83b	5.92b
F	6.75b	6.75b	6.20ab	6.58a	6.50a	5.83b

Higher values indicate greater preference.

Means in the same column followed by the same letters are not significantly different ($p > 0.05$).

Key to Legend: A, control (no *A. danielli* powder); B, 2% *A. danielli* powder; C, 4% *A. danielli* powder; D, 6% *A. danielli* powder; E, 0.2% ethanoic extract of *A. danielli*; F, 0.1% ethanoic extract of *A. danielli*.

3.4 *Sensory properties*

The sensory attributes of bread samples treated with *A. danielli* powder and extracts are shown in Table 4. There were significant differences in the sensory attributes as the bread samples increased as the concentration of the powder and extract increases, this is clearly indicated from the evaluation of the eating quality. From this study, bread with acceptable *A. danielli* flavour and aroma with desirable crust or crumb characteristics can be prepared using 2% *A. danielli* powder and ethanoic extract at 0.2%.

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