EFFECT OF COCONUT MILK SUBSTITUTION ON THE NUTRIENT AND SENSORY PROPERTIES OF MALTED AND UNMALTED SORGHUM OGI

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ABSTRACT

The effect of different levels of substitution of coconut milk (20%, 30% and 40%) on nutrient and sensory qualities of malted and unmalted sorghum ogi was investigated. The protein content in germinated sorghum ogi increased significantly compared to ungerminated sorghum ogi while no significant difference were recorded in carbohydrate, moisture, and fat contents. Relative increament were recorded in protein, fat, and moisture as the levels of coconut milk substitution increased. However, Ash, crude fibre and carbohydrate content significantly decreased (<0.05). pH, titratable acidity, and phytate content all decreased significantly with malting. Sensory evaluation showed that there were significant changes in the sensory attributes of samples at different enrichment levels. Any substitution beyond 30% was not acceptable. The 30% substitution was the peak of acceptability as indicated by the general acceptability parameter.

Key words: ogi, malting, germinated sorghum, coconut milk.

INTRODUCTION

Sorghum (Sorghum bicolor) is the second most commonly used cereal in the production of ogi after maize. Ogi is a sour gruel obtained by the submerged fermentation of some cereal like maize, sorghum and millet. It is an important traditional weaning food common in the whole of West Africa. It is being consumed as a breakfast cereal and is a food of choice for the sick in many cases (Adewunmi, 2011). Sorghum contains some nutrients, such as carbohydrates, protein, lipid, minerals and vitamin, these nuritients are made unavailable for use by the body because of the presence of some anti-nutritional factors such as phytic acids and polyphenols (Abd El Rahaman et al., 2000).

Germination processes have been developed to overcome these disadvantages of sorghum used in food products (Zhu et al., 2005). Germination is a complex metabolic process during which the lipids, carbohydrates, and storage proteins within the seed are broken down in order to obtain the energy and amino acids necessary for the plant's development (Jachmanian et al., 1995). Fortification of soghurm germinated ogi with coconut milk is another way of improving nutrient quality of ogi and product development to foster food security and employment generation. Coconut milk is the liquid that comes from the grated mature coconut. The colour and rich taste of the milk can be attributed to the high oil content. It is extracted by grating mature coconuts and squeezing them by using cheese cloth or both bare hands. The milk contains calories, protein, fat, carbohydrates, and dietary fiber, Sugar, Vitamins and Minerals (Marina, 2009; Che Man, 2009; & Amin, 2009). Coconut milk has a long-standing cultural association with health in the Ayurveda tradition. This natural drink is usually recommended for maintaining electrolyte balance and can also be used in case of

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dehydration (Nneli; Woyike, 2008). Some recent studies have suggested that coconut milk has hyperlipidemic balancing qualities, antimicrobial properties in the gastrointestinal tract or by topical application, and it has been used as a home remedy for healing mouth ulcers (Kester & Kata, 2003).

Phytate and polyphenols have been considered as anti-nutritional factors because they interact with food constituents such as minerals and make them unavailable for utilization by the body (Abd El Rahaman et al., 2007; & Idris et al., 2006). Reductions of such anti-nutritional factors by processing methods such as soaking, sprouting, cooking, malting and fermentation have long been documented by many researchers (El Maki et al.,1999; Idris et al., 2006; Lewu et al., 2010; Obizoba & Atii, 1994; Osman, 2011; &Vadivel et al., 2011). Therefore, the main objective of this research is to develop and evaluate the quality of coconut milk ogi developed from germinated and ungerminated sorghum.

MATERIALS AND METHODS

The samples of commercially grown varieties of white sorghum and mature coconut fruits were obtained from local market in Ota, Ogun Stete Nigeria. All the grains were graded, sorted, and cleaned to remove defective seeds, dirt, debris and other foreign materials while the coconut fruits were also graded before processing.

Germination of Sorghum

The malting process of sorghum was carried out as described by Nnam, (2000).The sorghum grains were cleaned and steeped in water at room temperature for 18hours and washed at 6hours intervals to prevent fermentation. Steeped grains were spread on sterile jute bags, watered, and covered with muslin cloth to prevent contamination while allowing aeration by oxygen, and left to germinate in a dark cupboard at room temperature (30 ± 1°C) for 72hrs. The germinating grains were watered when necessary but not less than once daily. Grains were dried at 60^0C to 10% moisture content using an oven drier. This is the sorghum malt used for Ogi manufacture after separation and removal of the sprout.

Preparation of Coconut Sorghum Ogi Powder

Malted sorghum ogi production was prepared as described by Teniola & Odunfa (2002), while production of unmalted sorghum ogi was carried out according to Nnam (2000). The processing operations include cleaning of the grain, steeping, wet milling, sieving, sedimentation (fermentation) for 3 days and Ogi slurry. Preparation of coconut milk involved sorting of coconut fruit, washing, deshelling to remove the mesocarp, grating, sieving to separate the milk, pasteurization at 65°C, cooling and bottling as described by Katan (2003). The design of the experiment indicated substitution of malted and unmalted ogi slurry with coconut milk at ratio, 60:40, 70:30, 80:20, 90:10 for ogi slurry and coconut milk respectively to produce ogi powder in compares with 100 percent malted and unmalted sorghum ogi powder. The coconut sorghum ogi slurry were dried at 60°C for 30 hours, cooled and packed in polyethylene bags.

ANALYTICAL PROCEDURES

Nutritional Composition of Ogi Powder

The chemical analysis (proximate) moisture, ether extract, crude fibre and ash were estimated using the method of AOAC (2005). The carbohydrate content was estimated by difference. The Kjeldahl method was employed to determine the total nitrogen and the crude protein (AOAC, 2000). 1g of ogi powder was digested with 12ml H2SO4 with two Kjeldahl tablets using digestor model FOSS 220. The digested sample was distilled with Kjeldahl distillation unit (FOSS 220) and the distillate collected over excess boric acid which was later titrated with 0.1N HCl and percentage of Nitrogen calculated before conversion to percentage protein.

Crude Protein= $\frac{\text{(Titre (of sample) – blank) x 0.01x 14.007 x 6.25}}{\text{1000 x weight of sample}}$

Value obtained x conversion factor of sample (used to convert the nitrogen n sample to protein) gives the final protein content of the sample.

Phytic Acid Determination

This was carried out according to the method described by AOAC (2002) which involves the titration of phytic acid in 0.6% HCL solution with standard $FeCL_3$ in 0.6% HCI, ammonium thiocyanate being used as an internal indicator. The end point is reached when a flesh pink colour is obtained which persists for 5mins.

SENSORY EVALUATION

The Multiple Comparison Test method was used for the sensory evaluation of the produced bread samples. A panel of 20 judges was used in carrying out the evaluation. Samples were coded with three digit random numbers and presented in random order. A 9-point hedonic scale rating with respect to appearance, flavour, mouth feel, colour, taste and overall acceptability with score "9" having excellent attributes, point "1" indicating extreme dislike was applied. The data generated was subjected to ANOVA (Analysis of Variance), in order to determine the significant difference, if any between the samples.

STATISTICAL ANALYSIS

The sorghum ogi flour and coconut milk samples data were statistically analyzed using SPSS (Statistical Package for the Social Sciences) Version 16. Data was presented as mean ± SE. One-way Analysis of Variance (ANOVA) was used for the proximate analysis data and two-way Analysis of Variance was used for sensory evaluation data. Comparison between groups were made using Duncan multiple range test for proximate analysis data while Least Significant Difference(LSD) test was used to separate the means of the sensory evaluation data. Differences were considered significant if Probability is less than 5% ($P < 0.05$) for both sets of data.

RESULTS AND DISCUSSION

Effect of Germination and Coconut Milk Substitution on the Nutritional Composition of Sorghum Ogi Powder

The proximate composition of ogi flour from both non-germinated and germinated sorghum is shown in Table 1. The effect of germination on the nutrients was significant ($P<0.05$), showing that crude protein increased while fat content and carbohydrates content decreased. The observed decrease in the carbohydrate and fat content could be attributed to their usage in the germination process as energy sources (Komberg & Beevers, 1957). The increase in respiration rate during germination brings about the release of energy from the breakdown of carbon compounds (Enujiugha et al., 2003). The increase in protein content observed may be due to the synthesis of enzymes or a compositional change following the degradation of other components. Other researchers Mostapha et al. (1987) and Bau et al. (1997) have also

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observed significant increases in protein content with seed germination. Moisture content, crude fibre and ash of the plain sorghum ogi flour also decreased significantly upon germination.

Table 2 showed the results of the nutritional composition of the coconut milk substituted sorghum ogi flour. There were significant increases (P<0.05) in the levels of crude protein, fat, and moisture content as the level of substitution increased with both non-germinated and germinated samples. In reverse, carbohydrate, crude fibre, and ash contents all decreased upon substitution. it can be seen that the P^H values significantly decreased (<0.05) as substitution levels increased (making the flour more acidic). This can be attributed to the fact that coconut milk has a higher acid content (3.1 ± 0.01) than plain sorghum ogi, (4.14±0.01), because of the presence of lauric acid (Nneli, 2008) in coconut milk. There was no significant change in the in the pH content after germination (>0.05).

Effect of Germination and Coconut Milk Substitution on the Antinutritional Factor of Sorghum Ogi Flour

The levels of anti-nutritional factor (phytic acid) of sorghum ogi flour samples from non-germinated and germinated grains respectively are presented in Table 3. The quantity of phytic acid in non-germinated flour samples was significantly higher than that found in germinated grains. This result agrees with the findings of Egounlety & Aworh (2002) which found that germination, is an effective means of significantly reducing the phytate content in cereals and legumes. From the results obtained, it can be established that there was no significant change in the phytate content on substitution with coconut milk.

Sensory Qualities of Malted an Unmalted Sorghum Ogi Substituted With Coconut Milk

The results obtained from the panelists showed that there were significant changes in the organoleptic properties of all eight ogi flour samples. Germinated ogi flour with 30% coconut milk substitution had the highest overall acceptability of 9.47, followed by ungerminated ogi flour with 30% coconut milk substitution, with an overall acceptability of 8.53. This showed that germination had little or no effect on the organoleptic properties of the samples. The 40% ungerminated ogi flour, with a value of 3.40, and 40% germinated ogi flour had the least acceptance, with a value of 2.60.

CONCLUSION

The results from this study indicated that more nutritious sorghum ogi flour can be developed from the substitution of various levels of coconut milk in either malted or unmalted sorghum for the production of Ogi and with reduced anti-nutritional factors by germinating the grains. Germination applied as a unit operation, along with coconut milk substitution will go a long way to improve the nutritional composition of sorghum ogi. In addition, sensory evaluation showed that there were significant changes in the sensory attributes of samples at different enrichment levels. 30% enrichment level had the highest general acceptability while 40% had the lowest rating. From the studies, it was observed that incorporating germination and nutritional enhancement of sorghum with coconut milk will improve the nutritional status of sorghum ogi. This therefore should be encourage to gravitate to a pilot plant state and industrial scale level, to improve the nutritional level of the people on the lower strata of the socio-economic group.

Table 1. Proximate Composition of Non-Germinated And Germinated Sorghum Ogi.

SAMPLE	*Non-germinated*	*Germinated*
FAT (%)	3.34± 0.01[a]	3.18 ± 0.01[a]
PROTEIN (%)	4.39 ± 0.04[a]	4.61 ± 0.02[b]
ASH (%)	0.82 ± 0.01[g]	0.756± 0.02[f]
MOISTURE (%)	5.73 ± 0.08[a]	5.69 ± 0.09[a]
CRUDE FIBRE (%)	1.64± 0.01[h]	1.28 ± 0.02[f]
CARBOHYDRATE (%)	84.68 ±0.05[g]	84.39 ± 0.06[g]

Mean of duplicate determinations ± standard error

Table 2. Proximate Composition of Non-Germinated And Germinated Coconut Milk Substituted Sorghum Ogi.

	NG	*G*	*NG2*	*G2*	*NG3*	*G3*	*NG4*	*G4*	*CM*
FAT (%)	3.34±0.01[a]	3.180.01[a]	6.50±0.02[b]	6.41±0.03[b]	8.15 ± 0.03[c]	8.11 ± 0.03[c]	9.82±0.07[d]	9.01 ±0.02[d]	18.84±1.0[e]
PORTEIN (%)	4.39±0.04[a]	4.61±0.02[b]	5.20±0.01[c]	5.40±0.02[d]	5.61 ±0.03[e]	5.88± 0.04[f]	6.10±0.02[a]	6.27± 0.02[h]	7.83±0.04[i]
ASH (%)	0.82±0.01[g]	0.756±0.02[f]	0.71±0.02[e]	0.68±0.02[e]	0.67±0.02[c,d,e]	0.63 ± 0.01[c]	0.65±0.02[c,d]	0.58± 0.01[b]	0.27±0.02[a]
MOISTURE (%)	5.73±0.08[a]	5.69 ±0.09[a]	6.16±0.06[b]	6.36±0.06[b]	7.59 ± 0.09[c]	7.78 ± 0.02[c]	8.30 ±0.10[d]	8.48 ±0.02[d]	65.18±0.0[e]

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CRUDEFIBRE (%)	1.64± 0.01^{h}	1.28 ± 0.02^{f}	1.35 ± 0.01^{g}	1.02 ± 0.04^{d}	1.13 ± 0.01^{e}	0.98 ± 0.02^{c}	1.08 ± 0.01^{e}	0.84 ±0.01^{b}	0.13±0.01^{a}
CARBOHYDRATE (%)	84.68±0.05^{g}	84.39±0.06^{g}	80.19±0.05^{e}	80.17±0.02^{e}	77.03 ±0.01^{d}	76.78±0.02^{c}	74.12±0.01^{b}	74.08±0.02^{b}	8.54±0.03^{a}
PH (%)	4.14± 0.01^{f}	4.12 ±0.01^{f}	3.905±0.02^{e}	3.63±0.02^{d}	3.45±0.04^{b,c}	3.49 ±0.03^{c}	3.38±0.30^{b}	3.49 ± 0.03^{c}	3.13±0.01^{a}

Mean of duplicate determinations ± standard error

LEGEND

NG: 100% Non-germinated sorghum ogi flour. G: 100% Germinated sorghum ogi flour.

NG2: Non-germinated sorghum ogi flour with 20% coconut milk substitution.

G2: Germinated sorghum ogi flour with 20% coconut milk substitution.

NG3: Non-germinated sorghum ogi flour with 30% coconut milk substitution.

G3: Germinated sorghum ogi flour with 30% coconut milk substitution.

NG4: Non-germinated sorghum ogi with 40% coconut milk substitution.

G4: Germinated sorghum ogi flour with 40% coconut milk substitution.

CM: Coconut milk.

Table 3. Sensory Qualities of Malted and Unmalted Sorghum Ogi Substituted with Various Proportions of Coconut Milk

	NG	*G*	*NG2*	*G2*	*NG3*	*G3*	*NG4*	*G4*	*CM*
PHYTATE CONTENT (%)	3.26 ± 0.00^{e}	0.93 ± 0.01^{c}	3.27±0.01^{e}	0.96±0.00^{d}	3.27±0.01^{e}	0.93±0.01^{c}	3.29 ± 0.01^{f}	0.91 ± 0.01^{b}	0.00

Table 4. Sensory Qualities of Malted and Unmalted Sorghum Ogi Substituted with Various Proportions of Coconut Milk

SAMPLE	*COLOUR*	*APPEARANCE*	*FLAVOUR*	*TASTE*	*MOUTH – FEEL*	*AROMA*	*HOMOGENEITY*	*OVERALL ACCEPTA-BILITY*
A	6.87±0.27	6.47 ±0.32	6.13± 0.41	5.93±0.48	6.47±0.26	6.33±0.21	6.33 ±0.35	6.60± 0.21
B	7.60±0.25	7.47 ±0.27	7.40± 0.21	7.53±0.22	7.80±0.20	7.93±0.18	7.60 ±0.16	7.73± 0.21
C	8.53±0.52	8.53 ± 0.13	8.27± 0.12	8.33±0.16	8.53±0.13	8.53±0.13	8.53 ±0.13	8.53 ±0.13
D	3.60±0.16	3.60 ± 0.13	3.40± 0.13	3.330.1±3	3.73±0.12	3.67±0.13	3.60± 0.13	3.40± 0.16
E	7.00±0.24	6.60± 0.13	7.27 ±0.15	7.07±0.18	6.20±0.20	6.26±0.12	6.73± 0.13	7.20± 0.11
F	7.33±0.13	6.53± 0.13	5.67 ±0.19	6.27±0.21	4.80±0.14	5.60±0.19	5.73 ±0.23	6.80±0.17
G	8.33±0.16	9.26± 0.12	9.07± 0.18	8.47±0.22	9.33±0.19	8.86±0.19	9.60± 0.15	9.47± 0.17
H	4.20±0.22	4.40 ± 0.13	5.33 ±0.16	2.40±0.24	2.40±0.16	2.60±0.25	2.47±0.16	2.60 ±0.51

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A: 100% ungerminated sorghum ogi flour. B: 20% coconut milk ungerminated sorghum ogi flour.

C: 30% coconut milk ungerminated sorghum ogi flour. D: 40% coconut milk ungerminated sorghum ogi flour.

E: 100% germinated sorghum ogi flour. F: 20% coconut milk germinated sorghum ogi flour.

G: 30% coconut milk germinated sorghum ogi flour. H: 40% coconut milk germinated sorghum ogi flour

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