Quality Of Bread From Wheat/Cassava Flour Composite As Affected By Strength And Steeping Duration Of Cassava In Citric Acid

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ABSTRACT: Cassava flour was prepared from tubers of TMS 30572 steeped in five varying concentrations of citric acid solution (1.0, 5.0, 10.0 15.0 and 20.0 % M/V db) and samples were generated for 24, 72 and 120 h. The resultant cassava flour was used in partial substitution 100% wheat flour at 90:10, 80:20 and 70:30 percent ratios in bread making. Sensory evaluation was conducted on the bread quality by 10 member panel on loaf volume, crumb texture, taste and overall acceptance using the 9-point hedonic scale. The bread from cassava flour steeped in 20% citric acid solution had the highest mean score of 6.32, for the loaf volume; taste, 5.16; crumb texture, 5.79 and overall acceptance, 6.22. The bread from 90:10 was rated the best in all the assessment made. On the other hand, steeping for 24 h gave the result in terms of bread taste, 4.69 and overall acceptance. The result indicates that it is possible to produce quality bread up to 30% substitution of wheat flour when cassava roots were pretreated with citric acid solution before milling into flour. Also, steeping in citric acid solution for 24 h gave the desired modification of cassava flour for a better bread quality. [Nature and Science. 2007;5(4):24-28].

Key words: cassava flour, citric acid, composite and bread quality.

INTRODUCTION

Asselbergs (1) defined bread as a food of any size and shape or form and consists of dough made from flour and water, with or without other ingredients, which have been fermented by yeast or otherwise leavened and subsequently baked or partly baked. High quality bread in terms of large volume, good crust and crumb texture is principally produced from wheat flour; from wheat- a temperate grown crop (11). The leavened wheat bread has become a favourite food of many households in developing countries which may be attributed to increasing populations, urbanization and changing food habits (12). Unfortunately, wheat cannot grow well in tropical climate and relying on imports would drain the scarce foreign exchange of these countries (8, 12).The concept of composite technology initiated by FAO in 1964 was targeted at reduction of fund out flow towards temperate countries by encouraging the use of indigenous crops such as cassava, yam, maize etc. in partial substitution of wheat flour (5, 14).

Several attempts have been made in the 1960s 1970s to produce wheatless bread or gluten –free bread in Nigeria (7, 14). In an effort to conserve currency, the government of Nigeria in 1987 ban wheat import but that was not sustained in subsequent years (2). The recent policy directive to mills in Nigeria to include 10% cassava flour in bread, biscuits and other confections manufacture was aimed at sustaining the production of cassava and to restrict fund out flow for import of wheat (13). According to Eggleston and Omoaka, (6) and Deflour, (4), getting quality cassava flour that will meet the need of the mills has remained a problem due to poor processing methods, varietal, age and environmental condition of growth of cassava.

The current production of unfermented cassava flour (12) for bread making however, may not address the issue of reduction of cyanide in cassava flour. Steeping in water, drying, milling etc. are known to improve flour functionality and also reduce levels of anti nutritional factors such as cyanide in cassava According to Iwuoha, (9), the improved functional characteristics of the flour are ultimately transferred to the recipient food systems. In the current study, peeled cassava chunks were steeped in varying concentrations of citric acid for a period of time, the resultant flours were used in different ratios with 100% wheat flour in bread making; and the baked loaves were subjected to sensory evaluation.

Materials and Methods

Cassava roots (TMS 30572) were harvested from the farm of Federal University of Technology, Owerri, Nigeria; peeled, washed and cut into chunks (5 cm thickness).

The chunks were steeped in previously prepared citric acid solution in five concentrations (SSC), (1.0, 5.0, 10.0, 15.0 and 20.0 % M/V) at loading rate of 1: 2 mass: volume. The steeping was carried out in plastic containers for a period (RSD) of 120h and samples collected for 24, 72 and 120h. The steeped out was further size reduced to 5mm thickness, oven dried at 65^{o}C, milled and sieved to pass 250μm and stored in cellophane bags.

Bread making

The straight dough method was used as modified by Onabolu *et al*. (12). Wheat flour was diluted with cassava flour at the ratios 90: 10, 80: 20, and 70: 30; the composite flour and other bread making ingredients (yeast, shortening, salt, sugar and water) were mixed in bowl mixer initially at low speed and later at high speed for the desired consistency. The dough was further kneaded, moulded, transferred into greased pans for proofing (for 45 min.) in a warm chamber at 43^{o}C. The proofed dough was transferred into the oven to bake at 180 - 200^{o}C and removed after baking; cooled at ambient temperature and wrapped.

Sensory evaluation

Ten member panelists drawn from usual bread consumers were used to assess the quality attributes of the baked loaves (for crumb texture, loaf volume, taste and overall acceptance). The samples were presented to with coded letters in identical white plates. The panelists were instructed to assess the samples based on 9-point hedonic scale ranging from (9)-like extremely to (1) disliked extremely as described by Ihekoronye and Ngoddy (7).

Statistical analyses of data

The scores of the quality attributes of the bread as a function concentration of citric acid (SSC) (5), root steeping duration (RSD) (3) and composite ratio (3) were fitted into a 5x 3x3 factorial experimental design and subjected to three-way ANOVA as described by Steel and Torrie (16). The means were separated using the least significant difference (LSD).

Results

The data in Table 1.0 shows the quality attributes of bread as affected by steeping concentration of citric acid solution. The loaf volume was significantly affected ($p<0,05$) by the percent increase in the citric acid solution. The bread from 20.0% SSC, had the highest loaf volume (6, 32) while the least mean score (4.12) was recorded for 1.0% SSC.

The taste of the bread was significantly affected ($p< 0.05$) by the increase of in citric acid solution. The highest mean score (5.16) was obtained for 20.0% SSC while 1.0%SSC gave the score (3.84).

Similarly the crumb texture of the bread increased significantly ($p<0. 05$) with increasing concentration of citric acid as the highest crumb texture of 5.79 was recorded for 20.0% SSC.. On the whole the panelists rated the bread from 20.0% as the best (6.22) followed by 15,0% (5.70) while the 1.0% SSC as least preferred with mean score of 4.19 in the overall acceptance.

The impact of composite ratio on bread quality

The data on the bread quality as affected by the composite ratio is shown in Table 2. The bread from 90:10, wheat/cassava composite flour had highest score for loaf volume, 6.25 followed by 80: 20, 4.99; while the 70: 30 had the least, 4.28.these values differed significantly under the condition of study $P< 0.005$.

The taste of the bread from 90:10 was preferred by the panelist (5.46) than the rest as shown in Table 2.0.

The 90:10 composite ratios resulted in high crumb texture, 6.03, followed by 80:20, 4.88, and 70:30, 3.93; these also differed significantly under the condition of study $P< 0.005$.

On the whole the panelist preferred the bread from the 90:10 ratios than the rest as shown in Table 2.0.

The impact of steeping duration in citric acid solution on the bread quality

The data in Table 3.0 show the effect of duration of steeping on sensory quality of bread. The loaf volume increased with increasing steeping duration. The highest score of 5.81was recorded for 120h while the least was obtained for 24h.

On the other hand, the panelists preferred the taste of bread from the 24h steeping duration, (4.69) followed by 72h, 4.49 while 120h had the least 4.26, these however differed significantly at $p< 0.05$.
The crumb texture of the 120h fermented had best rating 5.93, followed by 72h, 4.83 while the least value 4.08 was recorded for 24h as shown in Table 3.0.

Table 1: Mean scores of bread as affected by strength of citric acid solution

SSC % m/v	Loaf volume	Taste	Crumb texture	Overall acceptance
1.0	4.12 ± 1.03^{e}	3.84 ± 0.76^{e}	4.13 ± 1.34^{e}	4.19 ± 0.87^{e}
5.0	4.68 ± 0.93^{d}	4.02 ± 0.77^{d}	4.42 ± 1.21^{d}	4.69 ± 0.96^{d}
10.0	5.18 ± 1.03^{c}	4.48 ± 0.86^{c}	4.82 ± 1.19^{c}	5.30 ± 0.85^{c}
15.0	5.56 ± 1.08^{b}	4.89 ± 0.82^{b}	5.39 ± 1.10^{b}	5.70 ± 0.80^{b}
20.0	6.32 ± 0.92^{a}	5.16 ± 0.77^{a}	5.79 ± 1.00^{a}	6.22 ± 0.92^{a}
LSD	0.26	0.17	0.20	0.23

Means with uncommon superscripts letters of alphabets within the column differed significantly at $p < 0.05$

Table 2: Mean scores of bread as affected by percent composite ratios

Composite ratios(%)	Loaf volume	Taste	Crumb texture	Overall ac2ceptance
90:10	6.25 ± 0.99^{a}	5.46 ± 0.59^{a}	6.03 ± 1.07^{a}	6.20 ± 0.89^{a}
80:20	4.99 ± 0.91^{b}	4.38 ± 0.56^{b}	4.88 ± 091^{b}	5.18 ± 0.81^{b}
70:30	4.38 ± 0.96^{c}	3.60 ± 0.54^{c}	3.60 ± 0.97^{c}	4.28 ± 0.88^{c}
LSD	0.20	0.13	0.15	0.18

Means with uncommon letters of alphabets within the column differed significantly at $p < 0.05$

Table 3: Mean scores of bread as affected by duration of steeping in citric acid solution

Steeping duration (h)	Loaf volume	Taste	Crumb texture	Overall acceptance
24	4.51 ± 1.16^{a}	4.69 ± 0.08^{a}	4.08 ± 101^{c}	5.18 ± 0.81^{a}
72	5.21 ± 1.19^{b}	4.49 ± 1.05^{b}	4.83 ± 1.09^{b}	4.65 ± 1.04^{b}
120	5.81 ± 1.05^{c}	4.26 ± 0.84^{c}	5.93 ± 1.07^{a}	4.28 ± 0.88^{c}
LSD	0.26	0.17	0.20	0.23

Means with uncommon superscripts letters of alphabets within the column differed significantly at $p < 0.05$

Discussion

It was found that the loaf volume increased with corresponding increase in steeping solution concentration (SSC) which may suggest that the steeping solution (citric acid solution) modified the functional properties of cassava flour. It might as well be that the absorbed citric acid enhanced the activity of gluten in the wheat flour portion in the mix. Citric acid is a raising agent and its role as a flour improver has been reported by Smith (15).

The rating of bread from 20% SSC as the best in terms of taste in Table 1 might be that citric acid influenced the taste. The use of citric acid as a flavour enhancer in food systems has been reported by Macrae *et al.* (10). Citric acid is known for its ability to impact flavour, chelate heavy metals and deliver a "burst" of tartness in the recipient products.

The observed increase in crumb texture with corresponding increase in SSC% might be due to citric acid absorbed in cassava flour which enhanced the development of the texture of the bread. Citric acid has for long been used in the development of textural properties of food (10).

The ratio of flour composites was found to influence the sensory properties of bread. The highest loaf volume obtained in Table 2, for 90: 10, reflected the high content of gluten in the wheat flour portion which shows the superiority of wheat flour over other flour sources in bread making (3)
On the other hand, the high rating of the bread taste with the composite ratio may be associated with the complementary effect of citric acid in cassava flour.

Similar performance in crumb texture by 90: 10 ratios reinforces the decision of policy makers in Nigeria that millers should incorporate 10 percent cassava flour in bread making.

Steeping duration increased the loaf volume and crumb texture in Table 3. The highest loaf volume obtained for 120h (5.81) might suggest that more of the citric acid solution was absorbed with the resultant improvement in loaf volume and crumb texture.

The rating of taste by the panelist decreased as the steeping duration increased. The highest score obtained for 24h steeping duration (4.69) may suggest that when steeping in citric acid is a desirable step in cassava flour manufacture, it would be economically and technologically reasonable to limit the steeping duration to 24h. This is also supported by the highest rating of overall acceptance (5.18) for the steeping duration of 24h in Table 3.

Conclusion

The use of composite flour in bread making and other baked goods has become imperative for developing countries going by increasing cost of imported wheat. Steeping is a sure method of removing contaminants (residual cyanide) in food. Moreover, steeping in citric acid solution would play complementary roles as a modifier of texture, raising agent and as well as flavour enhancement which have been shown by the outcome of the investigations. It is deduce from the study that steeping for a period not exceeding 24h will give the best functional effect to baked goods. Finally steeping cassava in citric acid solution before milling is likely going to increase the percent ratio of cassava flour used in bread making and enhance the contribution of cassava to the nutritional wellbeing of developing countries. Other processing variables should be investigated and employed in improving the functionality of cassava flour.

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