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Microbial and sensory qualities of plantain flour and its reconstituted dumpling (amala) as influenced by blanching temperatures and duration

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ABSTRACT: The effect of blanching conditions on the microbiological quality of flour produced from plantain (*Musa AAB*) and sensory qualities of reconstituted plantain flour (dumpling or amala) were investigated. Results showed that varying the blanching temperature and time had considerable effects on the microbial quality of the plantain flour. The total viable counts of samples of unripe plantain pulp blanched at 60 °C for 5 minutes (UPB_{60-5}), unripe plantain pulp blanched at 60 °C for 10 minutes (UPB_{60-10}) and unripe plantain pulp blanched at 80 °C for 5 minutes (UPB_{80-5}) were the same (2.0 cfu/gx10^3). Whereas, extending the duration of blanching at 60 °C to 15 minutes (UPB_{60-15}) and dipping the samples in hot water at 80 and 100 °C for 10 and 15minutes (UPB_{80-10}, UPB_{80-15}, UPB_{100-10} and UPB_{100-15}) reduced the total viable count significantly. The control unblanched sample ($UPUB_{CO}$) had the highest total viable count of 3.0 cfu/g x10^3. Coliform was not found in any of the blanched samples. Mould and yeast growth were also higher in the control and samples blanched at a lower temperature of 60 °C for 5 and 10 minutes compared to the other samples treated at higher temperatures and longer duration. For the sensory quality evaluation, the samples blanched at 60 °C for 10 and 15 minutes were rated best for taste, colour and texture. Amala produced with plantain slices blanched at 60°C for 5 min had a similarly preferred texture but was less acceptable in terms of colour and taste. The Panelists downgraded products from plantain slices dipped in hot water at temperatures above 80°C for more than 10 minutes particularly in terms of colour, taste and texture.

Keywords: Plantain, Blanching, Sensory attributes, Microbial quality.

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INTRODUCTION

Plantain, the edible fruit of the genus *Musa,* is one of the major crops of the humid lowland tropical areas, whose production in Nigeria has gained considerable importance in recent years. Ogazi (1982) reported that over 80% is harvested during the period of September to February and that there is much wastage at this time as some of the products do not store for a long period. Plantain is a remarkable example of a neglected food crop because the proportion of research resources allocated to it falls far from other starchy fruits. The fruit ripens usually after harvest to soft sweet fruits of high sugar and low acid content. One of the reasons for the neglect of plantain by researchers is its close relationship to banana which has received more attention earlier and the common but erroneous belief that plantain and banana are similar in physiological pattern (Wilson, 1986).

Plantain is known to have an advantage over other starchy staple foods like yam, cassava and cocoyam where labour is an important factor of production as a result of its high energy returns per unit of labour. Plantain is widely consumed

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by the whole population and many different dishes from a wide range of cultural groups are prepared from it (Stover and Simmonds, 1987).
It is important to study the quality of the plantain flour to determine its suitability for use in the production of a thick traditional dumpling called "Amala" which is popular in south western Nigeria among the Yorubas. Amala is prepared by reconstituting two parts of the flours with about one part of boiling water which is mixed thoroughly with a wooden spatula over a heating medium (Ogazi, 1998).
The objective of this work was to produce and examine the microbiological quality of flour produced from blanched plantain as well as the sensory qualities of the reconstituted plantain flour known as Amala.

MATERIALS AND METHODS

Mature green and healthy plantain (*Musa*, AAB group) bunches were obtained from the International Institute of Tropical Agriculture (IITA), Oyo Road, Ibadan. All reagents used were of analytical grade.

Preparation of Plantain Flour

The fruits which were hard and green were subsequently defingered, washed, hand-peeled and manually sliced into cylindrical pieces of 2mm thickness. Blanching was carried out on the sliced samples in hot water at 60°C, 80°C and 100°C. For each temperature chosen, the timing was varied for 5, 10 and 15 minutes and dried in the air oven at 65°C for 24 hrs, while the unblanched samples (Control) were also dried using the air oven at the same temperature and time as recommended by Baiyeri and Ortiz (2000). The dehydrated pieces were milled in a hammer mill to produce flour which passed through a 150□m screen. The plantain flour obtained was packaged in polyethylene bags labeled and stored at room temperature for further analysis. The flours were coded as follows: UPB_{60}-$_5$ = Unripe plantain blanched at 60°C for 5 minutes; UPB_{60}-$_{10}$ = Unripe plantain blanched at 60°C for 10 minutes; UPB_{60}-$_{15}$ = Unripe plantain blanched at 60°C for 15 minutes; UPB_{80}-$_5$ = Unripe plantain blanched at 80°C for 5 minutes; UPB_{80}-$_{10}$ = Unripe plantain blanched at 80°C for 10 minutes; UPB_{80}-$_{15}$ = Unripe plantain blanched at 80°C for 15 minutes; UPB_{100}-$_5$ = Unripe plantain dipped in hot water at 100°C for 5 minutes, UPB_{100}-$_{10}$ = Unripe plantain dipped in hot water at 100°C for 10 minutes, UPB_{100}-$_{15}$ = Unripe plantain dipped in hot water at 100°C for 15 minutes and $UPUB_c$ = Unripe and un-blanched plantain (Control).

Microbiological examination

The samples were evaluated for microbiological examination as described by Anderson and Hollorook (1980). Plantain flours were examined for viable count of Bacteria, Coliform, Yeast and Moulds using Nutrient Agar (NA), MacConkey Agar (MCA) and Potato Dextrose Agar (PDA) respectively. The pour plate method was used to enumerate the total number of viable microorganisms in the plantain flour. Serial dilution was done using normal saline diluted to 10^{-3} dilution and 1ml of 10^{-3} dilution was added into each sterile Petri dish. Molten Plate Count Agar (MPCA) was added into the plates, agitated and allowed to solidify and incubated at 37°C for 48hrs. The number of colonies counted on the plates taken into consideration with the dilution factor.
The presence of coliform was determined by inoculating plantain flour samples on MCA and incubating at 37 °C for 18 hrs. The presence of yeasts and moulds were enumerated by inoculating the serial dilution of plantain flour samples on PDA. The plates were incubated at 25°C for 3 days as recommended by Harrigan and McCance (1976).

Sensory evaluation

A total of 10 semi–trained panelists drawn from the Department of Food Science and Technology, Federal University of Technology Akure assessed the sensory quality of the reconstituted plantain flour "amala". The

sensory quality of amala made from each flour sample was measured on a standard nine-point Hedonic scale. The panelists rated the amala samples for colour, taste and texture on a scale varying from 1 = dislike extremely to 9 = like extremely (Larmond, 1982).

Statistics Analysis

All the experiments were conducted in triplicates and the mean ± standard deviation were reported. Data were subjected to analysis of variance (ANOVA) and means separated by Duncan Multiple Range Test (DMRT) at a significance level of Pd" 0.05

RESULTS AND DISCUSSION

The microbiological evaluation of the plantain flour and sensory attributes of the reconstituted flour 'amala' samples are presented in Table 1. The Total viable count range between 1 - 3 x 10^3 cfu/g while the unblanched control had the highest value of 3 x 10^3 cfu/ g

Table 1: Microbiological Quality of plantain flour blanched at 60, 80 and 100 ^{O}C for 5, 10 and 15 minutes

Samples	$UPUB_{60}$			$UPUB_{80}$			$UPUB_{100}$			$UPUB_{CO}$
	5	10	15	5	10	15	5	10	15	
TVC cfu/gx10^3	2.0	2.0	1.0	2.0	1.5	ND	1.4	1.0	ND	3.0
Coliform cfu/gx10^3	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.0
Mould & Yeast sfu/gx10^3	3.5	3.2	1.4	2.4	2.2	1.0	2.0	2.0	1.0	4.0

ND = Not Detected

No viable counts were detected on samples $UPB_{80\text{-}15}$ and $UPB_{100\text{-}15}$ indicating that blanching at 80 to 100 ^{o}C for 15 minutes greatly hindered the microbial growth and thereby guaranteed the microbial safety of the flour products. Total viable count of sample: $UPB_{60\text{-}5,}$ $UPB_{60\text{-}10,}$ $UPB_{80\text{-}5}$ are not different from one another (2.0cfu/gx10^3) while that of the $UPB_{60\text{-}15,}$ $UPB_{80\text{-}10,}$ $UPB_{100\text{-}5}$ and $UPB_{100\text{-}10}$ which are treatments at either higher temperatures or longer durations are 1.0, 1.5, 1.4 and 1.0 cfu/gx10^3 respectively. These counts are minimal and are within safe levels and may not constitute health hazards provided the flour samples are well kept to prevent re-contamination and other microbial proliferation after processing. Coliform was only found in the Control sample (1.0cfu/gx10^3) indicating that the blanching process given to the other samples were effective against Coliform. Mould and Yeast count ranged between 1.0 to 4.0 cfu/g x 10^3. The $UPB_{60\text{-}5}$ had 3.5cfu/g x10^3 while the highest count was found in the unblanched Control (4.0 cfu/gx10^3).

The results of sensory evaluation in Table 2 showed that $UPB_{60\ -\ 10}$ was rated best in terms of taste which was significantly different (Pd" 0.05) from other treated samples and the Control except sample $UPB_{60\ -\ 15}$. Sample $UPB_{80\ -\ 10}$ was rated best in colour and was found to be significantly preferred (P d" 0.05) to samples $UPB_{60\ -\ 5,}$ $UPB_{80\text{-}5,}$ $UPB_{100\text{-}5,}$ $UPB_{100\text{-}10}$ and $UPB_{100\ -\ 15}$. The texture of sample $UPB_{60\ -\ 5}$, $UPB_{60\ -\ 10,}$ $UPB_{60\ -\ 15}$ and the Control were found to be higher and better and were significantly different (Pd" 0.05) from samples $UPB_{80\ -\ 5,}$ $UPB_{100\ -\ 5,}$ $UPB_{100\ -\ 10}$ and $UPB_{100\ -\ 15.}$ This means that dipping the plantain pulp in hot water at 100^{o}C is not advisable.

Table 2: Sensory Properties of Reconstituted Plantain Flour (Amala)

Sample	Taste	Colour	Texture
$UPUB_{CO}$	$5.8^{b,c}$	$6.9^{a,b}$	7.7^{a}
UPB_{60-5}	6.7^{b}	$5.4^{b,c}$	7.2^{a}
UPB_{60-10}	8.7^{a}	$6.6^{a,b}$	7.5^{a}
UPB_{60-15}	8.5^{a}	7.6^{a}	7.4^{a}
UPB_{80-5}	4.6^{c}	4.5^{c}	5.2^{b}
UPB_{80-10}	6.6^{b}	8.0^{a}	6.9^{a}
UPB_{80-15}	6.7^{b}	$6.8^{a,b}$	7.3^{a}
UPB_{100-5}	3.4^{d}	5.8^{b}	4.8^{c}
UPB_{100-10}	4.6^{c}	5.5^{bc}	4.6^{c}
UPB_{100-15}	$3.8^{c,d}$	4.6^{c}	4.4^{c}

Values in the same column with different letters in superscript are significantly different at $p< 0.05$

CONCLUSION

Blanching plantain pulp at temperatures of 60°C to 100°C for 10 to 15 minutes significantly reduced the microbial load and could therefore serve as a means of prolonging the shelf life of the chips from pulp or flour produced from it. Likewise the sensory qualities of taste, colour and texture appear to be enhanced at blanching at 60-80°C for 10-15 minutes. At 100°C for 10-15°C, the texture of the amala from this sample is found to be adversely affected. The temperature range of 60-80 and blanching time of 10 minutes is therefore found to be more suitable for the heat processing of plantain chips in order to produce acceptable quality flour.

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