



Full Length Research Paper

Effects of pre-peeling treatments on ease of peeling of whole plantain fingers and functional properties of the plantain flour

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Abstract

Mature intact whole fruits were blanched in hot water, varying concentrations of palm ash infusion and NaOH solution for some varying periods (2 to 10 minutes), then manually peeled by five people and the average time for peeling one plantain was calculated. The treatment that resulted to the shortest peeling period without cooking the fruits were chosen in the processing of the flour samples. The flour samples were used in preparing *fufu* and pie products. Evaluation of relevant sensory attributes were also done. The hot water, 2% ash infusion and 0.02%NaOH solution (for 6 minutes each), applied as pre- peeling treatments of intact whole green plantain fruits resulted to 50%, 57% and 60% reductions respectively in the average time (161 seconds) needed to peel one unblanched fruit. had no drastic The 2% ash infusion treatment gave a flour sample which resulted to the most acceptable *fufu* and pie products.

Keywords: *Plantain, Peeling, Blanching, Palm ash, NaOH.*

Introduction

Plantains are the fruit of the plantain plant (*Musa paradisiaca*). They constitute a major fruit crop in West Africa(Oracca-Tetteh, 1978). It is a staple, starchy food which is consumed in the form of chips, flakes, porridge and flours. The flour can be incorporated into many already existing recipes (Anon, 1991). Unripe plantain contains high amounts of resistant starch which gives a low glycemic index when consumed. This is beneficial in the formulation of diabetic diets. Fortunately, plantain cultivation is less cumbersome than other staples such as cassava, maize, rice and yam (Nakani and Poworie, 1981)

In Nigeria and most West African countries, one of the primary products of plantain fruits is the flour. It is made by peeling mature, unripe plantain and slicing the pulp into small pieces which are dried. The dried product is milled and sieved to obtain flour. The major problem associated with this process is the long time spent in peeling and as such the high rate of browning experienced during and after peeling due to the action of the enzyme polyphenol oxidase (Ihekoronye and Ngoddy, 1985). Several researchers have suggested different ways of reducing peeling time and minimizing browning during plantain peeling. These include treatments such as soaking raw plantain pieces for 3 minutes in Sodium metabisulphite solution(41g/dl), containing 3g of citric acid, followed by draining and drying in the oven at 65°C for 48hours. The fruits may also be blanched at 80°C for 5 minutes before slicing (Ngalani, 1989).

This research was therefore aimed at evaluating the effects of blanching in different hot solutions on the ease of peeling (peeling time) of the mature unripe plantain. The work will also investigate the effects of some chosen blanching treatments on the functional properties of the plantain flour produced, as well as the acceptability of the *fufu* (a starchy paste/dough usually moulded into small balls with the finger and swallowed after dipping in soup or sauce) and pie crust produced with the flour samples. Improving the efficiency of the peeling operation will certainly reduce labour, save time and energy and increase productivity. The development of cheaper plantain flours with acceptable qualities will increase utilization of the plantain.

Materials and Methods

Material Procurement

The mature unripe plantain fruits were purchased from Eke-ukwu market in Owerri, Imo state, Nigeria. Palm bunches (without palm fruits) were obtained from palm fruit processors in Ohaji, Imo state, Nigeria. They were burnt to obtain the ash used in the experiment. Sodium hydroxide was obtained from the Department of Food Science and Technology, Federal University of Technology, Owerri.

Determination of mean peeling time as affected by pre-peeling treatment

Different batches of fruits were blanched separately in different blanching media namely, tap water; Sodium hydroxide solutions at different concentration (0.02%, 0.04%, 0.06%, 0.08% and 0.1%) and palm ash infusion containing different concentrations (2%, 4%, 6%, 8% and 10%). These made up eleven blanching media. Each blanching treatment medium was separately applied for varying durations (0min., 2min., 4min., 6min., 8min. and 10min).

The plantain fruits from different treatments were evaluated for the average time (measured using a stop-watch) spent in the manual peeling of five fruits by five different peelers, using sharp kitchen knives. Thus the ease of peeling was calculated thus:

Mean peeling time for one plantain finger = Total time spent by each peeler / Number of plantain peeled

Production of Plantain Flours

The treatments which resulted in the shortest peeling time, without signs of overcooking, were chosen for plantain flour production. The mature but unripe plantain fruits were given the chosen treatments, namely, blanching in plain tap water for 6 minutes, 2% palm ash and 0.02% NaOH solution for 6 minutes. The samples from all the chosen treatments were separately cut into slices of 0.2cm and dried in a locally fabricated gas-fired oven at 75°C for 5hours. The dried chips were then milled in a locally fabricated attrition mill and sieved through a 300 µm sieve. The flour produced was stored in air-tight glass bottle for further studies.

Sensory evaluation

The plantain flour samples obtained by the pre-peeling treatment in boiling water, 2% palm ash and 0.02% NaOH and the unblanched fruit (as control), were used for preparation of *fufu* and meat pies. These products were served to a 30- man panel of judges. The *fufu* was served with egusi (melon) soup. The panelists scored the products for the various characteristics on a nine-point hedonic scale where 9 represents 'like extremely' and 1 represents 'dislike extremely'. The results were analysed using a two-way analysis of variance (Ihekoronye and Ngoddy, 1985).

Results and Discussion

Effect of Pre-peeling Treatment on Peeling Time

The results obtained are shown on Table 1. The results reveal that the longer the period of blanching the whole green plantain, the shorter the period (time) spent in removing the peels, that is, the higher the ease of peeling. However, blanching times of 8 and 10 minutes produced cooked plantain pulp after the treatment. Thus such levels of blanching are not advisable unless real cooking is intended. On the other hand increase in concentration of the blanching solution did not produce a reduction in average peeling time. Therefore the use of higher concentrations of palm ash (4% and above) infusion and NaOH (0.04% and above) is not advisable. Also such high concentrations were found to be corrosive on the peelers and utensils used in the pre-treatment operation and will result to an unnecessary higher cost of processing.

The average time spent on peeling the unblanched mature green plantain fruit was 161 seconds. Blanching in plain hot water for 2 minutes, 4 minutes and 6 minutes reduced the average peeling time to 118 seconds, 143 seconds and 80 seconds respectively. The 2% palm ash pre-treatment for 2 minutes, 4 minutes and 6 minutes reduced peeling time to 81 seconds, 111 seconds and 69 seconds respectively, while the 0.02% NaOH pre-treatment for 2 minutes, 4 minutes and 6 minutes reduced peeling time to 125 seconds, 108 seconds and 64 seconds respectively. Such increase in peeling efficiency has been reported for potato after immersion in 10-20% lye solution at 60°C-90°C, for 1-5 minutes (FDA, 1977). The use of hot water, steam, hot lye and other peeling aids have been in use since the 1940s especially for potato and tomato processing. The process seems to toughen (temper) the peel, while softening the outer layers of the pulp thereby weakening the 'bond' between them. This makes separation of the peel from the pulp much easier and faster.

Surprising, it was observed that the 4 minute pretreatment for hot water and some of the palm ash concentrations gave longer peeling times than the 2 minute treatments, even though the general trend was that the peeling time reduces with increase in blanching time. In each of those cases the peel seemed to be very difficult to separate from the pulp. As a result of all these, the 6 minutes blanching

treatments using 2% palm ash, 0.02% NaOH and hot water which gave the peeling time of 69, 64 and 80 seconds respectively were chosen as the treatment for the sensory evaluation.

Results of Sensory Evaluation

No significant difference ($p \geq 0.05$) was observed in the mouthfeel for all the fufu samples which ranged from 6.87 to 7.53 on a 9-point hedonic scale (Table 2). However significant differences ($p \leq 0.05$) were observed in the appearance, mouldability and overall acceptability of the *fufu* samples produced from the different pre-peeling treatments. The sample blanched in hot water for 6 minutes had significantly lower scores (5.53) for appearance than the rest which did not vary significantly. The 2% palm ash and 0.02% NaOH treatments also gave significantly higher scores for mouldability (7.73 and 6.80 respectively). The overall acceptability was highest (8.2) for samples treated with 2% palm ash, followed by 7.87 for the sample treated with 2% NaOH. The fufu produced from the unblanched sample and the boiling water prepeeling treatment gave lower scores of 7.00 and 6.87 respectively. The results suggest that prepeeling treatments with 2% palm ash and 0.02% NaOH gave *fufu* with better consumer acceptability than hot water blanching treatment. This shows that the prepeeling treatments which gave shorter peeling times did not adversely affect the sensory qualities of the *fufu* but rather improved on it.

No significant difference ($p \geq 0.05$) was observed among the pie samples in all the sensory parameters (Table 2). This suggests that any of these treatment can be chosen at the processors convenience and still achieve good results. However, it was observed that samples treated with 2% palm ash had consistently higher scores for appearance (5.87), flavor (6.93), crispiness (6.53) and overall acceptability (7.00).

These results suggest that these pretreatment chemicals at the concentrations applied, did not gain access into the edible portion of the plantain (the pulp), therefore the behavior of the plantain flours when used in the *fufu* and pie crust were not altered.

Table 1: Mean peeling time (sec) of mature unripe plantain fruits after blanching in different solutions for varying periods

Blanching treatment	Blanching Duration (min)					
	0	2	6	8	10	
Hot water	161sec	118sec	143sec	80sec	62sec	33sec
2% Ash	161sec	81sec	111sec	69sec	85sec	44sec
4% Ash	161sec	96sec	104sec	89sec	75sec	38sec
6% Ash	161sec	95sec	101sec	95sec	49sec	23sec
8% Ash	161sec	90sec	116sec	93sec	71sec	38sec
10% Ash	161sec	91sec	95sec	85sec	46sec	59sec
0.02% NaOH	161sec	125sec	108sec	64sec	41sec	21sec
0.04% NaOH	161sec	93sec	81sec	77sec	42sec	25sec
0.06% NaOH	161sec	95sec	87sec	87sec	29sec	20sec
0.08% NaOH	161sec	94sec	100sec	75sec	84sec	29sec
0.1% NaOH	161sec	99sec	77sec	75sec	36sec	19sec

Table 2: Mean sensory attribute scores for *fufu* and pie

treatments	Fufu Appearance	Fufu mouldability	Fufu mouthfeel	Fufu overall acceptability	Pie crust appearance	Pie crust flavour	Pie crust crispiness	Pie crust overall acceptability
2% ash for 6mins	6.40 ^{ab}	7.73 ^a	7.93 ^a	8.20 ^a	5.87 ^a	6.93 ^a	6.53 ^a	7.00 ^a
Boiling water for 6mins	5.53 ^b	5.80 ^b	7.13 ^a	6.87 ^b	5.27 ^a	6.07 ^a	5.27 ^b	6.13 ^a
0.02% NaOH for 6mins	7.00 ^a	6.80 ^{ab}	7.53 ^a	7.87 ^a	5.93 ^a	6.87 ^a	6.00 ^a	6.40 ^a
Unblanched sample	7.27 ^a	5.87 ^b	6.87 ^a	7.00 ^b	5.00 ^a	6.80 ^a	5.47 ^a	6.00 ^a

Means along the same column with different superscripts are significantly different at $p \leq 0.05$

Conclusion

From the above results, it can be seen that plantain fruits intended for plantain flour production should be blanched in 2% palm ash infusion or 0.02% NaOH solution for 6minutes in order to reduce peeling time. The product (*fufu* and pie crust) generated from the sample flours also compared favourably with the flours produced from unblanched plantain in terms of consumer acceptability. The 0.02% NaOH treatment is more adaptable to large scale industrial plantain processing since the supply is not seasonal like that of palm ash. However for rural dwellers who may not be very competent in handling of dangerous chemicals such as NaOH, the use of palm ash from spent palm bunches is recommended.

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