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Short Communication

Assessment of some locally developed technologies for shortening the retting time of cassava

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The need to shorten the time taken for cassava tuber to ret has arisen because of increased demand for processed cassava products occasioned by population growth in developing countries. Locally developed technologies aimed at this objective which involved the addition of chemical substances to steep water were assessed to determine their efficacy. Retting time measured in hours was determined during 25 retting trials using separately in each set, a control and 0.5 ml kerosene/L, 1 g trona/L and 10 g nails/L of steep water. The results reveal that addition of chemicals to various extents influenced growth of microbes and production of organic acids during cassava retting. Trona inhibited detoxification of cyanogenic glycosides while kerosene and nails did not. Statistical analysis of retting time data showed that nails were efficacious in shortening retting time but that kerosene and trona were not. The mechanism of action of nails probably involved enhancement of growth and enzyme activity of microbes involved in production of macerating enzymes responsible for softening of tubers during retting. A better understanding of this process will be useful in developing safer and efficacious chemicals for shortening the retting time of cassava.

Key words: Technologies, chemicals, cassava retting.

INTRODUCTION

Retting is one of the simplest methods for the processing of cassava (*Manihot esculenta* Crantz) tuber into various African staple foods. It simply involves steeping roots in water until they soften. However, this takes about three to four days under optimal conditions (Okafor et al., 1984). In other conditions, retting may take considerably longer, for example, with tubers older than 24 months or during the colder seasons of the year. In addition, up to 20% of tubers steeped under these conditions may fail to soften.

With the increasing demand for food due to the rapid population growth in many developing countries, the need has arisen to make process time for retting of cassava shorter. Successful research effort towards accelerating retting has been reported by Menezes et al. (1998) following additions of commercial preparation of cellulase and pectinase.

In Nigeria and other parts of West Africa, local processors have responded to this challenge by addition of various chemical substances to water for steeping of the roots. Chemical substances commonly employed include kerosene, trona and common wire nails. The use of these substances has their origins in local beliefs (kerosene as a solvent and trona and nails as tenderizers during cooking), and has not been shown scientifically to achieve intended purpose. A further point of concern is that these substances are applied in violation of laws guiding the use of chemical additives in food and therefore may pose potential danger to consumers. On the other hand, because these technologies were locally developed, local processors understand them. Thus, any scientifically developed efficient and safe technologies similar in operation will be easily adaptable by local processors who remain the major suppliers of retted cassava foods.

This study was therefore carried out to assess using scientific methods, the efficacy of these chemicals in shortening the retting time of cassava. It will also seek to understand the possible mechanism of action of any chemicals found efficacious. Knowledge of this will be exploited in future work to develop safer and more acceptable chemicals for shortening the retting time of cassava.

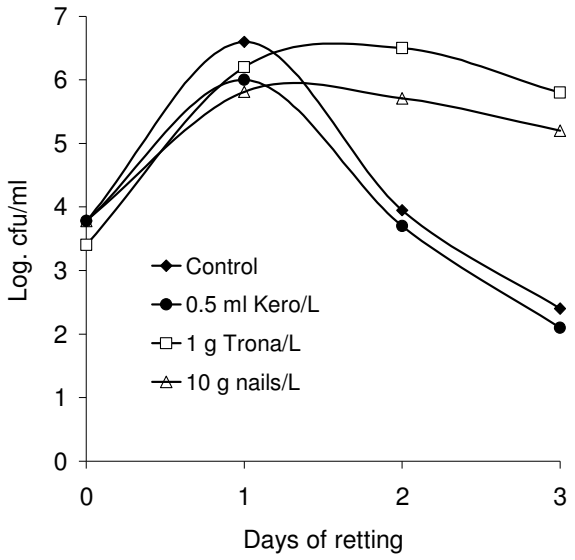

Figure 1. Viable count of organisms growing aerobically on Nutrient agar at 30ºC for 48 h.

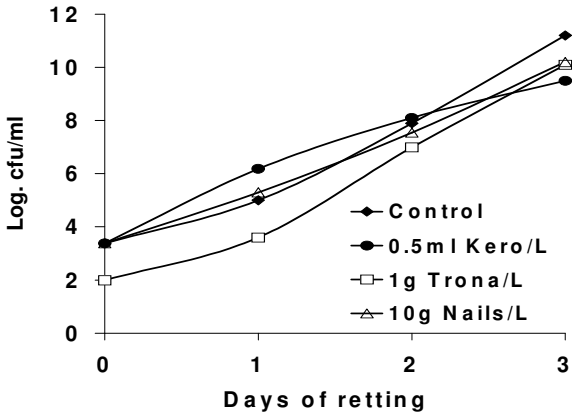

Figure 2. Viable count of organisms growing on MRS agar 30oC/48h

MATERIALS AND METHODS

Cassava samples and retting into "foo-foo"

Cassava roots of the "bitter variety" ranging in age between 15 and 30 months were used. Roots were peeled, cut into cylinders of approximately 10 cm length x 5 cm diameter and washed. Samples for each set of experiments were drawn from a single pool of washed pieces. Retting was performed by completely submerging approximately 1.5 kg of the cassava pieces in 2 L of tap water, contained in 4 L plastic buckets at a chosen temperature until retted. Kerosene and common wire nails made of mild steel were purchased from dealers in Abakaliki, Nigeria. Trona is the commercial grade of sodium sesquicarbonate (Solvay chemicals Inc.) The agents were added to water immediately after steeping the cassava roots at concentrations of 0.5 ml kerosene/L, 1 g trona/L and 10 g nails/L of steep water. The choice of these concentrations were based on observations (data not shown) that further increases in their amounts did not significantly change the time course and rate of production of lactic acid in cassava, during the 3 days of retting.

Retted roots were processed into "foo-foo" as described by Okafor et al. (1984). A part of each sample was dried in the oven (50°C) to a moisture level of about 13% for use in chemical analysis. All experiments were replicated trice.

Determination of retting of cassava pieces

This was done by observation at twelve-hourly intervals of the retting vessels for floating pieces of cassava tuber. Experience showed that this occurred about 12 hours before retting became complete. Retting was confirmed by hand feel.

The time from steeping of roots to confirmation of retting as described above (retting time) was determined in hours. Twenty-five retting trials were conducted using roots of different ages at 25 and 30°C. Each trial consisted of a set of roots of same age to which chemicals were added as follows: No chemical (control), 0.5 ml kerosene/L, 1 g trona/L and 10 g nails/L of steep water. Retting times were converted to scores (12 h = 1, 24 h = 2, up to 96 h = 8) and analysed using Analysis of variance (ANOVA). The Duncan's New Multiple Range Test was employed to determine any differences in retting time due to added chemicals at $p \leq 0.05$ (Watts et al., 1989).

Chemical properties and microbial populations in retting cassava

Aerobic mesophiles (AMC) and lactic acid bacteria (LAB) were enumerated daily on Nutrient agar (NA) and de Man Rogosa and Sharpe agar (MRS) (de Man et al., 1960), respectively. Media were prepared according to instructions of Difco Laboratories USA, suppliers of both media. All plates were incubated aerobically at 30°C and colonies counted after 48 h. Production of organic acids was determined daily by measurement of pH of retting liquor.

Total cyanides in dried "foo-foo" samples were analysed spectrophotometrically (Spectronic 21UVD) using picrate paper kit B2 of Bradbury et al. (1999).

RESULTS AND DISCUSSION

Analysis of retting time data at 25ºC showed that addition of 10 g nails/L significantly shortened retting time of cassava when compared with the control and other test samples. The mean retting time for control, 1 g trona/L, 0.5 ml kerosene/L and 10 g nails/L of steep water were 4.84, 4.8, 4.64 and 4.1, respectively. At 30ºC however, all samples showed the same retting time during the twenty-five trials.

The influence of added chemicals on aerobic mesophile (AMC) and LAB counts are shown in Figures 1 and 2 while changes in pH is shown in Figure 3. Samples of cassava retted with trona contained 20 mg/kg of total cyanides while other samples contained between 8 and 9 mg/kg of total cyanides. To varying extents, all three agents tested affected the growth of both categories of microorganisms studied. Aerobic mesophiles are reported to be responsible for production of macerating enzymes and lactic acid bacteria are known to be

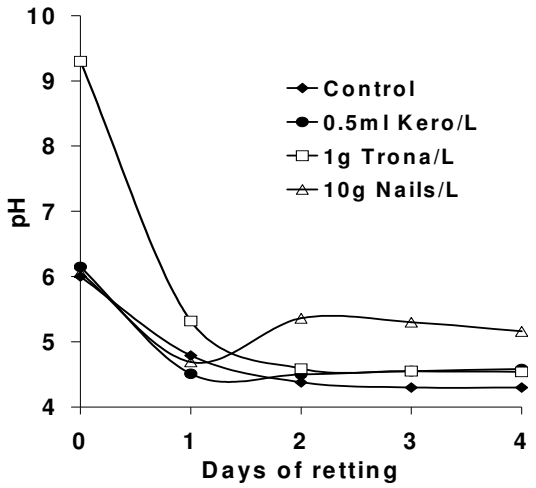

Figure 3. Influence of added chemicals on pH retting cassava

responsible for the aroma of retted cassava (Brauman et al., 1996). Their abilities to produce organic acids during retting were also influenced.

The addition of kerosene and trona did not show any effect on retting time. Nails, or in chemical terms the element, iron placed in retting water obviously underwent several chemical reactions and brought about a remarkable influence on many aspects of retting. Iron (III) oxide produced initially as rust was probably reduced by products of microbial activity in the retting liquor to iron (II) oxide, which is more readily utilized by bacteria. These reactions would also be responsible for coloured complexes which, were observed to impart a blackish discoloration on this product. Iron is a component of cytochromes and certain non-heme iron-proteins and a cofactor for some enzymatic reactions. The presence of iron in retting water possibly shortened retting time by a combination of factors. First, prolonged growth of aerobic mesophiles observed in this sample implied prolonged activity of microorganisms responsible for producing macerating enzymes. Additionally, pectinases are inducible enzymes and Sauvage and Expert (1994) have reported that low concentrations of iron favor the expression of genes responsible for their production. Finally, the rise in pH on day 2 observed in this sample suggests a peculiar microbial succession pattern. This would suggest a possible role for certain microorganisms not usually prominent during normal retting processes.

No differences in retting time were observed for the cassava samples at 30ºC. This can be explained from the report of Ampe et al. (1994) that the most influential factor affecting retting time is temperature (optimum at 34ºC). A temperature of 30ºC was on its own a factor strong enough to abolish observations of any contributions towards retting speed from other factors.

It is interesting that nails did not significantly affect the growth of LAB. Thus, this process would not adversely affect aroma or acceptability of the product. The detoxification process was also efficient, reducing HCN to 9 mg/kg which is below maximum level of tolerance (10 mg/kg) recommended by the FAO/WHO (1991).

This work has shown that kerosene and trona were not efficacious in shortening retting time of cassava. The addition of these substances to food should be discouraged. The addition of nails or in other words small quantities of iron to water for cassava retting is efficacious in shortening time for retting of cassava. Further studies of the mechanism of action will enable substitution with chemical compounds allowed in foods. This technology will be useful in making retting faster thus improving the supply of retted cassava products irrespective of season.

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