Kinetic study of retting:

A cassava traditional fermentation in Central Africa

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Cassava based foods are widely consumed in west and central african countries. In Congo, the second world cassava consumer after Zaïre, cassava roots stand for 47 % of the calories supply. One common step for Chikwangue and foo-foo preparation, the Congo indigenous cassava foods, is fermentation of the roots. This fermentation, also called retting, is a technique involving long soaking of cassava roots in water to effect the breakdown of tissues. Moreover retting permits an acceleration of hydrolysis rate of water soluble cyanogenic glycosides however it is still not clear whether cyanogenic glucoside degradation proceeds by the action of endogenous enzymes or through bacterial activity.

Despite the importance of this fermentation, no general kinetic study has been reported yet. The present work was therefore undertaken to study the physico-chemistery, the biochemistry and the microbiology of retting to provide a basis for its possible mechanization as increasing urbanization dictate the replacement of current artisanal scale handling with small scale factory production. The study was carried out to enumerate the main microorganisms of the process, to estimate the physico chemical parameters of the retting and to determine main metabolite production and some enzyme activities.

RESULTS

PHYSICO-CHEMICAL PARAMETERS OF RETTING

Cassava roots softening began on the second day of fermentation(fig 1). On the basis of penetrometry index, retting was considered over after 4 days. Cassava roots pH started to decrease 24 hours after the fermentation beginning and stabilized around pH 4 at the end of the process . On the contrary, the decrease of dissolved oxygen was even more drastic as it dropped from 5,5 mg/l to 0,4 in less than 10 hours. In all the assays, 90 % of total cyanide content was reduced thus the final concentration of free cyanide in retted roots was around 30 ppm.

BIOCHEMICAL PARAMETERS

Cassava organic compounds were assayed by high performance liquid chromatography. The main metabolites produced during the process were (fig 3) ethanol, lactate, butyrate acetate and propionate in order of importance. However their production kinetics differed appreciably. Only butyrate and to a lesser extend acetate increased gradually through out the fermentation. All other organics compounds assayed, lactate, propionate and ethanol, reached their maximum on the second or third day of the process. Their concentration gently decreased

afterwards. The high butyrate concentration in retted roots could be responsible for the characteristic flavor of the final products; Chikwangue and Foo-Foo.

Amylase, pectinesterase and linamarase activities were assayed during the transformation (fig 2). Amylase activity was not significant. The highest measured was for pectin esterase, which reached its maximum on the second day of fermentation (2UI / ml). Linamarase activity was maximum in freshly harvested roots and decreased gradually all along retting.

MICROBIOLOGICAL PARAMETERS

The following bacteria were enumerated in solid or liquid medium (fig 4)

TFB : Total fermentative bacteria (glucose, starch, lactate were used as carbon substrates)

TMB : Total mesophilic bacteria

TLB: Total lactic bacteria

AMB : Amylolytic bacteria

YE: Yeasts

PB: Pectinolytic bacteria.

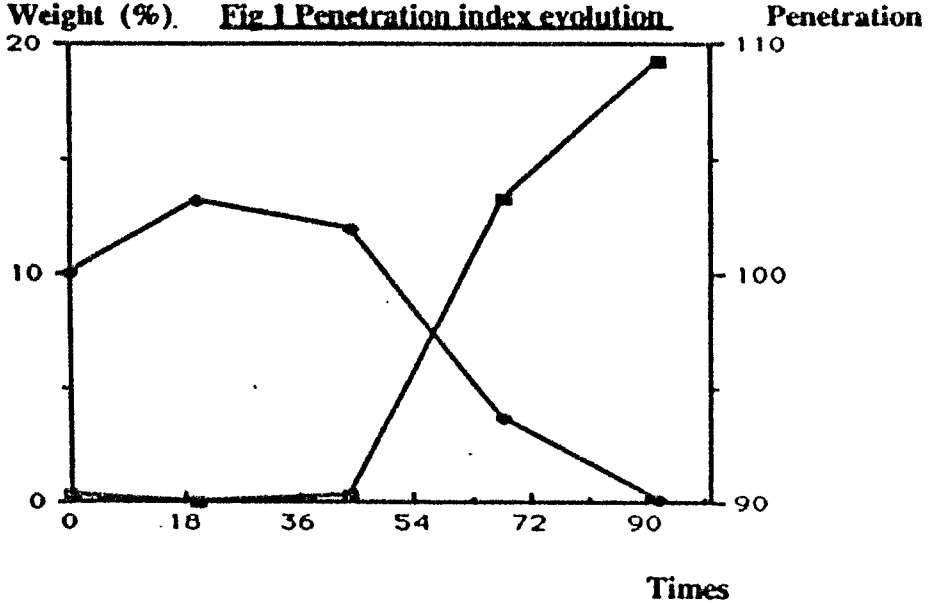
The TFB reached the highiest concentration of 10^{10} bact /g of fresh cassava on the second day of fermentation . They remain at this level until the end of fermentation .TLB seemed to be the main flora in this process as their evolution and concentration were similar to these of the fermentative bacteria.

The low number of yeasts and amylolytic bacteria clearly showed that these flora were not important in the transformation. However a lactic acid bacterium identified as *Lactobacillus plantarum* with significant a amylase activity was isolated from fresh cassava roots (paper in press) . The low level of pectinolytic bacteria is in contradiction with the high level pectin esterase activity, but the specificity of the pectynolytic medium needs to be improved

An enumeration of the different genus of lactic acid bacteria during the process revealed a pattern of microorganisms : cassava roots endogenous bacteria, mainly *Lactobacillus* were quickly replaced after the first day of fermentation by a heterolactic fermentative flora, in which *Leuconostoc* species seemed to be predominant . Moreover, all lactic acid bacteria tested, were resistant to 200 ppm free cyanide, except *Streptococci* species which grew in a medium containing more than 500 ppm.

CONCLUSION

From these results retting could be seen as a heterolactic fermentation with a caracteristic production of butyrate. Cell wall degradation was mediated by bacterial pectinases, whereas detoxication was mainly due to endogenous linamarase. Lactic acid bacteria, mainly Leuconostoc and Streptococci, was the predominant microflora of the transformation. Yeasts were more characteristic of the post-fermentation stage. Further research is needed to determine the pectinase and volatile fatty acid origin.


Weight (%).
Fig 1 Penetration index evolution
Penetration
20
10
0
110
100
90
0
18
36
54
72
90
Times

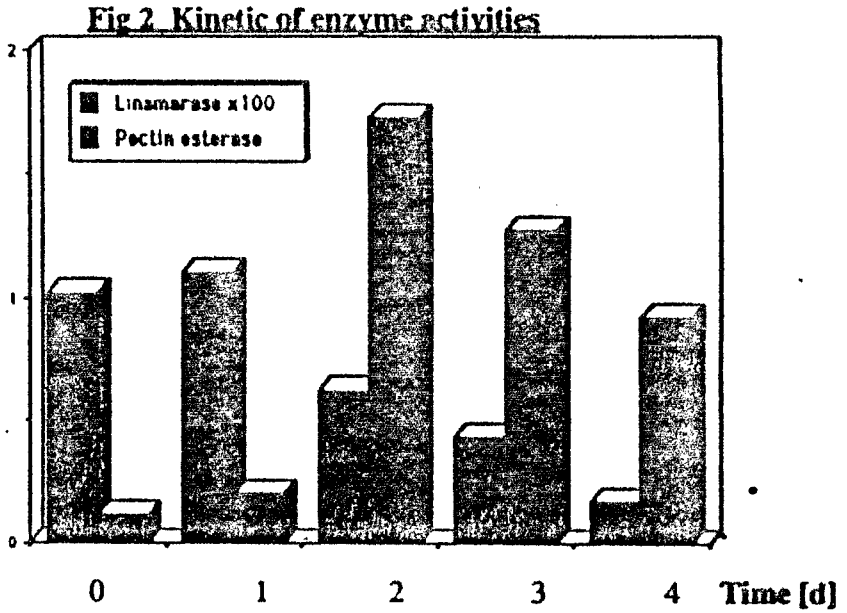


Fig 2 Kinetic of enzyme activities
Linamarase x100
Pectin esterase
2
1
0
0
1
2
3
4
Time [d]

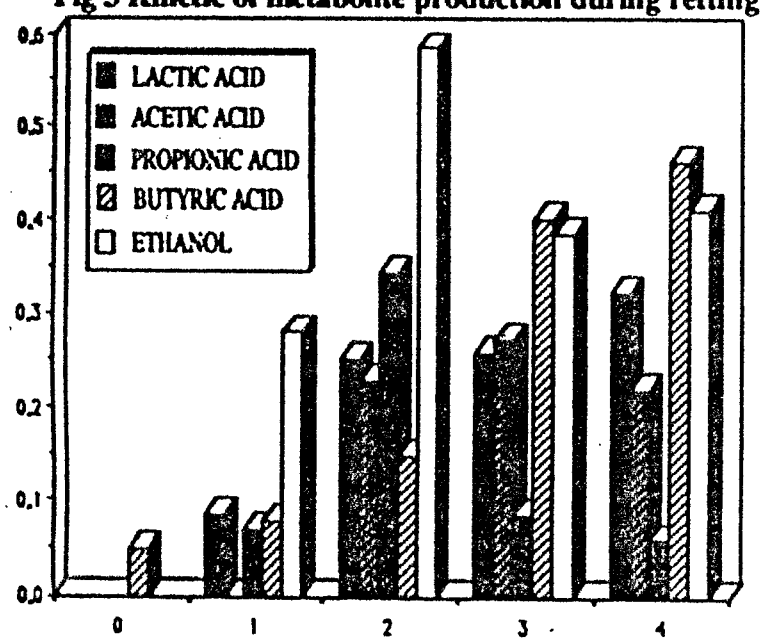
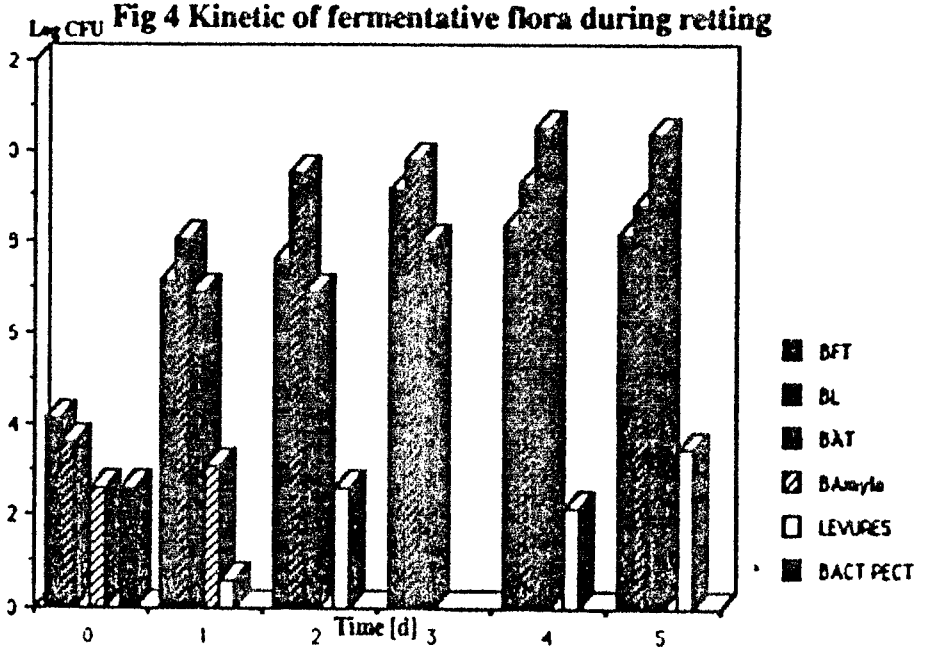


Fig 3 Kinetic of metabolite production during retting
LACTIC ACID
ACETIC ACID
PROPIONIC ACID
BUTYRIC ACID
ETHANOL
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
1
2
3
4


Log CFU
Fig 4 Kinetic of fermentative flora during retting
BFT
BL
BAT
BAmyla
LEVURES
BACT PECT
0
1
2
Time [d]
3
4
5

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