Application of experimental research methodology to the optimization of cassava traditional fermentation

AMPE F.[1], TRECHE S.[2], AGOSSOU A.[1], and BRAUMAN A.[1]
[1] : Laboratoire de Microbiologie et de Biotechnologie
[2] : Laboratoire de Nutrition
ORSTOM - BP 181 - Brazzaville - République du CONGO

Cassava retting - a major step in most indigenous cassava-based foods preparation, was optimized using experimental research methodology. Retting is traditionally performed to soften the roots, to give cassava-based foods their specific flavour through a pH decrease and organic acids production, and to degrade the endogenous cyanogenic compounds.
The quality and taste of cassava foods are quite variable. Indeed, differences between retting processes are quite significant. Different varieties of cassava can be used. Roots, peeled or unpeeled can be placed in rivers, standing water, large barrels of water or even buried in the soil. Fermentation temperature varies with the season and the location moreover Cassava roots are sometimes stored for a few days before fermentation. Some attempts have already been made to study the influence of some of these factors on retting. However, to the best of our knowledge, no general and systematic study on retting has yet been reported, each factor having always been considered apart from the others. It is not known which conditions give a better and safer product.
The present work thus intends to study the influence of several factors on cassava retting, taking into account the possible interactions between these factors. Its purpose is to define the optimal conditions for retting in terms of product quality and fermentation time. Recommendations will then be made to small cassava-processing units in urban areas.

EXPERIMENTAL METHODOLOGY

The main purpose of experimental research methodology relies on its mastering, description, assessment or explanation of the studied phenomenon. This methodology is essentially characterized by a good and flexible experimental design with well defined objectives.
These objectives can be reached through successive steps, each one being made of a series of experiments constituting an experimental matrix. The most frequently used experimental design applications involve :

- the screening of a great number of factors using a reduced number of experiments - the conditions of which are described in a peculiar matrix called Hadamard's matrix and which permits to determine among all the suspected parameters, those having a real influence so that they may be studied in detail.
- the use of factorial matrices which enable the study of the influential factors and interactions between them, unlike most classical strategies which take one factor at a time.
- the optimization of one or several of the experimental responses with the help of matrices such as Doehlert's, Hocke's, Box-Benhken's, which make it possible to assess all values of the experimental domain, thus making optimization far easier.

This methodology has been transposed to the study and optimization of cassava retting. The influence of six factors has been studied. The experimental matrix

shown in table 1 was built ; it set conditions for twelve experiments, and its efficiency coefficient G was 87.5%. Optimization was then attained on retting time and quality of product using a software (Nemrod, designed by LPRAI - Marseille).

Table 1 : Experimental matrix for experimental design.
Factors X1 to X6 respectively correspond to temperature (1 : 24°C - 2 : 28°C - 3 : 32°C), inoculum (1 : without - 2 : with use of an inoculum), variety (1 : Ngansa - 2 : Mpembé), Storage (1 : no storage - 2 : 48h storage), peeling (1 : before retting - 2 : after retting) and root size (1 : circumference<17 cm - 2 : circumference>22 cm).

Experiment #	Level of each Factor					
	X1	X2	X3	X4	X5	X6
I	1	1	1	1	1	1
II	1	2	1	2	1	1
III	2	1	2	2	1	1
IV	2	2	1	1	2	1
V	3	2	2	1	2	1
VI	3	1	2	2	2	1
VII	3	1	1	1	1	2
VIII	2	2	2	1	1	2
IX	3	2	1	2	1	2
X	1	1	2	1	2	2
XI	2	1	1	2	2	2
XII	1	2	2	2	2	2

RESULTS & DISCUSSION

Retting Time

Graphical analysis (Fig.1) shows that temperature had a tremendous effect on retting time : retting time considerably diminished a temperature of 32°C. Other factors appeared to have less effect. However, to speed up the process, roots should be peeled before retting and soaked in water immediatly after harvesting, large size Mpembé roots should be chosen preferably. The use of a 10% v/v inoculum slightly decreased retting time.

Organoleptic qualities of foo-foo (Fig.2)

The most influential factors were temperature, storage and peeling. To increase the quality of the final product, fermentation should be performed at 28°C, and roots should be peeled and soaked in water immediatly after harvesting. Other factors had less influence on foo-foo quality. If a choice had to be made, one would prefer Ngansa variety, large size roots and an inoculum-free fermentation.

Cassava detoxication

All flours had a total cyanide content below the limit of tolerance. As flours were soaked into boiling water to prepare foo-foo, free CN evaporated, and final cyanide content was even lower. However, graphical analysis of the experimental responses shows that the use of an inoculum significantly decreased total cyanide content. This may be because the pH of the cassava mash was close to optimum activity (pH 5.5) of cassava endogenous linamarase when an inoculum was used. Decrease of cyanide content could also be due to the action of microbial ß-glucosidase, as microbial population greatly increased with the addition of an inoculum.

Fig.1 : Graphical analysis of the effects of retting conditions on retting time

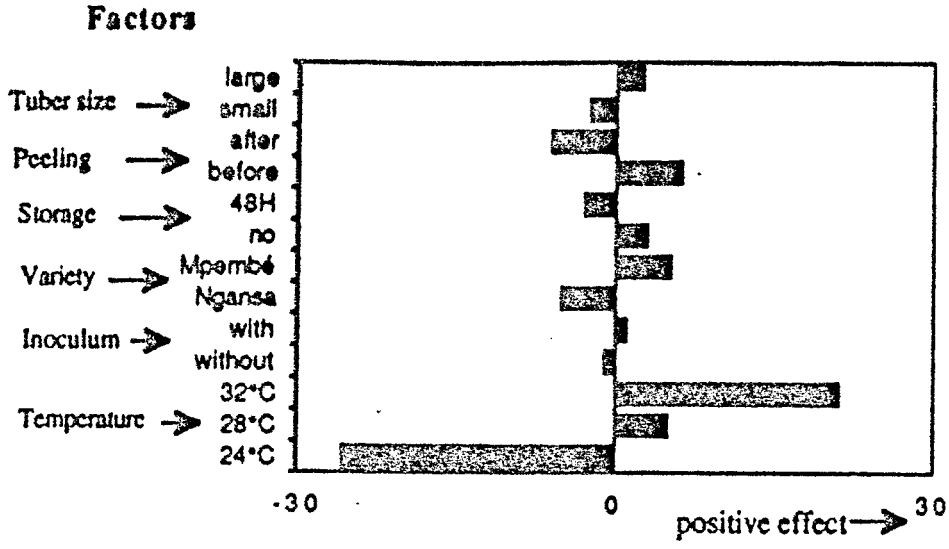
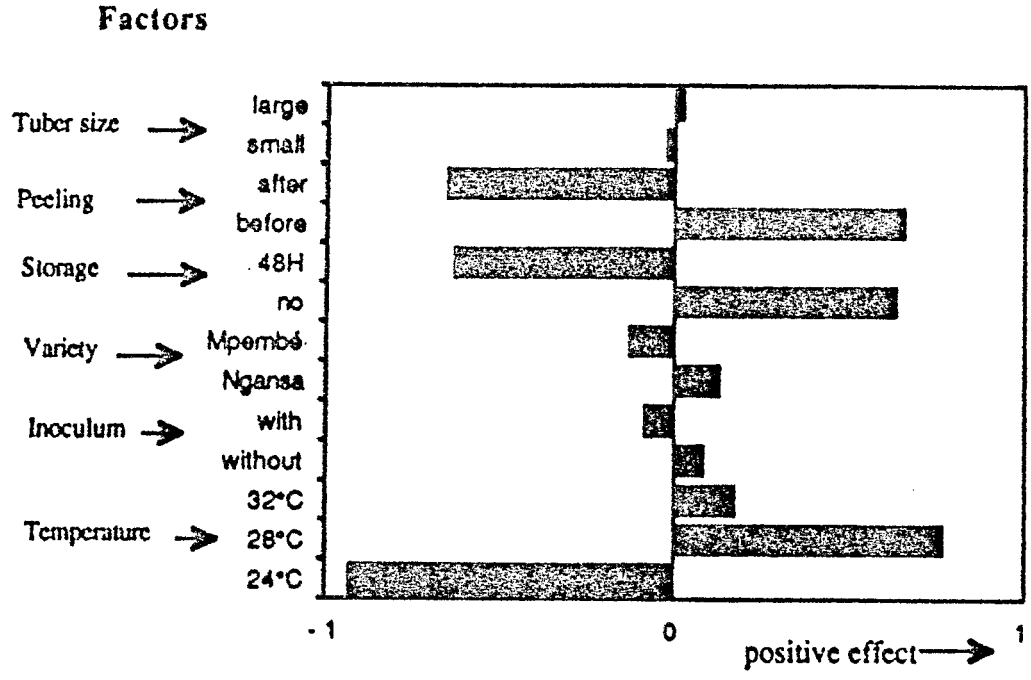


Fig.2 : Graphical analysis of the effects of retting conditions on foo-foo organoleptic qualities



Centro Internacional de Agricultura Tropical CIAT

TALLER "AVANCES SOBRE ALMIDON DE YUCA"

17 AL 20 DE JUNIO DE 1991

CIAT, CALI

RESUMENES

Evento realizado en el marco del programa colaborativo
CIRAD/CEEMAT- CIAT

"Producción y utilización del almidón de yuca"

con el apoyo financiero de

La Cooperación Regional Cientifica y Tecnica Francesa

CEEMAT

Centre d'Etudes et d'Expérimentation
en Mécanisation Agricole et Technologie alimentaire