

DEVELOPMENT OF STARTER CULTURES FOR LOCAL FOOD FERMENTATION IN NIGERIA

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ABSTRACT

Lactic acid bacteria (LAB) are the most important ingredients of starter preparations and lactic acid fermentation is an important food processing technology in Nigeria. Apart from general demands for starter cultures from the view of safety, technological effectiveness and economics, numerous specific aspects have to be considered when selecting strains for the different food fermentation. An overview on the role and potential of microorganisms in traditional food fermentation is given. Prospects for the implementation of starter cultures for household food fermentation are discussed. Specific attention is given to the Nigerian situation and the well-accepted lactic fermented, traditional food in the environment.

INTRODUCTION

Lesser developed countries require food processing technologies that are technologically appropriate, suitable for tropical regions and that are affordable in rural and urban economies. Household level fermentation is one such technology that has been developed indigenously for a wide range of food commodities and has been used in Africa for centuries. (Westby *et al.*, 1997; Oyewole, 1997) These include cereals and legumes, root crops, fruits and vegetables, dairy products, fish and meat (Steinkraus 1989; Campbell-Platt, 1994).

As a unit operating in food processing, fermentation offers a large number of advantages, including: food preservation, improved food safety, enhanced flavour and acceptability, increased variety in the diet, improved nutritional value, reduction in anti-nutritional compounds and in some cases, improved functional properties (Odufa, 1985; Sanni 1993, Olasupo *et al.*, 2001).

Food products resulting from fermentation processes are called fermented foods and these group of foods constitute a major portion of the people's diet in Africa (Odufa, 1985). The different types of fermented foods common to Nigerian environment and in which LAB are found are indicated in Table 1. Among the organisms involved in the production of fermented foods, lactic acid bacteria are usually the most important (Oyewole, 1997).

TABLE 1: Examples of Nigerian fermented foods containing lactic acid bacteria (adapted from Olasupo *et al.*, 1997a)

Cassava-based: Gari, Lafun, Fufu

Cereal-based: Ogi, Kunun-zaki

Dairy food products: Wara, Nono

Legume-based: Iru, Ogiri, ugba

Alcoholic products: Burukutu, Pito, Palmwine

Apart from LAB, yeasts and moulds are also known to be associated with some fermented foods. Lactic acid bacteria are a group of Gram-positive, non-sporing, non-motile, catalase-negative, non-aerobic organisms, usually non-pathogenic and ferment carbohydrates to produce lactic acid as the sole or major organic acid. Since LAB are the most important in food fermentation, it becomes imperative to think that a would-be starter culture for food processing, must be familiar/indigenous to such foods or its raw materials (Holzapfel, 1997). It is interesting to note that LAB associated with indigenous food fermentation (in Nigeria and many other countries) have been found to have good safety record over time, as they have been consumed for centuries. (Olasupo *et al.*, 1999a). Some characteristics of LAB promoting their application in food processing are given in Table 2

graduation of anti-nutritional factors and detoxification of toxic components

potential for improvement in sensory qualities and shelf- life

contribution to nutrients improvement.

CONCEPT OF STARTER CULTURES

A "pure" starter culture (*Lactococcus lactis*) formerly called *Streptococcus lactis*, introduced at the same time in Germany and Denmark in 1890, were used for the industrial fermentation of milk for cheese and sour-milk production. This LAB strain, due to its high acid production (acidification), was able to support the technical requirements and to obtain a desired quality of the end product. Substrate adaptation and other beneficial properties such as flavour and texture improvement also served as criteria for strain selection, and as an improvement on the rather traditional empirical approach of back-slopping which is typical in many African countries (Holzapfel, 1997).

Traditional fermented foods in Africa (including Nigeria) are fermented before consumption. Table 3 shows some unique features of these fermented foods. The problems facing fermented foods in Africa include inconsistent quality, short shelf life due to lack of standardization of processing procedures and the non-usage of starter cultures in their preparation (Onyekwere, 1989; Olasupo *et al.*, 1999a). In general sense, a starter culture may be described as a preparation containing a high number of viable microorganisms, which may be added to bring about desirable changes in a food substrate (Moss and Huxkes, 1993).

Unique properties of fermented food products (Hammes and Tichaczek, 1994)

They are ready to eat

Rich in flavour

Naturally preserved

Hygienically safe

Produced with low energy input

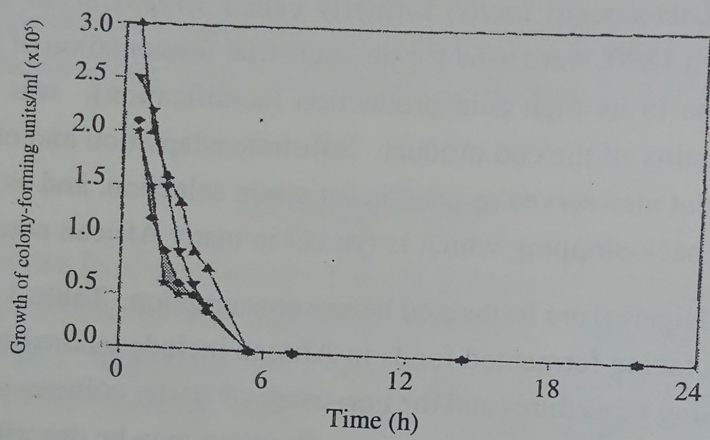
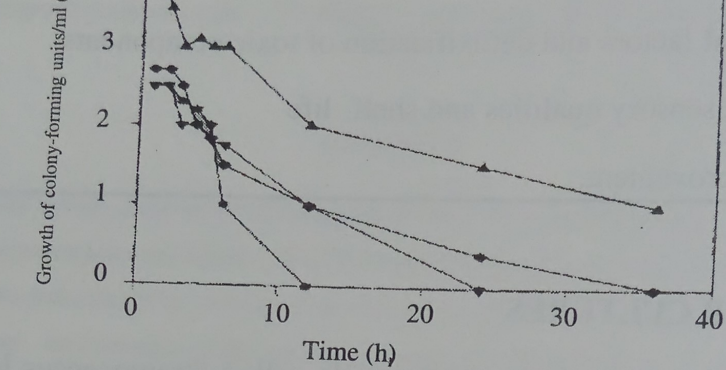
They have a high nutritive value

According to Hammes (1990) starter cultures are preparations which contain living microorganism and are applied with attention to make use of the microbial metabolism. This paper highlights the role of LAB in the improvement of the quality, safety, hygiene status and shelflife of traditional fermented foods in the Nigerian environment.

APPLICATIONS OF STARTER CULTURES IN FOOD PRODUCTS

Throughout the world, especially, the industrialized world, LAB starters have been found useful in the preparation of a wide number of foods. The industrialized countries benefit from a century of experience with starter cultures which have been carefully selected for large-scale industrial food fermentation (Holzapfel, 1997). The developing world including Africa cannot be said to have attained this level of applying starter cultures. In Nigeria, the application of starter cultures is still at its infancy, being limited to small-scale fermentation processes. However, there is growing interest in Africa to develop appropriate starter cultures for fermentation of Nigerian indigenous foods.

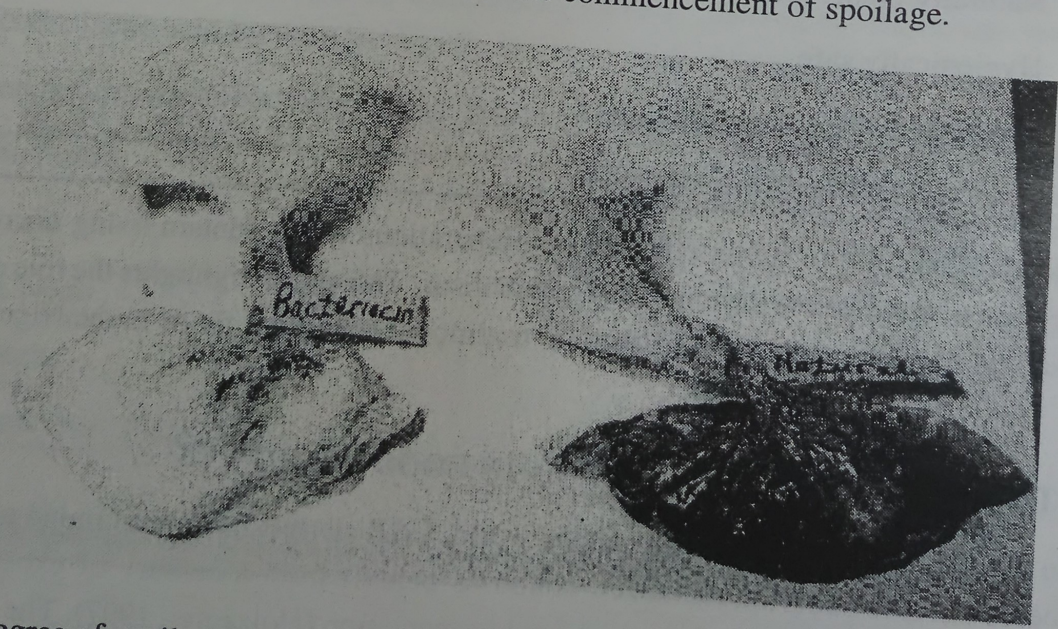
An attempt was made to use Ogi (fermented cereal-based food and the commonest weaning food in Nigeria) to control the quality of Ogi in our environment, Olukoya *et al.* (1994) used LAB starters to produce an improved Ogi called Dogik.



— *Vibrio cholerae*; — *Shigella flexneri*; — *Salmonella typhimurium*; — *Escherichia coli*.

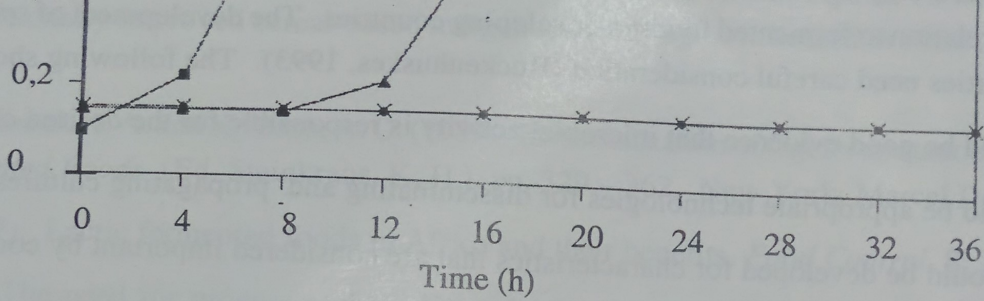
of the survival of diarrhoeagenic bacteria in ogi produced by natural fermentation (A) and that of starter cultures (B).

carried out by Olasupo *et al.* (1997b) on the use of LAB starter to produce agidi (a solid form of bacteriocin-producing *Lactobacillus* sp. was found to improve the shelf life of agidi from the days at room temperature (Fig. 2), before the commencement of spoilage.



the degree of spoilage in 'agidi' prepared from ogi fermented with the bacteriocin-producing strain 012 (left) and ogi fermented naturally (right) under room temperature (25°C) storage.

Olasupo *et al.* ((1999b) on the potential of bacteriocins as possible bio-preservative in foods, a *Lactococcus lactis* (isolated from wara, a Nigerian cheese product) was shown to have a notable effect on food borne pathogens such as *Listeria monocytogenes*, and *Bacillus cereus*. As an effect of the bacteriocin on *Bacillus cereus*.



of different *Lactococcus lactis* bacteriocins on growth of *Bacillus cereus* DSM 2301. (■) Control bacteriocin addition, containing only STD 1 both and on *Bacillus cereus* DSM 2301. (●) With addition of strain BFE 1500. (X) With addition of bacteriocin from strain BFE 921. (▲) With addition of the nisin A producing strain DSM 20729.

of starter cultures to improve the nutritional value of food, have also been exhibited in ogi by Olukoya and his co-workers used *Lactococcus* sp. as starters to improve the sugar and protein content. Similarly, Odunfa *et al.* (1994) investigated the possibility of improving the limiting lysine level in mutants from *Lactobacillus plantarum* were selected from thialysine resistant cultures capable of over and analysed for lysine production. Up to a 12-fold increase in lysine production was observed for Utilization of the mutants as starter cultures resulted in a three-fold increase in the lysine content of

ly in the Institute of Hygiene and Toxicology in Karlsruhe/Germany in collaboration with WAITRO the possibility of using LAB starters to reduce /degrade aflatoxins in Nigeria foods especially the foods (data not shown).

tions of protein and free sugars in ogi fermented naturally and that fermented with starter cultures (Olukoya *et al.*, 2000)

Concentrations of (mg/ml)*

Protein	Free sugar
1.84 ± 0.017	0.41 ± 0.01
2.63 ± 0.035	5.23 ± 0.053
2.28 ± 0.08	5.70 ± 0.083
2.83 ± 0.28	4.02 ± 0.17

ly fermented ogi without the use of starter

mented with *Lactobacillus acidophilus*

mented with *Lactobacillus pentosus*

mented with mixture of two starters

D

properties need careful consideration (Buckenhuskas, 1993). The following should be considered.

- It would be good evidence that microbial activity is responsible for the desired changes.
- It would be appropriate technologies for disseminating and propagating cultures.
- It should be developed for characteristics that are considered important by consumers.
- Economics of the use of the starter culture should be assessed.

...cultures to improve the safety, hygiene risk and shelf-life of some Nigerian fermented foods have
...in this paper. However, there are a number of issues to be considered to ensure that research and
...is not wasted whilst the real opportunities are identified and capitalized upon.

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