



## POLICY BRIEF

# Preserving African Food Microorganisms for Green Growth



Fig 1. Meeting with women's cooperatives, Fada-Ngourma, Burkina Faso, 2015

### Executive summary

Traditional spontaneously fermented food, produced by the activity of particular African food microorganisms, holds a strong but increasingly threatened position in the West African diet. Preserving these traditional local foods is important to ensuring food security and safety, meeting nutritional requirements, alleviating poverty, developing profitable local businesses and implementing green growth strategies.

In the GreenGrowth project, the key objectives were to implement sustainable methods and provide laboratory infrastructure for the preservation and applica-

tion of the unique West African microbial heritage and to bring improvements in the West African food systems through the introduction of value chain analyses and new business models. Predominant microorganisms for production of indigenous fermented food and beverages were isolated, identified and characterised for desired technological properties and positive effects on human nutrition and health. Their value for green food processing was verified through trials conducted by SMEs and local women's cooperatives. For the long-term preservation of microorganisms seen as potential starter cultures, bio-banks were established in Ghana, Burkina Faso and

Benin as national microbial culture collections. Common procedures and a mutual back-up system covering IPR and exchange of microbial cultures were agreed upon.

Based upon the research and experience gained from the GreenGrowth project, six policy areas have been identified i.e. i) *implementation of green processing technologies in urban and rural areas*; ii) *expansion, maintenance and utilisation of the West African microbial bio-banks*; iii) *transfer of microbial starter cultures to the West African food sector*; iv) *implementation of value chain analyses and business models to optimise quality and efficiency in the West African food sector*; v) *upgrading food safety by implementation of cost effective preventive measures in the food sector* and vi) *enhanced scientific exchanges and interactions within research and education*.

## Introduction

*The overall objective of the GreenGrowth project was to turn the traditional West African food sector into a driver for a green and sustainable growth by improving production methods through use of starter cultures, upgrading all parts of the selected food value chain and implementing new business models.*

GreenGrowth was a Danida-financed project headed by University of Copenhagen (KU) and conducted in collaboration with Food Research Institute (FRI) and University of Development Studies (UDS) in Ghana, the Department of Food Technology (DTA) in Burkina Faso, University of Abomey-Calavi (UAC) in Benin, and the Danish Technological Institute (DTI). Value chains

for traditional fermented food products seen as having a strong potential for green growth and income generation, were selected in a collaboration between the partners and West African SMEs. From the selected food value chains and the corresponding fermented food, predominant microorganisms were isolated and their technological properties characterised. The microbial cultures were shown to be multi-functional and represented a wide bio-diversity, indicating a variety of potential applications for green food processing. National culture collections were established in Ghana, Burkina Faso and Benin for safeguarding the unique West African microbial heritage. Bio-banks were established using state-of-the-art technology, i.e.  $-80^{\circ}\text{C}$  freezers with green power backup supply in order to ensure long-term preservation of the microbial cultures. For Ghana, Burkina Faso and Benin, a common system for expanding and managing the bio-banks was agreed upon and implemented including duplicate back-ups and IPR sharing. The system provides a basis for future integration into internationally recognized culture collections. The microbial cultures were successfully tested as starter cultures in partner SMEs to optimise product quality and prevent food spoilage.

## Background

Traditional fermented food products have held a vital position in the West African diet for several centuries. Preserving these traditional foods is therefore vital for meeting the nutritional needs of all ages of the population, as well as for ensuring food security, alleviating poverty, developing local businesses, providing job creation and implementing green processing strategies. As the traditional food culture and diets



Fig. 2 Illustrations from pictorial for proper production of fermented food, Burkina Faso

are very closely related among West African countries and to strengthen regional partnerships three countries were included in the GreenGrowth project, i.e. Ghana, Burkina Faso and Benin.

The important position of the traditional fermented foods in West Africa is exposed to severe threats. The most immediate threats are climate change affecting farmers yield and competition from imports of high caloric and nutrient deficient highly processed food. This change calls for urgent actions to preserve and increase green processing of traditional foods. In addition, the need for sustainable bio-packaging methods is obvious for West Africa in order to minimise the growing environmental and health hazards from plastic littering.

In West Africa, the informal private food sector forms the major part of the food industry. These informal SMEs often operate according to very old traditions, and actual development and improvements are very limited. This needs to be changed. An updated food system for traditional fermented food is needed in West Africa not only for the benefit of women processors, but for the benefit of the entire population and the overall economy.

## Results

From the results obtained in the GreenGrowth project the West African partners in Ghana, Burkina Faso and Benin have been able to upgrade their competences so that they are now able to:

- i. select food value chains and develop new business models for traditional fermented foods with strong potential for green food processing;
- ii. isolate, identify, describe and maintain microorganisms involved in green processing of fermented foods;
- iii. establish facilities and build capacity to manage and maintain the established bio-banks in Ghana, Burkina Faso and Benin;
- iv. implement a common regional system for industrial culture collections including quality assurance and IPR;
- v. install and maintain freeze driers for storage and production of stable microbial cultures for use by

SMEs and other food industries;

- vi. train women's cooperatives, SMEs and medium-sized enterprises on how to use value chain analyses and business models to expand green food processing, maximise profits and increase rates of employment;
- vii. build capacity and upgrade laboratory infrastructure at the West African research institutions for conventional and molecular based state-of-the-art research methodologies and thus contributing to new scientific information; and
- viii. create awareness in the food sector including relevant governmental institutions, NGOs and regulatory agencies on the importance of upgrading traditional food fermentation technologies to enhance value addition, nutrition, food security and safety.

## Conclusions

The GreenGrowth project, has with its West African and Danish partners, its infrastructure, project management and excellent productive collaboration among all partners, been very effective in meeting the objectives defined and agreed upon. It has been demonstrated for the selected food value chains that traditional fermented West African food can be a driver of sustainable food production, by introducing green processing methods by use of starter cultures, upgrading the entire value chain and implementing new business models for income generation and employment.



Fig. 3 Raw materials for West African green food products, Ghana



Fig. 4 Sensorial evaluation of fermented food made by starter cultures at SME level, Ouagadougou, Burkina Faso, 2017

A sustainable laboratory infrastructure and internationally accepted procedures were established for preserving the West African biodiversity of potential starter cultures in three national culture collections in Ghana, Burkina Faso and Benin managed by the African partners in an open collaboration with fully shared responsibility and ownership. As a consequence, interest was raised in the SMEs for using starter cultures and to implement food safety and quality management. Additionally, the project pointed out the need for further work to develop bio-degradable packing for fermented food.

Sharing of knowledge and facilities between West African and Danish scientists within microbiological research resulted in new scientific information publishable in international journals, education of PhD and MSc students and upgrading of research groups in West Africa; all to the benefit of the local food sector.

## Recommendations

In order to anchor the results and achievements gained from the GreenGrowth project six recommendations for further action are seen:

### *i) Implementation of green processing technologies in urban and rural areas*

Technical support from trained professionals is needed to upgrade the food sector in a more sustainable direction as well as for successful implementation of starter cultures in the informal food sector by SMEs and women's production associations. This requires appropriate vocational training at the national level. The use of bio-packaging is essential in the traditional fermented foods sector to avoid a growing menace of plastic littering, and development

of local bio-based packaging resources is therefore required.

### *ii) Expansion, maintenance and utilisation of the West African microbial bio-banks*

The bio-banks established are unique. They add a very strong competitive advantage to the production of the mainly plant-based West African fermented foods that are now increasingly facing fierce competition from imported high caloric foods often deficient in essential nutrients. The bio-banks should be further developed through a continuous addition of new microorganisms so as to offer new cultures with a wider range of technological and health beneficial characteristics. An enhanced regional focus on "the Nagoya Protocol on Access to Genetic Resources" is additionally required.

### *iii) Transfer of microbial starter cultures to the West African food sector*

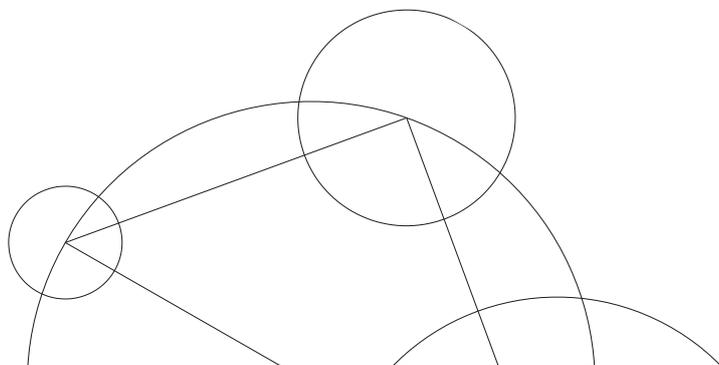
In order to upgrade the West African food sector, there is a need for commercial starter cultures for safe production of fermented foods. These starter cultures should be designed based on detailed knowledge of traditional West African food. Following the new knowledge, infra-structure and opportunities offered by the GreenGrowth project, there is a need to pursue the feasibility of establishing regional starter culture production in West Africa, taking into consideration upscaling and application, quality management, packaging, logistics and financing.

### *iv) Implementation of value chain analyses and business models to optimise quality and efficiency in the West African food sector*

There is a general need for value chain analyses and new business models within the entire West African food sector in order to prevent loss of raw materials, optimise income generation and maximise profit. Implementation of sustainable technologies should be accompanied by cooperative initiatives such as the establishment of food assembly halls with common use infrastructure and equipment that can be shared by SMEs and women's groups.

### *v) Upgrading food safety by implementation of cost effective preventive measures in the food sector*

In order to sustain the very promising future of the traditional West African fermented food, the risk of incidences of food borne diseases and intoxications should be minimised. For the respective food value



chains, internationally accepted cost-effective preventive measures and systems should be developed and implemented.

vi) *Enhanced scientific exchanges and interactions within research and education.*

The GreenGrowth project, together with previous projects in West Africa, has successfully developed regional research and educational collaboration within food science, which needs to be supported and sustained. The West African and Danish scientists together form a strong network with high capabilities at international level for research and education in food science and technology.



Fig. 5 GreenGrowth consortium meeting, Cotonou, Benin, 2018

Frederiksberg, 15<sup>th</sup> March 2019

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#### Further reading

- Houngbedji, M., Padonou, S. W., d'Auchamp, A. M., Akissoé, N., Mengu, M., Jespersen, L. and Hounhouigan, D. J. (2019) Improving food value chains for cereal doughs in West Africa: case study of mawè in Benin, Food Chain, accepted.
- Houngbedji, M., Johansen, P., Padonou, S.W., Akissoé, N., Arneborg, N., Nielsen, D.S., Hounhouigan, J. and Jespersen, L. (2018) Occurrence of lactic acid bacteria and yeasts at species and strain level during spontaneous fermentation of mawè, a cereal dough produced in West Africa. Food Microbiol., 76:267-278, (doi.org: 10.1016/j.fm.2018. 06.005)
- Ouoba, L.I.I., Nielsen, D.S., Anyogu, A., Kando, C., Diawara, B., Jespersen, L., Sutherland, J.P. (2015) *Hanseniaspora jakobsenii* sp. nov., a yeast isolated from Bandji, a traditional palm wine of *Borassus akeassii*. Int. J. System. Evol. Microbiol., 65, 3576-3579 (doi: 10.1099/ijsem.0.000461)
- Owusu-Kwarteng, J., Tano-Debrah, K., Akabanda, F. and Jespersen, L. (2015) Technological properties and probiotic potential of *Lactobacillus fermentum* strains isolated from West African fermented millet dough. BMC Microbiol., 15:261, 1-10 (doi: 10.1186/s12866-015-0602-6)