Bundesanstalt für Landwirtschaft und Ernährung

Projektträger Bundesanstalt für Landwirtschaft und Ernährung

Project update

Project title (Acronym):	Application of new packaging solutions to reduce food losses in West Africa by extending shelf-life of local perishable foods (WALF-Pack)
Geographical focus:	Benin, West Africa
Call reference:	Innovative approaches to process local food in Sub-Saharan Africa and Southeast Asia, which contribute to improved nutrition, as well as qualitative and quantitative reduction of losses
Cooperating partners:	University of Abomey-Calavi (Benin) Rheinische Friedrich-Wilhelms-Universität Bonn (Germany)
Duration:	01.10.2017 - 31.05.2021
Budget:	**351,297.97 €**

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Aim of the project:

The WALF-Pack project aims to decrease the food insecurity in Western Africa by reducing food losses through the implementation of simple biobased packaging solutions. Therefore, this project aims at the extension of the shelf life of perishable foods from Western Africa through the development of appropriate and simple-to-use biobased packaging solutions. The focus is on the supply chains of three different groups of foods from Benin, namely the leafy vegetable Gboman (*Solanum macrocarpon*), fried chicken and the cheese Waragashi.

The application of adequate packaging solutions can significantly reduce food losses in supply chains. This implies that the availability of the selected food products for consumption will increase and malnutrition can be minimized, because more nutrient- and protein-rich food is available.

The objectives in this project are:

- To investigate the entire supply chains of the selected products with focus on the identification of the hotspots and the steps where the losses mostly occur;
- To design simple and cost-effective packaging solutions for reducing the losses of these products along the supply chains, and evaluating the acceptance of different packaging solutions;
- To evaluate the effects of the packaging solutions on physico-chemical, microbiological and nutritional properties of the selected foods during storage;
- To perform cost benefit and resource efficiency analysis for the packaging solutions;
- To implement a good coordination framework among stakeholders at micro, meso and macro levels for a good dissemination of the project outputs.

Present results:

In work package (WP) 1, the entire supply chains of the products were intensively studied. Therefore, food losses and the product-specific spoilage flora were determined in order to precisely adapt the requirements to the packaging. The results were used to identify the hot spots of food losses in the supply chains, which occurred at different points in all chains. The hot spot in the chicken supply chain was determined for the processors with 6.1%; for the cheese Waragashi, losses of about 11% occurred equally among suppliers, retailers and consumers; with 16.1%, the hot spot in the supply chain of the leafy vegetable Gboman was identified at wholesaler level. Furthermore, during storage tests with the products, the main spoilage organisms and the end of shelf life were identified. The shelf life is 9 hours for Waragashi, 15 hours for chicken, and 30 hours for Gboman when stored at the average ambient temperature (30°C). After the requirements for every packaging solution had been adapted based on these results, the materials for the packaging could be selected. During WP 2 they were further studied focussing on the antimicrobial activity of medicinal plants and essential oils from Benin. If suitable, these plant extracts can be incorporated as additives to obtain an active packaging that retards spoilage. The ethanol extract of the plant *Gmelina arborea* has proven to be the most active extract, especially against *Pseudomonas spp.*, the typical spoilage organisms in many foods. Therefore, it will be incorporated as an active additive into a coating based on beeswax and other local oils. In addition, the antimicrobial activity of essential oils against specific spoilage organisms of Waragashi was determined.

As an active additive, the oils of *Ocimum gratissimum*, *Ocimum basilicum* and *Laurus nobilis* have shown to be the most promising candidates. The incorporation of the above mentioned additives into various materials has resulted in inhibition of bacterial growth in experiments performed in the lab. For example, a coating of the developed beeswax mixture with the additive *Gmelina arborea* was able to reduce the cell count of *Staphylococcus aureus* below the detection limit after 24 hours of incubation. This particular packaging solution was tested in a storage test with the food product Gboman (Fig. 1). The test showed that the thickness of the coating must be increased in order to increase the water vapour barrier. Corresponding adjustments were successfully carried out on a laboratory scale and will be followed by a second storage test.

Fig. 1 Storage test of Gboman with a packaging solution coated with the developed beeswax mixture

Furthermore, new packaging solutions based on PLA, local oils and fibers were developed in Benin and test pieces were produced. The addition of essential oils to these solutions was successful as well. After 10 days of storage in a packaging incorporating *L. nobilis*, the growth of *Pseudomonas spp*. on Waragashi was reduced by more than 2 log levels compared to the control (Fig. 2).

Fig. 2 Product tests of Waragashi packed in the developed active bioplastic bags

In addition, numerous papers were developed from local biomass, such as various grasses (*Typha domingensis, Cyperus articulatus, Cenchrus purpureus, Imperata cylindrica or Cyperus articulatus*) or the stem of the oil palm *Elaeis guineensis*. The aim is to implement these new solutions and therefore replace the usual packaging for grilled chicken and other meats, which can be hazardous to health (Fig. 3). Consumer acceptance of the packaging for Gboman has been overwhelmingly positive, while surveys are still being conducted for the other packaging solutions.

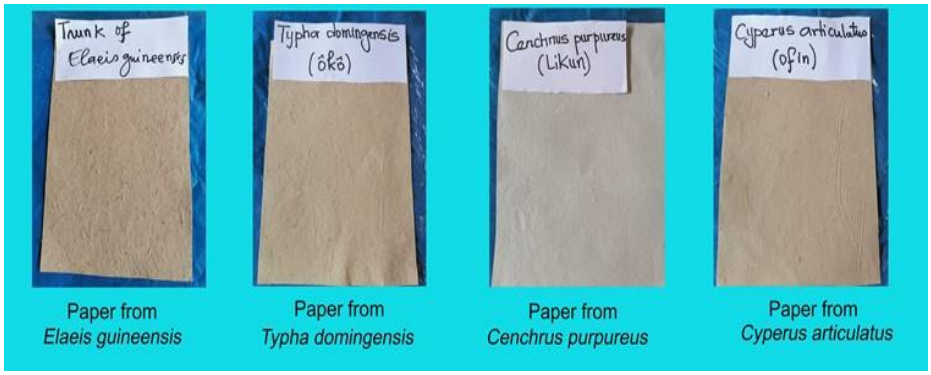

Fig. 3 Developed paper prototypes made from local Beninese plants

Key statements and policy advice:

The packaging solutions from local biomass have been developed for different areas of application and product testing on food products has been carried out. The majority of the packages are in the final stage of optimization. Furthermore, according to laboratory and product tests, the active packaging solutions are able to reduce spoilage organisms and thus probably also extend the shelf life of the product. The new packaging solutions represent sustainable biobased and locally producible packaging solutions. They are versatile and can be adapted to other food products with short shelf lives. Thus, they can make an important contribution to reduce food losses and malnutrition. As conventional packaging is not biodegradable and cannot be recycled in Benin, the negative environmental impact of food packaging is reduced, by replacing them with the new biobased and biodegradable packaging solutions.