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 - 30.09.2020
Budget:	**351,297.97 €**

Wikipedia GNU License

UNIVERSITÄT BONN

Stand Januar 2020

Aim of the project:

The aim of the project WALF-Pack is to diminish the food insecurity in western Africa by reducing food losses. Therefore, innovative and bio-based packaging solutions will be developed and implemented for different food supply chains to prolong the shelf life of easily perishable foods. The focus is on three different food supply chains (leafy vegetable, grilled chicken, and soft cheese) in Benin. The application of adequate packaging solutions enables a significantly decrease of food losses in the supply chains. And in turn, it also increases the availability of food and can lead to a minimization of malnutrition, as more protein and nutrient-rich food are available.

The following work will be carried out within the project:

- Identification of hot spots and the steps at which food losses occur in the supply chain of the selected products.
- The development of simple and cost-effective packaging solutions to reduce food losses of the selected products in the value chain and the investigation of their acceptance.
- To investigate the effect of packaging on the physicochemical, microbiological, and nutritional properties of the products during storage.
- A cost-benefit and resource efficiency analysis of the developed packaging solutions.
- The establishment of a good coordination network among stakeholders at micro, meso, and macro level to ensure wide dissemination of the project results.

Results:

In work package (WP) 1, the entire value-added chains of the products were intensively examined concerning food losses and their product-specific spoilage flora in order to precisely adapt the requirements to the packaging. The results were used to identify the hot spots of losses in the supply chains; these occur at different points in all chains. The hot spot in the chicken supply chain was determined for the processors with 6.1%; for Waragashi, losses of about 11% occur equally among suppliers, retailers and consumers; with 16.1%, the hot spot in the supply chain of Gboman was identified at wholesale level. Storage tests, with the various products, identified the main spoilage organisms and the end of shelf life of the food products. The shelf life is 9 hours for cheese, 15 hours for chicken, and 30 hours for leafy vegetables when stored at 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 and further investigated within the framework of WP 2. In the first step, the antimicrobial activity of medicinal plants from Benin was tested to incorporate them into the packaging as an active additive to extend the shelf life. Among 16 plants tested, the ethanol extract of the plant *Gmelina arborea* proved to be the most active, especially against Pseudomonas (the typical spoilage organisms in many foods) and will, therefore, be incorporated as an active additive. When investigating the antimicrobial activity of essential oils against specific spoilage organisms of food products, the oils of *Ocimum gratissimum*, *Ocimum basilicum*, and *Laurus nobilis* as additives for cheese packaging have shown to be the most promising approaches. Parallel to these studies, concepts for the packaging of the different products have already been developed (see Table 1). An overarching concept is the development of a biogenic active coating of beeswax, shea butter, and coconut oil with an active additive, which can be applied to different surfaces (banana leaves, fabric, and paper). Based on the requirements of the product to be packaged, this

can be individually adapted to the specific spoilage flora by exchanging the active substance. First results confirm the successful incorporation and thus the reduction of bacteria on the surface of the coating. This coating also serves as the basis for the packaging solution for the leafy vegetables in a box for storage on the market (Fig. 3). Additionally, an active bio-based plastic film with essential oils is being developed for the soft cheese and the chicken for the cooling chains. For the soft cheese and chicken for open markets, concepts have been developed to replace existing packaging with bio-based solutions to avoid a negative impact on the health of the consumer by the conventional packaging. Prototypes have been produced on a laboratory scale and are undergoing various product tests (WP3).

Table 1: Concepts of packaging solutions

Packaging solution	**Food product**	**Materials**	**Goal**
Active coating	Leafy vegetables, etc.	beeswax, coconut oil, shea butter and ethanol extract	Inhibition of pathogens and spoilage organisms, protection against oxidation processes, and water vapour barrier
Storage box	Leafy vegetables	Box with lid made of different solid materials, fabric with active coating, shelf inserts, absorbent cloth/sponge	Storage under optimal air humidity conditions and UV protection
Bags made of fibres	Soft cheese	fibres (pineapple, sisal, raffia)	Replacement of the plastic bags when boiling the product, improvement of food safety
Cellulose acetate film	Chicken, soft cheese in the cold chain	fibres, glycerol, polylactide and polyethylene glycol 600, mixture of acetic acid and acetic anhydride, cassava starch and essential oil	Inhibition of pathogens and spoilage organisms, protection against oxidation processes, improvement of food safety
leaf packaging	Chicken and others	banana leaves, beeswax, raffia fibres, wooden skewers or similar	Inhibition of pathogens and spoilage organisms, protection against pollution, improvement of food safety
Paper	Chicken	Material of the banana stem, *Typha domingensis*, *Cyerus articulates*, okra, cassava starch	Protection against pollution, improvement of food safety

Key statements and policy advice:
Packaging solutions using local biomass have been defined for different applications and first prototypes have been produced. Most of the solutions are in the final stages of development. According to the first results, the active packaging solutions can reduce spoilage organisms and thus probably also extend the shelf life of the product. These sustainable packaging developments are versatile and can be adapted to other food products with short shelf lives. They can, therefore, make an important contribution to reducing waste and malnutrition.

Figure 1: Women in Benin process banana leaves into packaging for food © Barbara Götz

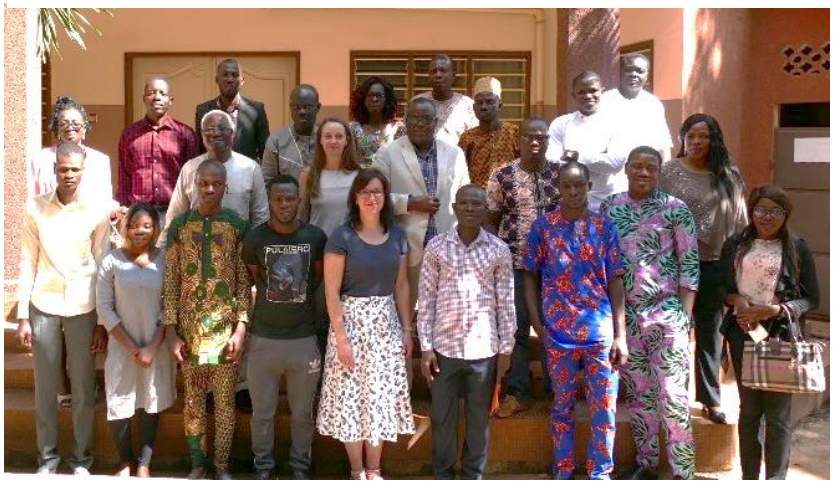

Figure 2: Participants of the Capacity Development Workshop and Mid-term Meeting in Benin at the end of 2019 © Barbara Götz

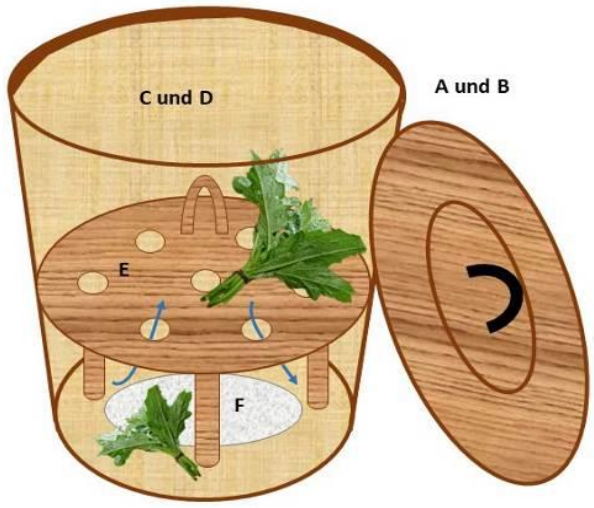

Figure 3: Concept of packaging solution for the storage of leafy vegetables Gboman; AB: Box of solid material with lid, CD: fabric impregnated with active coating; tier inserts with holes for ventilation; F Absorbent material to absorb excess water © Barbara Götz