Training course packages targeting food operators on the adoption and management of the technological innovations

BIO-BASED PACKAGING

Cassava starch- and chitosan-based edible coating and film material

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1. FoodLAND technical innovation for local food supply chains: concepts and approaches

The FoodLAND project has the ambition to impact on a large number of supply chains and communities, hence the process of food operators' capacity development has to be tailored and as much participative as possible. Accordingly, one of the assumptions of FoodLAND is that sustainable and nutrition-responsive farming systems can be achieved basically by strengthening the capacity development, and specifically by **a)** empowering farmers and processors through the implementation of capacity building processes and concrete opportunities; **b)** creating or consolidating cooperation and shared knowledge to overcome the lack of coordination among food operators; **c)** addressing the inefficient use of resources; **d)** trying to address and build resiliency to the high vulnerability of food systems to climate change; **e)** enhancing the integration of supply chains by creating commercial and stakeholders' networks; **f)** improving the responsiveness of the production sector to the market demand.

To implement these elements of capacity development, FoodLAND proposed the adoption of specific innovations, among which the organizational ones, to create strong and responsive links between producers and encompassing all the intermediate actors along the food value chain, such as researchers, SMEs, NGOs, local and national authorities. In order to ease the creation of those links and guarantee the sustainability over time of the results, 14 Food Hubs will be created in 6 countries as part of the organizational innovations. Food Hubs are conceived as multi-actors centers of innovation where to develop or enhance the organizational and operational conditions enabling local food supply chains (D3.6).

Functional to the implementation of the Food Hubs and of the innovations, the training courses were designed – in form of capacity development activities – as a two-phase process. Firstly, a training session focused on general, preparatory

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topics was provided to farmers as described and reported in D3.5 ("Group Introductory Training", GIT). According to the project GA, GIT broad set of goals were: to enhance the knowledge of consumers' nutritional needs and market opportunities, and to boost the notions about climate change, sustainability, resilience, and food culture. Secondly, a specific training session were organized to provide food operators with practical information on the adoption and management of the innovations tested at lab / small scale level and to contribute to validating them at appropriate scale.

However, as the whole approach has been designed by FoodLAND to ensure the inclusion of the local actors from the first moment, both the training sessions were set up accordingly. Indeed, yet in the inception phase of the project, an assessment on participatory methods has been run and Participatory Learning and Action (PLA) approach has been eventually assessed as the best one to ensure the inclusion of multiple perspectives. The main purpose of PLA is to support people within communities to analyze their own situation, rather than have it analyzed by outsiders, and to ensure that any learning is then translated into action (Gosling and Edwards 2003). In addition, a gender-sensitive approach has been applied to the trainings that have been designed considering gender roles and power relations; they have provided equal opportunities to participate in the process by caring to times, venues and use of local languages.

The GITs have been conceived as the first step towards the innovation validation and aim at involving the producers, yet from the inception phase. They are just the first step in a sequence of 6, summed up in **Table 1**. After the GITs, where farmers and processors meet and share their vision and goals for the Food Hubs and exchange information about specific topics, the Food Hubs were created and the innovation tested (first in pre-test, then in pilot phase). The constant iteration between researchers and local actors is a key feature of the project: specifically, the practical trainings focused the single innovations (step 5) are aimed at validating the innovations at adequate scale and planned to trigger feedback loops of control and improvement involving developers and adopters.

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Table 1. Activities with farmers and food processors (SMEs) and participatory approach

Step	**1**	**2**	**3**	**4**	**5**	**6**
Task	**T3.3**	**T3.3**	**T3.4**	**T4.1¸T4.5**	**T5.1¸T5.5**	**T5.1¸T5.5**
Activity	Group introductory training	Food Hubs creation	Innovation undertaking	Innovation tests	Individual and group practical training	Innovation pilot and validation

2. FoodLAND practical training: aims and scope

According to the project bottom-up and participatory approaches, following the courses on introductory topics GIT organized in the early project phase (T3.3), and as component creating / strengthening the Food Hubs as local innovation centres, FoodLAND has organized a second set of training activities with food operators based on active learning methods and gender equality principle (Task 5.1-5.9). In this regard, specific mechanisms (being aware of the gender roles and power relations; providing equal opportunities to participate in the process by putting attention to the times, venues, use of local languages, etc.) will be lifted to ensure women's participation. These training packages are aimed at providing the local farmers and food processors with operational instructions on the adoption and management of the validated innovations.

This second set of training activities has been organised – triggering PLA approach – as individual and group practical (demonstration/capacity building) activities to be conducted in parallel to the implementation of the technological research (where relevant) and of the innovation pilots and validation. These technology-centred trainings aim at strengthening the participants' understanding of novel production and post-harvest techniques, innovative tools and systems (e.g., climate smart/precision agriculture, hydroponics, and integrated aquaculture), new technologies for primary and secondary processing, and supply chain management. Thus they aim at fostering knowledge and operational

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capacity to deploy, manage, and maintain the validated technological innovations – documented by the released guidelines D4.1 ÷ D4.11 (e.g., training pamphlets, user manuals, flow diagrams, and operational recommendations) and practice abstracts D6.5 – validated jointly at appropriate scale.

3. Second training packages on the adoption and management of the tested innovations: an overview

The second training course aimed at consolidating the food operators' knowledge and practical skills to adopt, manage and validate the project innovations and complement the related guidelines. Specifically, the realized training materials provide local farmers and food operators with a set of notions and concrete information on a series of innovative tools and systems as per the following **Table 2**. It is clear that both the contents and formats of the learning packages widely differ across technologies as well as Food Hubs (when the same type of innovation must be validated in different contexts). The diversity that emerges from the proposed solutions reflects the different needs highlighted by farmers and stakeholders as well as the conditions and opportunities characterizing the local communities. Nevertheless, in order to take into due account the existing heterogeneity inside the local communities, the developed learning materials have been let available on the project intranet so as to be used for further training initiatives across the network of Food Hubs.

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4. Second training packages on practical information on the adoption and management of the tested innovations

Bio-based packaging

Cassava starch- and chitosan-based edible coating and film material

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FOODLAND

Bio-based packaging: cassava starch- and chitosan-based edible coating and film

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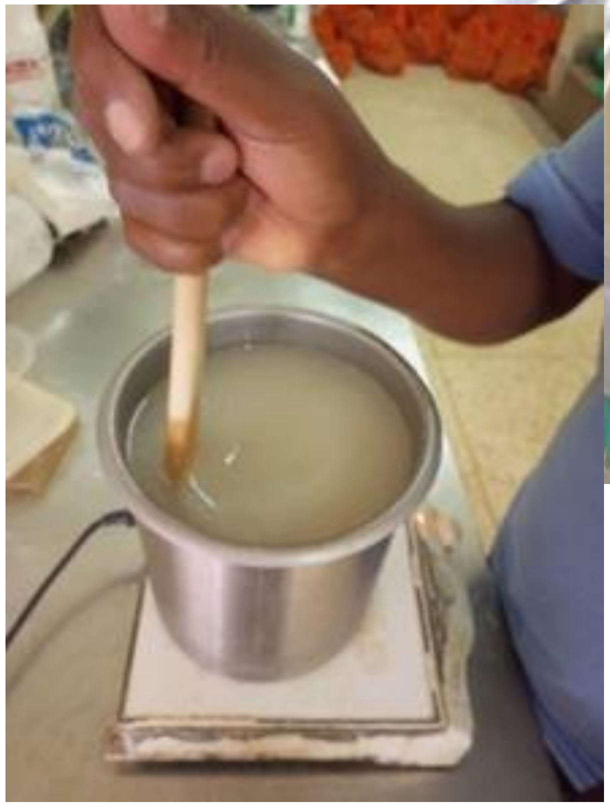
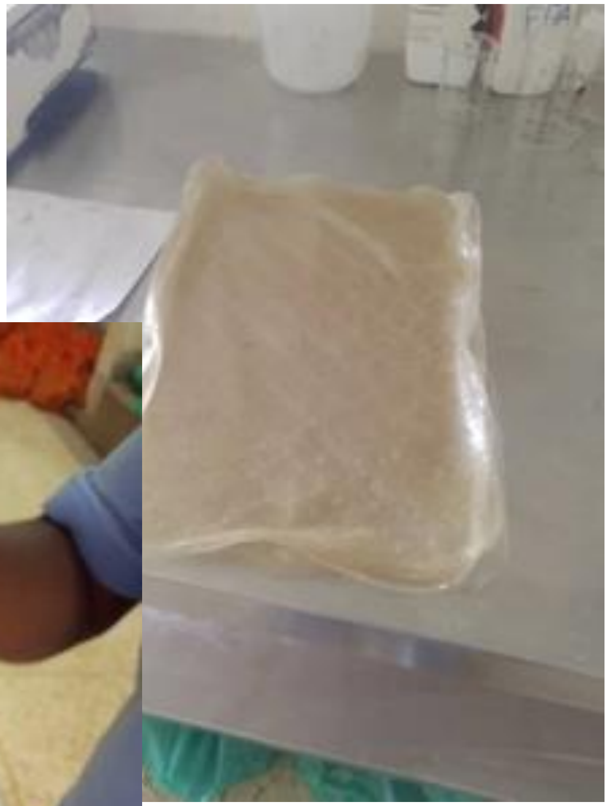
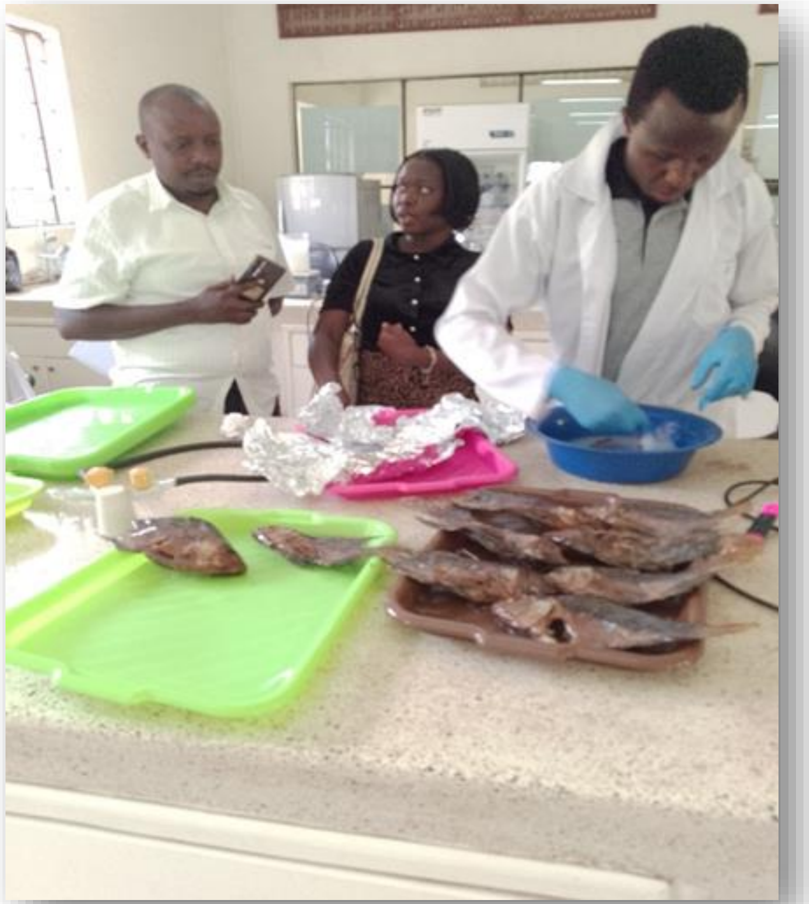
SELECTION OF LOCAL RAW MATERIAL

Cassava tubers (bitter varieties e.g. Magana), purchased at Kawempe market in **Kampala (UG)**, were chosen as local raw materials rich in starch to produce edible coating and film for the packaging of **fish products (soft-smoked fish fillets and fried fish fingers)**.







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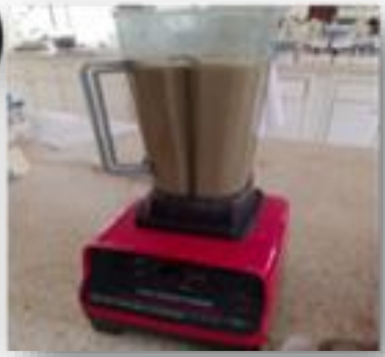
EXTRACTION OF STARCH FROM CASSAVA

Operative procedure for **starch extraction** from **cassava tubers**:

- Wash, peel and grate the fresh cassava tubers (**a**)
- Grind in a high-speed blender for 5 min
- Suspend the pulp in ten times its volume of water and stir for 5 min (**b**)
- Filter with a double folded cheese cloth (**c**)
- Leave the filtrate to stand for 2 h to allow the starch to settle (**d**)
- Decant, discard the top liquid and add water and stir the mixture for 5 min
- Filter with a double folded cheese cloth
- Allow the starch to settle and decant the top liquid
- Dry the sediment (starch) at 55 °C for 24 h and grind the dried starch (**e**, **f**).

a)

b)

c)

d)

e)

f)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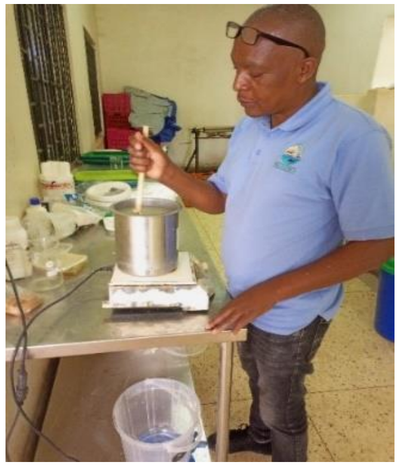
BIO-BASED EDIBLE COATING PREPARATION

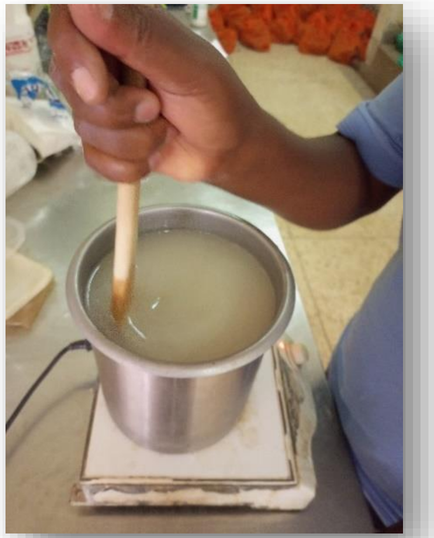
Operative procedure for the preparation of the **edible coating**:

- Disperse chitosan (1%, w/w) in an aqueous solution of glacial acetic acid (1%, v/v) and stir the suspension at 300 rpm for 2 h
- Filter the suspension through cheesecloth to remove the undissolved chitosan and keep the supernatant for later use
- Add 3% (w/w) cassava starch and 0.9% (w/w) glycerol to the chitosan solution
- Stir at 300 rpm for 2 min and then increase the temperature to 80 °C until completely gelatinisation (**a**, **b**)
- Let the solution cool to about 40 °C and use it as a coating solution.

a)



b)



The final solution have to be viscous and almost transparent without bubbles.

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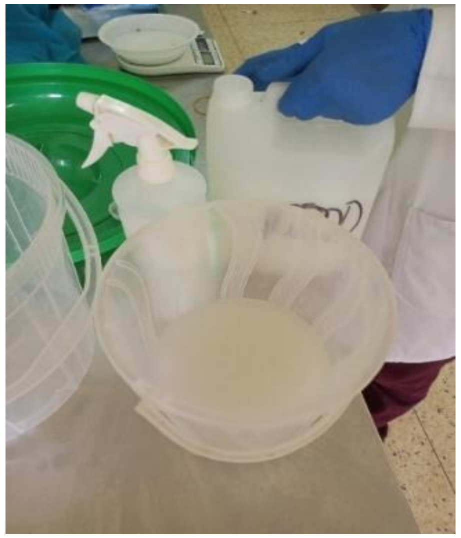
BIO-BASED FILM PREPARATION

Operative procedure for the preparation of **film material**:

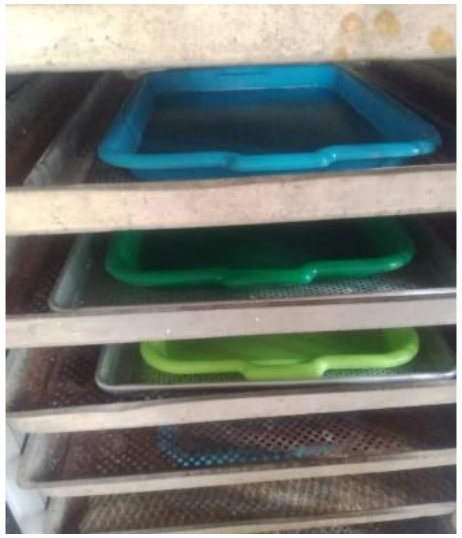
- Same formulation and procedure steps as for bio-based edible coating
- Cool the solution and cast 500 mL (**a**) onto a 0.1 sqm tray (**b**)
- Dry the film in an oven at 45 °C for 8-10 h (**c**)
- Remove the film from the trays (**d**).

a)



b)

c)



d)

Wrap film ready to use as packaging.

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MAIN MATERIAL CHARACTERISATION

- Solution viscosity (Brookfield DVE series viscometer)
- Thickness (Belibi et al., 2014)
- Moisture content (AOAC, 1999)
- Water activity (AquaLab Decagon Devices, Inc. USA)
- Water solubility (Tee et al., 2017)
- Transparency (Tran et al., 2020)
- Colour (Chroma meter CR-400, Konica Minolta, Japan)
- Biodegradability (Hermansyah et al., 2014)
- Water Vapor Transmission Rate (ASTM E96-95)
- Mechanical properties (ASTM D882-03)
- Overall migration limits (ASTM D882-03)
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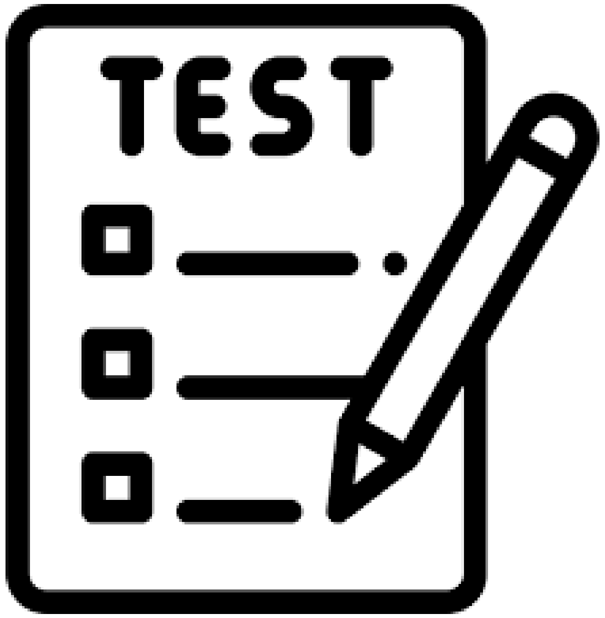
- .....



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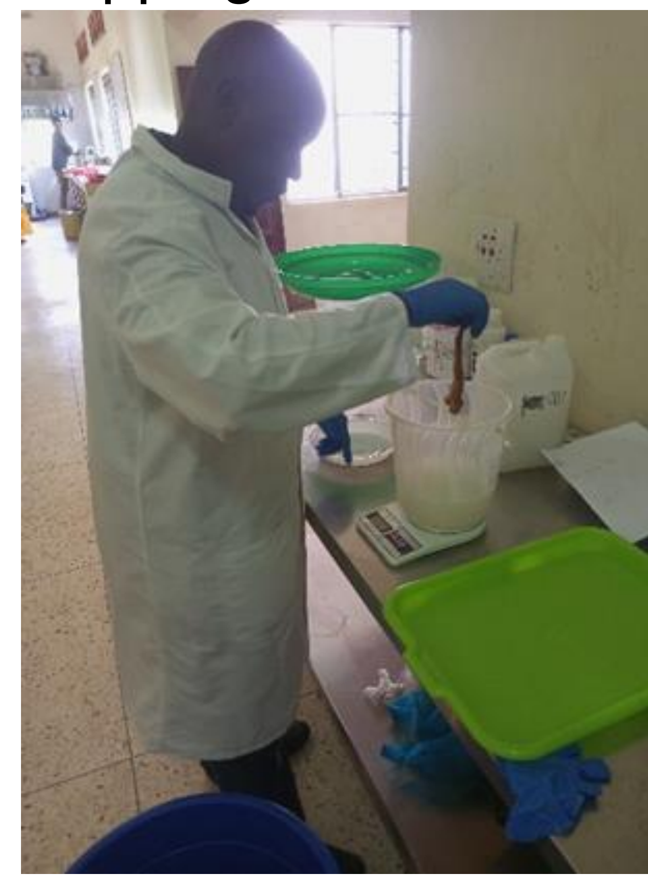
FOOD PACKAGING APPLICATIONS

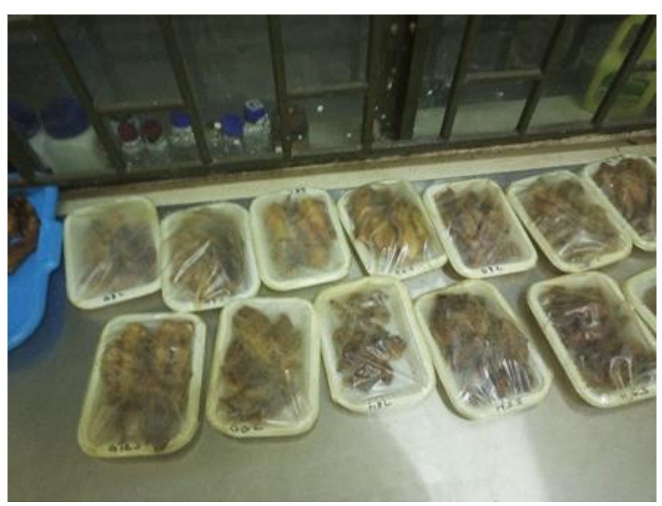
Examples of foods packaged with the bio-based edible coating and film that were tested by the NARO team during the shelf life studies:

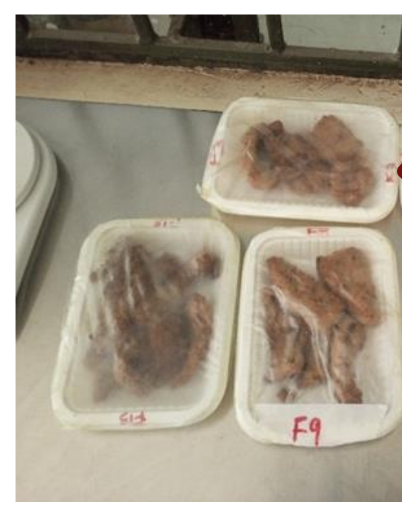
Soft-smoked fish fillets and deep-fried fish fingers:

Dipping:



Wrapping:





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