



PROCESSING

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

UPGRADE Plus: Decentralised postharvest processing of underutilised species into innovative value added products for improved food and nutrition security in West Africa

country/countries	Germany, Ghana, Nigeria, Sierra Leone
funding agency	Federal Ministry of Food and Agriculture - BMEL
project management	Federal Office for Agriculture and Food – BLE
project coordinator	University of Kassel (UNI KS)
project partner(s)	The University for Development Studies, (UDS), Ghana, Njala University (NU), Sierra Leone, The National Horticultural Research Institute (NIHORT), Nigeria, German Institute for Tropical and Subtropical Agriculture (DITSL), Germany

	Innotech Ingenieursgesellschaft mbH (INNOTECH), Germany
project budget	Approx. 1,100,000 €
project duration	15-10-2017 until 31-12-2021
key words	Underutilised species, postharvest processing, nutrition, innovative and high-quality value-added products, post-harvest losses, food security, gender, women self-help groups
background	<p>There is great need for better-adapted processing technologies geared towards smallholder farmers in order to meet the dual challenges of food loss and persistently high rates of malnutrition. 1.3 billion tonnes of food is lost or wasted each year at different stages of the food value chain; one-third of the world's total production (FAO, 2011). This results in a total economic loss of \$750 billion and significant harm to natural resources. Losses are particularly high in underutilised, highly nutritional crops. At the same time, more than 2 billion people worldwide are suffering from micronutrient deficiencies, also known as 'hidden hunger' (FAO, 2013). Women of reproductive age and children of 0-59 months are particularly susceptible to the severe consequences, with a majority living in Sub-Saharan Africa (SSA).</p> <p>The nutritional status of women and their livelihoods can be improved by the provision of low-cost, solar-driven technologies and processing techniques for the production of highly nutritional supplements and innovative food products based on underutilised, locally available plant and animal-based materials. There is great potential in processing underutilized species to supplement local diets, primarily consisting of nutrient-poor starchy staple crops, to improve nutrition among vulnerable groups such as women, infants and young children. Approaches which tap into this potential have not been adopted by smallholder farmers to a significant extent, as existing technologies are often complex, expensive, and require high-level energy input to operate. Consequently post-harvest losses remain high and traditional processing activities, which tend to be time-consuming and adversely affect product quality and food safety, continue to be the most common form of food processing. The project aims to fill the existing gap by developing a scalable, user-friendly, low-cost, low maintenance processing technology while taking advantage of the abundant supply of solar energy in the project countries.</p> <p>It is in this context that the project seeks to bring together a unique mix of technology development, rural income generating opportunities for women and local artisans, and improvement of nutrition in Sierra Leone, Ghana, and Nigeria. The potential innovation this project represents is</p>

	<p>the implementation of adapted, context appropriate best post-harvest practices and inclusive marketing strategies to the benefit of women operating in family farming systems and rural entrepreneurs, supporting the development of sustainable, socio-economically viable high-nutrition food production systems in SSA.</p>
<p>objective</p>	<p>The project aims to improve the diets of women, infants and young children while at the same time creating income generating opportunities for women's self-help groups in West Africa and reducing post-harvest losses in underutilized agricultural produce. Specifically, the project seeks to:</p> <ul style="list-style-type: none"> i) develop innovative small-scale modular, decentralised photovoltaic and solar thermal driven post-harvest food processing units suitable for local conditions, ii) utilise high-value underutilised species for the production of innovative and diverse nutrient-rich processed food products with extended shelf-life, iii) to empower women, especially those in self-help groups, in order to prevent micronutrient deficiencies in children as well as increase the health status of pregnant and lactating women, iv) stimulate the rollout of the technologies and processes through training of local artisans who will build the systems using mainly locally available materials and selected members of women groups who will train new users. <p>In addition, the project will provide an understanding of how health-promoting components are degraded during processing of USs, enhance the development of innovative processed food products with extended shelf-life, and stimulate the local uptake of such products in close partnership with women's self-help groups. In doing so, the project seeks to add to the growing evidence suggesting USs can play a central role in nutrition, income generation, and empowerment of women in Sub-Saharan Africa.</p>
<p>results</p>	<p>Over the period of 4 years, UPGRADE Plus project showed significant progress in fieldwork surveys and innovative product development in each of the partner countries – Sierra Leone, Ghana and Nigeria. NU in Sierra Leone tested a wide variety of sweet and savoury items that were fortified or enhanced with Vitamin A rich underutilised (US) species. Consumer acceptance studies revealed a clear preference to the fortified products as compared to their non-fortified "traditional" versions. Additionally, NU also identified that mother-support-groups are primarily established because of Government policy, promoted by large NGOs but were not "embedded" within society. Even with such shortcomings, women's work groups and especially the financial groups (VSL's) are functioning well.</p>





NIHORT in Nigeria evaluated the quality attributes of innovative products from USs. These include; tomato paste from snake tomato, juice from Spondias mombin (hog plum), ready-to-eat snack from pigeon pea, fermented cocoyam flour, pouno-cocoyam flour, white sweet potato flours and noodles from OFSP-wheat composite flours. As a part of the quality assessment, the glycaemic index and anti-diabetic properties of cocoyam flours were analysed. Results showed that cocoyam flour has a low glycaemic index and can therefore be promoted among diabetics for consumption. Additionally, the storability tests performed with cocoyam flours showed that it is better stored in flexible packages such as HDPE bags under room temperature. Further tests and sensory analysis for products developed from Cocoyam flours showed successful integration of the developed products for e.g. sensory analysis of dough made from pouno-cocoyam flour received a positive response from the consumers.

UDS in Ghana also undertook series of activities to develop innovative food products from USs. UDS conducted series of drying experiments with Orange Flesh Sweet Potato (OFSP), pumpkin, aerial yam and frafra potato to identify the best option for the development of high quality OFSP, pumpkin, aerial yam and frafra potato flours. Quality parameters such as colour, water activity, and nutritional properties of each of these products for each treatment option during processing as well the flour functional and pasting properties based on appropriate instrumentation were assessed. Based on the results obtained and through further optimisation, UDS developed high quality OFSP, pumpkin, aerial yam and frafra potato flours for commercialization. Furthermore, UDS also developed various food products such as cookies and bread from OFSP and pumpkin flours.

The DITSL team developed a method based on the Collaborative Learning Approach to empower women's groups to develop and establish joint ventures for the processing of rarely used crops. This was tested with three women's groups in Nigeria and Ghana and enabled the women's groups to acquire knowledge and practical skills in processing (especially drying) and marketing the products produced. Local constraints (e.g. availability of clean water, seasonal shortages in the availability of raw products) were taken into account and the women's groups were empowered to develop solutions. Most importantly, through Participatory Monitoring and Evaluation, women's groups were able to increase their competencies by carrying out joint processing ventures, as this gave them the opportunity to monitor the profitability of the business model and make adjustments. By documenting the process of working with the women's groups, the experiences and practices derived from them continue to be available for use in other similar projects. The participatory and inclusive capacity-building strategy chosen here makes these innovations accessible specifically to women who make their living in rural parts of West Africa through a combination of agricultural activities and processing. The aim is to provide women with a higher income with which they can improve the nutrition of the family and especially of the growing children.

	<p>INNOTECH designed and developed the modular solar processing unit in close collaboration with UNI KS, which enables smallholder farmers and processors to dry fruits and vegetables in the field. The developed solar dryer is low cost, flexible and transportable in nature. These dryers are currently on field in the three partner countries with selected women's group to process various USs. .In addition to the modular solar dryer, to allow for ease of transportation of the dryer, INNOTECH planned, developed and further modified a Tuc-Tuc (APE) to incorporate units such as grinder, charger, etc to allow for further processing of the dried product. Thus, further extending their shelf life and allowing for easier marketability of the product.</p> <p>UNI KS conducted experimental investigation with varying products to identify and optimise the processing parameters that can be integrate in the processing guideline. The video-based processing guideline, thus established allowed for further dissemination of appropriate processing techniques for USs species. In addition to the processing guideline, UNI KS also supported INNOTECH in the design and development of the modular unit, which were delivered to the selected women's group in the three partner countries. Once the dryers were setup in the three countries, online training workshops were conducted to train local craftsmen and womens group to replicate the construction of the drying system and for processing food into high quality products, respectively. The workshops thus conducted allowed for further capacity development among the local craftsmen to develop drying systems using local materials and empowered womens group to process various USs into innovative high quality products.</p> <p>Overall, the UPGRADE Plus project has also been successfully represented across 33 conference proceedings, 21 publications in impactful scientific journals, 6 interactive workshop, 3 press releases and 11 published dissertations (Masters and PhD).</p>
recommendations	<ul style="list-style-type: none">• Based on nutritional analysis, USs are definitely rich in essential nutrients that can meet daily nutritional requirements of all age groups. And thus essential to promote USs species as much as possible across SSA• Innovative value added USs products developed had a great acceptance across the consumers and thus can be taken to a commercial level• New technologies such as the modular solar dryer allows for income generating possibility for womens group due to the production of high quality products. Therefore, development of new systems using local materials such be further supported• Policies and stakeholder engagement should increase in the development of innovative USs products, to ensure both food and nutrition security.

photos

	Photo	Photo Info & Copyright
		<p>UPGRADE Plus Logo (UPGRADE Plus Project, 2018)</p>
		<p>Women selling Amaranth green in Nigeria (Lelea, 2018)</p>
		<p>Discussion with women's group about the use of different species in terms of cultivation, processing, utilisation and quantities (Ojo, 2018)</p>
		<p>Modular solar dryer (from Germany) on field in Sierra Leone (Martin, 2021)</p>