



Bridging the Research Innovation-Industry Assimilation Gap Through Technology Capacity Building in Rural

Training Report

Dairy Research Improvement and Innovation
Consortium

JULY-AUGUST 2023

Table of Contents

INTRODUCTION.....	3
PROJECT OVERVIEW	3
PROJECT OBJECTIVES.....	4
1. PALM OIL PROCESSING TRAINING, KADE	5
TRAINING OVERVIEW	5
OBJECTIVES	5
EXISTING TECHNOLOGY	5
TRAINING INTERVENTION.....	7
2. EGG PROCESSING TRAINING, DORMAA.....	9
TRAINING OVERVIEW	9
TRAINING OBJECTIVES	10
EXISTING TECHNOLOGY	10
TRAINING INTERVENTION	11
3. FRUITS PROCESSING INNOVATION	13
TRAINING OVERVIEW	13
OBJECTIVES	14
EXISTING TECHNOLOGY	14
TRAINING INTERVENTION.....	15
4. DAIRY PROCESSING INNOVATION	16
TRAINING OVERVIEW	16
OBJECTIVES	17
EXISTING TECHNOLOGY	17
TRAINING INTERVENTION.....	17
5. FISH PRESERVATION INNOVATION.....	19
TRAINING OVERVIEW	19
OBJECTIVES	19
EXISTING TECHNOLOGY	20
TRAINING INTERVENTION.....	20

6.TOMATO PROCESSING INNOVATION	21
TRAINING OVERVIEW	21
OBJECTIVES	22
EXISTING TECHNOLOGY	22
TRAINING INTERVENTION	22
KEY LEARNINGS & CONCERNS.....	24
SUSTAINABILITY	25
CONCLUSION	26
APPENDIX	27

INTRODUCTION

The innovations in food processing training were part of the *Bridging the Research Innovation-Industry Assimilation Gap* (BRInG) Project. The training programs were developed and delivered by faculty members from the Dairy Research, Improvement, and Innovation Consortium (DRInC) in collaboration with the University of Ghana Business School Nest (UGBS Nest).

Based on key learnings from stakeholder engagement and a training needs assessment, innovative processing training modules were developed for dairy, egg, tomatoes, fruits, fish, and palm fruits. Each module addresses food safety, process development, product development, testing, and shelf-life issues related to the product.

Through this project, DRInC has contributed to building the capacities of rural small enterprises by training them on food process enhancements and innovations from the existing research, technologies and knowledge available at the Consortium.

PROJECT OVERVIEW

Despite continuous conversations, interventions and a national government-led move towards capacity building as a core priority area in rural enterprise development, there remains increasingly unequal opportunities for enterprises in the rural communities to source technology solutions for their businesses. The lack of adoption of appropriate technology is a significant barrier to enterprise development in several rural areas in Ghana. Nevertheless, several underutilized technologies are simultaneously available and resident in research institutions across Ghana and can be absorbed into small rural businesses to enhance their productivity. Through the RISA programme, a team of researchers at the University of Ghana Business School has discovered a gap in the research-industry technology applications framework, particularly in rural Ghana and have initiated this project to facilitate research learnings and activities to closing this gap.

The BRInG project seeks to build the capacities of rural small enterprises by training them on process enhancement innovations from the existing research and innovation

knowledge available at Dairy Research, Improvement, and Innovation Consortium (DRILnC) at the University of Ghana. In building the capacities of local entrepreneurs, the project prioritizes learning towards empowering disability-owned businesses and under-represented groups of society. By delivering the project through our existing research and technology transfer infrastructure, the project widens the scope of the number of small enterprises that are likely to assimilate knowledge and innovations emanating from research communities in Africa.

PROJECT OBJECTIVES

The overall objective of the project is to improve the technology assimilation capacity of rural enterprises through capacity building training modules across six (6) regions in Ghana. The project also aims at documenting learnings from these capacity building approaches through building an ecosystem of hub partners and rural enterprises which continually creates the synergistic research-industry innovation assimilation loop that makes impact beyond this project.

The project presently in this report seeks to engage a sample of opinion leaders and target rural enterprises in the project catchment areas (Takoradi, Cape-Coast, Kade, Dormaa, Techiman, Atimpoku) to understand the current landscape of technology across selected enterprises in these communities and their readiness cum needs pertaining to the capacity building workshops to be conducted with them. The specific goals of this program were to:

- Understand and consolidate existing and relevant information about rural enterprises, their preferred technology capacity to be built, and how to present appropriate technology knowledge, materials, and other resources in a comprehensive and an easily accessible manner for the trainee rural enterprises in the catchment areas; Western region (Takoradi), Central region (Cape Coast) and Volta region (Juapong).
- Develop a roadmap to subsequent training activities in the catchment areas and lay the foundation for association heads and formed networks in the areas to facilitate long-term interactions with project teams and exchange information progressively.

I. PALM OIL PROCESSING TRAINING, KADE

TRAINING OVERVIEW

As part of the project objectives, the palm oil processing training was the first of six training courses intended to improve the technology assimilation capacity of rural enterprises through capacity building. The training was targeted at rural communities in the Eastern region where most enterprises are Artisan palm oil processors. Participating communities are Kade, Subi, Adonkrono, Otumi, Asenase, Amamu and Damaa.

The training was designed to address technical challenges in processing faced by these communities' using findings from DRIInC research as well as offering basic business and product management strategies, food safety and quality assurance requirements as far as palm oil processing is concerned that will help upgrade their enterprises and compete positively in the industry.

OBJECTIVES

The overall objective of the training was to introduce beneficiaries to new technologies and processing innovations in palm oil processing from farm to consumer in response to findings from needs assessment.

The specific goals of this program were to:

- Train beneficiaries on simple test techniques that will enable them to check for moisture content to improve the shelf life of their products.
- Introduce new technologies that utilize processing by -products and waste to improve waste management and resource optimization.
- Introduce them to some importance of quality assurance and FDA standards in product packaging and labeling.
- Equip them with practical knowledge in business management.

EXISTING TECHNOLOGY

Even though small-scale processors contribute about 60% of Ghana's crude palm oil production, a large percentage of the palm oil produced by small-scale processors cannot be utilized by the larger scale industries in Ghana or abroad because of its poor quality.

Prior to the training, the team identified some processing practices that caused the poor quality of oil produced by these small enterprises. These processing practices included storage of ripe fruits to rotten point before boiling, poor disposal of effluent, use of spent tires for boiling fruits, little to no clarification of the oil and lack of an accurate method of determining the moisture content of the finished product.

These practices and factors affected the overall quality and shelf life of the oils as well as reduced their revenues.



[Scenes from a trainee's palm oil processing sites]

TRAINING INTERVENTION

The main technology and knowledge transferred through this training was in-process quality control techniques. This offered very affordable yet scientific techniques and methods by which an improved outcome can be obtained.



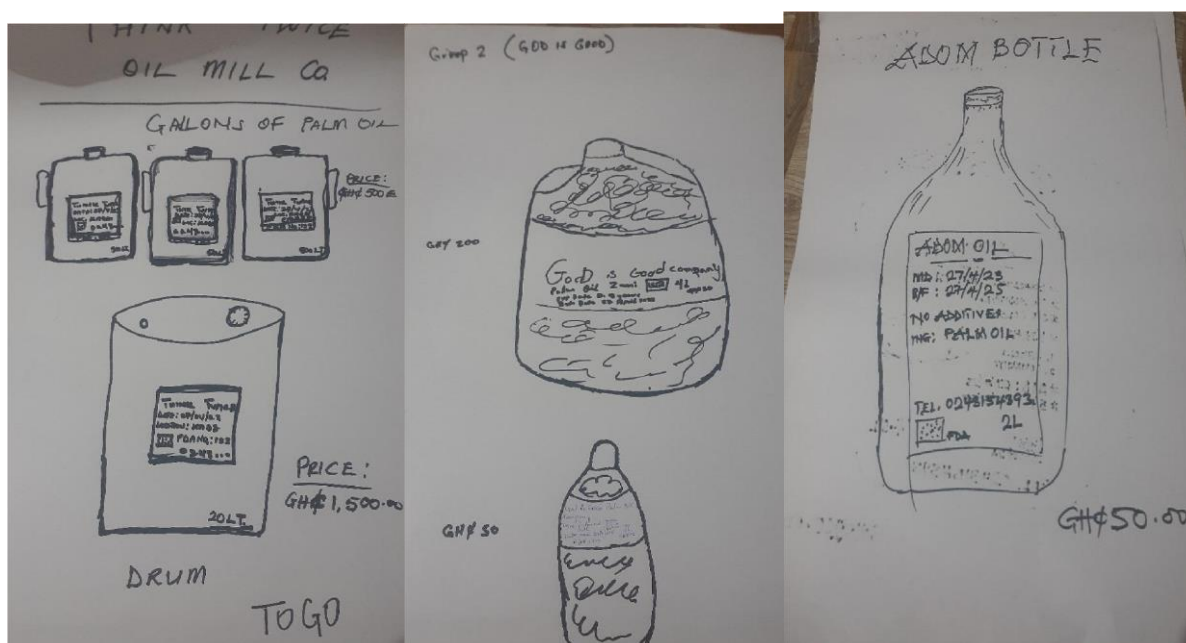
[Cross-section of trainings testing for moisture content of oils using kitchen tools]

Processors were introduced to innovative channelling methods to collect effluent and reuse them as fertilizers and a biofuel source, boilers that could conserve heat while reducing smoke such that there will be no need for spent tires and most importantly, determination of moisture content using the bubble test.

Adoption of these innovations will not only improve the processing quality, quality of oil and its shelf life but will also increase optimization of resources as well as increase revenue for these small enterprises.



[Trainees from the palm oil processing training during a break-out session]



[Some presentations made by trainee groups during the break-out session]

2. EGG PROCESSING TRAINING, DORMAA



TRAINING OVERVIEW

Based on findings from community engagements and needs assessments, the egg processing training, which was one of the six food foci of the project, was to deliver some existing research and technology in the poultry industry to widen the scope of the small and medium poultry and egg enterprises in Dormaa Ahenkro.

The training was designed to introduce and offer hands-on experience in new avenues through which postharvest losses as well as shelf-life issues can be curbed along the egg value and supply chains using findings from DRInC research. The program also offered basic business and product management strategies, general food processing principles, food safety and quality assurance requirements in egg processing to help upgrade their enterprises and create new markets.

TRAINING OBJECTIVES

The overall objective of the training was to introduce beneficiaries to dried egg processing. A detailed processing training that seeks to help beneficiaries develop new products from their existing produce with extended shelf life, added value and help reduce the impact of post-harvest losses of eggs. This innovation was in response to the outcomes of the needs assessment.

The specific goals of this program were to:

- Train beneficiaries on the detailed plain egg powder processing procedure using affordable and appropriate technology.
- Give beneficiaries an insight in general food processing and its principles.
- Introduce beneficiaries to food safety and Good Hygiene Practices (GHPs) in processing.
- Teach participants on egg physical qualities, composition, functional properties, and some quality considerations in egg powder processing.
- Introduce some important quality assurance and FDA standards in egg product packaging and labeling.
- Introduce some other innovations that utilizes the waste products (eggshells) of the egg powder production.
- Equip trainees with practical knowledge in business management.

EXISTING TECHNOLOGY

Dormaa Ahenkro is the largest egg producing community in Ghana. They produce 4,000 tons eggs annually of which 1,048 crates are lost per week post-harvest due to the perishability of the product and breakages as the eggs are transported across the supply chain.

Prior to training, there was no existing technology to curb these challenges. Eggs usually lose their quality after three weeks, become unappealing to consumers and unsafe after

four weeks. When these happen, eggs are discarded and producers and vendors bear the costs, thereby constantly decreasing their profit margins. At best, eggs with cracked shells are poured into plastic bags and sold at a lower price for street food vendors.



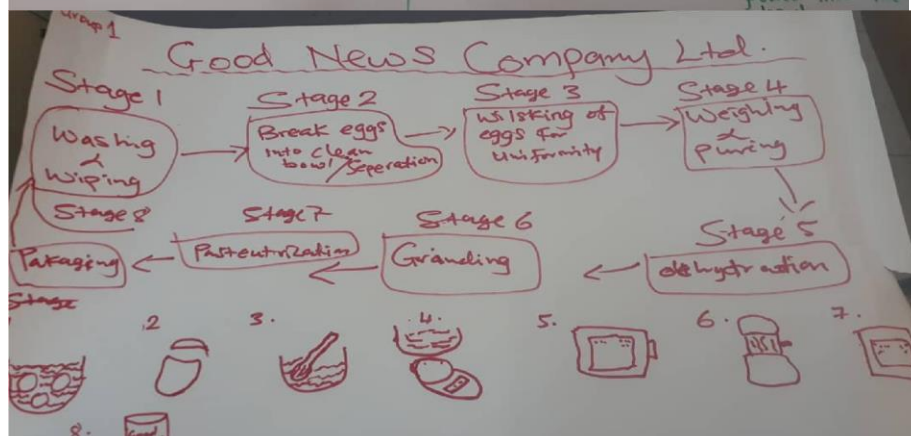
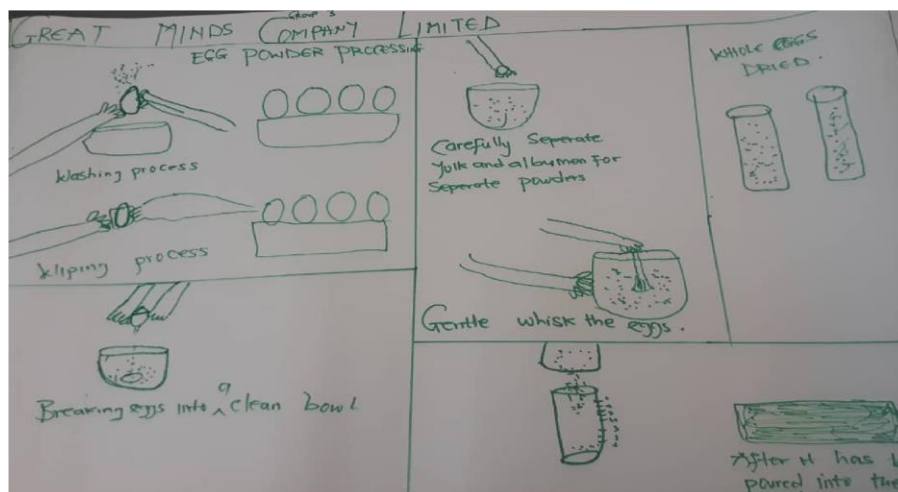
[Cross section of farmers packaging broken eggs for sale at lower prices]

TRAINING INTERVENTION

The technology transferred was egg processing innovation. The training offered basic dried egg processing skills. The processing utilizes the raw eggs only without any added ingredients. Beneficiaries were taught how they could use everyday materials in making egg powder. This new product is less vulnerable to transportation and has a longer shelf life without any significant difference in functional properties. There is not only increasing demand for it but also a promising avenue to curb post-harvest losses as well as generate revenue.



[Cross section of participants processing egg powder themselves]



[Some presentations made by trainee groups during break-out sessions]

3. FRUITS PROCESSING INNOVATION



TRAINING OVERVIEW

As part of the project objectives, the fruit processing training was intended to improve the technology assimilation capacity of start-ups and MSME's (Micro, Small and Medium scale businesses) through an intensive 5-day capacity building and practical training. The training was targeted at fruit processors and individuals who are interested in processing fruits as their new economic activity. This was organized in Cape Coast and its surrounding communities in the Central Region. Participating communities were Elmina, Abura, Ayensu, Ewim, Ankafu, Efutu, Nkanfoa, Essuekyir, Kotokraba, UCC etc. The training was to address the technical and business challenges faced by fruit processors at Cape Coast after conducting needs assessment. Therefore, tailored training content was designed using findings from DRIInC; our training partners to equip trainees with the skills and knowledge in improving their activity using innovations in fruit processing. Other skilled transferred include basic business and product management strategies, food

safety and quality assurance requirements among others. The approach used was both presentation (PowerPoint) and practical (Trainees made to experiment what was thought)

OBJECTIVES

The overall objective of the training was to introduce beneficiaries to new technologies and innovations in fruit processing from farm to consumer based on findings from needs assessment.

The specific goals of this program were:

- To give beneficiaries fundamental knowledge on food processing innovations and safety.
- To equip beneficiaries with skills in innovations in fruit processing.
- To introduce beneficiaries to some importance of quality assurance and FDA standards in product packaging and labeling; and
- To guide beneficiaries through the basics of product development.

EXISTING TECHNOLOGY

Based on our interaction with the trainees, we realized that most of the trainees were into processing fruits into fruit juices and smoothies using the basic methods of juicing. Thus, washing the fruit, extracting the juices (using juicers or blenders) and bottling with little or no idea of the technicalities and standards involved in ensuring the quality of fruits processed. Hence, trainees were faced with challenges such as fermentation of their juices, inconsistency in taste and color, inability to maintain or expand their consumer base, as well as not able to maintain or expand the shelf-life of processed juice and smoothies.

Our findings:

We also noticed the following:

- Some produce without pasteurization.
- They do not utilize by-products after production (e.g. fiber from pineapple juice production)
- Most processors do not check sugar, temperature and pH of the raw and finished

products which leads to inconsistency in the taste of their finished products.

- Some processors had little or no idea of the production of dried fruits, fruit powders and fruit gummies; and
- Most of them do not have proper documentation, both financial and processing records.

TRAINING INTERVENTION

Based on the needs assessments report and interactions with the trainees. They were introduced to the following.

- Quality and technicalities in fruit processing. Trainees were introduced to the relevance of food hygiene and safety while processing. They were also introduced to the tools and equipment used in measuring and weighing fruits before processing such as; pH testing, sugar, temperature and viscosity testing. Some of these tools include digital weighing skill scales, PH meter, Refractometer (Brix), etc.
- Innovations in fruit processing. Trainees were introduced to other innovations in the fruit processing industry as additional products (gummies, dry fruits, and fruit powders) to their current products (Fruit juice and Smoothies). This will serve as an additional means of income stream. This new product development includes.
 - o Dehydration technology to produce dried fruits and fruit powder; and
 - o Making of Fruit gummies using the by-product after juice extraction.
- Others include making apple vinegar and jam (taught in a form of presentation and demonstration)
- Pasteurization (heat treatment) techniques to stabilize and improve shelf life of product.
- The relevance of gelatin in gummy production using fresh juice and fiber from extracts.
- The concept of product development included proper labelling, packaging, and branding.



4. DAIRY PROCESSING INNOVATION



TRAINING OVERVIEW

As part of the project objectives, the dairy processing training was intended to improve the technology assimilation of Start-ups and small to medium scale businesses through capacity building. The training was targeted at food processors in Takoradi and its surrounding communities in the Western Region. Participating communities are.

The training was designed to equip participants with the skills in processing yoghurt from powdered milk. Using findings from DRIInC research as well as offering basic business and product management strategies, food safety and quality assurance requirements as far as dairy processing is concerned will help boost their start-ups and positively affect the dairy industry.

OBJECTIVES

This training was to teach participants how to produce fresh yoghurt from powdered milk, master the critical steps in yoghurt processing that assure quality and be introduced to the concept of product development and innovations in dairy processing.

The specific goals of this program were:

- Equip trainees with the fundamentals of Food Processing.
- Teach trainees how to produce yoghurt from powdered milk
- Teach trainees how to apply innovations in yoghurt processing for commercial gain.

EXISTING TECHNOLOGY

Based on our interaction with the trainees, the team realised that they were all new to yoghurt processing. They raised some concerns about yoghurt being lumpy and wanted clarification on the inoculation process.

TRAINING INTERVENTION



Per reports on the needs assessments done and interactions with the trainees. They were introduced to the following;

- The relevance of food hygiene and safety while processing
- Importance of records keeping
- The importance of weight and measurement
- Pasteurization (heat treatment) techniques to stabilise and improve shelf life of product
- Yoghourt production from powdered milk
- The concept of product development
- The need for proper labelling, packaging and branding

5. FISH PRESERVATION INNOVATION



TRAINING OVERVIEW

Preserving the freshness of fish has presented a longstanding challenge in Ghana, persisting over an extended period. As part of the project objectives, the training was intended to teach innovative technologies to preserve fresh fish to extend its shelf life and maintain its freshness to improve quality. The training was targeted at 60 fisher folks at Atimpoku. Other participating communities included Akosombo, Afabeng, Abomi, Gyemeni, and Kokotekpeji in the Eastern and Volta Regions of Ghana.

The training was designed to equip participants with skills that help to increase the shelf life of fresh fish with an innovation proposed by Dairy Research, Improvement, and Innovation Consortium (DRInC). The training program involved providing participants with education and practical training in fish management and handling practices, as well as imparting knowledge on food safety and quality assurance measures specifically related to the preservation of fresh fish.

OBJECTIVES

The aim was to train participants on the methods of preserving fresh fish, while also introducing them to concepts such as safety, hygiene, quality control, assessment, and product development.



EXISTING TECHNOLOGY

Trainees had prior basic knowledge about food processing, fish preservation, food hygiene, food safety, and food quality. For fish preservation, trainees already knew the use of regular ice for fresh fish preservation and some other methods of fish preservation including salting and drying. However, there was no effective method to retard their fish deterioration process. The team discovered that fisher folk laid bait for fish three days before a catch. Most often than not, fishes got trapped before the third day and as a result the catch were hardly alive and usually started deteriorating before reaching the fish processors. Processors curb the impact of this situation by salting or smoking the fish rather than selling them fresh, these are still of lower quality since the fish is not freshly gutted.

TRAINING INTERVENTION

Participants were taught the principles of fish spoilage and preservation. This helped them understand the need for regular check on bait rather than doing so after 3 days.

In addition to the use of regular ice to keep fish catch fresh, the trainees were introduced to the dry ice method. This method is more effective and keeps fish fresher for a longer time than regular ice.

The team also introduced a new bait made from the guts of fish. This was to optimise waste management after degutting and also effective for attracting more fish than their

regular fish traps. This way, catch could be made regularly and decrease the number of fishes that are lost to spoilage.

6.TOMATO PROCESSING INNOVATION

TRAINING OVERVIEW

The tomato processing training was designed to deliver some existing research and technology in the tomato processing industry to broaden the scope of the small and medium tomato farmers in Techiman based on findings from community engagements and needs assessments.

The program was created to introduce and provide practical experience with novel ways to reduce postharvest losses as well as shelf-life challenges along the tomato value and supply chain. In order to help participants improve their businesses and open up new markets, the program also included fundamental business management, product development approaches, general food processing concepts, and food safety and quality assurance criteria for tomatoes.



OBJECTIVES

The main goal was to familiarise the participants with the production of tomato paste and puree. A thorough processing education aims to aid participants in creating new goods from their existing fruit that have a longer shelf life, enhanced value, and lessen the effect of tomato post-harvest losses. In response to the findings of, this invention was made.

The specific goals of this program were to:

- Educate beneficiaries on utilising accessible and appropriate technologies to process tomato into paste and puree.
- Provide beneficiaries with knowledge of the basic concepts of food processing.
- Inform participants of the physical qualities, composition, functional properties and certain quality issues to be aware of when processing tomato paste and tomat puree.
- Introduce some important quality assurance and FDA standards in tomato pure and paste packaging and labelling.
- Equip trainees with practical knowledge in business management

EXISTING TECHNOLOGY

Techiman is one of the towns that produce the most tomato in Ghana but due to post-harvest and pre-harvest, they lose more than 60% of the tomatoes they plant.

They do not have any way of preventing post-harvest and pre-harvest loss from occurring so they sell what they can sell, eat some, and leave the rest to spoil and others remove the seeds to plant or sell to other farmers while throwing the rest of the tomatoes away.

TRAINING INTERVENTION

To curb the current situation, the training transferred existing processing knowledge to the beneficiaries. This covered the fundamentals of processing tomato paste and puree. Only the raw tomato was used in the processing; no other ingredients were added. Beneficiaries learned how to make tomato paste and puree using common household items.

This product has a longer shelf life, is less susceptible to damage during transportation, and has the same functional property as raw tomatoes. It is also a viable way to reduce post-harvest losses and create new markets.



KEY LEARNINGS & CONCERNS

Overall, the training program was well-structured and intensive. Generally, participants were willing to learn and commercialise the knowledge learnt from the training. Some key outcomes from the training are listed below:

1. Based on the participatory workshop, there was an overwhelming request by the community stakeholders, value chain actors and workshop participants to organize additional training in other areas of the value chain. There was also a call to expand this training to new beneficiaries.
2. We also identified other challenges such as inefficiencies in various unit operations in the processing chain that can be addressed by already existing innovation from academia. For instance, most artisanal mills have challenges disposing of their Palm Oil Mill Effluent (POME) which results in land and water pollution. There has however been a bio-digester designed on the university campus that has been field tested with the POME. These bio-digesters are able to safely process the POME for reuse in other aspects of the value chain.
3. Based on the participatory workshop, community stakeholders together with trainees were concerned about the energy consumption rate and affordability of commercial scale dehydrators and requested help in finding alternatives.
4. Again, during the training we realised that the participants for some product categories such as the palm industry was made up of an aged population who might find it difficult to implement the knowledge transfer. Therefore, to ensure the sustainability of the industry there is the need to train the next generation of industry players who will be capable of efficiently implementing the knowledge transferred.
5. Competent-based training of local entrepreneurs and their beneficiaries to ensure sustainable livelihood and application of knowledge transfer.

6. Beneficiaries also raised the issue of certification. This will allow the processor to access global markets to increase their revenues.

7. Participants were concerned about where to obtain raw materials such as milk powder and yoghurt starter, dry ice etc. as well as prices of equipment needed and requested for help.

8. Participants also had additional interests to learn about other value additions of their produce, tools and mechanisms to detect adulterations on the markets etc.

SUSTAINABILITY

To ensure assimilation and adaptation of knowledge and skills transferred. There is the need to:

- Monitor their activities and progress. There should be frequent calls and visits to their facilities to ensure they are doing the right thing or conduct an M&E workshop to measure progress.
- Assist trainees in procuring processing machines and equipment that can be used in a form of a community-share, more like a community processing center (fully furnished and equipped with modern fruit processing equipment, such as Dehydrators, Juicers, sugar, and acidic tools, ect.).
- Equipment design and fabrication, also offers additional opportunities for rural folk to gain employment and develop new skills. There could be additional training for these.
- Continuously build the capacity of these beneficiaries so that they can also train others who are interested in venturing into fruit processing as their economic activity.
- Building local collaborations will enhance the uptake of innovations.
- Initiate support groups/associations for dairy processors for future engagement and collaborations.

The team encountered a young fabricator in Dormaa Ahenkro who could manufacture some locally sourced dehydrators which is an affordable alternative. Mr. Emmanuel Kwadwo Safo is a 31-year-old graduate of the University of Cape Coast and a native of Dormaa Ahenkro. Partnering with such individuals to source local inputs to facilitate innovation assimilation would improve adoption rate of our technology and overall impact of the training as more processors would be able to afford the dehydrators which is the key equipment needed to process the eggs into powder.

The queen mother of Apaaso was willing to give out land where the production of dry ice could be commercialised for effective assimilation of the fish preservation technology in the region.

CONCLUSION

The training was very impactful and a learning experience for both participants and trainers. All key objectives were met. As academics, we observed that these small scale and artisanal industry players had basic knowledge and skills on food processing and preservation through experience. However, they had minimal understanding of the principles behind their skills and practices making the training very eye opening for them.

The impact of the training will go a long way in positively re-orienting local/artisanal food processing and preservation techniques and even food waste management approaches.

Participants were appreciative of the knowledge transferred and showed interest in the possible existence of other research findings such as tools, techniques or technologies that could detect food adulteration, spoilage, contamination etc.

Additional knowledge from the training such as fundamentals of food product development and business management will help in the value addition of locally manufactured food products, standardisation, scale up, proper revenue management and competitive pricing.

Ultimately, the training fosters processing innovations and will help beneficiaries compete positively in the food industry. Participants also looked forward to more engagement with academia as we do with them.

APPENDIX

