**COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH (CSIR)**

**FOOD RESEARCH INSTITUTE (FRI)**

**CSIR-FRI/TDTC-COTVET**

# REPORT ON THE TRAINING OF SMALL SCALE FRUIT PROCESSORS ON VALUE ADDITION TO MANGOES BY DRYING USING A GAS CABINET DRYER, CONDUCTED AT CESPIM, TANTRA-HILLS, ACCRA

**By**

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Table of Contents

**ACRONYMS**

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| CESPIM | Centre for Skills Entrepreneurship Productivity and Management |
| COTVET | Council for Technical and Vocational Education and Training |
| CSIR | Council for Scientific and Industrial Research |
| FRI | Food Research Institute |
| FPMAG | Fruit Processors and Marketers Association of Ghana |
| TDTC | Technology Development and Transfer Center |
| GMPs | Good Manufacturing Practices |
| HACCP | Hazard Analysis and Critical Control Points |

**SUMMARY**

Following the successful design, fabrication and installation of the gas cabinet dryer at CESPIM, Tantra Hills, a training program was held for staff of the company and other members of the Fruits Processors and Marketers Association of Ghana. This training was aimed at introducing staff of the company to dried fruit processing and also to orient them on the operation of the gas cabinet dryer. The training included both theory and hands-on practical sessions. Mangoes were used to practically demonstrate the various unit operations involved in processing dry fruits. The participants were taught the details of each unit operation involved in the processing of dry fruits. They were also given an expose on food safety in food processing. The participants expressed much appreciation at having taken part in the training program because they acquired the skills and practical knowledge required to process fruits by drying. They were urged to apply the knowledge gained in their line of work in order to produce good quality dried fruits for the local and international markets.

**1.0 Introduction**

Processing of fruit into dry forms is one of the most expedient value addition opportunities in postharvest management. Most fruit growers in Ghana prefer to sell their produce in its raw form. However this is option characterized by heavy losses due to spoilage, which reduces the economic returns on harvests. In seasons of glut, for instance, losses of up to 30-50% has been estimated for fruits and vegetables. One of the methods available to address this situation is by drying the fruits. Apart from increasing its shelf life and making it available all year round, drying also adds more value to the raw fruit. Dried fruits are convenient and retain most of the nutrients of fresh fruits and are therefore considered healthy. Dried fruit products are increasingly becoming popular in Ghana, and this has a huge market potential.

The desire to process dried fruits has been a long standing one, but the ability and capacity to achieving this desire is limited, especially among micro and small scale enterprises. Many of these companies either lack technical expertise or equipment or may be constrained by both factors. It is based on this premise that CSIR-Food Research Institute, through the TDTC-COTVET funded the design, fabrication and installation of a gas cabinet dryer for two small scale fruit processing company. The gas cabinet dryer has the capacity of about 50 kg and is designed to churn out good quality dried fruits for the local and international markets. This is an important initiative in Ghana's drive towards a paradigm of adding more value to the country's raw produce. It would contribute to enhancing the earnings of fruit processing enterprises, creating more employment opportunities, improving income levels and livelihoods.

Following the successful installation of the dryer, a training was held for staff of CESPIM and some members of FPMAG. This report presents the events and activities at the training program, which was facilitated by researchers from CSIR-Food Research Institute.

**1.1 Objective**

To introduce the staff to the technology of processing dried fruits to enhance their skills and strengthen their capacity in fruit processing.

**1.2 Opening Remarks**

Jonathan Ampah, a research scientist with FRI, in a short opening remark, gave a background to the training. He mentioned that the training is one of the scheduled activities under the Fruit Drying Project, which follows the design, fabrication and installation of the gas cabinet dryer. He noted that following the successful installation and trials, this training was necessary to orient the staff of CESPIM on the operation of the new gas cabinet dryer and processing of dried fruits. He advised the participants to take the training seriously so as to improve their technical skills for their personal as well as corporate benefit. Trainees were urged to keenly follow the various

activities earmarked for the training, especially the practical demonstration sessions. Mr. Ampah concluded by assuring Mr. Ampadu, CEO of CESPIM that CSIR-FRI is always ready to partner with them to render technical and analytical services and also to provide backstopping assistance.

**1.3 Participants**

The staff of CESPIM, a fruit processing company located at Tantra Hills in Accra and members of FPMAG took part in the training on processing of dried mangoes.

**2.0 Fruit processing**

Presentations were given by Papa Toah, Mr. Ampah and Mrs. Buckman which centered on Good Manufacturing Practices (GMPs), Hazard Analysis and Critical Control Points (HACCP), the nutritional and economic importance of fruits and the need to preserve and add value to raw fruits through processing. They were also introduced to the importance of drying as a method of processing and preserving fruits and the types of drying systems available for fruit drying. Participants were also briefed about the effect of parameters such as temperature, moisture content, size/thickness of slices on drying.

**2.1 Basic operations in fruit drying**

Participants were given a general overview of the unit operations involved in drying fruits. These processing steps ought to be carefully followed in order to ensure that good quality dry fruits are produced. After the general overview, the details of these unit operations were explained further and demonstrated during the practical session. The trainees were also advised to observe hygiene and safety food processing precautions to ensure that the final product is safe for human consumption.


Figure 1: Theory session of the training

2.1.1 Raw material selection and fruit handling

Fruits used for drying must be of good quality since this directly affect the outcome of the final product. They were taught to use healthy, mature and ripe, but firm fruits. This would ensure that the final product has good texture and appearance and is attractive to the consumer. The participants were advised against including diseased or bruised fruits during production. In this regards, they were taken through the rudiments of sorting. This would ensure that only good quality fruits are selected for processing.

2.1.2 Raw material preparation

The participants were given theoretical and practical demonstration on washing, peeling and slicing of fruits. Washing and sanitizing are important steps in processing fruits. These unit operations are carried out by immersing the fruits in chlorine solution (sodium or calcium hypochlorite) for about 3 min. This process sanitizes the fruits by significantly reducing microbial load. Washing also reduces agro chemical residues on the fruits. Once fruits are sanitized they can then be peeled and sliced. Peeling and slicing are done manually with sharp stainless steel knives or automatically with a peeler and slicer. Trainees were educated on the importance of producing thin and evenly-shaped fruit slices. This would enhance moisture removal from the fruits and also ensure that slices dry uniformly. The trainees were, however cautioned against cutting fruits into very tiny bits or extremely thin slices (less than 2mm) so that the slices can be removed easily from drying trays/racks without tearing the fruit apart.

2.1.3 Drying

Drying is the most important operation in this training program because the product quality is heavily dependent on this process. The participants were taken through the details of drying fruits in the gas cabinet dryer. After slicing and evenly spreading the fruits on drying racks, the racks are arranged carefully in the dryer. Drying temperatures ranged between 65 and 70 °C. In order to be certain of uniform drying and good quality end products. Participants were taught how and when to interchange the racks during drying. The racks were interchanged at a 4 h interval during the initial stages of drying with a reducing hourly interval as the products approach the desired moisture content. After drying the fruits are cooled at room temperature before packaging.

2.1.4 Packaging

The participants were given a general overview on the packaging process and its importance in relation to keeping the dried fruits wholesome. Dried fruits are mostly packaged in clear flexible polyethylene or polypropylene pouches and sealed to exclude air and moisture. They were advised to take packaging seriously because it is the only means by which the integrity of the product could be maintained after processing.

**2.2 Operating the gas cabinet dryer**

The trainees were given a detailed explanation of the procedures involved in operating the dryer. Operation begins with checking the gas pipes for leakages. This is followed by an initial pre-heating to a temperature 70-80 °C for 30 min, before the sliced fruits are loaded. Temperature regulation is done by setting the gas burners to desired intensity and monitoring the temperature readings on the dial thermometers. Trainees were told that it is a normal experience for the temperature to drop by nearly 10°C immediately after loading as a result of product moisture and the opening action of the cabinet dryer. Once the samples have been loaded, the LPG regulator is adjusted until a temperature of 65-70 °C is attained in the drying chamber. When the fruits attain the desired moisture content, the source of heat is then turned off by shutting the gas supply on the LPG regulator. Drying is discontinued by removing the racks from the cabinet and allowing the fruit slices to cool.

**2.3 Food Safety**

Issues concerning safe food have become a global phenomenon because of several reported outbreaks of food borne diseases worldwide. Food safety is necessary to safeguard the health of consumers by preventing illnesses attributed to food consumption. It has several components including HACCP and GMPs, which manufacturers are encouraged to implement in order to reduce the production of unsafe food. The trainees were introduced to HACCP and its pre-requisite programs as a food safety management tool. The principles of HACCP and key elements of GMPs were discussed as well as the need to observe current good manufacturing practices in food processing.

**3.0 Practical demonstration**

Fully ripe but firm mangoes were used in the practical demonstration. These were purchased from the local fruit market at Dome and carefully sorted. All the participants were encouraged to take active part in the practical demonstration in order to equip them with the skill required to execute the unit operations involved in fruit drying.

After sorting, the mangoes were also washed in potable water and sanitized in chlorine solution before peeling, cutting and slicing. The fruits were spread thinly on drying racks, loaded into the pre-heated dryer and dried at 65-70 C for 8hrs. After drying the fruits were cooled to room temperature, packaged in flexible polypropylene pouches and sealed.

Figure 2: Trainees washing mangoes

Figure 3: Trainees peeling mangoes

Figure 4: Slicing mangoes

Figure 5: Spreading mangoes unto racks

Figure 6: Dried mango slices

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**4.0 Observations and general remarks**

The training was successful and participants appreciated the hands-on mode adopted. Although dried fruit processing was new to them, they showed enthusiasm and observed the basic rules of safety and hygiene during processing. The Table below presents a summary of the input and output values for mango slices dried

| Date | Name and description of the product | Quantity of Units produced | Initial and Final MC% | Number of hours worked per day |
|---|---|---|---|---|
| 20/04/17 | Dried mango slices | Input 50kg<br>Output 7.4kg | 75.1% and<br>14.4% | 9 |
| 21/04/17 | Dried mango slices | Input 50kg<br>Output 6.5kg | 75.1% and<br>13.1% | 9 |

**5. 0 Conclusions and recommendations**

The training was successfully carried out and participants learnt the basic operations in fruit drying and operation of the gas cabinet dryer. Based on the training and general observations made, the following recommendations were suggested

- A shed should be erected over the dryer to keep it from direct contact with rain.
- Although they have food safety measures in place there is the need to develop and implement an HACCP in the processing facility.
- Support the company through technical backstopping

**6.0 Closing remarks**

Mrs. Buckman congratulated the participants for making time to attend the training program and asked them to continually practice what they have learnt to improve their processing activities. Mr. Ampadu also extended a word of appreciation to CSIR-FRI for the opportunity to take part in the COTVET/TDTC Project, and also to the facilitators for their efforts and inputs, which made the training a success.