KIST

CENTRE FOR INNOVATION AND TECHNOLOGY TRANSFER (CITT)

TECHNOLOGY DEVELOPMENT OPPORTUNITIES IN FOOD PROCESSING

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LIST OF ACRONYMS

KIST	Kigali Institute of science and technology
CITT	Centre for Innovation and Technology Transfer
RBS	Rwanda Bureau of Standards
KEBS	Kenya Bureau of standards
HACCP	Hazard analysis critical control point
CCPS	Critical control point
PET	Polyethylene Tetra phthalate
WFP	World food programme
MINAGRI	Ministry of agriculture - Rwanda
MINCOM	Ministry of commerce – Rwanda
UNIDO	united nation's industrial development organisation
LR	lactometer reading
UHT	ultra heated milk
US	United States of America

EXECUTIVE SUMMARY

CITT was established in 1997 to address the acute shortage of technical skills in Rwanda through the provision of teaching, training, research and consultancy services in technology development and enterprise management.

Given that, about 90% of the Rwanda population is depend on agriculture for subsistence and the population density is over 300 persons per square kilometre, with a population growth rate of 2.9% per annum. The per capita income is about $230, with about 70% of the population living below poverty line. Then in order to reduce dependency on rain fed agriculture, which is risky there, is need to embark on alternative diversification offered by technology and industrial development.

CITT is mandated to alleviate poverty through development of appropriate technology targeting primarily the community and other indirect beneficiaries as service providers to offer sustainable interventions.

The purpose of the study was to explore opportunities for technology and small-scale businesses creation in food processing. The centre of focus in this consultancy is Irish potato, dairy, and fruit processing. The areas under focus have enormous potential to grow from mere production to profitable processing. Application of tested small-scale food technologies in the Eastern Africa region were explored in the basis of viability, ease to fabricate and use.

Methodology used in the study is an adhoc questionnaire to key respondents. These include KIST/CITT staff, farmers, milk cooler attendants, satellite centre managers and supermarket attendants. Literature was conducted review through studying of CITT/ KIST documents.

Food technologies currently developed and disseminated by CITT which include fruit concentrate and jam making were appraised and recommendations provided. Other technologies examined were the pineapple press and the energy saving Jiko as tools of food processing. Improvements were suggested into making them more suitable for the process required.

A rapid market survey in potato processing was integrated and provided a suitable potato processing into crisps as well as other additional suggestions on their preservation to reduce post harvest technologies.

Dairy processing, testing, handling, and standardisation were covered in details providing for small scale adaptation of the technology. A business operations model was explored revealing the profitability of milk processing venture. Inclusive is the record keeping system of a dairy trader.

Design and dissemination considerations were examined and recommendations provided.

For all viable businesses a list of technology suppliers was provided with the approximate costs of the small scale.

INTRODUCTION

Rwanda like other African countries depended on imports from the north with its primary economic activity being agriculture. Technology was by the side not well articulated or integrated to offer any solutions of profitable value addition. With the global opening in trade, the prices of imported goods and services have continued to soar with little increase in income from farm products. This has led to increased poverty to the scale of 70%. This was aggravated by the 1990-94 civil war, which destroyed existing resources delaying economic recovery. Overpopulation and dependence on land has led to deforestation, degrading of soil, leading to soil erosion and utter destruction of environment. Few alternative means of livelihood are available in form of small and medium scale businesses (SMEs). Few that exist have been stunted by lack of appropriate technology in both skills and equipment.

In order to improve the status of SMEs to create and address their constraints both in business and technology the government of Rwanda sought to set Kigali institute of science and technology(KIST) to address shortage of technical skills through provision of teaching, research and consultancy services in technology development and enterprise development. However, KIST was unable to combine conventional teaching and with appropriate technology transfer initiatives. Centre for innovations and technology transfer (CITT) was thus established in 2002 to spearhead rural socio economic transformation and development through technology development and dissemination.

Some of the CITT's core achievements in technology development include energy supply technologies, water supply technologies, solar technology, sanitation and water management technology, low cost housing, rural transportation and agro-based technologies. The latter include post harvest processing and storage, packaging of perishable fruits, oil extraction, milling and hulling machines, maize shellers, rice threshers and winnowers.

In pursuit of technology, food-processing technology had emerged as one key sub sector that has the potential for growth through value addition, employment creation, income generation and provision of market access to rural farmers. Food processing technology seem to be new in the country and well developed lacking in processing skills, standards and equipment. A consultancy was commissioned to address these issues.

1.0.0 Terms of reference for the study

1.1.1 Objective

The objective of the consultancy was to conduct a broad study on CITT developed food processing technologies and provide direction for others that are yet to be developed. CITT's mode of food processing technology dissemination strategies was also included. Emphasis was given to milk and fruit processing. The broad assessment of food processing technologies at CITT should provide leeway to recommendations on those to be adopted and disseminated.

1.1.2 Scope of work

The scope of was hinged on CITT's strategic documents, evaluation and progress reports. Map the strategic partners in food processing subsector who include communities, CBOs, Satellite centres including small-scale food processing businesses. Current food processing methods will be studied and analysed with bias to milk processing, fruit processing and standardisation. However, in the course of implementation it was discovered that some of the groups and technologies that had been mentioned earlier did not exist. These include milk processing and pineapple juice processing. In the pineapple

case, only a screw press was in existent. Other areas were the study of marketing and record keeping of milk.

1.1.3 Expected outputs

The expected outputs were

- Selected fruit and milk processing technologies containing quantities information and cases.
- Findings and analysis including recommendations
- An equipment-costing resume for establishment of a small-scale milk and/or fruit processing in production.
- Full report from the consultancy providing recommendations for appropriate technologies to be developed and dissemination strategies including milk standardisation.

1.1.4 Methodology

The Methodology used in the consultancy-involved assessment of all food-processing technologies available within CITT, CBO and the satellite centres with a view to appraise them for production. CITT strategic documents and reports were studied. Visits to satellite centres, local SMEs, CBOs, farmers and markets for finished products were also conducted. Adhoc questionnaire was used to collect the relevant data.

1.2.0 Definition of technology

Definition of technology as an aspect of guidance to provide bases for assessments and analysis for the purpose of the consultancy was given as Technology containing four facets that include :-

- Physical – machinery, equipment and infrastructure
- Technical skills
- Process technology – recipes
- Information

2.0.0 CURRENTLY AVAILABLE TECHNOLOGIES

Several key informants from various categories were interviewed who include government officers, CBOs, institutions, and physical visits to the satellite centres as is illustrated in ANNEX IX. Currently available technologies that can be/are used in food processing are passion and pineapple fruit processing, pineapple press, potato peelers and energy saving stoves. Communities were difficult to secure appointments. They seemed to have been over studied and thus wished to stay away. At Nyirangarama, it seemed they were secretive with their information provision. Cameras were left behind and only limited information could be provided in processing and little in outputs or input manufacturing data.

2.1.0 Fruit processing technology

In the year, 2005 CITT in bid to disseminate technology to the community trained two women groups in fruit processing for income generation. Kacyiru and Zion Temple Women Group were among the pioneering groups that have commenced production and selling. The groups have been processing pineapple, passion fruit juice concentrates, and jams on part time bases say 2 -3 days a week. They produce successive batches after the initial ones are sold out. Zion temple and Kacyiru group boasts of about 10 and 30 members active members respectively. Passion fruit juice /concentrate is the most widely consumed juice in Rwanda and is popularly known as *maracunja*. The passion fruit seem to be grown in most parts of Rwanda. The annual national production level stands at 14,200 tonnes. From the statistics available from MINAGRI show that only 5% of production is processed while 55% is exported and 40% consumed whole, locally.

In the processing, they use kitchen utensils for production; that is sufurias, blenders, kitchen knifes, and wooden spatulas. Apart from the weighing balance, quality control tools like thermometers and refractometer were missing. However, others like Nyirangarama who are more advanced are using an electrically driven pulper and water-jacketed boilers for processing. They have even secured export market to Belgium.

2.1.1 Process technology

The process technology used in processing juice concentrates by the women groups as was delivered by CITT is as follows:-

I. the fruits are purchased from the market, washed and weighed,
II. peeled and sliced
III. pulping is done using the kitchen blender,
IV. pulp is weighed,
V. sugar is weighed and mixed with water,
VI. sugar water mixture is boiled
VII. citric acid is added when VI is boiling and then removed from the fire to cool,
VIII. at about 60^{o}C the boiled mixture is mixed with the juice, and sodium benzoate added
IX. The mix is left to cool for 24 hours and then packaging is done package in ½ litre and 1 litre PET plastics and labelled.
X. The bottles are packed in cartons for distribution.

2.1.2 Evaluation of the process technology

The women seemed to have had a good glimpse of the process technology. They have in effect observed lots of hygienic procedures such using flowing water for cleaning the fruits and utensils, use of face, hair masks and gloves as well as general premise cleanliness. Moreover, from the observations this simple technology is fit and affordable to small-scale business start-ups. The two women groups visited had hired a house to carryout the work while the work can easily fit in a standard kitchen. Other areas observed were;

- The volumes handled are small compared to the market demand of the group – are processing 120 litres a week yet the market is said to be insatiable.
- Use of synthetic preservatives like sodium benzoate may eventually lower the value of the product or limit the market to local. Use of sodium benzoate has been in the past disputed as it has properties of accumulation in the body tissues. Sodium benzoate is an aromatic compound with a stable benzene ring, which is difficult to break by the liver.
- Preservation without chemicals is unachievable with plastic bottles as packaging materials.
- Use of wooden spatulas is a leading cause of contamination- the porous nature of wooden surfaces keep a culture of spoilage bacteria and is a source of toxic substances.

2.2.0 Energy saving stoves

Energy saving stoves are lined with ceramic/brick insulation layer to allow focus all heat generated from the fuel on to the cooking pot, in order to limit heat losses and increase energy utilisation efficiency. Energy being a substantial input into food processing leave this technology indispensable

The current design has the heat transfer done directly to the cooking pot holding the food. This is unsuitable for food processing, as it will cause burning by making the pot surface temperature high enough to destroy the nutrients in food. However, with little modifications the design is versatile and applied to many types of applications.

2.2.1 Pineapple press

This is a Juice expeller and produces clear Juice with little pulp mainly suitable for wine making. The press is partly made of the mild steel, stainless steels and uses a screw ram to press the peeled fruit to release the juice. The press was made in CITT as adopted technology from India. It was taken to Nyagatare satellite centre for testing which has about 55 hectares of pineapple and continue to increase annually.

Some of the general design faults of the technology include the screw, which is slow for mass production, and can only take small batches at a time. The greases applied to the screw are likely to contaminate the juice. Mild steel surfaces exposed to the juice will result in rust. The crevices, sharp corners and slots are susceptible to contamination as they are difficult to clean.

3.0.0 OPPORTUNITIES FOR FUTURE TECHNOLOGY DEVELOPMENT

3.1.0 Dairy sector

The dairy sector is currently the main dominant economic activity in the eastern province. The dominant livestock found in this area are the Ankole breed yielding between 5 and 10 litres a day. The national production and processing statistics are as shown in table 1.

National milk Production/processing and imports in tonnes

Year	2001	2002	2003	2004	2005
National production	63,480	97,981	112,463	154,790	178,598
processing	-	-	650	1,221	1,582
Imports	1,398	1,574	728	627	700
Total	64,795	99,566	113,196	154,790	178,598

Source: MINAGRI – livestock department Rwanda.

Current milk production statistics show that 178,598 tonnes/year of milk are consumed annually with an annual increase of about 30% while processing occupies insignificant less than 1 % of total production. The per capita consumption stand at 21.3 litres, which is below the FAO requirement of 120 litres; 6 time less than the recommended. During the rainy season, when fonder is abundant, there is excessive milk by 10% which is converted sour milks or are spoiled. This process is mainly done at home for consumption in the household. In our tour we could not identify any small scale processor either doing it on his own or having been trained by CITT.

Information on powder milk imports/substitutes was not available but from random checks at supermarket shelves and hotels, it appears to be extensively consumed in urban areas.

Most of the milk is consumed fresh in whitening tea and as sour milk. Most of the milk produced in the rural areas is sold in the urban areas. It is sold at 110FRWs by farmers to middlemen and then at 150 -170FRW to the urban consumers. Processed and packaged milk is sold at FRW 600/litre and yoghurt at FRW 1,700/litre. Information from MINAGRI indicates that there is a herd-upgrading programme with out sourcing of the breading cows from Kenya and other countries.

At Nyagatare the Umutara dairy cooperative has a cooler capacity of 19,040 litres. They can only use 3,200 capacity which is about 17%. The other coolers are not in working order. They use ressasulin test for all milk and had no knowledge of other alternative tests. The cooling plant building is well dilapidated with the concrete floor rough and worn out. The smell of sourness was dominant and the compound next to the reception very dusty. Some of the milk was delivered in plastic cans which are unhygienic. Some of the milk collection centres located far do not have coolers thus the milk takes long up to midday in the sun before collection to be transported to the urban areas.

3.1.1 Opportunities for dairy processing

High prices for the milk products are a result of high demand and low supply. Processing will be profitable because demand high and will create alternative products that will lead to increased per capita consumption. Processing should also lead to

- Counter imports which are exorbitantly priced and save on foreign currency
- Support increased production to assist mop up excess milk and provide market access to farmers.
- Added value products like mala, yoghurt and, cheeses, ghee and butter resulting in increased returns to farmers. The added value products are not only profitable and have a longer shelf life thus providing more time to get to the market. The establishment of such businesses could start as small as kitchen

business with ability to expand to become major factory that is from say 20 litres to 10,000 litres a day. See ANNEX I, II and III for details.

- Most of the small-scale cooling plants up country are owned by farmer's thus increasing return to them.

There is also opportunity to reduce market inefficiencies thus enhancing the profit margins along the milk chain. examples of inefficiencies include; expensive and time consuming milk testing procedures like the ressusulin test, unjustifiable high capital investment and running costs with low utilisation and low capacity utilisation as is the case of many coolers lying unutilised, poor milk handling practices as in cleanliness, type of containers used to deliver milk, and under developed milk distribution and marketing channels

3.2.0 Findings From Pineapple Sub-Sector

The annual pineapple production as year 2005 stood at 18,000 metric tonnes, while the total amount of land under pineapple is 900 Ha. From MINAGRI the currently annual production level is at 20 tonnes per acre. This is achieved through traditional farming methods without irrigation, fertiliser and other inputs. However, production is bound to increase to between 40- 85 tonnes a year if the modern technology is applied. At Nyagatare in the eastern province were there are about 55 hectares of pineapple farmland. The Yield is about 825,000 fruits per year in the eastern province. Each fruit is sold at FRW 100 at farm gate and FRW 300 in the urban centres. The pineapples are consumed as raw sliced fruit, fruit juice, and fruit wine. In processing, 3 whole fruits yield I litre of concentrate. 1litre of concentrate is sold at FRW 2,000 resulting in sevenfold increase in value. About 27% consist of post harvest loses worth about FRW 22 million. If processed the value would be FRW 147 Million. Concentrates/juices have a ready market in Rwanda and opportunities for export – e.g. Nyirangarama who is exporting passion and pineapple concentrates.

3.2.1 Opportunity for pineapple processing

Given the high value of processed juices/concentrates and availability of market then pineapple processing is viable. Processing will increase the consumption and stock the surplus at the period over production. The suitable products for both local and export market are fruit juices, pineapple juice concentrates, dried packaged pineapple crisps and pineapple wine. See ANNEX IV & VIII for details.

3.3. 0 Findings From Irish Potato

Irish potatoes are widely grown in Rwanda northern and eastern province as both food and cash crop. Annual national production level stands at 1,073,000 tonnes. Potatoes are popular and widely consumed in fried, steamed, roasted forms and as packaged crisps throughout Rwanda. During the high and low season the farm gate prices are FRW 40 and 65 respectively. The potatoes are sold at FRWs 80 in Kigali. About 30% of the produce is lost during the high season through rotting.

3.3.1 Opportunity for technology development in potato processing

To save the situation of post harvest losses, there are opportunities in establishing cold potato storage facilities. This can be achieved by working in liaison with the MINAGRI and MINCOM. MINCOM in its bid to develop small-scale industrial base is liaising with UNIDO to promote entrepreneurship and technology development. UNIDO is known to have a strategy of establishing technology development centres in the developing world. Liaising with MINCOM will avoid unnecessary duplication. Currently MINAGRI has a strategy to increase production is barred by lack of sufficient market, low prices of farm produce and post harvest losses. Some this shortcoming can be tackled through processing into products that last longer and have the ability to stabilise the market prices. These include:-

- Crisps – small-scale industries can easily stem out of this line. The investment level is low and can be done in the house. See ANNEX V

- Frozen chips
- Commercial starch for food and industrial application
- Establishment of cold stores.

4.0.0 FOOD PROCESSING STANDARDS.

4.1.0 Milk standardisation

Milk standardisation seemed not feature any where within the milk handling and marketing chain. Milk Standardisation usually refer to butter fat content in milk and milk products. During the processing of milk various types of products may require different levels of fat content. Locally the consumer perspective in lower earning groups prefer milk with high butterfat. However, higher income households prefer low fat dairy products. The standard butter fat content allowable is for pasteurised milk is 3%. This is in assumption that the protein level does not change with subsequent changes in butter fat.

Most of equipments used to skim milk provide certain set constant percentage of butter fat. This provide certain challenges to people who would like to vary the butter fat ratios in the production of dairy products such as cheeses, fresh and sour milks.

Some of the methods used in standardising include;-

- milk with too high fat percentage may be adjusted by
    - adding skimmed milk
    - adding low fat milks
    - skimming part of the milk and then adding skimmed milk to the reminder of the high fat milk
    - Use of a standardised centrifuge to take sufficient cream off the milk so that the remaining cream and milk together form the correct standard.
- Milk deficient in fat may be adjusted by
    - Adding cream
    - Adding milk richer in fat
    - Skimming part of the milk and adding cream so produced to the reminder of the low fat milk

Pearson square method is applied to determine the volumes of various mixtures required to attain the standard required. See ANNEX X for details

4.2.0 Other verification standards

For all the processors visited it was evident that no particular standard was being followed. Food being sensitive to human health, need to have standards enforced. RBS is currently formulating standards for the same. There is also interest in the export market, which can serve only by well-regulated processing standards. Some of the modern standards that have been adopted globally include HACCP, GMP and ISO.

4.2.1 GMP – Good Manufacturing Practices

GMP Regulations are promulgated by the US Food and Drug. These regulations, have the force of law, require that manufacturers, processors, and packagers of drugs, medical devices, some food, and blood take proactive steps to ensure that their products are safe, pure, and effective. GMP regulations require a quality approach to manufacturing, enabling companies to minimize or eliminate instances of contamination, mixups, and errors. GMP regulations address issues including recordkeeping, personnel qualifications, sanitation, cleanliness, equipment verification, process validation, and complaint handling.

Most GMP requirements are very general and open-ended, allowing each manufacturer to decide individually how to best implement the necessary controls. This provides much flexibility, but also requires that the manufacturer interpret the requirements in a manner which makes sense for each individual business. This makes it difficult for implementation by small scale manufacturers and besides there no legal mechanisms/structures for its enforcement outside the US.

4.2.2 ISO 22000 standard

ISO 22000 is new global standard on managing food safety in plants, first published by the International Organisation for Standardisation (ISO).

It is a specific standard for food processors setting out safety management procedures. The standard is to play a key part in the efforts by governments and regulators to keep contaminants out of the food chain. It will also be a key method for global processors to ensure that their suppliers around the world are following approved food safety standards.
ISO 22000 food safety standards generally enforce the implementation of HACCP system for food hygiene in a harmonised way. HACCP is the new modern standard advocated all over the world.

4.2.3 HACCP

HACCP stands for Hazard Analysis and Critical Control Point

- It is an internationally recognised food standard – for ensuring consumer safety and elimination of hazards during entire process of food handling.
- Contribute to better market access e.g. exporting to EU,US markets, etc
- In Kenya, custodian of HACCP standards is the KEBS – currently supporting food production industries in adopting HACCP.
- There appears to be a vacuum in custodianship of HACCP in Rwanda – this presents an opportunity for CITT to champion this.

Addressing consumer safety and other needs as well as concerns must be the absolute priority for all stages of the food chain – farmers, intermediaries/traders and processors. Achieving and maintaining the highest standards of hygiene within the means of the players in the food chain is imperative. Of necessity, all players must accept a shared responsibility for food safety. This is achieved through a range of actions aimed at improving the quality and production standards of food.

4.2.4 Implementation Steps in HACCP

- Conducting an intensive analysis of food production lines to identify potential points of hazard entry/occurrence
- Developing an elaborate HACCP plan i.e. making decisions on how food can be produced and sold safely
- Implementation of HACCP plan i.e. putting the above into practice(controlling hazards at critical points in the process
- Carrying out audits to make sure that the system is working well and applying/stepping up control measures.

HACCP is predominantly applied in large-scale food industries within a factory setting. However, it is possible to apply it at small-scale level. ITDG/Practical Action in collaboration with the KEBS piloted the institution of HACCP within the context of a warm milk value chain. See ANNEX VI for details.

4.3.0 Health and nutritional benefits of milk and fruits

Whereas the consultancy put most effort in food processing as an income generating activity whose focus is to supply urban population it is necessary to look at they offer to the rural community where the majority live. The practice in Rwanda fruit farmers follow the pattern of producing for the market and consuming the rejects or what is left over. As for the dairy farmers in the eastern province, who are primarily pastoralists they produce for both their own consumption and the market. Milk and its products form part of their staple diet. Health as an indicator of good nutrition is what is embraced in this report. In the field visits there were no evidence of people met within the western, eastern and northern provinces who were suffering from malnutrition which result from lack of sufficient proteins, scurvy that result from lack of vitamin c , rickets that is calcium deficiency. All the people encountered with directly or indirectly during the consultancy could be classified as healthy and eat balanced diet. Some few cases were encountered of people suffering from

HIV and AIDS pandemic as indicated in the reports and posters promoting VCT services. Well the fruits and dairy products should be in this case provided to assist boost their immunity and live a normal life. The fruits and milk production does not only create business opportunities but will promote access to various foods necessary for food security and health.

The health benefits are clear milk provide Vitamin A, B, D, E and minerals like calcium which is good for the strong bones, well balanced growth in children as well as source of energy in form of lactose and fats.

The fruits provide Vitamin C, fructose and calcium. Fresh fruits also provide the body with fresh enzymes and other live chemicals that fortify the body against disease and help in regeneration of body cells

5.0.0 RECOMMENDATIONS - DESIGN CRITERIA FOR FOOD PROCESSING TECHNOLOGY.

In the case of Kacyiru and Zion women groups, the food processing technology design criteria should be guided by three aspects namely business requirements, process requirements and equipment design considerations. This aspect is important also for future food-technology development strategies.

5.0.1 Business requirement for food processing technology

In the case of Kacyiru and Zion temple groups the technology skills were well received, understood and well applied but the business aspect was not covered thus their low expansion rate and supposedly abandoning of the groups by some of their members. Other areas of interest are to limit the numbers joining a certain sector to avoid saturation and fallouts. The current drive for training seems to be targeting any body and every body. Business requirements thus seek to look at the viability through feasibility study to reveal the existing market size, market needs and possible means of penetration. The factors looked at will consist;

- Is there sufficient existing/or potential market?
- Is the product /technology profitable?
- Are the raw materials available?
- What business skills are required to run the enterprise?
- How many entrepreneurs are likely to serve this market?
- Is the policy environment supportive to the business?

5.0.2 Process requirements

The pineapple press seemed to be a stand alone as equipment. There is need to link the equipment to the process and the standards. Further, the process requirements are necessary to detail the process technology or recipe and all steps in manufacturing from raw material reception to finished product. This process will ensure product sustainability, brand consistent, and customer royalty. Consitency in taste, colour and texture are very important to the customer. It seems that in Kacyiru women group that consistency is difficult to attain. In the design of the process, the following points are necessary;

- The process should be able to provide the desired product as demanded by the customer or consumer
- Use of no preservative is ideal, however, use as is recommended by public health and RBS.- sodium benzoate, sodium metabisulphite, sorbic acid, etc.
- Heat treatment and preservation should be well controlled – use of thermometer, time metering, use of indirect heating
- Identification, control and prevention of hazards that is likely to affect the safety of the consumer. E.g. instituting hygienic standards, integrating simple controls within process, regular medical examination and certification of staff
- Packaging that enhance efficient handling, safe preservation and appeal to customers.
- Simple to follow and little need to make judgements and decisions – should allow workers to productive without many decision making points.

5.0.3 Food processing equipment design considerations.

This portion directs engineers and fabricators on how to design and fabricate machinery and equipment suitable for food processing. This will help in the modification of existing technologies such as the pineapple press, the fruit juice processing by women groups such as Kacyiru and Zion temple.

- Well curved and smooth texture surfaces that are easy to clean leaving no space for food accumulation and decay
- Use of foodgrade materials for all the surfaces exposed to food. The food grade materials consist of stainless steels, aluminium, and permitted plastics. Use of materials that are not recommended end

in food poisoning, contamination, change of taste, colour, etc depending on the type of food and materials.

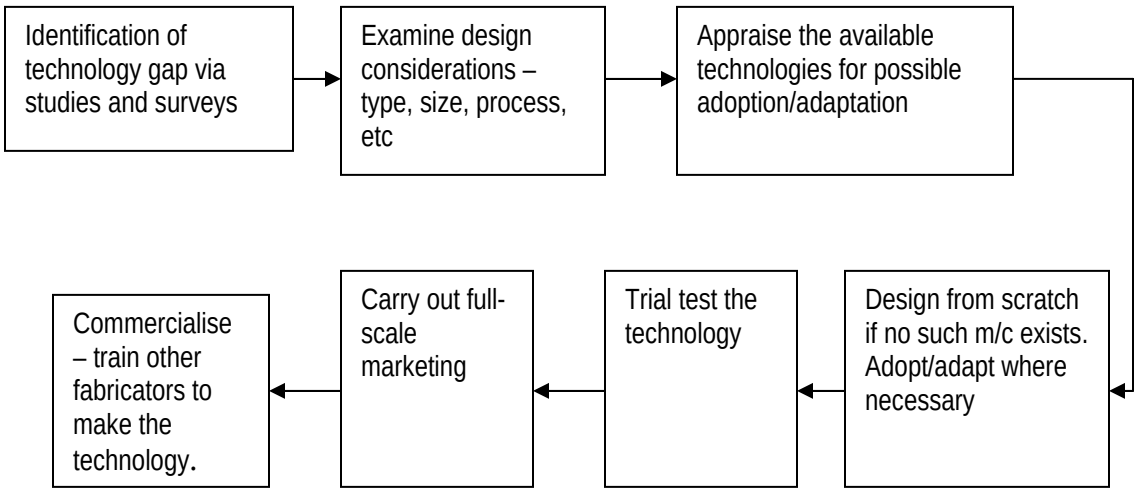
- Depending on the value or scale of the food product, the throughput should be considerably high. Most of the foods are perishable and should be processed within a set limited time to avoid excessive enzymic conversion in fruits as well as bacteria growth.
- Efficient energy utilisation. Energy is expensive and proper utilisation will ensure savings on operations costs leading to increased profitability. Direct heating should be avoided and use of waterbath system introduced to avoid dismembering of valuable nutrients and preservation of taste and colour. See ANNEX VII for details.
- Availability of local capacity to fabricate, procure parts and services – easy to transfer to other fabricators. Ability to manufacture locally enhances accessibility to technology. Availability of spare parts make operations efficient and offer continuity and sustainability of using the technology.

6.0.0 TECHNOLOGY DISSEMINATION STRATEGIES IN CITT

Technology transfer and dissemination is the key role of CITT. Current strategies and methods adapted are use of satellite centres which reach out to the communities and assess their needs. Needs assessment seem to be adhoc and has no direct and systematic plan laid on the ground. Technology in food processing has been acquired through adoption and adaptation of the already existing technologies. other ways are through the enquiries of the users as is the case of the pineapple farmer who would like to start juice processing. The show room, which was set, recently serves as away of exposing the technology to the community.

Dissemination can be achieved in many ways such as incorporating dissemination plan at the technology concept stage. Other methods that are likely to yield better results are need to give the first prototype to a person for trials in order to provide the necessary performance data in a business setting. The person should also provide designers with the information on performance and allow for modifications. The business used in trying the technology may be allowed to purchase the technology at a discounted price. The results should be used to prepare a business profile/package. Involvement of the intended beneficiaries in the development of the technology from the concept to implementation stage is bound to create interest, ownership and thus uptake. Other ways that can make dissemination more efficient include:-

- Mapping the target group to determine their need and level of income in order to match the technology effectively
- Provide innovative ways of accessing technology by creating linkages with financials. CITT should have linkages with banks and other financial institutions that can lend money based on the technology.
- Use group dynamics such as is in farmers associations and other group organisations. Farmers associations and business groups have the ability to purchase technology and share services for commercial gain e.g. cooling plant owned by dairy farmers help preserve their milk prior to selling to traders.
- Communicate and network with the stakeholders/beneficiaries other Government departments say MINAGRI, MINCOM, RIEPA, CAPMER, RBS, etc – expanding your marketing department. The ministries are known to have outreach that is extended up to the village level. By working closely with them will result in increased technology information getting to the grass root communities. Other benefits will stem from increased donor and government support to the centre.
- Only develop technologies that have potential for uptake. Avoiding technology for the sake of technology is noble.
- Create two-tire approach marketing. The marketing is bound to target potential fabricators of the equipment as well as the users who are the eventual beneficiaries. Say like help open up the market for food processors by actively promoting the products in the market and then take the available market gap as a business opportunity
- Embrace a technology development process, which will provide the necessary loop system as shown below;



- Most of the technologies currently developed in food processing did not have prior studies carried out to provide data and constraints at every stage in the value chain. There is therefore need to carryout sector specific studies highlighting;
    - Production levels or availability of the resource
    - Existing gaps in the sector – say for value addition, spoilage, etc lack of transport
    - Existing /potential market for the final product
    - Value chain and all possible interventions on all parts of the chain
    - Potential to create employment and income generation
    - Detail the necessary service providers needed to create sustainability

Annex I
Dairy Processing Technology

1.0 Production of Cultured "Maziwa Lala"

Cultured milk may be produced in quantities ranging from as little as 50 litres per day to 500 litres per day for small scale dairy plants to several thousand litres per day in medium scale dairy plants' whatever the size of the operation, the basic steps are the same. The difference will be in the type and size of equipment applied.

For production of good quality Maziwa lala you require good quality milk;

1. Ensure you have good quality starter culture;
2. Have all physical dirt removed through filtration;
3. Pasteurise the milk at 80-85^{o}C for 30 minutes in a batch pasteurizer which can be a 50 litre milk can. It is heated in hot water or improved wood fuelled cook stove. (Stir the milk during pasteurisation process using a plunger or stirrer).
4. After pasteurisation the milk is then cooled to 20-25^{o}C. Cooling may be done rapidly in a cold-water basin or trough. Cooling in water is faster and more efficient than cooling in air and is more commendable.
5. After cooling, inoculate the milk with 2-3% active starter culture. Stir well for 2-3 minutes to ensure uniform distribution of starter culture;
6. Incubate at ambient temperature overnight (for 16-18 hours);
7. Check the coagulum. It should be compact without cracks and whey on top. You may cool the coagulum before stirring or breaking and curd if you have the facilities. This will improve the viscosity and consistency of the product but it is not essential.
8. Break the coagulum and stir well to homogenize the curd to a smooth consistency. You may add sugar and flavourings at this stage. To minimize contamination, sugar may be added towards the end of the pasteurisation process i.e. when the milk is still hot.
9. Pack the finished product in retail containers for marketing. You may use plastic sachets, plastic cups (½ litre to 1 litre or plastic cups 150 ml to 200 mls). Avoid contaminating the product during packaging (swollen packages in the market is often due to contamination at this stage). Ensure the packages are well labelled and attractive.

Pasteurising is done to:

- Destroy spoilage and pathogenic bacteria;
- Produce a smooth and viscous product;
- Prevent wheying off in the sour curd;
- Enable starter cultures to grow well in the milk

1.2 Production of Yoghurt

The manufacturing process for yoghurt is similar to "Maziwa lala" with the exception that yoghurt starter culture is used instead and the milk is incubated under warm conditions. To produce good quality yoghurt proceeds as follows:

1. Ensure you have good quality milk and Ensure you have good quality starter culture;
2. Filter the milk to remove physical dirt in a batch pasteurizer which can be a 50-litre can be heated in hot water or improved wood fuelled jiko;
3. After pasteurisation, the milk is cooled to 42-45^{o}C. Cooling may be done rapidly in a cold water basin or trough;
4. After cooling, inoculate the milk with 2-3% active starter culture. Stir well for 2-3minutes to ensure uniform distribution of starter culture;
5. Incubate at 42-45^{o}C for a period of 2-3 hours;
6. Check the coagulum. It should be compact without cracks and whey on top;
7. Check the acidity. It should be 0.8-0.9% lactic acid or pH 4.3-4.2.
8. Cool the coagulum by placing the cans in chilled water or store in a refrigerator for 12 hours. This is essential in preventing over souring of yoghurt. It also improves consistency and viscosity as well as full yoghurt flavour development.
9. Break the coagulum and stir well to homogenize the curd to a smooth consistency. You may add flavour at this stage. To minimize contamination sugar should be added towards the end of the pasteurisation process i.e. when the milk is still hot;
10. Pack the finished product in retail containers for marketing. You may use plastic sachet (½ litres to 1 litre plastic cups 150 ml to 200 mls). Avoid contaminating the product during packaging (swollen packages in the market is often due to contamination at this stage). Ensure the packages are well labelled and attractive.

An alternative method for production of yoghurt is to incubate at 30^{o}C for overnight. This type of yoghurt has less risk of wheying off after coagulation due to the slow acid development. It will have richer flavour, high viscosity, mild taste and will require less sugar than conventional yoghurt.

Basic Practical Requirements for Production of Good Quality Cultured Milks:

a) Use high quality milk, thus:
   - Milk that is free from colostrum and mastitis milk;
   - Milk that is free from starter culture inhibitory (antibiotics, chemical and drug residues);
   - conduct regular inhibitory tests on milk destined for production of cultured milks;
   - milk that is low in acidity;
b) Use clean equipment;
c) Pasteurise the milk to recommended temperatures;
d) Use fresh starter cultures;
e) Cool yoghurt coagulum promptly and maintain cold chain during marketing to avoid over souring;
f) Package the products in attractive and well-labelled containers.

Annex II

1.0 Quality Control in milk processing and handling

Quality control is used to assess the suitability of raw materials for processing and for confirmation that finished food products are fit for human consumption. Random samples of a food product are subjected to a series of tests to establish its quality parameters.

1.1 Packaging

Three packaging options are suitable for the small scale dairy processing. These are plastic bottles, plastic cups and plastic sachets. As for pasteurised milk, if it is packaged before pasteurisation then the sachets are suitable due to the ease heat transfer into the package. If packaging is done after pasteurising then both the sachet and the bottle are suitable.

As for mala and yoghurt either the sachets or wide mouthed bottles are used. Plastic cups can also be used if they are properly sealed. However, if the fermented milk is to be served in a short period then plastic jerry cans or simple plastic cups should be used.

1.2 Milk Testing

There are two categories of milk tests subjected to raw milk;

a) Acceptance tests. These are used to determine the suitability of raw milk for processing.
b) Payment tests: These are used to establish commercial value of the milk for the purpose of producer prices.

1.3 Organoleptic Tests

Milk samples are subjected to sensory evaluation by use of sight, smell and taste. Taste, however, is used only when a herd is certified as disease free. Sensory tests are used as quick tests for milk acceptance, and where there is doubt, milk is further subjected to confirmatory tests.

1.4 Lactometer Test

A lactometer is a hydrometer, which is used for measuring density of milk. Density of normal milk ranges from 1.026 to 1.032^{o} L.R., which is normally, expressed as 26.0 to 32.0^{o} L.R. Milk that is adulterated with water addition. Normally has a lower lactometer reading while milk skimming is indicated by higher lactometer readings. Lactometers are calibrated to read at specific temperatures, e.g. at 20^{o}C.

	COLOUR CODED LACTOMETER	NORMAL LACTOMETER	WHAT DOES RESULT MEAN?	WHAT DO YOU DO?
OBSERVATIONS	Surface of milk is within pink part of the lactometer	Surface of milk is between the number 26 and 32	The milk is pure and has no water or solids added to it	Accept the milk but subject to further tests
	Surface of milk is within yellow part of the lactometer	Surface of milk is above the number 32	Solids have probably been added to the milk e.g. wheat flour	Reject the milk
	Surface of milk is within blue part of the lactometer	Surface of milk is below the number 26	The milk has been diluted probably using water.	Reject the milk

1.5 Alcohol Test

Ethyl alcohol (ethanol) of 68% concentration is mixed with equal volume of a milk sample, (normally 2ml by volume) and observe for clots. Milk that clots is rejected as bad milk. For U.H.T. milk process, ethyl alcohol of 72% concentration is used since U.H.T. requires much higher temperatures.

1.6 Resazurin Test

Resazurin is manufactured in form of tablets. A tablet is dissolved in specified quantity of distilled water to give a purple solution. Resazurin is dye which measures redox potential of milk and hence the aerobic bacterial activity. 1ml of a freshly prepared resazurin solution is mixed with 10ml of a milk sample and incubated at 37^{o}C for 10 mins.

Using a resazurin disc, the colour change is read and usually corresponds with specific readings. Colour changes range from purple via pink to white. Purple colour reading of 6 indicates the best milk (1st grade) while white represented by 0 reading indicates the reject milk.
This is a more accurate test for quality measurement of milk.

1.7 Clot on Boiling

This test is done to detect the level of milk acidity just as the ethanol test, however, it is less sensitive although reliable if well applied. It usually detects milk if the spoilage is very advanced. The Equipment required are Stainless steel, teaspoon or a small scoop. The heat source like Candle or a matchbox

ANNEX III

Equipment for dairy processing

Item No.	Equipment/ machinery needed for 500- 1000 litres/day	Cost in US $
1	10 – 50litre milk cans	900
2	500 – 1000 litre milk cooling plant(if milk cans are not used for holding)	5,000
3	500 litre heating Kettle with plunger/stirrer	900
4	Impulse sealer	80
5	Lactometer, test-tubes, measuring scoops	2
6	Charcoal chiller for 6 -50litre milk cans	700
	Total	7,582

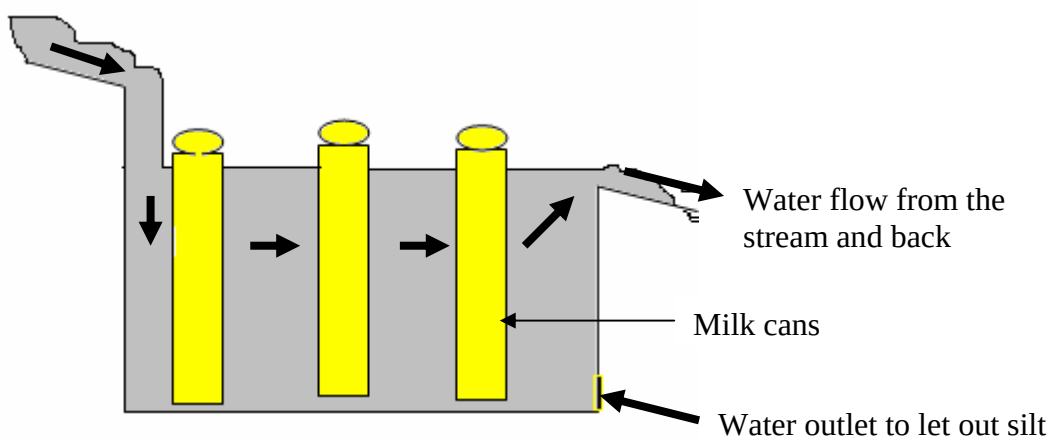
The process can be made more affordable by boiling the milk and processing it directly in the milk can. The milk is immersed in hot water and the temperature controls carried out accordingly. Stirring should be continuous to avoid fat separation. The culture incubation is inoculated into the milk can. Other advantages of using this method will be limiting the critical points where hazards are likely to occur.

Other equipments that can be used affordably for cooling milk and maintaining low temperature to prevent spoilage due to bacteria activity are use of charcoal fridges, and flowing river streams to cool milk. The design of cooling trough in the stream can be enhanced by construction of a concrete embankment that will effectively control the water flow and ease handling. Depending on the initial investment capital available a charcoal chiller may be used as an alternative to a cooling plant. Further there may be no need for either of milk is ordered for and delivered at the required time and in good quality.

If we fix the capacity to about 500 litres then the minimum fixed capital investment will consist of Item 1, 3, 4 and 5 amounts to US$ 1882.00. The working capital per day will be 500 litres at US$ 0.27 giving US$135.

Item No.	Input/ output description	Cost in US$
1	500 litres of milk at US$ 0.26	130
2	Labour 3 employees @ US 6/day	18
3	Water @ US$ 0.3/ cubic metre	2
4	Electric heating energy at 50KW-h per day	10
5	Packaging materials(1000-1/2 litre plastic cups)	200
6	Cultures and flavours @ US $ 60	60
7	Total	420
8	Miscellaneous services at 15%	63
9	Grand total per day	483
10	Costs of operating 20 days a month	9,660
11	Sales revenue at US$ 3 /litre(whole sale) for 500 litres for 20 days	15,000
12	Profit before tax	5,340
13	Total capital fixed +working =1882+ 462	2,344
14	Payback period = total capital/profit = one month	

Milk cooling in a stream – Nandi hills in the Kenyan rift valley



The advantage is that the river acts as a heat sink and is absolutely free of charge designed by ITDG

Charcoal Chiller

Use of charcoal fridges where there is sufficient water. It has possibility of chilling down to 4^{o}C. charcoal is highly porous and provide ideal surface for water evaporation. The heat of vaporisation is derived from the body services in contact with the charcoal thus leading to cooling.

The charcoal chillier in use at Mosoriot near Eldoret town in the northern rift valley of Kenya designed by ITDG

Annex IV

Fruit Juice processing

Juices are beverages derived from fruits and are used for quenching thirst. Preparation of juices varies depending on the type of fruit and the product being made. However, the preliminary treatments listed above apply to all the fruits. General steps for processing of juices include:

1. Selections of raw materials –Completely ripe fruits are used. Size and shape is not important in the selection of raw material for juices.
2. Size reduction of the material - this involves maceration, comminution or crushing of the fruits to destroy the cellular structure of the fruits. Crushers, hammer mills etc. can be used. This applies to such fruits as pineapples and pears but not to others like oranges and passion fruits.
3. Juice extraction from the material – this may be done by passing the material through a finisher. It separates the material into juice, seeds, pulp and peels if peeling had not been done. The thickness of the pulp is controlled by use of different screens as required. The process removes the undesirable material.
4. Clarification – some juices such as orange juice and apple juice have to be clarified using fine sieves or cloth to get rid of solid substances.
5. Pasteurization – different juices are given different heat treatments but generally temperatures of 60-90^{o}C/30 min are used.
6. Packaging – The juice is aseptically packaged hot in clean sterile containers. Alternatively, the juice could be packaged and then pasteurized afterwards.

Fig.1: Flow diagram for small scale juice processing

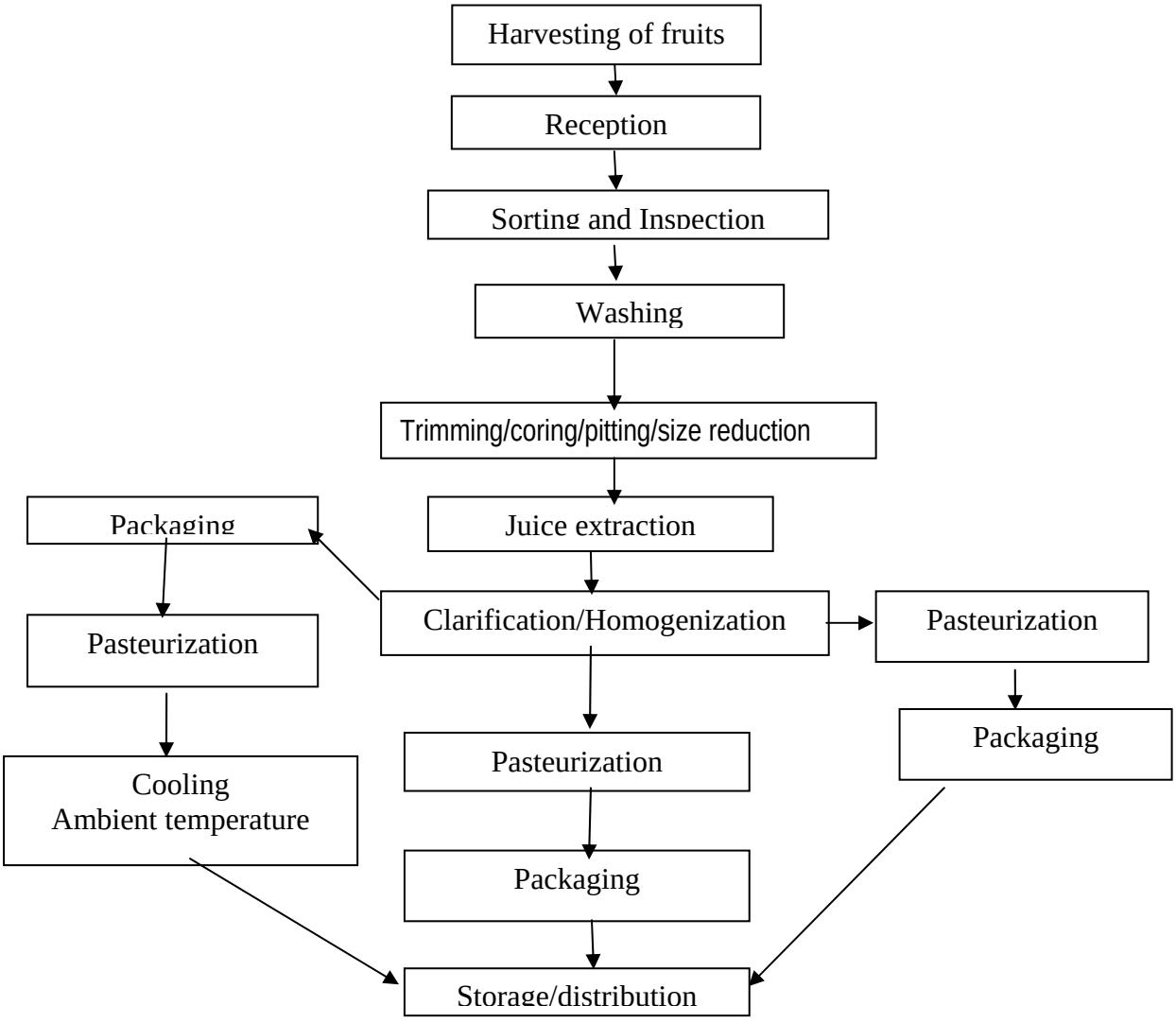
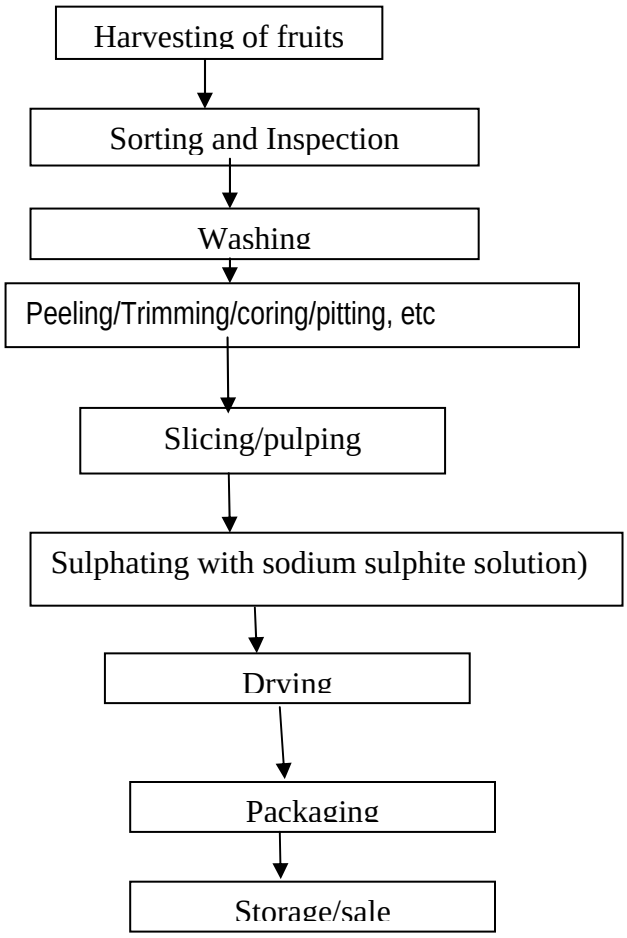


Fig.2: Flow diagram for small scale processing of Dried Fruits



Annex V

Potato processing technology

Potato processes – crisps making. Potato crisps are widely used as snacks.

I. Select potatoes which are at least the size of a chicken egg
II. Wash the potatoes with clean running water
III. Peel either by knife or potato peeler (the use of equipment is dependent on scale)
IV. Slice using a potato slicing machine and immediately dip in water to avoid browning due to oxidation
V. Drip dry with a centrifuge
VI. Deep fry immediately(this a process of expelling water from the potatoes to inhibit bacteria and fungal activity)
VII. Remove the crisps after it is evidence that no bubbles are coming out of crisps and the desired browning colour is attained.
VIII. Salt and flavours are added. They are then packaged in impervious airtight plastic packages or aluminium foil for distribution.

Equipment required and their costs

Item No.		Cost (US $)
1	Potato peeler	200
2	Potato slicer (manual)	80
3	Centrifuge – water dripper	150
4	Frying pans/deep fryer, frying ladles	70
5	Impulse sealing machine	70

The prices given are a guide within the range and market price in Nairobi. The prices will also increase with increased scale of production.

Annex VI

Practical action's experience in HACCP establishment in the north rift

ITDG/Practical Action in collaboration with the (Kenya bureau of standards) KEBS piloted the institution of HACCP within the context of a milk value chain. This included;

Activity 1

■*Grouping Farmers and Traders–organized by the players*

■*Formation of a HACCP Implementation teams consisting of farmers, bicycle transporters, pick up transporters and regulatory authorities*

■*Drawing of the HACCP plan with Kenya dairy board(KDB)*

■*Documenting the HACCP system*

Activity 2

■*Construction of bulking centres with simple cooling facilities*

■*Choosing a starting date*

■*Implementation of the HACCP plan*

■*Keeping records as per HACCP plan*

Activity 3

■*Testing*

■*Lactometer readings to be done 100% as part of monitoring at the CCPs*

■*Where the volume of milk per trader is large and testing takes in total more than one hour this can be reduced to 30%.*

■*Alcohol tests to be done only at bulking centres based on organoleptic appearance or at the rate of 30%*

Activity 4

■*KDB to do random tests at least once a month, as part of verification and verification data to be kept by the Board*

■*KDB to be the internal auditor*

■*Review of the system to be done once in a year.*

Hazards in milk marketing chain include

1. *Physical Hazards*
   Include but are not limited to cow dung, pieces of sisal twine or plastic fibres used for restraining the cow during milking, particles of soil, hair both from the cow and handlers and other dirt.

2. *Chemical Hazards*
   Include but are not limited to:
   - Veterinary drug residues from treated animals
   - Acaricides (dipping solution)
   - Pesticides used to control pests
   - Antimicrobial agents applied intentionally or accidentally (e.g. Hydrogen Peroxide)
   - Detergents and soaps due to poor rinsing of containers

3. *Physical Hazards*
   Include but are not limited to cow dung, pieces of sisal twine or plastic fibres used for restraining the cow during milking, particles of soil, hair from both the cow and handlers and other dirt.

4. *Chemical Hazards*
   Include but are not limited to:
   - Veterinary drug residues from treated animals
   - Acaricides (dipping solution)
   - Pesticides used to control pests
   - Antimicrobial agents applied intentionally or accidentally (e.g. Hydrogen Peroxide)
   - Detergents and soaps due to poor rinsing of containers

6. *Biological Hazards*
   Include but are not limited to:
   - High bacterial loads due to poor hygiene, long distance of the market from production areas and prolonged retention before boiling or pasteurization.
     Pathogenic bacteria associated with milk are coliforms (*Escherichia coli*), *Brucella abortus (brucellosis), and Mycobacterium bovis (TB)*
   - Viruses

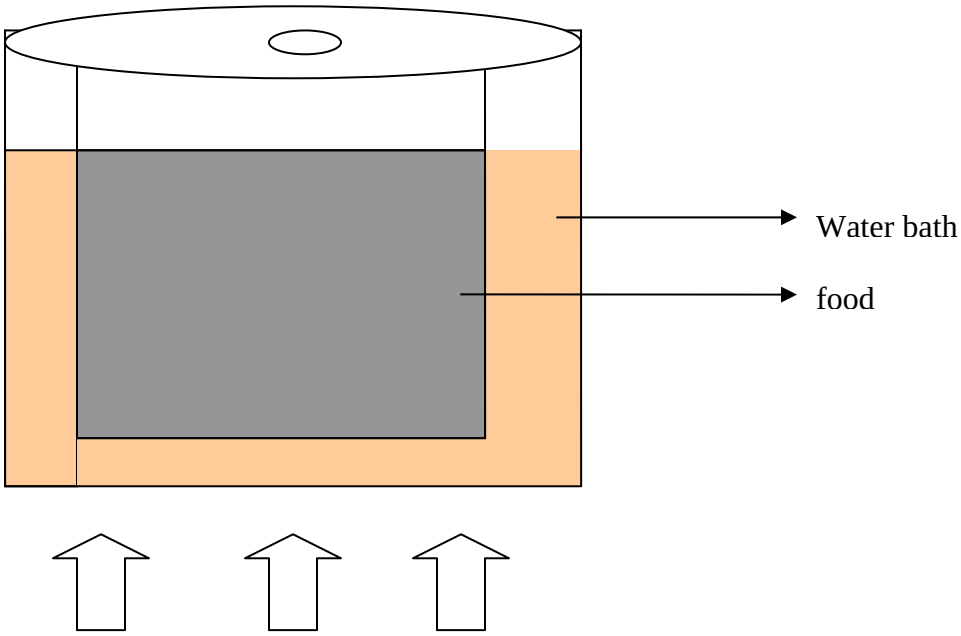
Results

After successful application of HACCP and formation of committees, the quality of milk reaching the market improved considerably. The milk losses due to spoilage/rejection dropped substantially. The volume of milk getting to the market increased by threefold. The public health and regulators took over the programme and have since graduated from policing to facilitation and the media is full of their messages.

Annex VII

Water bath system for food processing.

Direct heating in processing food is usually destructive to the nutrients and in some cases is known to cause chemical changes in food that tend degrade their benefits for human consumption. Water bath systems, which are at times referred, as heating kettle or food boilers are the most commonly used. The figure below illustrates the principle.



Fruit and vegetable driers. Have been extensively used in the Kenya, Uganda, and Tanzania. They are made of wooden structure covered with greenhouse polythene.

Annex VIII

Sources of food processing Equipment and materials

Unighir Ltd
P. O. Box 10049
Telephone +2542-533749/534682/536397/8
Fax: 534138/536398
Nairobi
E-mail; unighir@form-net.com

Promaco Ltd
P.O. Box 24556
Nairobi
Tel: +2542-884576,883586
Fax: 8845576,884031
E-mail: promaco@net2000ke.com
They import small-scale dairies as well as retailing cultures, impulse sealers, milk cooling plants

Specialised Engineering Co. Ltd
Addis Ababa Rd
Tel: +2542-536720
Nairobi.
Manufacture small-scale batch pasteurizers, pulpers, general food processing equipment

Rural technology enterprises
Lusaka rd Opposite City stadium
P. O. Box 28201
Nairobi
Tel: +2542-557946
Fax: 540447
Email: rteretap@nbnet.co.ke
Manufactures small scale food processing technologies

V D.K. Engineering Ltd
P.O. Box 28342
Tel: +2542-536389/537343/350258
Fax: 604940
Nairobi
Imports and manufactures food processing technologies – fruit pulpers, batch pasteurizers, plungers,

Vi Marina machinery (k) ltd – is a supplier of pulpers
Tel: +2542-556685, 559504, 553272,552834
Fax: 545656
Nairobi.

Vii Desbro Engineering Limited – is a supplier of electric kettle

Tel +2542-556907/555210/558802
Viii Kamco (K) Ltd
Tel: +2542- 536991/2/3
Manufacturers of pulpers, heating kettles, stainless steel products.

Viii Local supermarkets and household shops – are suppliers of cooking vessels and knifes.

Sources Of Packaging Materials
a). NAS plastics ltd
Enterprise road
P. o. Box 19170
Tel: +2542-552864, 553827, and 540185
Fax: 554214
Products: *plastic cups and bottles with lids of various sizes fit for packaging of honey, yoghurt, jams, and tomato pastes among other things. The containers are available in both clear and coloured textures.*

b). General plastics ltd
Enterprise road
P. o. Box 10032
Tel: +2542-530032/3/4/5,
Products: *plastic jars, cups, bowls and bottles which are used to package honey, sauces, jams, jellies, fruit juices, and cosmetics*

c). Afro plastics (K) ltd
Off Baba Dogo rd, Ruaraka
Tel: +2542-862041/2/4/5
Products: *plastic jars, cups, bowls and bottles which are used to package honey, sauces, jams, jellies, fruit juices, and cosmetics*

e). Techpack industries ltd
Ectoville est.
Tel: +2542-531980
Products: *plastic containers for packaging yoghurt and fresh produce.*

f). Thermopack limited
Manufacturers of disposable plastic containers
Funzi Road, off enterprise area
P.O. Box 17793, Nairobi
Tel: +2542-540077, 352025
Fax: 555358
Email: sales@thermopak.co..ke Web: www.thermopak.net

Products: *packages used for Horticulture, confectionery, dairy, meat/poultry, and fast food.*

Central glass industries
Thika road
Tel: +2542- 803681/860380 Nairobi

Milly Glassworks ltd – for glass bottles.
Tel: +264225201-4, 222448/9 Mombassa
Nairobi.

Specific sources for juice processing equipment

Name of equipment	Source	Contact Address	Price in US $
Manual Pulper	As in above mentioned suppliers	020 556685/020 559504	350
Electric Pulper			500 – 5,000
Electric Orange squeezer	Sheffield Steel Systems	020 553872/554256	400
Charcoal/firewood pasteurizer	Associated Steel Ltd, Mombassa Rd - Nairobi.	020 650141/352051	1,000
Glass Bottles 300ml	Central Glass Industries/Milly processors		6/ dozen with crate
Manual bottle capper	Kenya Industrial Research Development Institute (KIRDI)	020 535966/84/90	500
Crown Corks (caps)	Metal Crowns Ltd	020 532419/21/535805-8	
Polyethylene Tetra phthalate (PET) jars and lids	As in above plastic packaging materials supplier		2 /dozen
Laminated/metalized polyethylene sachets			From 3 -5 per 100pcs
Aluminum cooling troughs	Any Workshops that fabricate Aluminum wares	-	From 200 depending on the scale
Bottle holder	Any fabrication shop with ability to handle stainless steels	-	300 upwards depending on scale.

The above-mentioned equipments can be fabricated at CITT and the technologies disseminated to other fabricators within Kigali. It is best to first purchase prototypes from Kenya and where possible, get engineering drawings so as assist in the production. Where necessary the Practical Action/ITDG is ready to assist CITT to identify and link up with suppliers based in Nairobi.

Choice of packaging materials for Fruit Juices

The material found suitable for packaging of the fruit juices was glass bottles because these can resist the high temperatures required for Pasteurization/sterilization of the juices after filling or hot filling of pasteurized juice. The pasteurized juice need no preservatives and last for at least one year

Packaging Materials for Dried Fruits and Vegetables

The materials that were found suitable for the packaging of dried fruits and vegetables are glass/ PET jars or laminated/metalized polyethylene sachets because these materials good barrier properties against water vapour (moisture) and oxygen which is an important requirement for dried fruits and vegetables.

ANNEX IX

List of people and organisations visited

	Person contacted	Designation	Institution/organisation
1	James Muranura	Project officer	Nyagatare satellite centre -CITT
2	Dr. Kaunde	Head of food processing dept	CITT
3		Project officer	Ruhengeri satellite centre - CITT
4	Laurent Munyankusi	Head of WTCD	CITT
5	CITT technology showroom		CITT
6		Chairlady	Kacyiru women group at kacyiru Kigali
7		Record keeper	Umtara dairy marketing cooperative
8		Food technologist	
9	Sunrise Supermarket	Shop attendant	Rimera shopping centre
10		Shop attendant	Rimera shopping centre
11	Dr. Gafarasi Esidore	Livestock officer	MINAGRI
12	Raphael Mapayana	Deputy manager	Horticultural task force
13		Pineapple farmer	Nyagatare
14	Norbert Sendege	Post harvest technologies officer	MINAGRI- Rubirizi
15	Rosemary Kyokunde	Treasurer	Zion Temple project
16	Nyiramgwera Teresa	Chairlady	Zion Temple project
17	Mr. Nyirangarama	Managing Director	Nyirangarama food processors
18	Mr. Namtembesa	Standards officer	RBS
19			

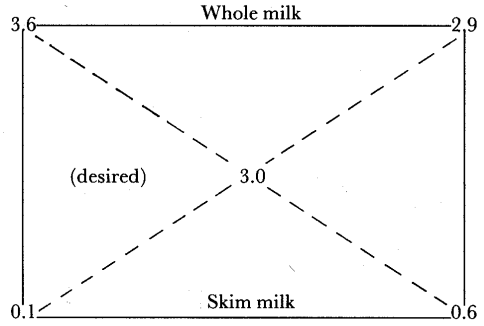
Annex X

Standardisation of milk and cream

The usual method of making standardization calculations is the **Pearson's Square technique**. To make this calculation, draw a square and write the desired fat percentage in the standardized product at its centre and write the fat percentage of the materials to be mixed on the upper and lower left-hand corners. Subtract diagonally across the square the smaller from the larger figure and place the remainders on the diagonally opposite corners. The figures on the right-hand corners indicate the ratio in which the materials should be mixed to obtain the desired fat percentage.

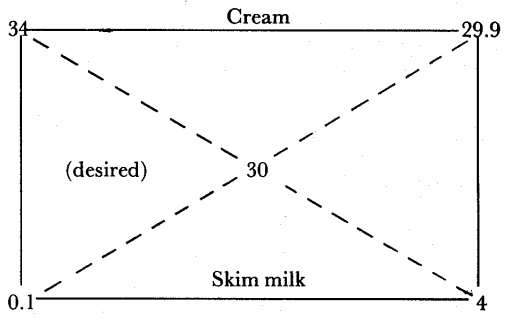
The value on the top right-hand corner relates to the material on the top left-hand corner and the figure on the bottom right relates to the material at the bottom left corner.

Example 1



In this example, the fat content of whole milk is to be reduced to 3.0%, using skim milk produced from some of the whole milk. Using Pearson's Square, it can be seen that for every 2.9 litres of whole milk, 0.6 litres of skim milk must be added.

Example 2

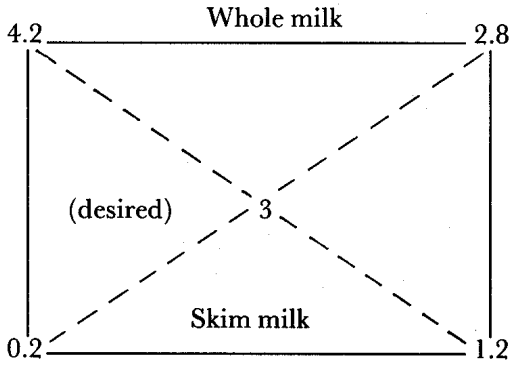


How much skim milk containing 0.1 % fat is needed to reduce the percentage fat in 200 kg of cream from 34% to 30%?

If 29.9 parts of cream require 4 parts of skim milk, 200 parts of cream require *x* parts of skim milk.

Weight of skim milk needed = *x* = (200 × 4)/29.9 = 26.75 kg

Example 3



The fat content of 300 kg of whole milk must be reduced from 4.2% to 3% using skim milk containing 0.2% fat.

Every 4.0 kg of the mixture will contain 2.8 kg of whole milk and 1.2 kg of skim milk.

If 2.8 kg of whole milk requires 1.2 kg skim milk, 300 kg of whole milk requires (1.2 × 300)/2.8 = 128.6 kg of skim milk

Thus, 128.6 kg of skim milk (0.2% fat) must be added to 300 kg of whole milk (4.2% fat) to give 428.6 kg of milk containing 3% fat.

ANNEX XI

Record keeping in dairy industry.

Record keeping in dairy industry combines quantity of milk supplied and traceability records which clearly detail the record history of the milk and consequently the supplier. This can be done as shown in the table below. The quantity is only filled if the milk is accepted.

MONITORING OF HACCP RECORD FORM

Date	Source/ Supplier	Container No	Tests Carried Out (Results)				Action	Quantity in litres
			Organoleptic	Lactometer reading	Clot of Boiling	Alcohol	Acceptance / Rejection	
18/8/05	Rugut	1	Sweet smelling white	26	Not clotted	Passed	Accepted	50
		2	Sour smell white	26	Clotted	Failed	Rejected	