



**CSIR-FOOD RESEARCH INSTITUTE
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**VALIDATION OF GOOD MANUFACTURING PRACTICES FOR
JUICE AND OTHER
PRODUCTS FROM BANANAS AND PLANTAINS**

By

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Introduction

Plantains and bananas are valuable starchy staples in Ghana. They provide not only a rich source of dietary energy (Stover and Simmonds, 1987) but also contribute to providing good quality diet and rural income (Ortiz and Vuylsteke, 1996). In Ghana, plantain contributes about 13.1% of the Agricultural Gross Domestic Product (AGDP) and its per capita annual consumption is 96.4kg per head (Lescot, 2000). It is a grate socio-economic and nutritional significance and generates considerable employment. In Ghana, plantains are consumed at 5 different stages of ripeness (green, half ripe, ripe, fully ripe and over-ripe). Fully ripe plantains are often deep fried or cooked in various dishes. Plantains and bananas are used as *Fufu*, *Ampesi* and as snack. They could also be processed into *Tatale*, *Kaaklo*, chips, flour and *ofam*. Recently bananas are being used for fruit juice.

1. Plantain Chips

Plantain chips are a product obtained by deep-frying thin sliced and spiced plantain in vegetable oil. There are two types. One is made from mature green plant and the second type is made from ripened plantain. They are all easily eaten as a snack only.

Theoretical unit operations	Practical unit operations	Observations
<p style="text-align: center;"> Fruit selection ↓ Washing ↓ Peeling ↓ Slicing ↓ Frying ↓ Draining ↓ Flavouring ↓ Cooling ↓ Packaging ↓ Labeling ↓ Transporting and Marketing </p>	<p style="text-align: center;"> Fruit selection(UnRipe and ripe <i>Apentu</i>) ↓ Washing ↓ Peeling ↓ Washing ↓ Slicing ↓ Frying (add spices) ↓ Draining ↓ Cooling ↓ Flavouring with salt ↓ Packaging ↓ Labeling ↓ Transporting and Marketing </p>	<p style="text-align: center;">Strengths</p> <ul style="list-style-type: none"> • <i>Apentu</i> (falsehorn) plantains are used • Fruits are washed before and after peeling to reduce microbial load • Clean tap water is used for washing • Spices (ginger, onion/garlic) are added during frying to improve flavour development <p style="text-align: center;">Weaknesses</p> <ul style="list-style-type: none"> • The slicers are not washed after each batch • The use of charcoal as source of heat may bring about uneven heat transfer. • Aluminium pans and stirrers are used for frying instead of stainless steel • Addition of salt after frying may bring uneven distribution of salt particles (specific amount per wt of chips)? • The oil used for frying is reused several times and new oil is added to make up for volume lost (rancidity) • No paper is used for draining the excess oil. • The fried chips are exposed to the atmosphere during cooling.

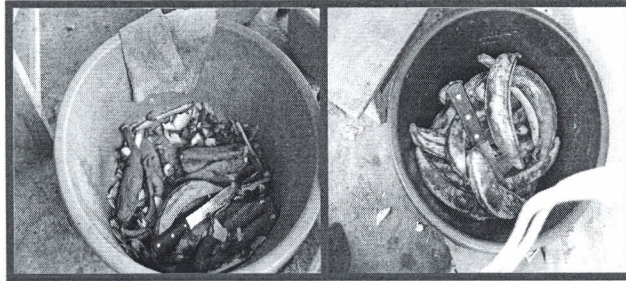


Fig. 1: Selection of fruits for chips preparation



Fig. 2: Washing and peeling of fruits

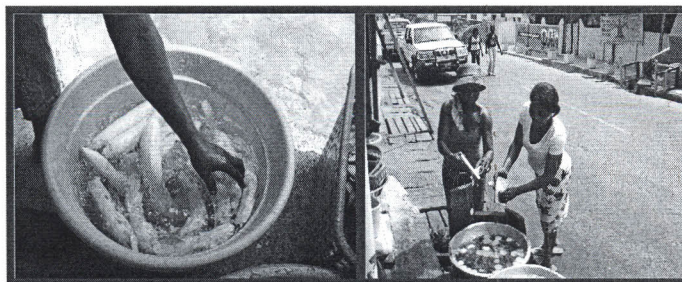


Fig. 3: Slicing of plantain into chips

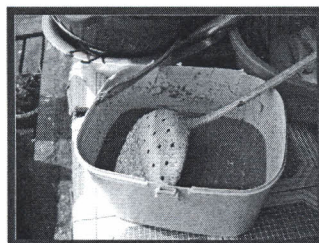


Fig.4: Spices added during frying of chips



Fig.5: Deep frying of chips

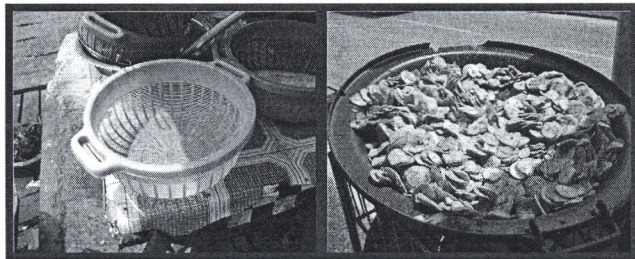


Fig.6: Draining of oil

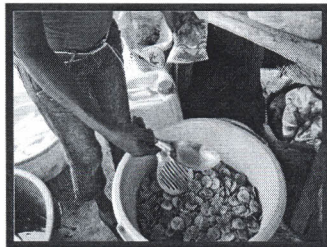


Fig.7: Flavouring chips with salt



Fig.8: packaging of chips into plastic bags

2. *Tatale*

Tatale is a fried over ripened plantain pancake. It is shallow fried in spoonfuls in a little hot palm oil until golden brown. Excess oil is drained on kitchen paper and served hot with cooked cowpea/bambara beans. It is eaten as a main meal.

Theoretical unit operations	Practical unit operations	Observations
<p>Fruit selection(over-ripe <i>Apentu</i>)</p> <p>↓</p> <p>Washing</p> <p>↓</p> <p>Peeling</p> <p>↓</p> <p>Blend with salt and spices</p> <p>↓</p> <p>Add wheat flour</p> <p>↓</p> <p>Mix</p> <p>↓</p> <p>Frying (with palmoil)</p> <p>↓</p> <p>Draining</p> <p>↓</p> <p>Packaging</p> <p>↓</p> <p>Marketing</p>	<p>Fruit selection(over-ripe <i>Apentu</i>)</p> <p>↓</p> <p>Washing</p> <p>↓</p> <p>Peeling</p> <p>↓</p> <p>Blend with salt and ginger, onion, pepper and spices</p> <p>↓</p> <p>Add wheat flour to bind</p> <p>↓</p> <p>Mix with a ladle</p> <p>↓</p> <p>Ferment</p> <p>↓</p> <p>Frying (Add bits of palm oil)</p> <p>↓</p> <p>Draining</p> <p>↓</p> <p>Packaging in polythene bags</p> <p>↓</p> <p>Put in warmer</p> <p>↓</p> <p>Marketing</p>	<p style="text-align: center;">Strengths</p> <ul style="list-style-type: none"> • Stainless steel bowls , spoons and frying pan are used • Blending as against pounding over -ripe plantains gives a better consistency. • Portions of Wheat flour are added to plantain mash to ensure the right texture. • Mash is left to ferment and expand. • The use of gas as a source of heat ensures uniform heat distribution. • The <i>tatale</i> is not deep-fried in palm oil (oil absorbed is minimal) • The frying pan was locally designed and fabricated from stainless steel. • Clean tap-water is used for the unit operations <p style="text-align: center;">Weaknesses</p> <ul style="list-style-type: none"> • Paper is not used in draining excess oil, making the product slightly soggy. • Burnt product may have acrylamide



Fig.9: Fruit selection for *tatale* preparation



Fig.10: Washing of selected fruits

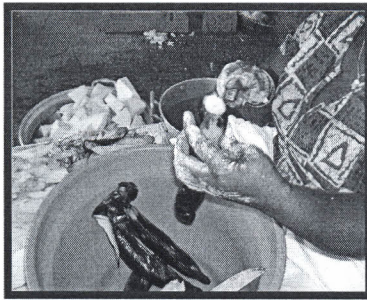


Fig.11: Peeling and slicing of fruits

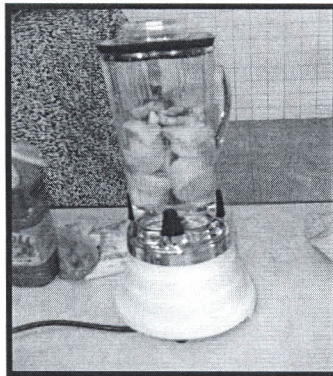


Fig.12: Blending with spices

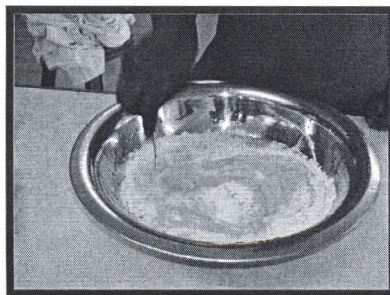


Fig.13: Addition of wheat flour to blended fruits

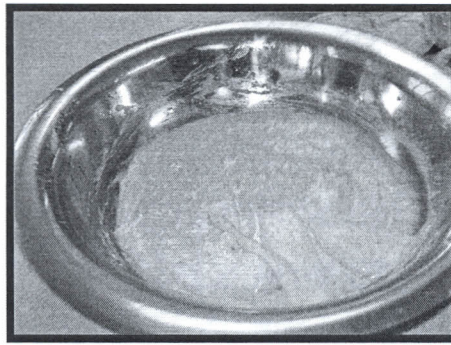


Fig.14: Fermentation stage

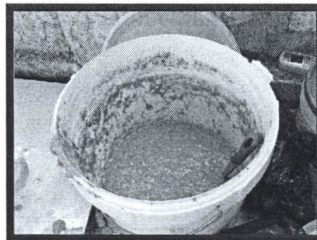


Fig.15: Blended plantain mixed with spices and wheat flour



Fig.16: Frying of *tatalé* with palm oil



Fig.17: Packaging of *tatalé* for marketing

3. Kakro

Kakro is a product made from over-ripe plantain fruit mixed with corn flour, powdered chilies, salt and other spices. It is deep-fried in vegetable oil into oval shapes. It is eaten as a main meal with cooked cowpea and palmoil (with gari).

Theoretical unit operations	Practical unit operations	Observations
<p>Fruit selection(Over-ripe <i>Apentu</i> and <i>Apem</i>)</p> <p>↓</p> <p>Washing</p> <p>↓</p> <p>Peeling</p> <p>↓</p> <p>Pounding with spices</p> <p>↓</p> <p>Frying</p> <p>↓</p> <p>Draining</p> <p>↓</p> <p>Cooling</p> <p>↓</p> <p>Packaging</p> <p>↓</p> <p>Marketing</p>	<p>Fruit selection(Over-ripe <i>Apentu</i> and <i>Apem</i>)</p> <p>↓</p> <p>Peeling</p> <p>↓</p> <p>Pounding</p> <p>↓</p> <p>Mix with roasted corn with pepper, ginger, salt and spices powder</p> <p>↓</p> <p>Frying</p> <p>↓</p> <p>Draining</p> <p>↓</p> <p>Cooling</p> <p>↓</p> <p>Marketing</p>	<p style="text-align: center;">Strengths</p> <ul style="list-style-type: none"> • Both <i>Apentu</i> (falsehorn) and <i>Apem</i> (French) plantains are used. • Roasted corn flour is used to serve as a binder • Clean tap water is used • The frying is done at high temperatures where microorganisms cannot survive. • The high sugar content of the fruit gives a low water activity that hinders growth of microorganisms <p style="text-align: center;">Weaknesses</p> <ul style="list-style-type: none"> • Plantains are not washed before peeling • The use of charcoal gives uneven distribution of heat. • Hands are used to mix the roasted corn flour and the mash. Though unhygienic, the high frying temperature takes care of microbes. In addition hands are also used to mould the mixture into oval shapes into oil • Use of wooden mortar and pestle for pounding is unhygienic • Aluminium pans, strainers,

		<p>frying pans and stirrers are used instead of stainless steel.</p> <ul style="list-style-type: none">• The oil used for frying is reused several times and new oil is added to make up for volume lost (rancidity)• Burnt product may have acrylamide
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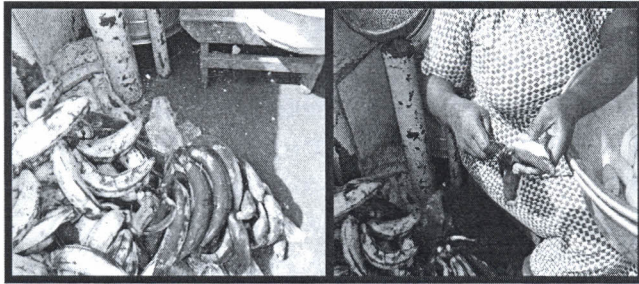


Fig.18: selection of over ripe plantain for *kaakro* preparation

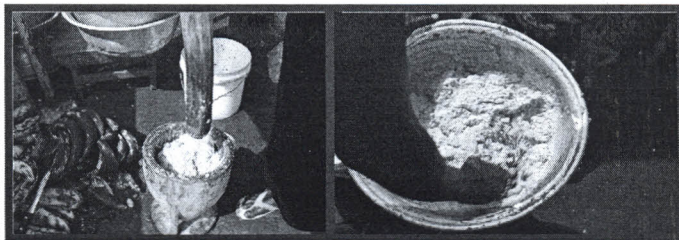


Fig.19: Pounding of plantain and mixing with spices and corn flour



Fig.20: Deep frying of *kakro*



Fig.21: Draining oil from fried *kakro*



Fig.22: Cooling and marketing of *kakro*

4. *Ofam*

Ofam is a baked plantain cake made from blended over-ripe plantain fruits mixed with powdered chilies, salt and other spices, palmoil and wheat flour. It is consumed as desserts and appetizers.

Theoretical unit operations	Practical unit operations	observations
<p>Fruit selection(over-ripe <i>Apentu</i>)</p> <p>↓</p> <p>Washing</p> <p>↓</p> <p>Peeling</p> <p>↓</p> <p>Pound in mortar and pestle</p> <p>↓</p> <p>Add salt and spices to taste</p> <p>↓</p> <p>Put in baking sheet</p> <p>↓</p> <p>Bake</p> <p>↓</p> <p>Packaging</p> <p>↓</p> <p>Marketing</p>	<p>Fruit selection(over-ripe <i>Apentu</i>)</p> <p>↓</p> <p>Washing</p> <p>↓</p> <p>Peeling</p> <p>↓</p> <p>Pound with wheat flour, pepper, ginger, salt and spices</p> <p>↓</p> <p>Add palm oil</p> <p>↓</p> <p>Put in baking sheet</p> <p>↓</p> <p>Bake</p> <p>↓</p> <p>Cooling</p> <p>↓</p> <p>Packaging</p> <p>↓</p> <p>Marketing</p>	<p style="text-align: center;">Strengths</p> <ul style="list-style-type: none"> • Stainless steel pans were used • Temperature and time for baking were specific. Will ensure product uniformity • Spoons are used to mix and dish out the mash into baking pans <p style="text-align: center;">Weaknesses</p> <ul style="list-style-type: none"> • Use of wooden mortar and pestle for pounding is unhygienic • Aluminium instead of stainless steel pans are used for baking. • Fruits are not washed after peeling.

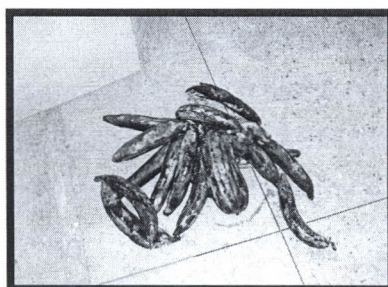


Fig.23: Fruit selection for *ofam*



Fig. 24: Washing of selected fruits



Fig.25: Peeling of fruits



Fig.26: Pounding of only fruits

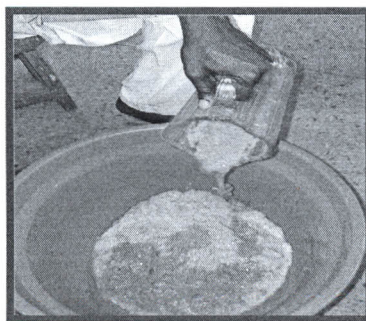


Fig.27: Addition of spices to pounded fruits

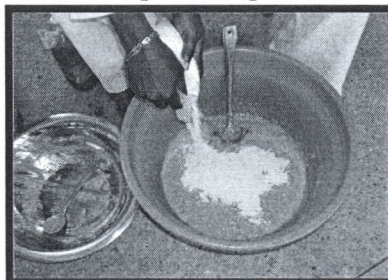


Fig.28: Addition of wheat flour



Fig.29: Addition of palm oil



Fig.30: Dishing out into baking pans

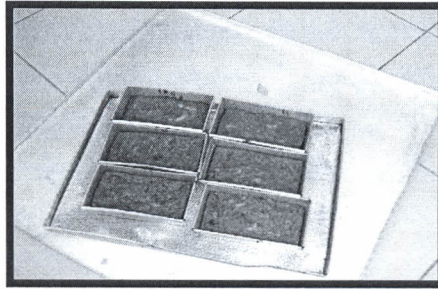


Fig.31: Baked *ofam*

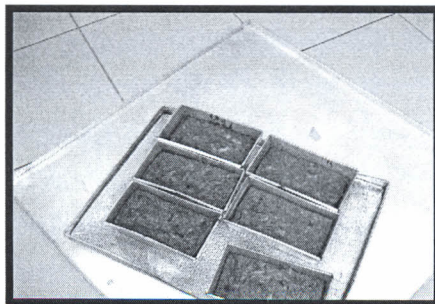


Fig.32: Cooling stage

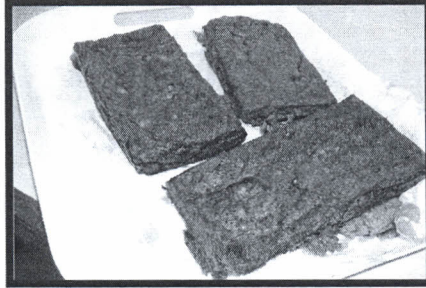


Fig.33: Final product

5. Banana juice

Banana juice is a beverage from the pulp of ripe banana in combination with other fruits such as pineapple and orange.

Theoretical unit operations	Practical unit operations	observations
<p>Fruit selection ↓ Peeling ↓ Pulping ↓ Sieving ↓ Formulation ↓ Pasteurisation ↓ Filling bottles ↓ Marketing</p>	<p>Fully ripe bananas free from moulds selected ↓ Peel into 1% sodium metabisulphite solution ↓ Pulped with a blender into orange/pineapple juice. ↓ Sieved through a fine mesh ↓ Formulation: pH and brix adjustment, addition of preservative ↓ Pasteurization at 70°C for 10min, Sodium metabisulphite is added ↓ Filling into sterile bottles and capped immediately ↓ Kept in cool dry place away from sunlight ↓ Marketing</p>	<p style="text-align: center;">Strengths</p> <ul style="list-style-type: none"> • Fruits were washed in 1% sodium metabisulphite and citric acid to reduce microbial contamination. • All the working surfaces and items used were sterilized with 1% sodium metabisulphite and citric acid • Bananas were peeled into citric acid solution to prevent browning. • Head gear, laboratory coat gloves were worn. • A clean fine mesh was used in sieving to obtain a clear juice. • Preservatives were added. • Juice was filled hot into sterile bottles. • Temperature during sterilization was monitored. <p style="text-align: center;">Weaknesses</p> <ul style="list-style-type: none"> • An aluminium utensil instead of stainless steel is used during pasteurization.

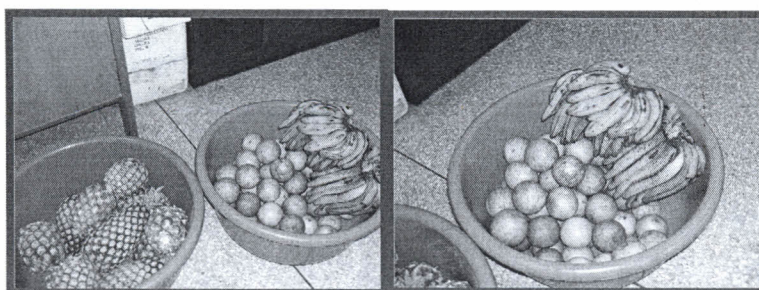


Fig. 34: Fruit selection for banana juice preparation

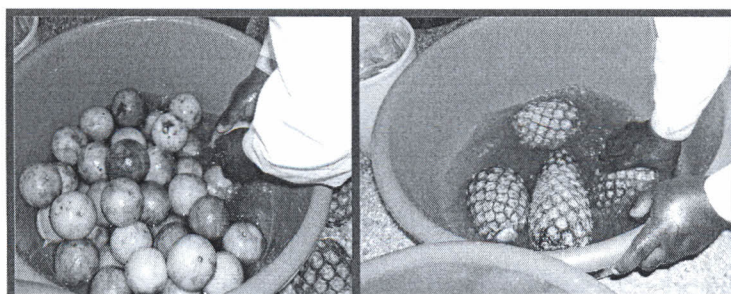


Fig.35: Washing of fruits

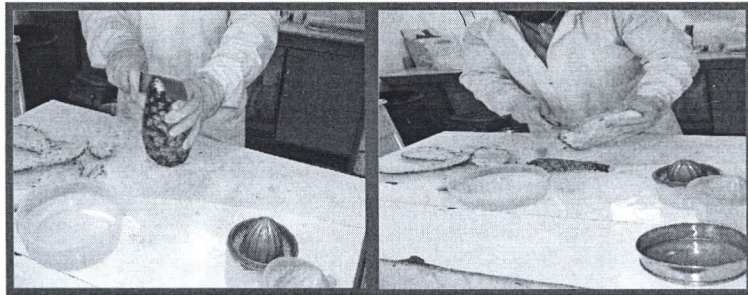


Fig. 36: Peeling of pineapple fruit



Fig. 37: Peeling of banana

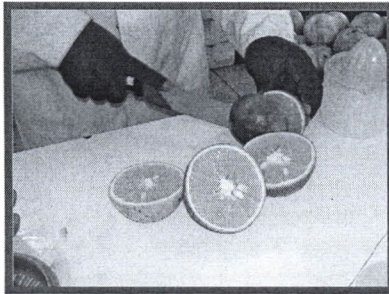


Fig.38: Cutting of oranges for juice extraction

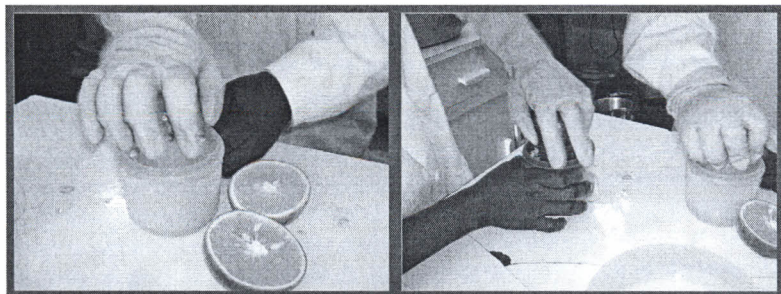


Fig. 39: Juice extraction from orange

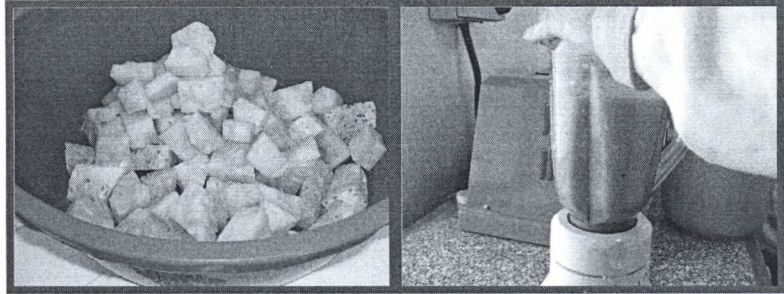


Fig. 40: Extraction of pineapple juice

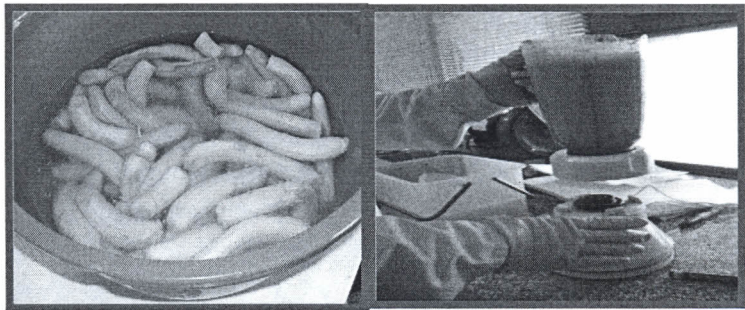


Fig. 41: Pulping of banana in orange/pineapple juice



Fig.42: Sieving of banana-orange/pineapple blend

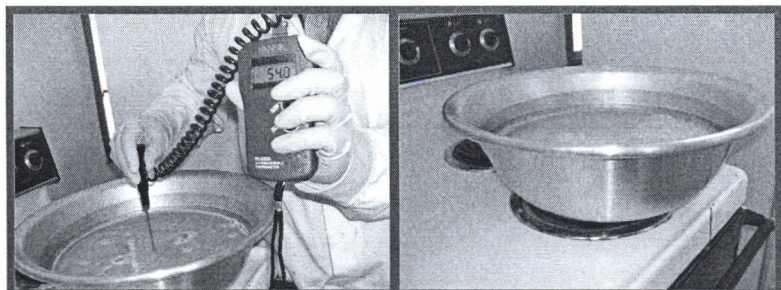


Fig.43: Pasteurization of banana-orange/ pineapple blends



Fig.44: Filling of bottles with banana-orange/pineapple juice

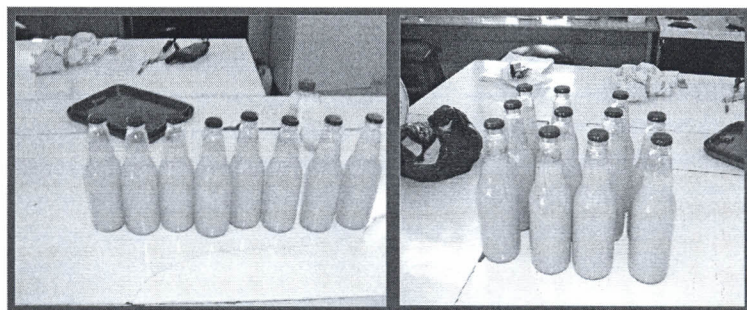


Fig.45: Marketing of juice