PM Formalisation of

Micro Food Processing Enterprises (PM-FME) Scheme

HANDBOOK OF

PREPARATION OF PINEAPPLE CANDY

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TABLE OF CONTENTS

CHAPTER 1
INTRODUCTION

1.1 History of Pineapple

The pineapple (*Ananas comosus:* Bromeliaceae) is one of the most popular tropical fruits. The name *pineapple* in English (or *piña* in Spanish) comes from the similarity of the fruit to a pinecone. *Ananas* comes from *anana*, the Tupi word for the fruit, meaning "excellent fruit". *Comosus* means *tufted* and refers to the stem of the fruit.

Pineapple is an important tropical fruit showing an increasing demand world wide, over the years. World trade on fresh pineapple has shown 100 % increase during the last one decade. Even though India is the fifth largest producer of pineapple in the world, its share in the world market is only 0.1 %. The different Asian countries and the countries around the Indian ocean is importing about two lakh tons of pineapple in an year, mostly coming from distant countries. This market can be exploited by Kerala if an earnest effort is made in the right direction.

1.1.1 Importance

Pineapple (*Ananas comosus*, Bromeliaceae) is a wonderful tropical fruit having exceptional juiciness, vibrant tropical flavour and immense health benefits. Pineapple contains considerable calcium, potassium, fibre, and vitamin C. It is low in fat and cholesterol. Vitamin C is the body's primary water soluble antioxidant, against free radicals that attack and damage normal cells. It is also a good source of vitamin B1, vitamin B6, copper and dietary fibre. Pineapple is a digestive aid and a natural Anti-Inflammatory fruit. A group of sulfur-containing proteolytic (protein digesting) enzymes (bromelain) in pineapple aid digestion. Fresh pineapples are rich in bromelain used for tendering meat. Bromelain has demonstrated significant anti-inflammatory effects, reducing swelling in inflammatory conditions such as acute sinusitis, sore throat, arthritis

and gout and speeding recovery from injuries and surgery. Pineapple enzymes have been used with success to treat rheumatoid arthritis and to speed tissue repair as a result of injuries, diabetic ulcers and general surgery. Pineapple reduces blood clotting and helps remove plaque from arterial walls. Studies suggest that pineapple enzymes may improve circulation in those with narrowed arteries, such as angina sufferers. Pineapples are used to help cure bronquitis and throat infections. It is efficient in the treatment of arterioscleroses and anaemia. Pineapple is an excellent cerebral toner; it combats loss of memory, sadness and melancholy. Pineapple fruits are primarily used in three segments, namely, fresh fruit, canning and juice concentrate with characteristic requirements of size, shape, colour, aroma and flavour.

1.2 Statistics

1.2.1 Global scenario

Pineapple exhibits increasing demand world wide, over the years. The global trade is around 50% as fresh fruit, 30% as canned product and 20% as juice concentrate. World trade on fresh pineapple has shown 100 % increase during the last one decade. Even though India is the sixth largest producer of pineapple in the world with a share of about 8% in production, its share in the world market is negligible. The main pineapple producers are Brazil, Thailand, Philippines, Costa Rica, China, India and Indonesia. The different Asian countries and the countries around the Indian ocean are importing about two lakh tonnes of pineapple in a year, mostly coming from distant countries. The leading exporters are Costa Rica, Belgium, Cote d'Ivoire, Philippines, Ghana, Netherlands, USA and France. Major importers are USA, Belgium, France, Italy, Germany, Japan and UK. MD2 or Dinar pineapple developed through hybridisation by Del Monte scientists in Costa Rica is the most popular variety in the international market because of its colour, flavour, shape, life span and ripeness being superior to other varieties.

1.2.2 National scenario

India ranked sixth with a share of about 8 % of the world production of pineapples. The total area under pineapple cultivation in India is 84000 hectares with a production of about 1341000 t. India exports pineapple mainly to Nepal, Maldives, United Arab Emirates, Saudi Arabia, Kazakhstan, Oman, Bahrain, Bangladesh, Zambia, Pakistan and Qatar. 'Kew' and 'Mauritius' are the two varieties of pineapple grown in India. It is grown in Karnataka, Meghalaya, West Bengal, Kerala, Assam, Manipur, Tripura, Arunachal Pradesh, Mizoram, and Nagaland. It is also cultivated on limited areas in the coastal belt of Tamil Nadu, Goa and Orissa. Though Assam has the largest area under pineapple West Bengal is the largest producer. Karnataka, West Bengal and Bihar are the three states reporting high productivity. Overall, Indian productivity of 16.00 t/ha poorly compares with the world average of 22.58 t/ha.

1.2.3 Important varieties cultivated in different states of India are given below :

State	Varieties mostly grown
Assam & other N.E. states	Kew, Queen, Mauritius
Kerala	Mauritius, Kew, Queen
West Bengal	Giant Kew, Queen

1.3 Value Added Products from Pineapple

Any step in the production process that improves the product for the customer and results in a higher net worth, is known as value addition. Typical value-added products include jams, jellies, preserves, fruit sauces and spreads, pickles, preserved vegetables, tapenades, hot chili sauces, extra virgin olive oils, herb-flavored olive oils and vinegars, and salsas.

Typically fruits and vegetables have a low price when they are in the raw state, but can be processed into a range of dried foods, jams, juice, pickles and etc, which have a

considerably higher value. The high added value means that the amount of food that must be processed to earn a reasonable income is relatively small. Hence, the size and type of equipment required to operate at this scale can kept to levels that are affordable to most aspiring entrepreneurs. In many countries, vegetables and fruits are among the most accessible raw materials for processing.

1.3.1 Pretreatments prevent fruits from darkening during long-term storage

Sulfuring:

In this method, sublimed sulfur is ignited and burned in an enclosed box with the fruit. The sulfur fumes penetrate the fruit and act as a pretreatment by retarding spoilage and darkening of the fruit. The sulfur fumes also reduce the loss of vitamins A and C.

Sulfite dip:

Sulfite dips can achieve the same long-term anti-darkening effect as sulfuring, but more quickly and easily. Either sodium bisufite or sodium meta-bisulfite that are USP (food grade) or Reagent grade (pure) can be used.

Directions: Dissolve ¾ to 1 ½ teaspoons sodium bisufite per quart of water. (If using sodium sulfite, use 1 ½ to 3 teaspoons. If using sodium meta-bisulfite, use 1 to 2 tablespoons.) Place the prepared fruit in the mixture and soak 5 minutes for slices, 15 minutes for halves. Remove fruits, rinse lightly under cold water and place on drying trays for drying.

Ascorbic Acid

Ascorbic acid (vitamin C) mixed with water is a safe way to prevent fruit browning. However, its protection does not last as sulfuring or sulfiting.

Directions: Mix 3000 mg ascorbic acid tablets, crushed in 2 cups of water. Place the fruit in the solution for 3 to 5 minutes. Remove fruit, drain well and place on dryer trays. After this solution is used twice, add more ascorbic acid.

Fruit juice dip

A fruit juice that is high in vitamin C can also be used as a pretreatment, though it is not as effective as pure ascorbic acid. Juices high in vitamin C include orange, lemon, pineapple, and grape. Each juice adds its own color and flavor to the fruit.

Directions: Place enough juice to cover the fruit in a bowl. Add sliced fruit. Soak 3 to 5 minutes, remove fruit, drain well and place on dryer trays. This solution may be used twice, before being replaced.

Honey dip

Honey dipped fruit is much higher in calories.

Directions: Mix ½ cup sugar with 1 ½ cups boiling water. Cool to lukewarm and add ½ cup honey. Place fruit in dip and soak 3 to 5 minutes. Remove fruit, drain well and place on dryer trays.

1.4 Scope of Pineapple Industry

- Standardization of technology to bring down cost of production of fresh pineapple and its adoption by growers, assured market for the produce and to produce pineapple throughout the year may go a long way in promoting pineapple industry in India.
- The bulk of the world production of pineapple is used by canning industry and the trade in fresh fruits is limited. About 97% of the world output is utilized by

processing industry. Among the canned fruits, pineapples are important next only to peaches.

Though pineapple is an excellent material to be preserved in different forms; bulk of the pineapple produced in the country is consumed in fresh form, the production used for processing being less than 10%. This is in contrast to the principal producing countries, where over 95% of the pineapple is absorbed by the processing industry.

The processing industry for pineapple is not very well developed in India. Major constraints in processing of pineapple are as follows :

1. High cost of canning due to high cost of fruit, sugar, containers and overheads.
2. Non-availability of fruits throughout the year.

CHAPTER 2

PREPARATION OF PINEAPPLE CANDY

2.1 Pineapple Processing

Pineapple is one of the popular fruits and is liked by majority of the people irrespective of their age group. As is the case with most of the fruits and vegetables, their availability is limited during off-seasons. Many techniques have been developed to make available seasonal fruits as well as vegetables even during off-season. The pineapple does not lend itself well to freezing, as it tends to develop off flavours and lose texture or crispiness. This fruit is highly perishable and seasonal. Hence processing is necessary. Processed pineapple is popular and is exported by many countries. Brazil is considered the main pineapple producing country in the world since 2005. During processing, nutritional quality of pineapple can be affected but there are recent researches carried out which use new technologies to retain the nutritional quality of the pineapple fruit.

This is to meet the consumer demand for healthy, nutritious and natural products. Some of the food industries based on pineapple are described below.

2.1.1 Pineapple dried products

Dried pineapple for processing is used in many areas such as an ingredient in confectioneries, breads and desserts. Dried fruits are often eaten directly out of the container, with yogurt, or by adding them to homemade baked goods such as cookies. They are generally added in processed foods such as snacks including biscuits, cookies, chocolates, bread, yogurt, fruit jelly, breakfast cereal, health foods, or sauce for Japanese-style pancakes. Bakery products and breakfast cereal mixes are the largest end users of dried fruit. According to the Institute of Food Technologists, dried fruits and fruit chips are the hottest trends in the snack business.

Pineapple can be dried as slices. They can be freeze dried. Fresh fruit is frozen and placed in a drying chamber under vacuum. Heat is applied and water evaporates from the fruit while still frozen.

The fruit becomes very light and crispy and retains much of its original flavour. Dried fruit is widely used by the confectionery, baking, and sweets industries. Because of its nature, organic production is highly suitable for small and medium-sized farmers working in areas which may not be suitable for large-scale food production. Pineapple is one among important organic products within the segment of preserved fruit for industrial use.

Dried fruit is mainly used as a snack or in breakfast cereals, bakery products, dairy products and desserts. The types of dried fruits used and the types of processed foods applicable diversify every year. Hence greater opportunities are there for pineapple drying industries.

2.2 Current trends in pineapple processing

Some of the processing methods using the new technologies are as follows:

i. Vacuum frying - This is a technology where food products are deep fried under vacuum or near vacuum conditions to reduce the fat content compared to normal deep-frying. It is a process that produces healthy fruit snacks (pineapple chips) which partially preserve the fruit's original colour and nutritional compounds and have a high hydrophilic antioxidant capacity.

ii. Radiation processing - Under radiation processing, the food is subjected to radiation by exposing it to a source of ionising radiation. This ionising radiation usually is in the form of gamma rays from a source of cobalt-60 or from a non-radioactive source like electron beam generated from electricity. A dose of 2 kGy did not affect significantly the nutritional value as well as the sensory quality of minimally processed pineapple.

iii. Thermal processing – Thermal treatments are critical in controlling foodborne pathogens in ready-to-eat (RTE) food products. Food products are subjected to a combination of temperature (80□C to 150□C) and time (30 minutes to few seconds) required to eliminate desired number of microorganisms. It helps in the improvement of colour, as a quality attribute of processed pineapple puree. This is made possible by the increase in knowledge of kinetics of colour change.

iv. Ultrasound drying - This is a pre-treatment for drying of pineapple. Ultrasound pre-treatment consists in immersing fruit pieces in water or in an osmotic solution and to subject the fruit and solution to ultrasonic waves (at frequencies ranging from 18 to 40 kHz) for a period of time (usually less than 60 min). Ultrasound is showed to have higher influence on fruits with high water content (pineapples, melons) and high content of fibers and phenolic cells.

v. Osmotic evaporation – It is the partial removal of water from plant tissues by immersion in a hypertonic (osmotic) sugar or brine solution. Water is removed by evaporation at atmospheric pressure and temperatures near the ambient temperature. The pineapple juice is concentrated at moderate temperatures and pressures with good

nutritional and sensory qualities. This process has minor changes in the concentrated juices which makes it more preferable.

vi. High pressure technology - This method is used in food processing where food borne micro-organisms and enzymes are inactivated at low temperature, without the need for chemical preservation. It is a cold pasteurization technique which consists of subjecting food, previously sealed in flexible and water-resistant packaging, to a high level of hydrostatic pressure (pressure transmitted by water) up to 600 MPa / 87,000 psi for a few seconds to a few minutes. This is done in fruit juice processing to preserve most of the nutritional qualities similar to a fresh product.

2.2.1 Fruit Processing

Fruits are highly perishable items which needs processing to make it durable. Fruit processing is any deliberate change in a fruit that occurs before it's available for us to eat. Processing methods extend the shelf life of fruits.

Fruit processing has three major aims:

1. To make fruit safe (microbiologically & chemically).
2. To provide good quality products with good flavor, color, texture and taste.
3. To make convenient fruits products

Fruits should be prepared for preservation as soon as possible after harvesting within 4 to 48 hours. As time passes spoilage increases rapidly. Fruit processing involves many steps.

Cleaning and washing

First, the fruits should be cleaned thoroughly to remove any adhering dirt or pesticide residues. This cleaning process usually involves washing the product with running water.

Sorting

To achieve a uniformly sized product, fruits and vegetables are sorted immediately after cleaning according to their size, shape, weight or colour. Sorting by size is especially important if the products are to be dried or heated, because their size will determine how much time will be needed for these processes.

Peeling

Many types of fruits have to be peeled in order to be preserved. This can easily be done with a stainless steel knife. It is extremely important that the knife be made of stainless steel because this will prevent the discoloration of the plant tissues.

Cutting

Cutting is important in order to get uniform pieces for heating, drying and packing. Fruits are usually cut into cubes, thin slices, rings or shreds. The cutting utensils have to be sharp and clean to prevent micro-organisms from entering the food.

Blanching

Blanching is a slight heat treatment, using hot water or steam that is applied mostly to fruits before canning or freezing. It is done by immersing fruits in water at a temperature of 90-95°C. The result is that fruits become soft and the enzymes are inactivated. Blanching is done before a product is dried in order to prevent unwanted colour and odour changes and an excessive loss of vitamins.

2.3 Fruit Preservation

Fruit preservation is the process of treating and handling food to stop or slow down fruit spoilage, loss of quality, edibility or nutritional value and thus allow for longer fruit storage.

Preservation usually involves preventing the growth of bacteria, fungi (such as yeasts), and other micro-organisms as well as retarding the oxidation of fats which causes

rancidity. Fruit preservation can also include processes which inhibit visual deterioration, such as the enzymatic browning reaction in apples after they are cut, which can occur after fruit cutting.

Many processes designed to preserve food will involve a number of fruit preservation methods. Preserving fruit by turning it into jam, for example, involves boiling (to reduce the fruit's moisture content and to kill bacteria, yeasts, etc.), sugaring (to prevent their re-growth) and sealing within an airtight jar (to prevent recontamination).

Maintaining or creating nutritional value, texture and flavor is an important aspect of fruit preservation.

Preservation methods

Drying

Drying is one of the most ancient fruit preservation techniques, which reduces water activity sufficiently low to prevent bacterial growth. Drying is the partial removal of water from solid foods. It is one of the oldest methods of food preservation. It was traditionally carried out in the presence of sun.

Refrigeration

Refrigeration preserves fruit by slowing down the growth and reproduction of micro-organisms and the action of enzymes. Refrigerators should be set to below 4°C to control the growth of micro-organisms. This lowered temperature also reduces the respiration rate of fruits and retard the spoilage.

Commercial and domestic refrigerators improved the shelf life of foods such as fresh fruits and salads to be stored safely for longer periods, particularly during warm weather.

Vacuum packing

Vacuum-packing stores food in a vacuum environment, usually in an air-tight bag or bottle. The vacuum environment strips bacteria of oxygen needed for survival, slowing spoiling. Vacuum-packing is commonly used for storing dried fruits to reduce loss of flavor during oxidation.

Freezing

Freezing is also one of the most commonly used processes commercially and domestically for preserving fruit including prepared fruit stuffs which would not have required freezing in their unprepared state. Lowering the temperature below the freezing point of the product stops microorganisms from growing and reduces the activity of enzymes. Fruits are heat treated (blanched) before freezing to eliminate enzymes. Home freezers are held at -10°C,commercial freezers are under -18°C. At this temperature, the growth of micro-organisms is almost stopped.

Pasteurization

Pasteurization is a process of heating a product at a specific temperature for a controlled period of time to destroy the most heat resistant vegetative pathogenic organism. The process is also applied for fruit juices and juice products.

Canning

Canning involves cooking food, sealing it in sterile cans or jars and boiling the containers to kill bacteria.

2.3.1 Importance of Sugar & Preservatives in Fruit Preservation

Sugar is used to preserve fruits, either in syrup with fruit such as apples, pears, peaches, apricots, plums or in crystallized form where the preserved material is cooked in sugar to the point of crystallization and the resultant product is then stored dry. This method is used for the skins of citrus fruit (candied peel) and ginger.

Preservative / food additives can be antimicrobial; which inhibit the growth of bacteria or fungi, including mold or antioxidant; such as oxygen absorbers, which inhibit the oxidation of fruit constituents. Common antimicrobial preservatives include calcium propionate, sodium nitrate, sodium nitrite; sulfites (sulfur dioxide, sodium bisulfate, potassium metabisulfite, etc) and antioxidants which include BHA (Butylated Hydroxy Anisole) and BHT (Butylated Hydroxy Toluene).

Storage

Always store the preserved food in a cool place, at a temperature below 20°C. Keep glass bottles and jars out of light. The storage area has to be dry and with a consistent temperature. Moisture will make tins rust.

2.4 Formulation of Pineapple Candy

Raw Materials Required	Weight
Pineapple Fruit	**40 %**
Sugar	**20 %**
Citric Acid	**0.1 %**
Water	**40 %**

2.4.1 Flow chart for Pineapple Candy

Selection of Fruits

↓

Washing

↓

Pricking with fork

Salt treatment
(kept in 2% salt solution for 24hrs)

↓

Washing & alum treatment

(Kept in 2% alum solution for 24hrs)

↓

Washing & blanching till become soft

↓

Steeping in 50% sugar syrup (24hrs)

↓

Steeping in 60% sugar syrup (24hrs)

↓

Adding of citric acid 1.5g/sugar

↓

Steeping in 70% sugar syrup (24hrs)

↓

Steeping in 75% sugar syrup (24hrs)

↓

Drawing excess sugar syrup

↓

Coating with pectin or sugar

↓

Shade drying upto 15% moisture

↓

Packing in polyethylene pouches

↓

Store in cool and dry place

2.4.2 FPO Specification:

1. Total sugar not less than 70 %
2. Reducing sugar(as per cent of total sugar) is not less than 25 %

2.4.3 Equipments involved

Blancher

VEGETABLE CUTTER

TRAY DRYER

CHAPTER 3

PACKAGING OF PINEAPPLE CANDY

3.1 Characteristics of Candy

Pineapple candy is hygroscopic in nature and requires protection against the ingress of moisture, and exposure to high temperature. A candy or candies product may be adversely affected by many things. Hard candy, brittles and crunch products are most sensitive to moisture and absorb water vapour fairly rapidly from the atmosphere.

The factors that lead to spoilage of candies are highlighted as below:

Crystallisation

The sugar component of most of the candies are in a soluble form and it is essential that this form be maintained, since crystallisation of the sugar alters the taste and texture giving impression of an old product. Moisture interchanges play a major decisive role in deciding the shelf-life of candies items. The Equilibrium Relative Humidity (ERH) of a confection during its life determines its sensitivity towards all physico-chemical changes that occur due to environmental conditions. Data on moisture sorption characteristics of a candies are very important in understanding the storage stability as regards its chemical and physical changes, growth of microorganisms and also drying characteristics and product formulation and package selection.

Sugar Bloom

Candies can be affected by condensation giving sugar bloom, in which a fine layer of sugar crystals form on the surface of the product. This renders it un-saleable and if left unchecked can lead to mould growth.

Odour Absorption

Odour absorption by oils and fats can also be a problem. Odourous compounds are often very soluble in oils and fats and can be readily absorbed from materials such as paints, printing inks, petroleum oils and disinfectants. When the product is eaten, the odours are released in the mouth producing objectionable flavours. Candies can also

deteriorate in other ways including exposure to heat, light, moulds, yeast, foreign odours and mechanical damage.

Selection of Packaging Material

Factors to consider include product damage, fines, stickiness, bag opening size, re-closure among other things. In selection of packaging materials for candy the following need to be considered:

Water Vapour Transmission Rate (WVTR)

Knowledge of WVTR of packaging materials and the effect of folding, creasing, crumpling of materials on papers and aluminium foil show considerable effect. However, thermoplastic materials are not much affected.

Effect of Folding and Crumpling on the WVTR of candy

	WVTR, g/m², 24 hr. 38°C & 90% RH.			
	Flat	Folded	Crumpled	Gelboflex
Met PET (12µ)	0.9	1.7	3.4	18
Met PET / LDPE (50µ)	0.5	0.6	0.7	0.6
2-sides PVDC coated PET	4.2	3.7	5.9	4.8
2-sides PVDC coated PET/LDPE	2.9	3.6	3.3	3.1

Gas Transmission Rate

Permeability to gases like oxygen decides the shelf-life of oxygen sensitive candies items. The oxygen transmission rates (OTR) of some plastic materials and the effect of folding and Crumpling.

Effect of Folding and Crumpling on the OTR

	Oxygen transmission rate, ml /m², 24 hr. Atm. at 25°C.			
	Flat	Folded	Crumpled	Gelboflex
Met PET (12µ)	< 1	5.5	16	59
Met PET / LDPE (50µ)	< 1	< 1	2	3.5
2-sides PVDC coated PET	6	6	8	7
2-sides PVDC coated PET/LDPE	7	7	9	11

Besides OTR, permeability to volatiles and flavours is important in candies packaging. Polyolefins have high values, whereas plastics such as polyester, nylons, ethylene vinyl alcohol (EVOH) have good barrier properties for transmission of volatiles. The odour permeabilities (for volatiles used in candies) of some materials.

Odour Transmission of Packaging Materials

Packaging Material	Thickness (µ)	Days to Aroma Leakage			
		Vanillin	Menthol	Piperonal	Camphor
BOPP / PE	17/50	6	2	1	13
PET / PE	12/50	2	16	5	< 30
PET / EVOH	12/15	< 30	< 30	30	< 30
OPP / EVOH / PE	18/15/50	30	< 30	27	< 30
PET / EVOH / PE	12/15/50	15	25	27	< 30

Tensile Strength & Elongation

Tensile Strength and Elongation properties of materials need to be studied as their running on high-speed machines should be suitable.

Tear Strength

For a candies film, tear strength is of importance as low tear values are necessary and useful for opening packages by hands.

Heat Seal Strength

The performance of a finished package is determined by the effectiveness of the package seal i.e. the permeabilities to water vapour, gases and volatiles increase if the seal is not perfect. Thermoplastic films such as polyethylene give excellent heat seals.

Performance Properties

Apart from the above mentioned important properties, a material has to perform well on machines, therefore knowledge of physical properties like slip, stiffness, blocking resistance is also necessary.

Twist retention for twist wrap is also of importance. The initial function of packaging is to protect. However, the emotional role played by packaging is also of importance, especially when the confection is a gift. A sophisticated packaging using deluxe materials is often used as a way of expressing feelings.

Candy packaging must also be specialised for specific target groups. A different pack size is required for quick impulse buys at petrol stations and roadside shops than for the super markets selling predominantly family sized packs.

3.2 Packaging Materials used for Candy Items

A very high quantum of polymeric materials, besides cellulosics and aluminium foil are used for candy items. Paper board and metal containers are also used for certain applications. Although a variety of packaging materials are available, the ultimate choice of the wrapper depends upon the required shelf-life, performance on the wrapping machine and the cost which is purely based on the segment of the market targeted by the manufacturer. The most common choice of packaging medium is plastic (generally flexible) as it provides the required protection and preservation, grease resistance, physical strength, machinability and printability. Plastics being lighter in weight are, therefore, the most preferred material for packaging of candies.

There are many changing trends in the packaging of candies. Plastic films and their laminates are increasingly replacing waxed papers due to better properties and aluminium foil laminates due to price and better flex crack property. Depending on the

type of package i.e. twist wrap, pillow pack and vertical flow pack or roll pack, the plastic based packaging films used for candies are listed below.

Polyethylene (PE)

It is considered to be the backbone of packaging films. Since one of the greatest threats to the integrity of candies products comes from moisture, polyethylene with its low water vapour transmission is of definite interest. Polyethylene films are fairly free of plasticizers and other additives and are quite extensively used as a part of lamination. Its ability to heat seal increases its value.

Low Density Polyethylene (LDPE) is an economical material with low WVTR, however, it has high permeabilities to flavours/volatiles, poor grease resistance and are limp. High-density polyethylene (HDPE) is stiffer, more translucent and has better barrier properties but needs higher temperature for sealing.

Later additions include high molecular weight high-density polyethylene (HM HDPE) and linear low-density polyethylene (LLDPE). HM HDPE is a paper like film with high physical strength and barrier properties, but is less transparent than ordinary polyethylenes. HM HDPE is available in twist-wrap grades. Polyethylene films are also suitable for making bags and pouches. A copolymer of polyethylene and poly vinyl alcohol, and EVOH has outstanding gas barrier properties specially when dry.

Polypropylene

Polypropylene films are undergoing a growth trend in the candies industry. They have better clarity than polyethylenes and enjoy superior machineability due to stiffness. Lack of good sealability has been a problem, however, PVDC and vinyl coating have been used to overcome this problem. Some varieties of PP have been specially developed for twist-wrap applications as they have the ability to lock in position after twisting. Pearlised polypropylene with an opal finish and attractive gloss is also used. Both as laminates and overwraps, PP film is now widely used for all types of candies packaging applications.

Poly Vinyl Chloride (PVC)

PVC is a stiff and clear film having low gas transmission rate. PVC can be used as small wraps, bags and pouches. PVC when co-polymerised with polyvinylidene chloride is known as Saran. Since it is a costly material, it is only used as a coating to obtain barrier properties and heat sealability. PVC film is also used for twist wraps, as it has twist retention properties and is excellent on high-speed machines.

Polyesters (PET) and Polyamide (PA)

Polyethylene terephthalate film has high tensile strength, gloss and stiffness as well as puncture resistance. It has moderate WVTR, but is a good barrier to volatiles and gases. To provide heat seal property, PET is normally laminated to other substrates. Nylons or polyamides are similar to PET, but have high WVTR.

Metallised Films

When polymeric films are metallised there is an improvement in their barrier properties. Metallisation is also used for decorative purposes and aesthetics. The films, which are used for metallisation are PVC, PET, PP and polyamides. To safeguard the interest of the consumer the Standards of Weights & Measures (Packaged Commodities) Rules, have imposed a limit on the weight of the wrapper. Under this, it is essential that in the case of twist wrap and pillow wrap candies, where the weight of the individual pieces is less than 10 grams, the size of the wrapper and the type of wrapping material selected is such that it meets the limit on weight of wrapper, under the above rules.

Candies items are commonly consumed by the populace and generally used for taste and desire and becoming very popular especially amongst children and youth. There are various types of candies items available in market i.e. cakes, pastries, doughnuts, candies, wafers, chips, chewing gum and chocolates. There are some leading industries in the field of candies products are Cadbury, Nestle, Perfetti, Wrigley, Parle and Amul etc.

A package intended for sugar and chocolate candies has to perform several functions during distribution, storage and sales. Essentially, the package has to preserve the

quality attributes of the product and afford protection against chemical and microbiological deteriorative reactions. For sugar candies items and chocolates, the major functional packaging requirements include protection from:

a) Dust, dirt and other contaminating agents

b) Moisture/water vapours pickup or loss resulting in sugar and fat bloom, stickiness, hardening and desiccation.

c) Rancidity due to interaction with moisture and oxygen.

d) Colour and aroma loss and tainting.

e) Physical damages like dusting, breakage and loss of shape.

Role of Water Activity (aw) in Candies Products

The end of shelf life due to moisture loss or gain, with subsequent changes in textural and other properties, is often the main problem in confections. Thus, an understanding of water activity is important for control of shelf life and stability. Water activity in confections generally falls below the critical values for microbial growth, with few exceptions. Water activity is influenced by the presence of dissolved sugars, other sweeteners (e.g. polyols), salts (e.g., caramel), and humectants in confections. Microbial growth is directly related to aw, with certain types of microbes unable to grow when water activity is below some critical value. The following table shows the water activity range of different candies items is listed below.

Category	Crystallinity (%)	Moisture (%)	a_w
Hard candy	0-2	2-5	0.25–0.40

Growth of microorganisms dependent on water activity (aw)

Microbial growth also decreases with reduction in water activity. Majority of bacteria and many yeasts stop growing below water activity of 0.88. Only few osmophilic yeasts and molds grow below water activity of 0.7 and no microorganisms can grow below the water activity of 0.6.

3.2.1 Types of Packages

Hanging Bags

Hanging bags are frequently seen in grocery stores and other retail locations. They are a type of plastic bag that is sealed on both ends and sometimes with a back-middle seam as well. Hanging bags have a pre-cut hole that allows them to hang easily from hooks, so they can be displayed in an attractive way. These bags hold multiple pieces of candy, which can be pre-wrapped inside the bag to preserve freshness.

Pillow Bags and Pouches

Another common type of candy packaging is a pillow pouch or bag. These are often used to hold pre-wrapped candies in bundles, so you can buy more than one piece at a time. The bags get their name from their shape, which resembles a pillow. They are found lying flat on grocery store shelves and have been known to hold mini chocolate bars and individually wrapped gummy candies.

Gusseted Poly Bags

Gusseted bags are often called flat-bottom bags because they feature a tucked in pleat that's been pressed flat. It allows the bag to expand for greater carrying capacity and to keep the shape of a box if necessary. These types of poly bags can be heat sealed, tied, stapled, or taped shut. They're the perfect poly bag for anyone looking to get more candy in a single bag. You will often see gusseted poly bags next to a pick-n-mix station where you fill up a bag full of different candies to take home.

Reclosable Zipper Bags and Pouches

Reclosable bags and pouches are essential for candy products because they give customer convenient access to their goodies while preserving freshness. Zipper closures let customers use portion control or take their candy on the go.

Candy Trays

Candy trays can be ordered in bulk in multiple sizes, or they can be custom molded to your products. These are the plastic trays you find inside deluxe two-piece boxes or gift boxes that hold individual candies in place. They are popular in assorted chocolate gift

boxes where manufacturers like to display each individual chocolate separately for a clean appearance.

Twist Ties or Heat Sealers

With any poly bag application, you need a way to close the bag of candy to keep everything from falling out. That's where twist ties and heat sealers come in handy. For simple applications that don't require much travel time, twist ties are an inexpensive option for closing your poly bag. For candy applications that require longer shelf lives, you would want to use a heat sealer to create a durable, air-tight seal in the bag. This helps preserve the freshness and taste of your candy for longer.

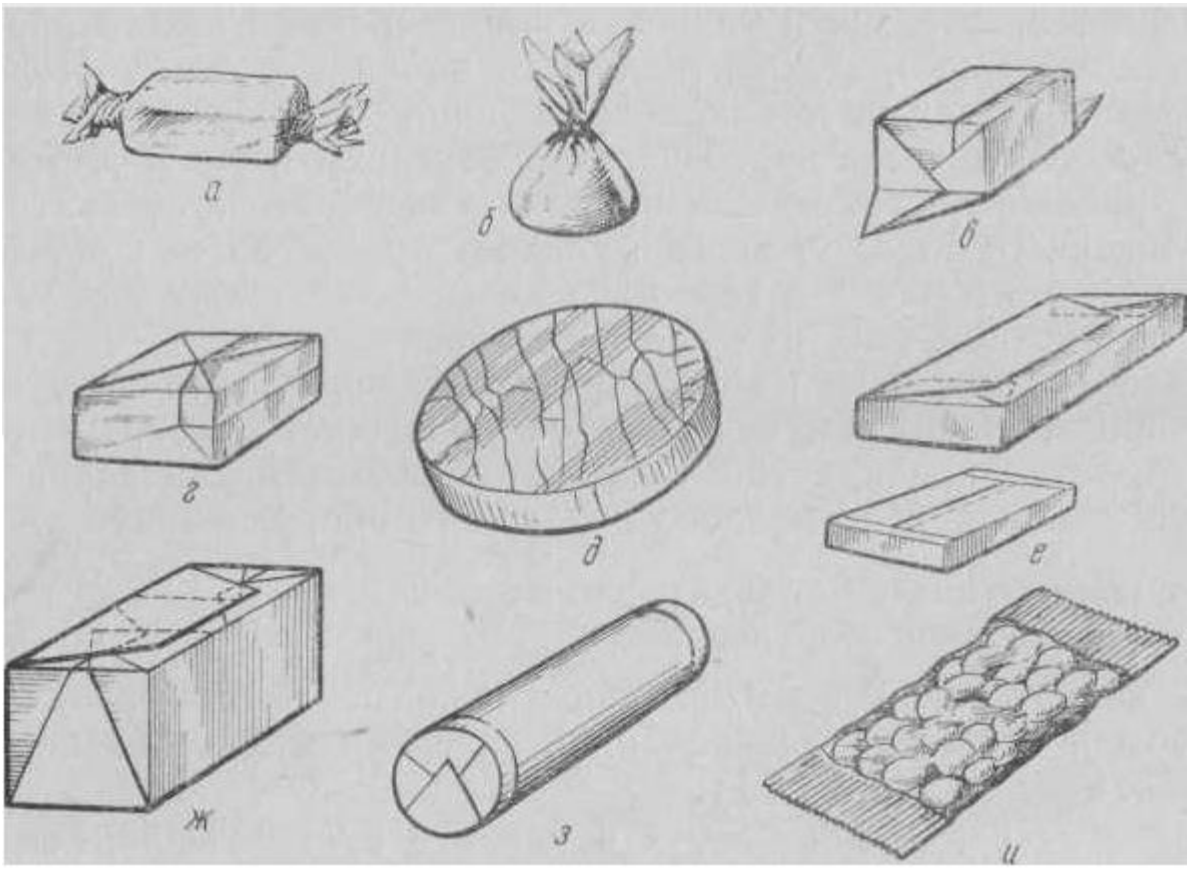
Flexible Pouches

Flexible pouches are a great option for holding candy pieces and other sweet treats. They can be manufactured with zipper-seal closures, which help keep the interior contents fresh for use. Flexible pouches offer amazing printing capabilities, so you can add your attractive candy branding to the pouch itself. Many pouches stand up on their own, which helps you improve your shelf appearance.

Foil Wrappers

Foil wrappers are used to help preserve the freshness and taste of different candies. They are commonly seen wrapped around various chocolates and other types of delicious treats. Foil wrappers are usually supplied in various sizes and colors, plus they can be customized with printing for your application.

Classification packaging methods, processes and equipment for packaging



Wrapping, packing and packaging of candies products are made in order to protect them from moisture, foreign odors, mechanical damage, to ensure sanitary requirements for products and more long-term storage, as well as to give the products an attractive appearance. Packing and packaging of a number of varieties of candies products in packs and boxes are also made for the convenience of selling these products in the trading network. The wrapping and packaging of candy at most modern candies enterprises of the Soviet Union are mechanized and carried out with the help of various equipment.

3.3 Methods for packaging of candies and packing equipment

In the candies industry, various methods and types of mechanized wrapping and packaging of candies are used.

- Wrapping candy in a waxed roll label with a double-sided twist around the ends of the label is the most common method of wrapping
- Wrapping candies in a waxed roll label with a one-sided twist or in a bow - “sachet”;
- Wrapping candies in a waxed roll label or a colorful flate label with embedding the ends of the label “in a corner”;
- Wrapping of candy in a waxed wraparound label with a curved tail;
- Wrapping chocolates in foil without a parcel or wrapped in foil with pasting paper colorful parcel
- Wrapping candy in an envelope - in a colorful label with underlay and foil
- Wrapping candy in the stack into a colorful label with parchment podvertkoy in cellophane or plastic films
- Wrapping (with pre-packing) candy tablets in tubes (rollers) in a waxed roll and flat colorful label
- Packing small-piece products in cardboard packs from pre-printed and carved colorful blanks; packing small-piece products (candy) in bags of thermally cellophane or various films (and); packing fruit drops in tin boxes.
- Wrapping materials can be rolled or flate pre-cut individual colorful labels fed into the wrapping mechanism, usually vacuum suckers from a stack.

Wrapping Materials

Waxed paper of various density for roll labels and wraps, writing paper for flate labels, aluminum foil, cellophane, thermosetting cellophane, plastic films, cardboard, parchment and sub-parchment, used for inner bags or wrapping in packaging or packing fat-containing products, such as cocoa powder, cookies, etc.

The characteristics of the main wrapping materials used in the most common wrapping and packaging equipment are given below in the characteristics of the corresponding equipment. Depending on the assortment of candies products and the above-listed

methods of wrapping and packing, the candies industry uses a variety of equipment that can be reduced to the following main groups: machines for wrapping caramels, chocolates and the iris, including:

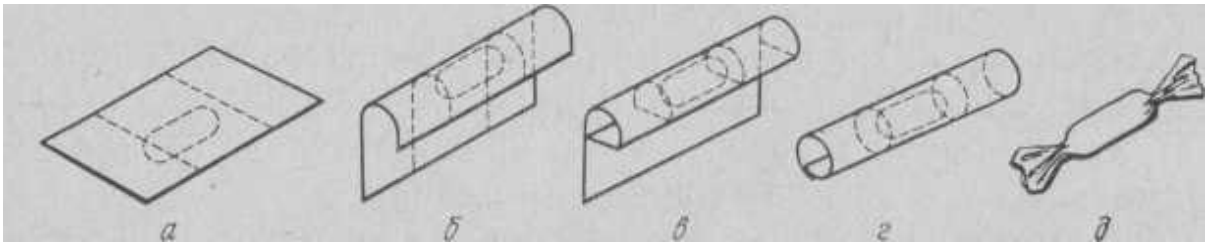
- semi-automatic machines and automatic machines for single-piece wrapping of candy;
- units for wrapping (with preforming) candy;
- machines for wrapping (with pre-laying) candy in tubes or rollers;
- packaging of various small candies products (caramel, dragee, fruit drops).

3.3.1 Processes wrapping and packaging of candies products

Wrapping candies products and the piece can be the group where multiple products are strictly oriented relative to each other. When packing candies are arranged in a shell of packaging material randomly. For piece wrap, products are packaged in one label; in the label and roll; in the label, foil and roll. Before wrapping the wrapper is applied to the product. The most common combinations are the following:

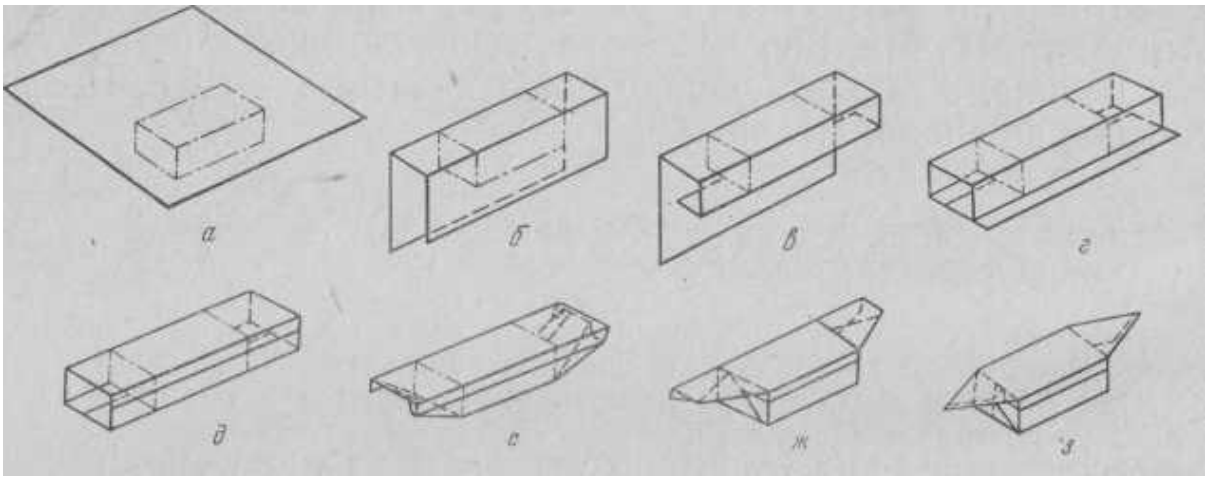
- wrap is applied to the product;
- wrapper supplied by the product;
- wrap is applied to the side face;
- wrapper is supplied from two sides of the product.

The packaging material is symmetrically or asymmetrically relative to the longitudinal axis of the article. In subsequent operations, the product is wrapped or fitted by. The final operation of the wrapping process is to seal the ends of the wrapper. Consider the technological processes of individual wrapping products (with the sealing of the ends of the twist, in the corner, the type of "sachet" and others), group wrapping (unwrapped and pre-wrapped products) and packaging (in packs, bags, boxes) candies. Wrapping with the sealing of the ends of the packaging material twist.



Wrapping products with conductor end

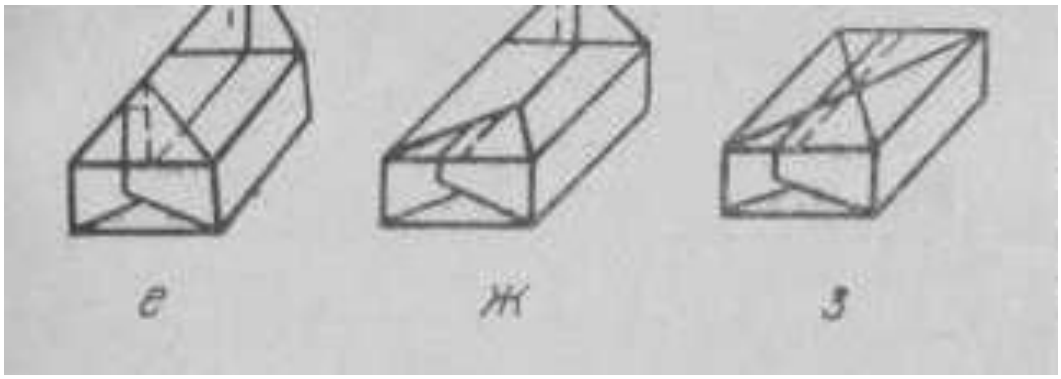
The formed corners in order to avoid disclosure are pressed. Wrapping products with sealing of the ends of the label with corners bent onto the base. The sequence of such a wrapping operation. The blank of the wrapper is applied asymmetrically to the side edge of the product.



Wrapping products with sealing ends "in the corner"

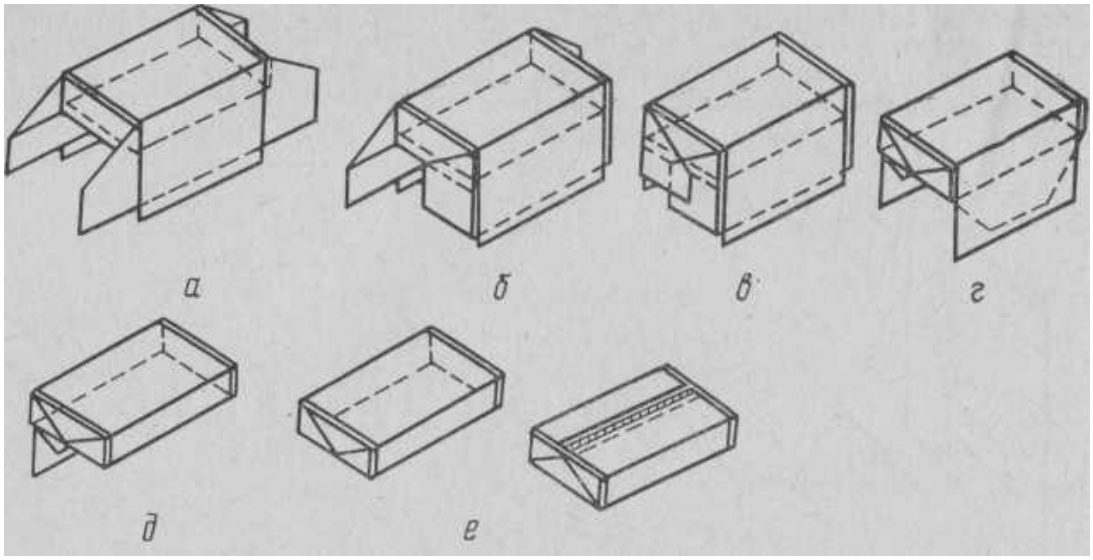
Simultaneously with the wrapping of the wrapper around the faces the corners are formed along the ends. At first, the formed corners are arranged at an angle to the wide face, and then pressed against it and fixed in this position.

In order not to bend the corners, the product passes through the channel of the electric heater. From the effects of temperature paraffin wax is melted, which, when it cools, results in fixing the position of the corners. Wrapping products with sealing the ends of the label according to the "sachet" method.



First, the product is applied asymmetrically wrap the blank. Then bent down one, a smaller part of the wrapper.

Combined wrapping:



This type of wrapping is used most often when packing chocolate bars, long loafs, candy “Benefit” and cookies. In this case, the foil or turnout form the valves on the base, and the label is wrapped with a parcel.

At first, the product is packed with a roll with five watchmen, and a label with a packet from three, with the turn forming four vertical edges deep folds. Folds pairs are pressed against the ends of the product. Folded valves lay at the base of the product. During the last operation edge of the label glued to the inner edge of the label which previously smeared with glue combination wrapping products

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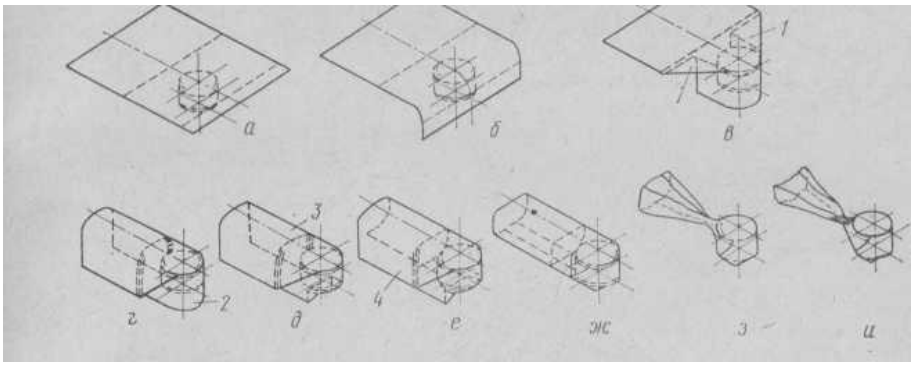
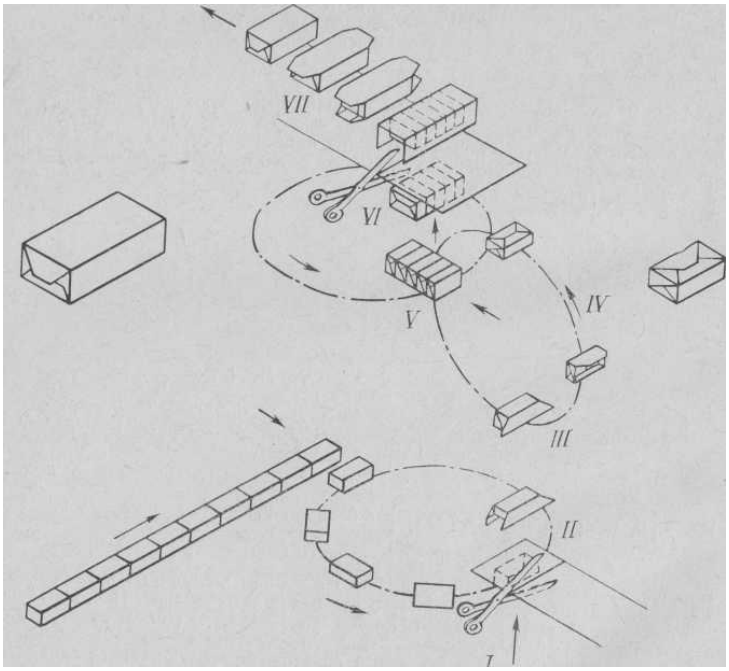


Individually and group wrapping products

Piece and group wrapping products

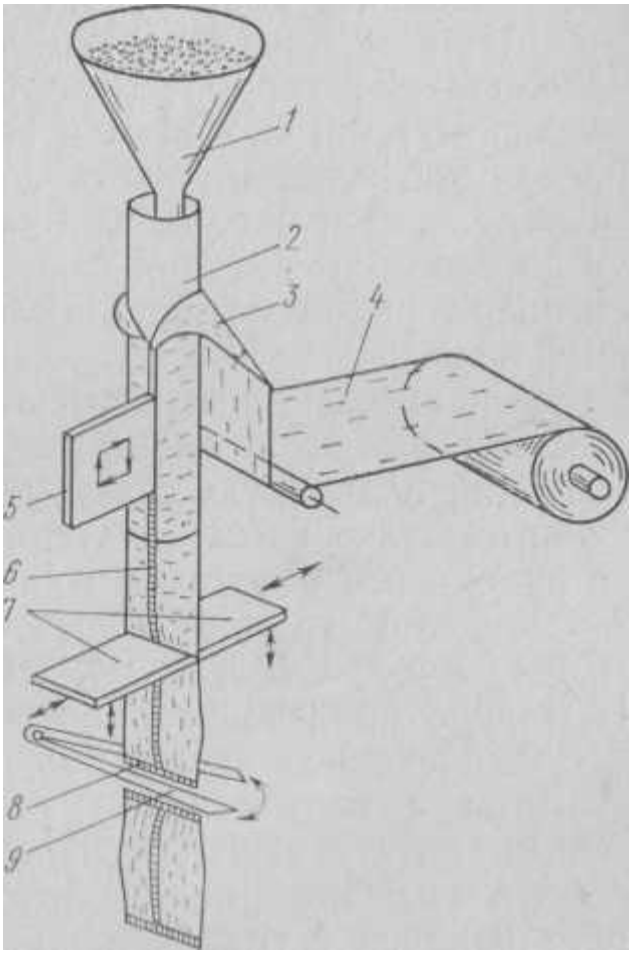


Packaging products in film material

This method can be carried out either in one machine or in two successively installed machines. The thermally cellophane tape, tucked between the 3 vertical guide and the 2 forming cylinder, coils down when pulled down.

The resulting longitudinal seam 6 of the packet tube is glued together by pressing and heating the 5 electric iron at 120 — 130 ° C. It is then crimped, heated and glued transverse seam of the tube with an electric heater 7, which simultaneously pulls the tube down. The product is poured from the dispenser I of the machine into the tube.

Next, the transverse seam of the 8 tube above the product is crimped, heated and glued. A product-filled bag is cut off in the middle of the upper glued 8 cross seam with 9 scissors. In this case, the lower sealed end of the packet tube becomes the bottom of the next packet. Ready-made packages supplied to the output tray. When packing the product dosing over the volume, mass or individually. Packaging of articles may also be in a pack of rigid cardboard.



3.4 Future Trends

The candies market is one of the most competitive in the FMCG area. Major companies continuously battle to entice sweet-toothed consumers from competing brands. A strong brand

The developing trends in candy packaging are:

- Widespread and increasing use of cold seal
- Use of laminated structures and cold seals for premium products
- Increasing use of opaque multi-packs for grocery outlets
- Switch over to higher yield opaque films for cost reduction
- Replacement of Al foil / paper wraps by OPP laminates
- Developments in low temperature heat seal packs

CHAPTER 4

FOOD SAFETY REGULATIONS AND STANDARDS OF PINEAPPLE CANDY

4.1 Standards

4.1.2 Processed fruits

Includes all forms of processing other than peeling, cutting and surface treating fresh fruits.

4.1.2.7 Candied fruits

Includes glazed fruits (fruits treated with a sugar solution and dried), candied fruits (dried glazed fruit immersed in a sugar solution and dried so that the fruit is covered by a candy-like sugar shell), and crystallized fruit is prepared (dried glazed fruit rolled in icing or granulated sugar and dried).

Food Category System	Food Category Name	Food Additive	INS No	Recommended maximum level	Note
4.1.2.7	**Candied / glazed / crystallised fruit including murrabba***	**Allura red AC**	**129**	**100 mg/kg**	
		Annatto	160b	200 mg/kg	
		Aspartame	951	2,000 mg/kg	191
		BENZOATES		1,000 mg/kg	13
		Brilliant blue FCF	133	200 mg/kg	
		Canthaxanthin	161g	200 mg/kg	
		CAROTENOIDS		200 mg/kg	
		CHLOROPHYLLS AND CHLOROPHYLLINS, COPPER COMPLEXES		**250 mg/kg**	
		Caramel III - ammonia caramel	150c	200 mg/kg	
		Caramel IV - sulfite ammonia caramel	150d	7,500 mg/kg	
		beta-Carotenes, vegetable	160a(ii)	1,000 mg/kg	
		Curcumin	100	200 mg/kg	
		Diacetyltartaric and fatty acid esters of glycerol	**472e**	**1,000 mg/kg**	
		Erythrosine	127	100 mg/kg	
		Fast green FCF	143	200 mg/kg	
		Grape skin extract	163(ii)	1,000 mg/kg	
		HYDROXYBENZOATES PARA		1,000 mg/kg	27

		IRON OXIDES		250 mg/kg	
		Indigotine (Indigo carmine)	132	200 mg/kg	
		Neotame	**961**	**65 mg/kg**	
		PHOSPHATES		10 mg/kg	33
		Ponceau 4R	124	200 mg/kg	
		RIBOFLAVINS		300 mg/kg	
		SORBATES		500 mg/kg	42
		SULFITES		100 mg/kg and 40 mg/kg (for murabba)	44
		Sucralose (Trichlorogalact osucrose)	955	800 mg/kg	
		Sunset yellow		**200 mg/kg**	
		FCF			
		Tartrazine	102	200 mg/kg	
		Acesulfame potassium	950	500 mg/kg	188
		Tartaric acid	334	GMP	
		*No sweeteners and colours permitted in murrabba			

4.2 Food Safety

Part I - General Hygienic and Sanitary practices to be followed by Petty Food Business Operators applying for Registration (See Regulation 2.1.1(2))

SANITARY AND HYGIENIC REQUIREMENTS FOR FOOD MANUFACTURER/ PROCESSOR/HANDLER

The place where food is manufactured, processed or handled shall comply with the following requirements:

1. The premises shall be located in a sanitary place and free from filthy surroundings and shall maintain overall hygienic environment. All new units shall set up away from environmentally polluted areas.

2. The premises to conduct food business for manufacturing should have adequate space for manufacturing and storage to maintain overall hygienic environment.

3. The premises shall be clean, adequately lighted and ventilated and sufficient free space for movement.

4. Floors, Ceilings and walls must be maintained in a sound condition. They should be smooth and easy to clean with no flaking paint or plaster.

5. The floor and skirted walls shall be washed as per requirement with an effective disinfectant the premises shall be kept free from all insects. No spraying shall be done during the conduct of business, but instead fly swats/ flaps should be used to kill spray flies getting into the premises. Windows, doors and other openings shall be fitted with net or screen, as appropriate to make the premise insect free The water used in the manufacturing shall be potable and if required chemical and bacteriological examination of the water shall be done at regular intervals at any recognized laboratory.

6. Continuous supply of potable water shall be ensured in the premises. In case of intermittent water supply, adequate storage arrangement for water used in food or washing shall be made.

7. Equipment and machinery when employed shall be of such design which will permit easy cleaning. Arrangements for cleaning of containers, tables, working parts of machinery, etc. shall be provided.

8. No vessel, container or other equipment, the use of which is likely to cause metallic contamination injurious to health shall be employed in the preparation, packing or storage of food. (Copper or brass vessels shall have proper lining).

9. All equipments shall be kept clean, washed, dried and stacked at the close of business to ensure freedom from growth of mould/ fungi and infestation.

10. All equipments shall be placed well away from the walls to allow proper inspection.

11. There should be efficient drainage system and there shall be adequate provisions for disposal of refuse.

12. The workers working in processing and preparation shall use clean aprons, hand gloves, and head wears.

13. Persons suffering from infectious diseases shall not be permitted to work. Any cuts or wounds shall remain covered at all time and the person should not be allowed to come in direct contact with food.

14. All food handlers shall keep their finger nails trimmed, clean and wash their hands with soap, or detergent and water before commencing work and every time after using toilet. Scratching of body parts, hair shall be avoided during food handling processes.

15. All food handlers should avoid wearing, false nails or other items or loose jewellery that might fall into food and also avoid touching their face or hair.

16. Eating, chewing, smoking, spitting and nose blowing shall be prohibited within the premises especially while handling food.

17. All articles that are stored or are intended for sale shall be fit for consumption and have proper cover to avoid contamination.

18. The vehicles used to transport foods must be maintained in good repair and kept clean.

19. Foods while in transport in packaged form or in containers shall maintain the required temperature.

20. Insecticides / disinfectants shall be kept and stored separately and `away from food manufacturing / storing/ handling areas.

4.3 Labelling Standards

Labeling requirements for packaged food products as laid down in the Part VII of the Prevention of Food Adulteration (PFA) Rules, 1955, and the Standards of Weights and Measures (Packaged Commodities) Rules of 1977, require that the labels contain the following information:

1. Name, trade name or description
2. Name of ingredients used in the product in descending order of their composition by weight or volume
3. Name and complete address of manufacturer/packer, importer, country of origin of the imported food (if the food article is manufactured outside India, but packed in India)
4. Nutritional Information
5. Information Relating to Food Additives, Colours and Flavours
6. Instructions for Use
7. Veg or Non-Veg Symbol
8. Net weight, number or volume of contents
9. Distinctive batch, lot or code number
10. Month and year of manufacture and packaging
11. Month and year by which the product is best consumed
12. Maximum retail price

4.3.1 Wherever applicable, the product label also must contain the following

The purpose of irradiation and license number in case of irradiated food. Extraneous addition of coloring material. Non-vegetarian food – any food which contains whole or part of any animal including birds, fresh water or marine animals, eggs or product of any animal origin as an ingredient, not including milk or milk products – must have a symbol of a brown color-filled circle inside a brown square outline prominently displayed on the package, contrasting against the background on the display label in close proximity to the name or brand name of the food.
Vegetarian food must have a similar symbol of green color-filled circle inside a square with a green outline prominently displayed.

All declarations may be: Printed in English or Hindi on a label securely affixed to the package, or Made on an additional wrapper containing the imported package, or Printed on the package itself, or May be made on a card or tape affixed firmly to the package and bearing the required information prior to customs clearance.

Exporters should review the Chapter 2 of the “FSS (Packaging and Labeling) Regulation 2011” and the Compendium of Food Safety and Standards (Packaging and Labeling) Regulation before designing labels for products to be exported to India. FSSAI revised the labeling Regulation and a draft notification to that effect was published on April 11, 2018, inviting comments from WTO member countries and the comments received are under review and the publication date remains unknown.

According to the FSS Packaging and Labeling Regulation 2011, “prepackaged” or “pre packed food” including multi-piece packages, should carry mandatory information on the label.

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