

Rationale

- One of the oldest crops grown in India
- Referred as Tree of Heaven, Tree of Abundance, Tree of Life and Kalpavriksha
- India accounts for 18% of world's coconut production
- Stands third in production after Indonesia and Phillipines
- Grown in 1.5 million ha with a total production of 10,000 million nuts
- 91% of total area and production is concentrated in southern states of India
- Milling of copra provides 3 lakh tonnes of oil annually ; 15% used in industry, 30% for edible purposes and the rest 55% for toiletry
- Makes a contribution of 6% to the total edible oil production

All India Production of Coconut (2002-2003)

States	Area ('000 Hectares)	Production (Million nuts)	Productivity (Nuts/ha)
Andhra Pradesh	105.3	1158.6	11003
Karnataka	375.4	1525.3	4063
Kerala	905.5	5338.0	5895
Tamil Nadu	345.9	2860.7	8270
All India	1918.9	12159.6	6337

Source:

Directorate of Economics & Statistics, Ministry of Agriculture, Government of India.

Composition of Coconut

- Husk – 35%
- Shell – 12%
- Meat – 28%
- Water – 25%

Present status of coconut processing sector

- Household and religious purposes: 60%
- Tender coconut : 3.5%
- Milling copra : 35%
- Desiccated coconut : <2%

- Product diversification and by-product utilization have not yet been given due attention during the past
- India lacks behind in the post harvest processing sector
- Various coconut kernel based products have been developed such as coconut milk, coconut milk powder, desiccated coconut, skim milk, milk shake and Nata-de-coco

Copra



- ↪ 11 –12 months old nuts are utilized for copra making
- ↪ Highly valued commodity in the world market
- ↪ Oil content 65 – 70 %, richest source of fat
- ↪ Requirement of copra drying is to bring down the m.c of wet meat from 50 –55% to 5 – 6 %
- ↪ 1 tonne of copra yield 645 kg of oil

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Types:





1. Edible copra – Consumed as dry fruit
2. Milling copra – Used for oil extraction

Edible copra processing

Two types: **Ball and Cup copra**

Popular in Lakshadweep, India - Calicut, Tumkur

Matured nuts  Shade drying (8 –12 Months)


Marketing  Storing  Deshelling  Dehusking

Copra

- Trade name of the dried coconut kernel
- Prepared from fully matured coconuts
- Prepared in the form of cups and balls
- Cup copra is mainly used for oil extraction
- Ball copra is made only for edible purpose and is superior in quality
- Prepared by storing fully matured nuts for 10-12 months under shade
- Copra in the form of ball is removed after cutting open the shells
- Yield and quality depends on maturity, variety, season of harvest, age of the palm, period of storage and agro-climatic conditions

Milling Copra - Processing

- ∩ Initial m.c of coconut kernel 50 % dried in to 6%
final m.c
- ∩ Drying methods
 - ∩ Sun drying
 - ∩ Artificial drying

Drying methods

- Sun drying
- Dehusked nuts are split into halves and the water is drain off
- Halves are exposed to sun for 2-3 days; m.c of kernel reduced to 20-28%
- Kernel can be easily detached from the shell
- To obtain good quality copra, m.c is reduced to 6% for which 7days of continuous drying is essential

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Sun drying

- ∞ Drying period 7 – 10 days
- ∞ During rainy season to avoid microbial spoilage wet kernels are treated with Glacial acetic acid – Recommended by CPCRI, Kasargod.
- ∞ Observed that copra yield was increased about 10 % when coconuts are dipped in NaOH or NaHCO_3

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- ∞ Tested with chemicals for prevention of fungal infection during drying & storage
- ∞ 1 % GAA- applied as a thin coat over the kernel, prevents fungal growth for 36 – 38 h
- ∞ If R.H > 90%, the treatment should be repeated 3 times every 5 day intervals

Artificial drying

Types

- i. Kiln drying
 - a. Direct smoke copra drying
 - b. Semi direct copra drying
- ii. Hot air drying
- iii. Solar drying

Direct smoke copra drying

- ∞ Batch type – drying time 36 – 40 h
- ∞ Fire bed located below the copra bed

Kiln drying

- Coconut kernel is dried by the hot gases generated by burning of coconut shells
- Coconut cups are spread over a platform made of bamboo or wood
- Subjected to the heat of slow fire for 4-5 days
- Hot smoke with a temperature of 40-45°C passes through the stakes of copra and hastens drying process
- Copra produced by this method is of inferior quality and brownish in colour

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Semi direct copra drying

- € Combustion pit located 3' away from drying bed
- € Smoked hot air goes through underground tunnel to the drying bed



Indirect hot air drying

- Kernel is not exposed to direct contact with the combustion gases or smoke of the fuel
- Drying takes place by the hot air generated inside the drier
- Two types namely natural draft and induced draft
- In natural draft- hot air is passed over copra by means of dampened ventilator
- Induced draft- hot air is generated in a separate system and blown into the drying chamber by means of blower and is evenly distributed by baffles below the platform
- Increased efficiency and better quality copra can be obtained

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Hot air drying

- ¥ Uncontaminated smoke free hot air (60°C) passed through the copra bed
- ¥ Produces good quality copra with 6 % m.c

Spoilage of copra kernel

- ¥ Four different molds causes spoilage
- ¥ *Rhizopus spp.* Destroys significant qty of oil in the meat
- ¥ *Aspergillus niger* Grow at 12 – 20% m.c cause 40 % of oil loss
- ¥ *Aspergillus flavus* - Grow at 8 –12% m.c, cause >40 % of oil loss
- ¥ *Penicillium glaucum* grows even at <8% m.c

Quality Standard for Copra in the Philippines: (Based on Method of Drying and Appearance)

Class	Name/Designation	Requirement (Appearance)
A.	Hot air, kiln or mechanically dried	Clean, whitish or pale; free of smoke, moulds and dirt
B.	Sun dried	Dull white; low in dirt, mould and decay; free of smoke
C.	Smoked	Tinged with soot; low in mould, dirt a decay; not unduly charred or burned
D.	Mixed	Low in mould, dirt, soot and decay

Safe Storage of Copra

- ⊕ Various insects in store can cause >15% loss to copra when stored >6 months
- ⊕ Precautions
- ⊕ Dry the produce to 4 % m.c
- ⊕ Avoid heap storage, which causes max damage
- ⊕ Store copra in netted poplythene bags / gunny bags

Value added products from coconut

- *Tender Coconut Water*
- *Tender Coconut Kernel – Candy*
- *Dressed tender nuts*
- *Snowball Tender Nut*
- *Nata – de – Coco*
- *Desiccated Coconut*
- *Copra*

Tender Coconut Water

- ❧ Most sterile of all the naturally occurring drinks
- ❧ Coconut fruit at 7 –8 month maturity contain @ 300 ml water with 20 g sugar & 2 g of potassium (Thampan, 1984)
- ❧ It has numerous medicinal values



Chemical Constituents of Coconut Water

	Mature Coconut	Tender Coconut
Total solids%	5.4	6.5
Reducing sugars %	0.2	4.4
Minerals %	0.5	0.6
Acidity mg %	60	120
pH	5.2	4.5
Potassium mg%	247	290
Sodium mg%	48	42
Calcium mg%	40	44
Magnesium mg %	15	10
Phosphorous mg%	6.3	9.2
Iron mg%	79	106
Copper mg%	26	26



Medicinal Uses

- ❧ Kills intestinal worms
- ❧ Presence of saline and albumen makes it a good drink in cholera cases
- ❧ Excellent tonic for the old and sick
- ❧ Cures malnourishment
- ❧ Effective in the treatment of kidney stones
- ❧ Found as blood plasma substitute



Packed Tender Coconut Water

- ❧ Technology developed by DFRL and CDB
- ❧ Packed in flexible pouches and aluminium beverage containers
- ❧ Shelf life 9 – 12 months

Drawbacks

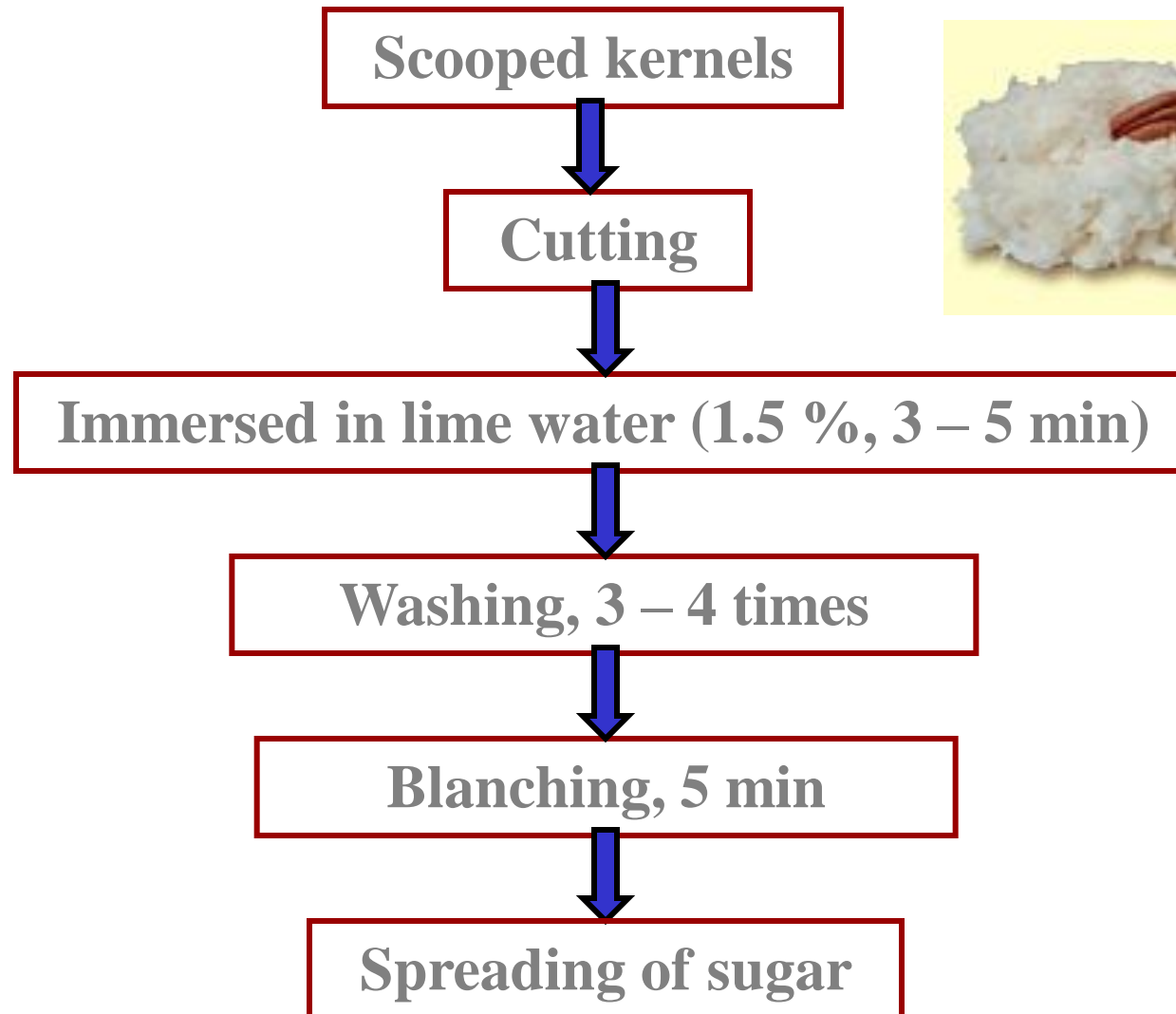


- ❧ Thermal processing causes nutrient loss and flavour loss & limits the marketability
- ❧ Further investigation is required to extend the shelf life, improve quality and suitable packing system

Tender Coconut Kernel Processing

- ↪ 250 g of kernel obtained from one nut
- ↪ Good source of CHO, protein, fiber and other nutrients
- ↪ Development of new products such as tuity - fruity and candy from fresh kernels left after the use of tender nut water
- ↪ Young coconut kernel products ideal for dessert or snack food

Tender Coconut Kernel - Candy



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Draining of syrup

Addition of citric acid

Boiling of syrup with coconut pieces

Drain off the syrup

Drying (Sun / hot air)

Packed in bottles / polythene bags



Dressed tender nuts



7 – 8 months tender nuts

Machine shaved – Hexagonal shape

Wrapped with polythene bags

Store at refrigerated conditions

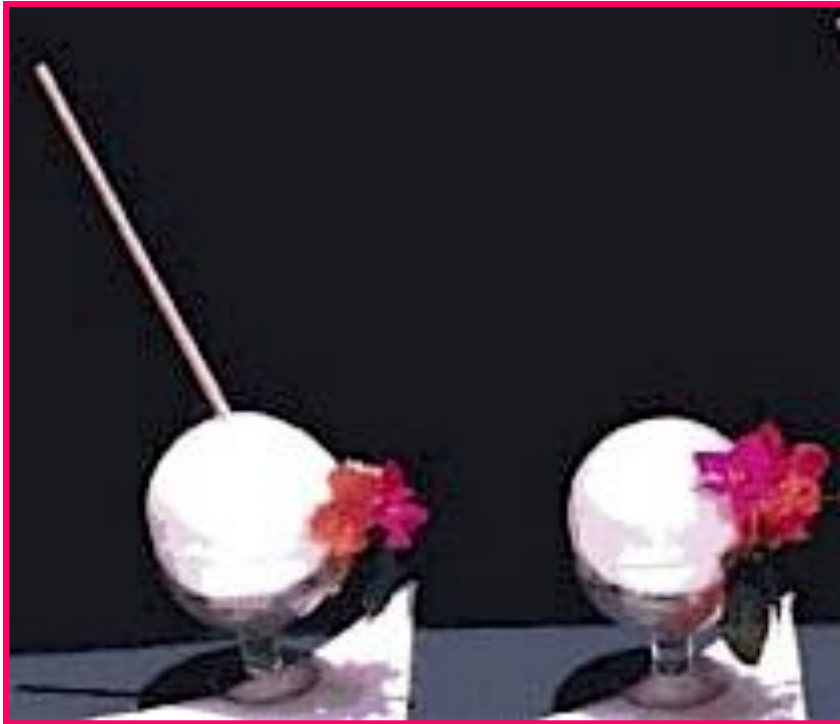


Snowball Tender Nut

- ★ Snowball Tender nut is a tender coconut without husk, shell and testa
- ★ Ball shaped and white in colour
- ★ 8 month old coconut is suitable for making SBTN



Snowball Tender Coconut Processing



8 –9 months tender coconut



Dehusking & shell removal



Kernal ball

Nata – de – Coco

- ✧ It is a white, gelatinous food product
- ✧ obtained by the action of microorganism
A. xylinum on coconut water / coconut milk
- ✧ Good quality nata is smooth, clear and chewy



Nata – de – Coco Processing

Coconut water (Filtered, Boiled & cooled)

Enrichment, (sugar 10%, 1% Glacial acidic acid,)

Inoculation (*A. xylinum*)

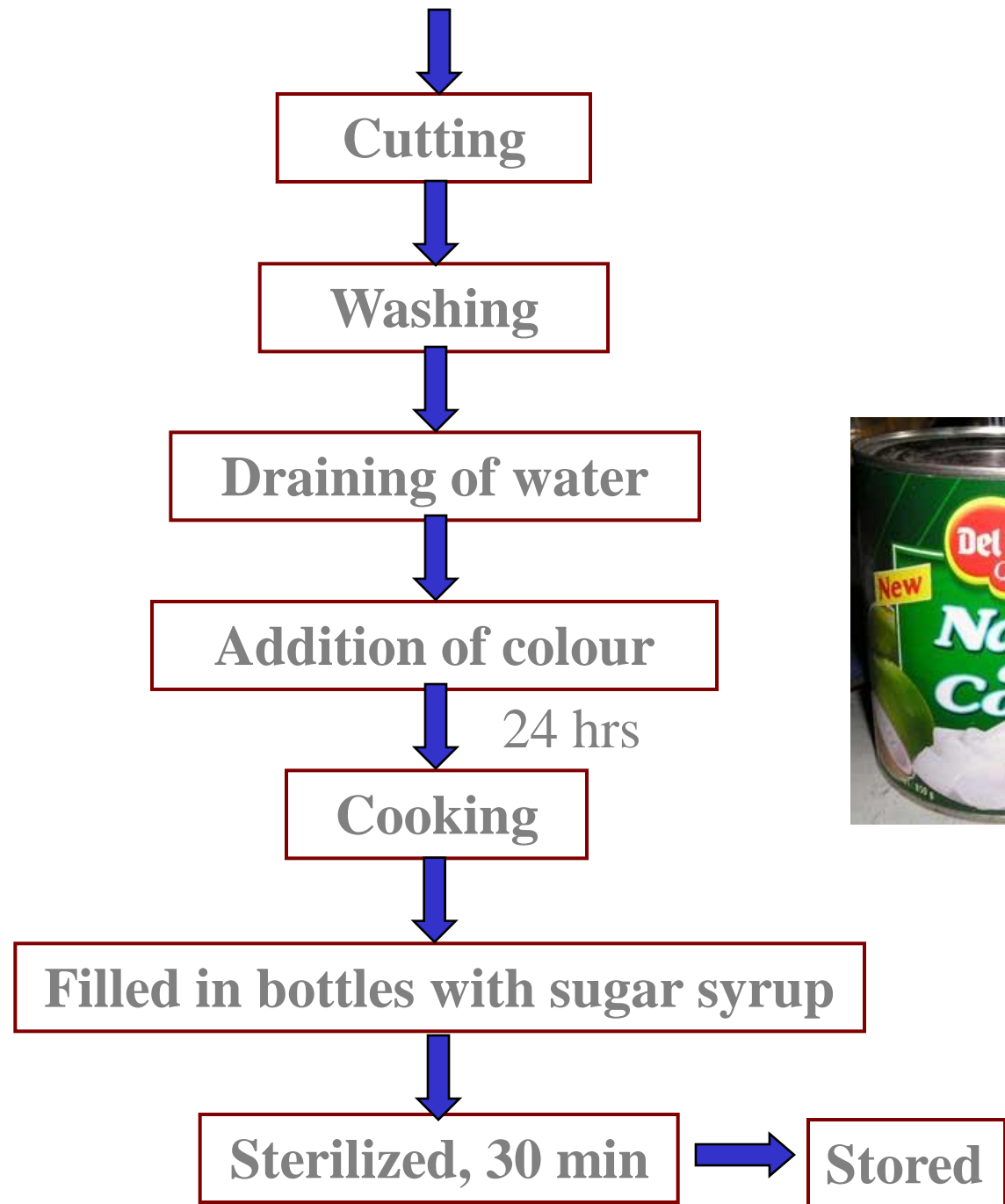
Kept for 12- 15 days at 28°C

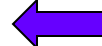
Nata Formed

Harvesting



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Desiccated Coconut

- ¥ It is a dried disintegrated coconut meat
- ¥ Crisp, snow – white in colour
- ¥ Very important commercial product used in confectionary & other food industries
- ¥ Major producers - Philippines and Sri lanka
- ¥ Major consumers – USA, West Germany, Australia
- ¥ Production in India is still in its infancy stage



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Classification based on oil content

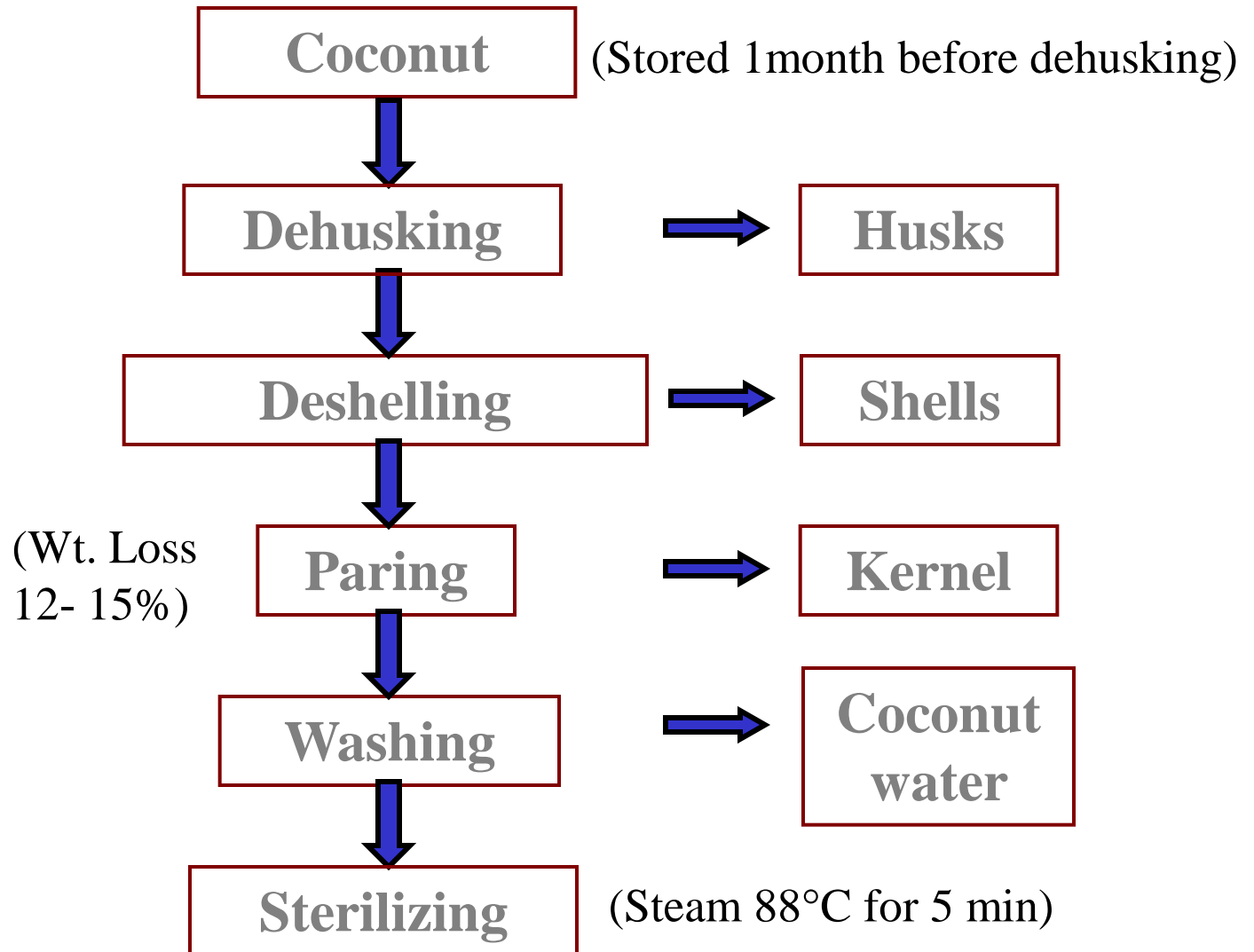
- ⊕ Low fat desiccated coconut 40 – 45%
- ⊕ High fat desiccated coconut 65 – 68%

Based on size

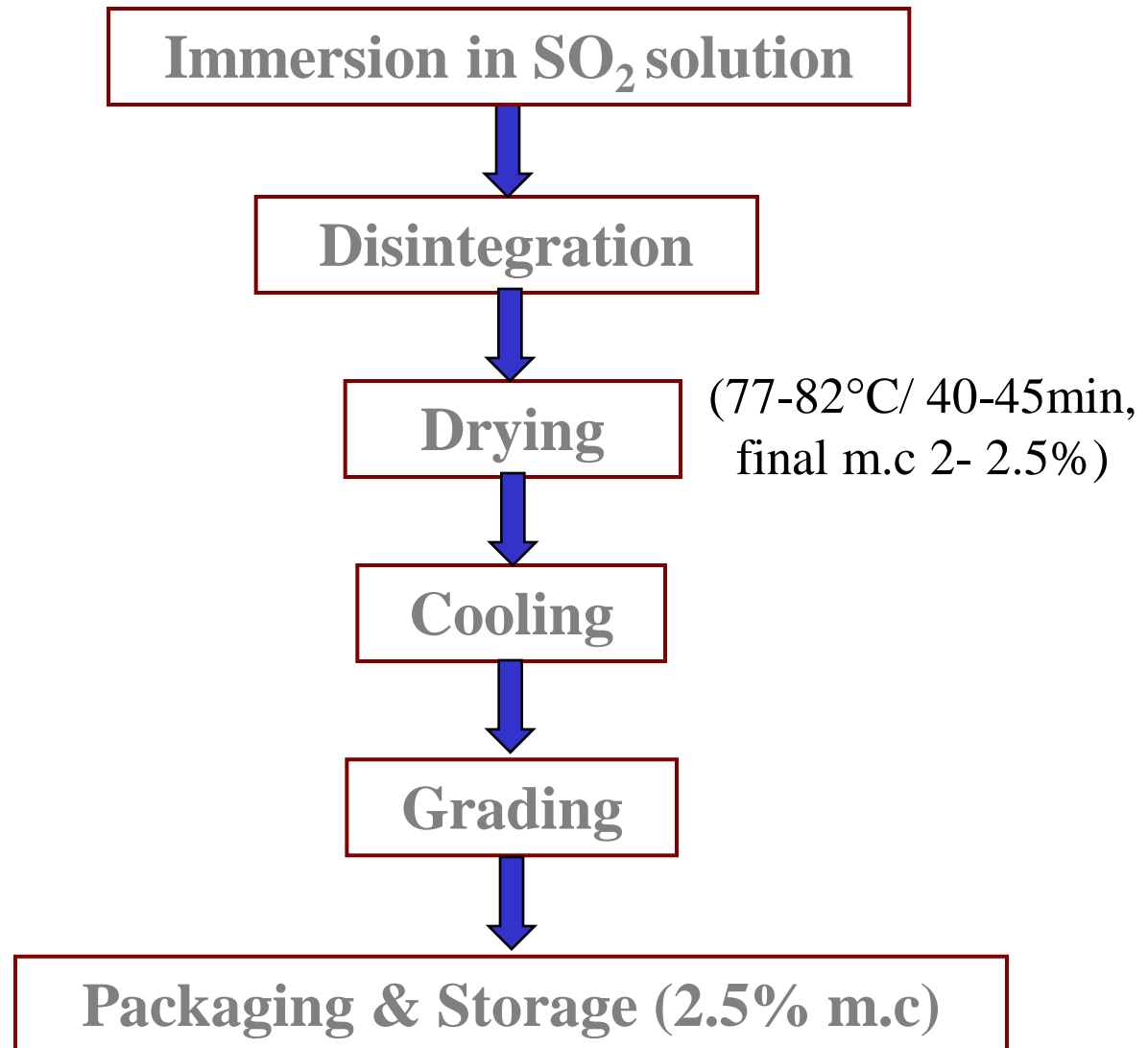
- ⊕ Course grade – 1.4 to 4.76 mm
- ⊕ Medium grade – 1 – 2.8 mm
- ⊕ Fine grade – 1.4 – 1.88 mm
- ⊕ Super fine grade – 1 mm



Desiccated Coconut Processing



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- § Yield depends on maturity & weight of fully matured nuts
- § India: 8000 – 9000 nuts produce 1 tonne of desiccated coconut
- § Philippines: 7000 nuts produces 1 tonne of desiccated coconut

Desiccated coconut powder

- Fully matured coconut
- Husking
- Shelling
- Paring
- White coconut kernels
- Slicing
- Washing
- Sterilizing
- Disintegrating
- Drying at 85°C
- Desiccated coconut

Coconut flour

Wet kernel

↓
Washing

↓
Disintegrating

↓
Sieving

↓
Grating

↓
Drying

↓
Hydraulic pressing

↓
Coconut flour

Coconut skim milk powder

Coconut milk



Centrifuging in cream separator



Coconut skim milk (40% total solids)



Spray drying



Coconut skim milk powder



Storage under vacuum

- Cake left after extraction of oil
- Contains about 32-40% of copra crushed
- Stored in polythene bags or polythene lined containers without any spoilage
- Ration containing coconut cake increase milk yield of cattle
- Imparts a firmer texture and better flavour to butter
- Useful for feeding poultry and manure for field crops

Coconut water

- Vinegar
 - Coconut water
 - Straining
 - Mixing with brown sugar to adjust the sugar concentration of medium to 10-12%
 - Heating and allowed to cool
 - Fermentation for 5 weeks – Alcohol changes into acetic acid
 - Vinegar
 - Filtered,sterilized and bottled

Coconut shell charcoal

- Manufactured by shells of fully matured nuts
- Burning in a limited supply of air sufficient only for carbonization
- Used as refining agent both as a deodoriser and decolouriser
- Used as primary raw material for production of activated carbon

Coconut shell

- Composition
 - Cellulose : 33.0%
 - Lignin : 36.5%
 - Pentosans : 29.29%
 - Ash : 0.6%

Activated carbon

- Shell charcoal is used as primary raw material for production of activated carbon
- Carbonaceous material in which millions of tiny holes are created by carbonizing and activating substances of any biological origin
- Tiny holes form an internal structure of interconnected capillary passages not much larger than the molecules it absorbs
- Other carbon sources utilized for activation are coal, lignite and wood
- Shell based activated carbon is considered to be superior – More effective for adsorption of gas/vapour and for the removal of colour and odour compounds

Methods

- Steam activation
 - Adopted throughout the world
 - First stage called carbonization process is carried out using brick kilns
 - Second stage called steam activation process carried out using rotary kilns
 - Charcoal is reacted with steam between 900-1100°C under controlled atmosphere
 - Reaction between steam and charcoal takes place at the internal surfaces of the charcoal removing carbon from the pore walls and thereby enlarging them
- Chemical activation(Phosphoric acid or Zinc chloride)

Vinegar

- Product from coconut water
- Involves two stage fermentation
- First stage -Sugars are converted into ethyl alcohol by the action of yeasts (*S.cerevisiae*) – Anaerobic
- Second stage – Acetobacter oxidises ethyl alcohol to acetic acid – Aerobic fermentation
- Small amounts of glycerol and acetic acid is produced during fermentation of sugar

Coconut oil

- Production in India is >3.0 lakh tonnes
- 35%- edible purpose; 60%- soaps, cosmetics; 5%- confectionary, candy etc
- Extracted by both dry and wet process
- Dry process is universally popular and extracted from copra
- Yield of oil depends on cultivar, methods of oil extraction, oil content of copra and efficiency of milling equipment
- Quality is judged by colour, flavour, clarity and appearance
- Oil content ranges from 34-45% in the ripe endosperm and 60-77% in well dried copra
- Contains maximum amount of saturated fatty acids, predominantly lauric acid (30%)

Extraction methods

- Expellers – 63-65%
- Hydraulic press
 - Capacity varies from 1-50 tonnes per hour
- Chekkus – 58-60%
 - Capacity is 100kg in 8h
- Rotaries – 62-63%
 - Capacity is 300-400 kg in 8h

Applications

- Food & confectionary uses
 - Highly resistant to oxidative rancidity because of its high content of saturated fatty acids
 - Retains pleasing flavour
 - Preferred as a fat source in the preparation of ice-creams, confectionary, bakery products, infant milk powder etc.
- Pharmaceutical uses
 - Ointments, eye lotion
- Industrial uses
 - Soaps, cosmetics, detergents etc.

Disadvantages

- Higher oil absorption during frying
- Impart a rubbery flavour to the oil upon exposure to sunlight
- Higher susceptibility of triglycerides to hydrolysis causes rapid development of free fatty acids in the oil – causes the production of soapy flavour

Coir & Coir products

- Extracted from coconut husk
- Excellent raw material for floor coverings
- Resistance to rot, dampness and water, strength and durability
- Extraction of fibre after retting (bacteriological process) in saline water – white fibre
- Fibre extracting machines used for extraction of fibre – better productivity, cost effectiveness

End uses

- Weaving into mats, mattings and wall coverings
- Used for making brooms and brushes, brush door mats
- Manufacture of mattresses, upholstery, insulation material
- Rubberized coir is used in car seats
- Used for spinning yarn for manufacture of coir products