TBT PROGRAMME
OVERCOMING TECHNICAL BARRIERS TO TRADE

TRAINING MANUAL
GOOD MANUFACTURING PRACTICES

PLANTING, HANDLING AND PROCESSING OF MELON SEEDS (EGUSI)

(Citrullus colocynthis L)

Melon - Egusi

- Melon seeds (Egusi)
  - NIS xxx:2016 Standard for Melon seeds (Egusi)

- Ground Melon (Egusi)
  - NIS XXX 2016 Standard for Ground Melon

Melon Key Issues

- Microbiological contamination of fruit
- Effective Fermentation of fruit and washing of Mucilagenous material
- Damage to Melon seeds
- Proper drying of seeds and de-shelled seeds
- Fungal contamination
- Insect and animal infestation

- Pesticide residues
- Chemical and other contaminants

Melon

Parameters0	NIS Specification	REFERENCE TEST METHOS
Moisture Content (%) max	4.9	ISO 712: 2009
Total Carbohydrate (%) max	10.8	AOAC 996:11
Crude Protein (%) max	23.6	AOAC XXXX
Crude fibre (%)max	12.1	ISO 5498:1981
Ether Extract (%) max	45.8	XXXX
Ash (%)max	3.8	ISO 2171:2007

MICROBIAL	NIS SPECIFICATION	REFERENCE TEST METHODS
Total plate (cfu/g, max)	$2.0X10^3$	ISO 4833:2013
Salmonella spp. (cfu/25g, max)	Absent	ISO 6579:2002
Yeast/mould (cfu/g, max)	$2.0x10^3$	ISO 21527-1,2:2008
E. coli(cfu/g, max)	10^2	ISO 16649-2:2001

S/N	PARAMETER	LIMIT
I	Total Aflatoxins (ppb)	4

S/No	PARAMETERS	REQUIREMENTS
1.	Arsenic (mg/kg) max	1.0
2.	Lead (mg/kg) max	0.2
3	Cadmium (mg/kg) max	1.0

Ground Melon

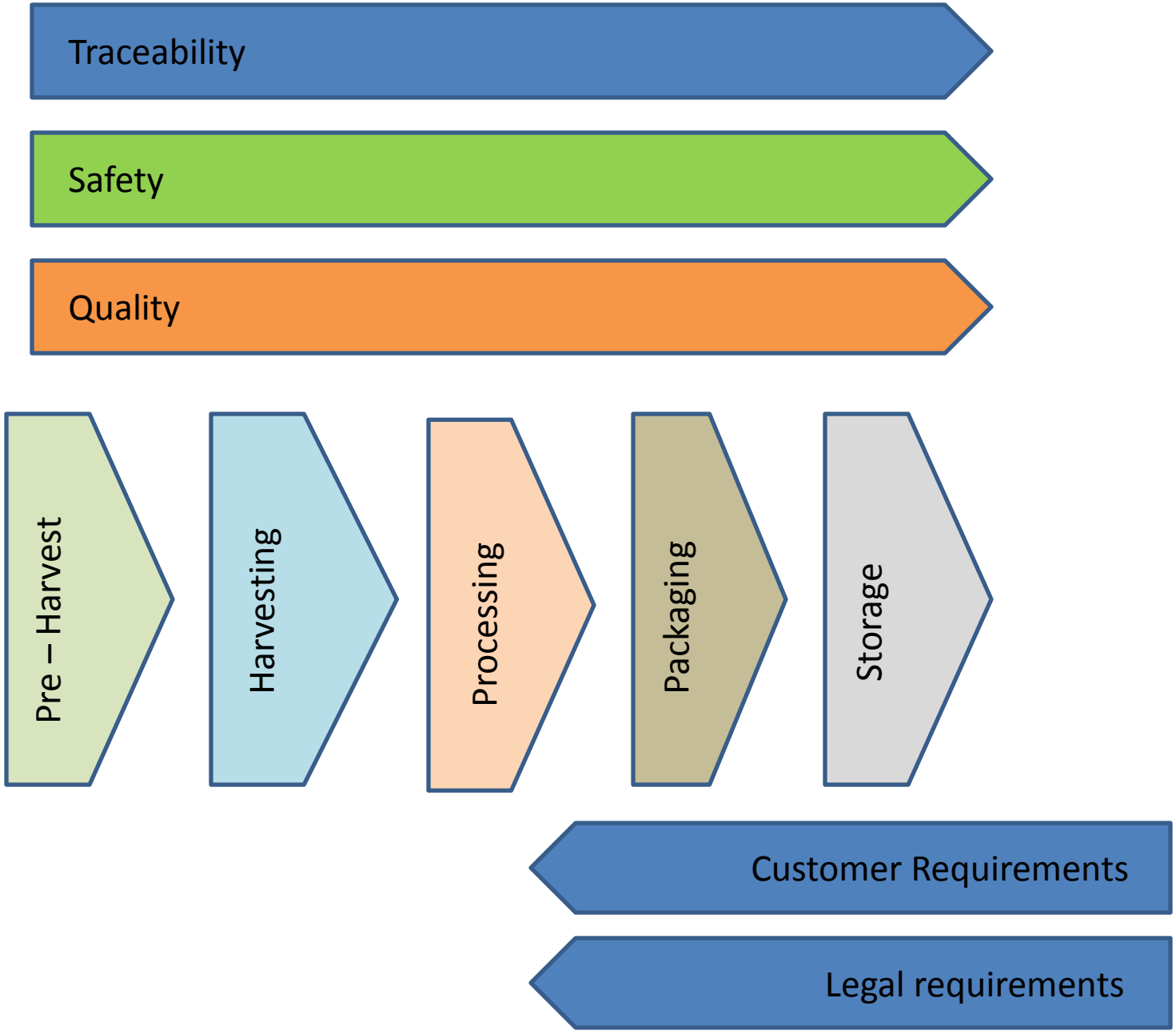
S/N	Parameter	Specification	Test Method
1.	Moisture content %(max)	4.6	ISO 939:1980
2.	Ash (%) (max)	10	ISO 930:1997
	Ether extract (%) (max)	45.7	ISO 1108
4	Crude protein (%) (max)	23	Codex stan 174-1989
5	Crude fibre (%) (max)	12	ISO 5498
6	Carbohydrate (%) (max)	10.6	
7	Particle size	>95% of the product shall pass through a sieve of nominal aperture size 500um	

Microorganisms	Tolerance Limit	Test method
Total viable Count(cfu/g)(max)	10	CAC/GL21-1997
Coliform bacteria(cfu/g)(max)	10	CAC/GL21-1997
E.coli(cfu/g)	Nil	"
Salmonella sp(cfu/g)	Nil	"
Staph aureaus(cfu/g)	Nil	"
Mould(cfu/g)(max)	10	"

Toxin	Tolerance limits	Test method
Aflatoxins B1 (ppb)max	2.0	Codex stan 228-2001
Total aflatoxins(ppb)max	4.0	

Pesticides	Max tolerable limits	Test Method
Permethrin (ppm)	0.05	Codex stan cx 4/40.2 1990.
Cyfluthrin (ppm)	0.05	"
Cypermethrin (ppm)	0.05	"
Carbofuran (ppm)	0.05	"
Methidathion (ppm)	0.1	"

S/N	Parameter	Max Limits	Test method
1.	Arsenic(ppm)	0.1	CAC/RCP 49-2001
2.	Copper(ppm)	2.0	CAC/RCP 56-2004
3.	Lead(ppm)	0.1	CAC/RCP 49-2001
4.	Mercury(ppm)	0.1	CAC/RCP 49- 2001
5.	Cadmium(ppm)	0.3	CAC/RCP 51-2003
6.	Iron(ppm)	0.3	CAC/RCP 56-2004


Traceability
Safety
Quality
Pre – Harvest
Harvesting
Processing
Packaging
Storage
Customer Requirements
Legal requirements

Good Agricultural Practices melon

Planting

- Clean level seedbed
- Prevent contamination and soil-borne diseases from crops grown in the previous season

- Soil free from debris of plant remains or materials that will encourage fungal growth.

- Soil tests can help to determine if there is need to apply fertilizer and/or soil conditioners to assure adequate soil pH and plant nutrition to avoid plant stress.

- When obtainable, use seeds developed for resistance to seed-infecting fungi and insect pests.
- Only seed varieties recommended for use in a particular area of the country shall be planted in that area.

- Isolation distance to separate melon crop from fields of other related crop species and fields of the same variety not planted at the same time.

- Avoid overcrowding of plants by maintaining the recommended row and intra-plant spacing for the species/varieties grown.

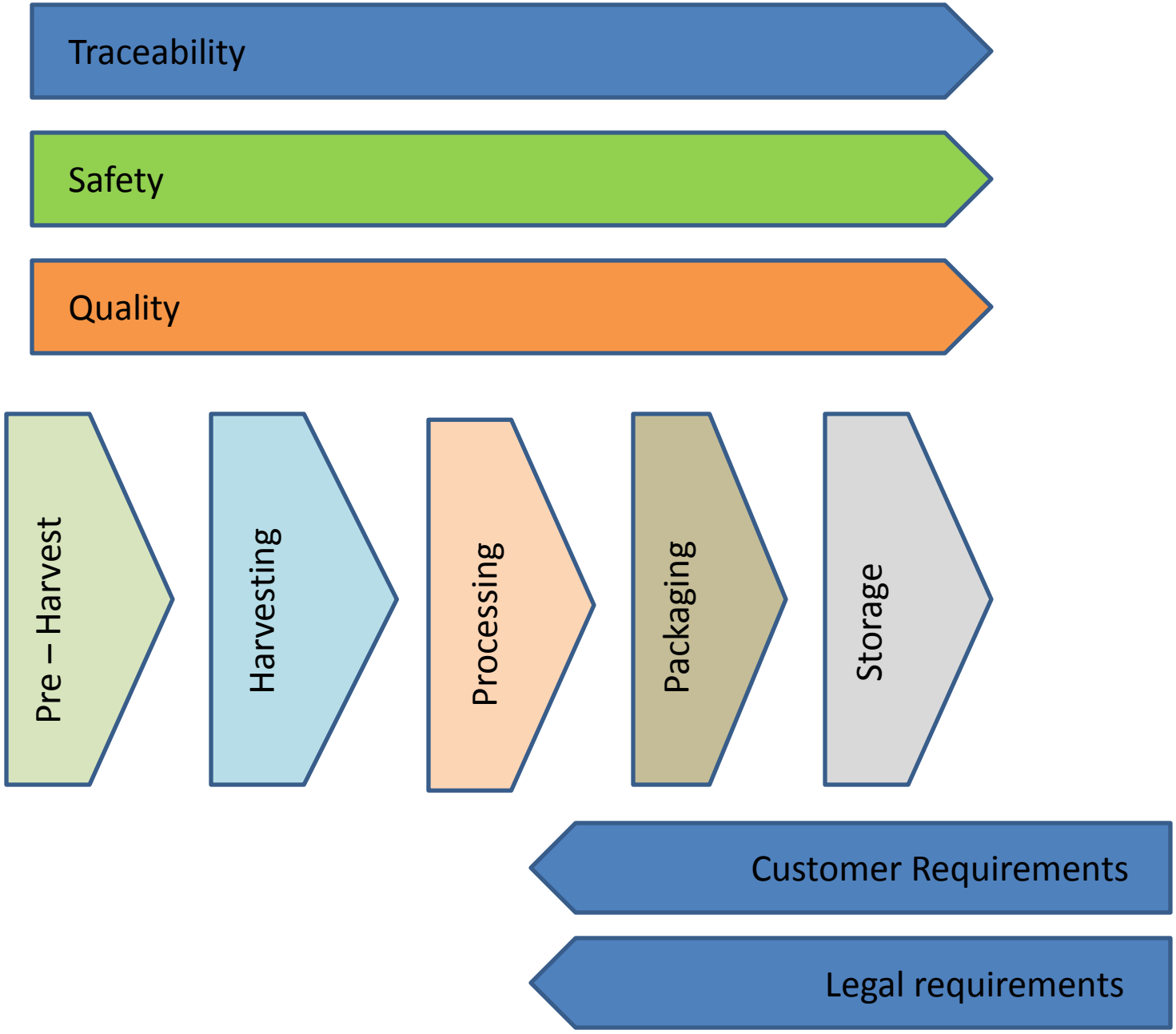
Pre-harvest operations

1. Minimize insect damage and fungal infection by proper use of acceptable insecticides, fungicides and other appropriate practices within an integrated pest management program.

2. Weeds controlled by manual/ mechanical removal or by use of appropriate herbicides or other safe and suitable weed eradication practices.

3. Mechanical damage to plants during cultivation shall be minimized to avoid contamination of plant by fungi.

4. If irrigation is used, ensure that it is applied evenly and that all plants in the field have an adequate supply of water.


Traceability
Safety
Quality
Pre – Harvest
Harvesting
Processing
Packaging
Storage
Customer Requirements
Legal requirements

Module 1 : Melon harvesting and handling

Exercise 1: **Harvest rice**

Suggested minimum instructional time: **40 minutes**

Learning outcomes

1.1 Identify the signs of maturity in Melon

1.2 Harvest Melons

1.3 Prepare melons for fermentation

Teaching strategy:

Learning activities for the trainee must include the instructor to:

- Identify and explain the signs and maturity in Melon
- Explain and understand the Harvesting and handling process

Assessment condition: Trainee must be given access to:

i) information and handouts

Assessment criteria:

1.1.1 Signs of maturity in Melon are identified correctly

1.1.2 The process is understood

Assessment method: To demonstrate achievement of the above criteria the trainee will be given:

- oral questions
- or written questions
- Practical demonstration

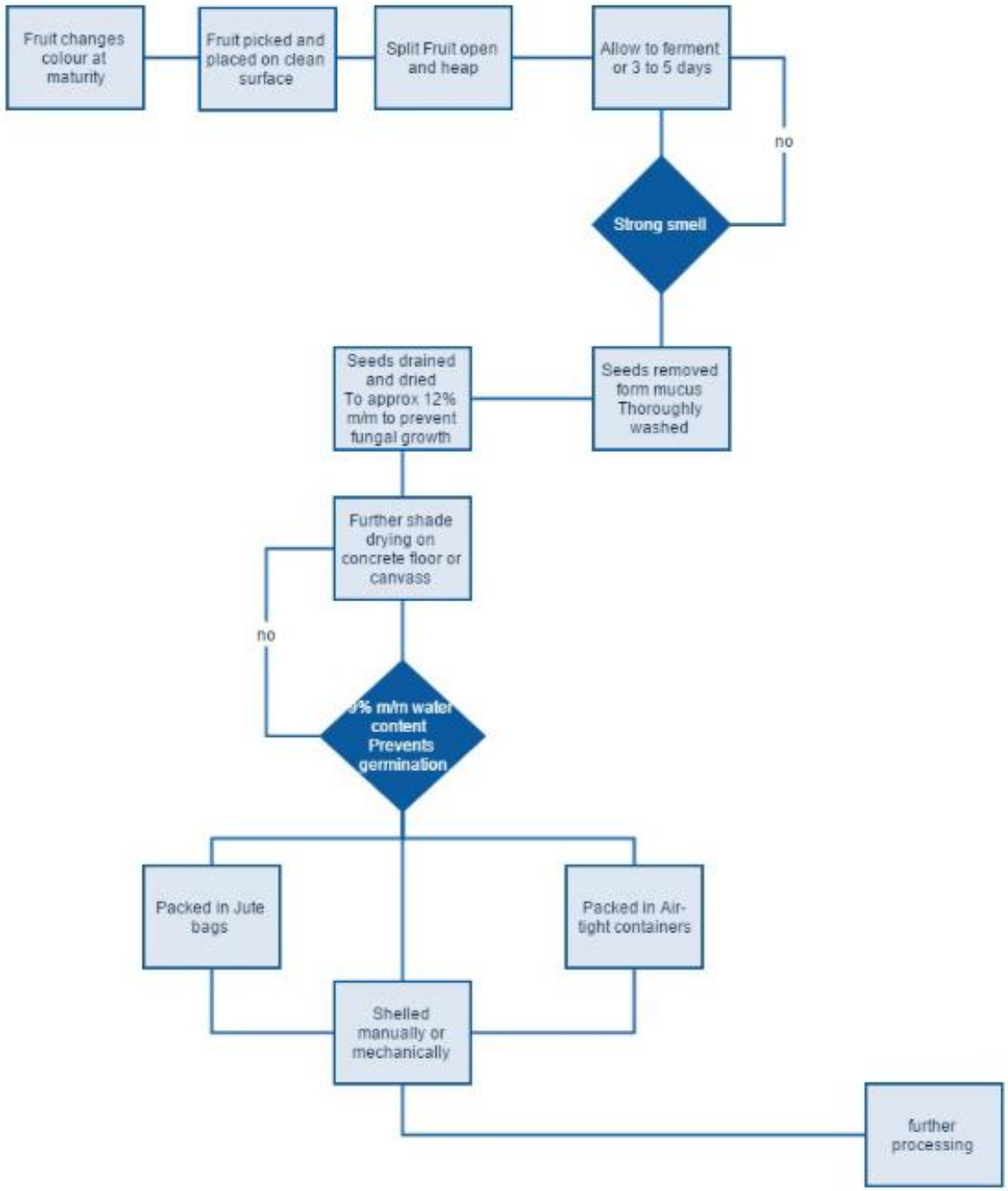
Processing of melon

- Postharvest processing of melons is usually associated with some impediments such as seed extraction and seed shelling.
- Processing of melon involves depodding, fermentation, washing, drying, cleaning and shelling.
- Depodding and fermentation are carried out simultaneously as the pods are left on the field to rot for three to four days.

- However, the process of fermentation and washing are very unpleasant, stressful and dangerous which sometimes lead to stings from scorpions and bits from snakes that hide within the rotten pods.

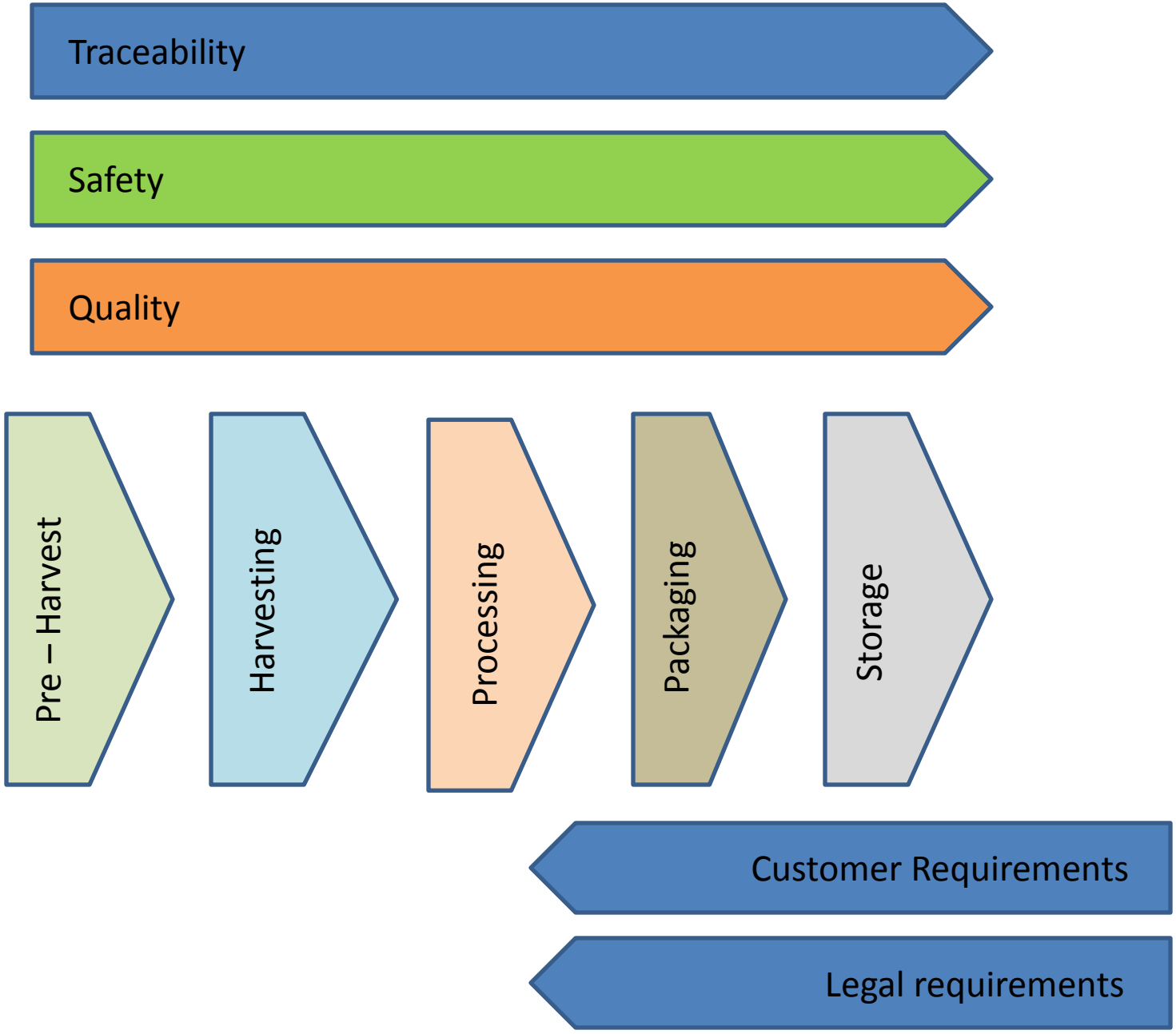
- This was followed by the drying of the seeds using the open air drying system. The ambient temperature at the period of drying ranged from 30 - 32°C, while the relative humidity fluctuated between 65 - 68%.

- The dried seeds were then collected and sorted to remove bad and damaged seeds after which it was shelled


Fruit changes colour at maturity
Fruit picked and placed on clean surface
Split Fruit open and heap
Allow to ferment or 3 to 5 days
no
Strong smell
Seeds drained and dried To approx 12% m/m to prevent fungal growth
Seeds removed form mucus Thoroughly washed
Further shade drying on concrete floor or canvass
no
9% m/m water content Prevents germination
Packed in Jute bags
Packed in Air-tight containers
Shelled manually or mechanically
further processing

General Requirements for Harvest and Processing

- Containers (e.g., wagons, trucks) to be used for collecting and transporting the decomposed hulls from the field to drying facilities, and to storage facilities after drying, should be clean, dry and free of insects and visible fungal growth before use.
- Hulls should be heaped on appropriate surface other than direct soil to allow for decomposition.
- The material used to cover the hulls for decomposition should be free from materials that can aid in contamination of melon seeds.


Traceability
Safety
Quality
Pre – Harvest
Harvesting
Processing
Packaging
Storage
Customer Requirements
Legal requirements

EXERCISE 2: FERMENTATION AND WASHING MELON SEED

Teaching strategy:

Learning activities for the trainee must include the instructor to:

- Explain the purpose of Fermenting Melons
- Understand the risks to product quality associated with the fermentation process.
- Be familiar with the need to wash melon seed and understand the potential risks to product quality associated with the process.

EXERCISE 3: DRYING MELON SEEDS

Learning outcomes

3.1 Dry Melon to the required moisture content

Teaching strategy:

Learning activities for the trainee must include the instructor to:

- Explain the reasons for the two-step drying of washed Melon seed
- Explain the required moisture content of properly dried Melon seed to prevent a) fungal infestation and b) germination.
- Explain and demonstrate the ways for testing dryness of Melon seed.
- Understand shade drying of Melon Seed.

- Clean water should be used to wash off decomposed mesocarp off the melon seeds.
- Allow washed seeds to drain in clean woven basket or container for 2hrs.
- Damaged and discoloured seeds should be removed by sorting.
- Washed seeds should be dried in a manner that will not encourage the growth of moulds.

- Spread seeds thinly on clean surface (raised concrete floor, polyethylene sheets) for initial drying in an airy environment or shaded area near the sun

- Drying continues until melon seeds are completely dried
- Seeds allowing drying to 9% moisture content.
- Improper dried seeds germinate inside the storage container and grow mouldy
- Such seeds represent total loss.
- Washed seeds shall be dried in a manner that disallows infestation by rodents, insects and other contaminating substances.

- Washed seeds shall be dried in such a manner that damage to the seed is minimized and moisture levels are lower than those required to support mould growth during storage

- Harvesting and washing procedures implemented each season shall be documented by taking notes of measurements (e.g., temperature of decomposition, moisture, and humidity) and any deviation or changes from traditional practices.

Packaging

- Dried unshelled melon seeds are stored in air tight (hermetic) containers like metal drum with lid, plastic drum/bucket with lid and polythene-lined jute bag
- Seeds are kept in good condition both for consumption, sowing and marketing
- Jute bag and clay pot are inadequate for storage over a long period

MODULE 2: POST HARVEST PROCESSING

Learning outcomes

Understand how Melon Seeds are further processed

Teaching strategy:

Learning activities for the trainee must include the instructor to:

- Identify the different stages of post harvest processing and their methods
- State the advantages and disadvantages of each method
- Explain and demonstrate the different stages using each method.

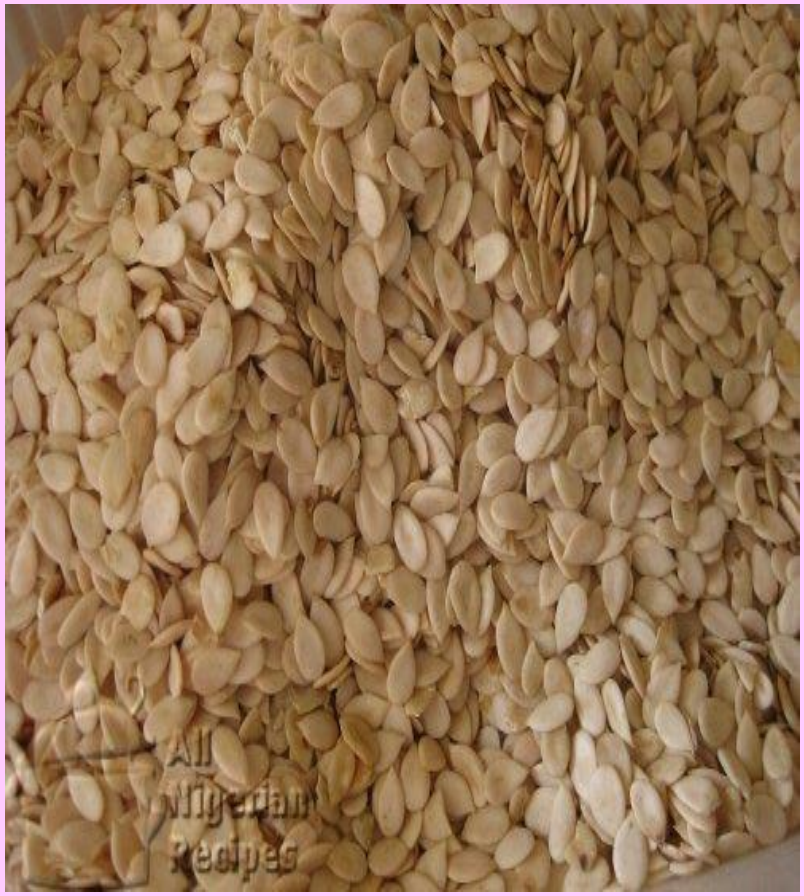
Assessment condition: Trainee must be given access to:

i) information and handouts
ii) Instruction on manual shelling of Melon seeds
iii) Melon seed shelling Machine
iv) Dried whole Melon Seeds
v) Dried shelled Melon Seeds

Assessment criteria:

Different methods of processing Melon Seeds are identified correctly

Shelling



1. Manual

- Shelling can be done manually or mechanically
- Manual shelling is preferred by consumers as broken seeds are not included

- So traditional method of shelling melon appears to be too slow, time consuming, tedious, inefficient and unhygienic.

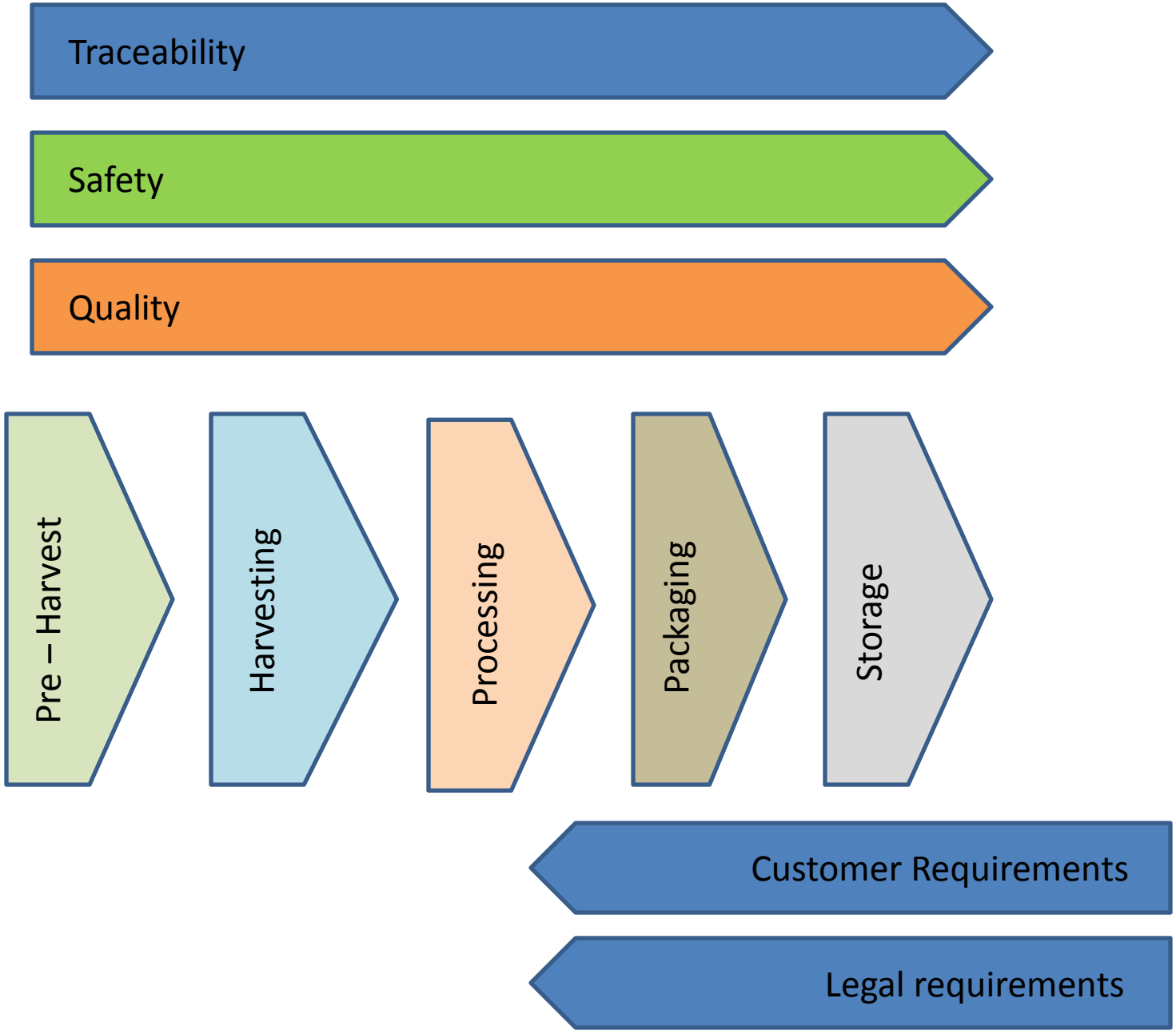
2. Mechanical shelling machine

- The melon seeds machine can separate kernels from shells automatically, and a melon seeds shelling production line can save time and labor for larger scale production.

- The melon shelling machine use a rubbing action motion to peel the seed coat.
  - Carefully adjust the sheller to minimize damage to the seed
  - New or thoroughly cleaned shelling machines can cause damage to seeds; once “worn in” the machines deliver better results.
  - Seed without coat is fragile and susceptible to spoilage

- The melon seeds shelling machine is used for large-scale production of oil and protein sources to shell melon to meet the capacity required for industrial use over a specified period of time in Nigeria.
- The melon seeds machine can separate kernels from shells automatically, and a melon seeds shelling production line can save time and labor for larger scale production.

- For commercial purposes to produce large quantity, mechanical shelling is preferred.
- For commercial purposes in large quantities unshelled seeds are preferred for marketing
- For small and medium scale, shelled melon seeds are preferred for marketing


Traceability
Safety
Quality
Pre – Harvest
Harvesting
Processing
Packaging
Storage
Customer Requirements
Legal requirements

Storage

- Store dried unshelled melon seeds in ambient conditions (store/room) to avoid moisture uptake
- Shelled melons seeds are not stored over a long period (to avoid mite infestation) except in conditioned environment.
- Rancidity may occur after long storage (due to level of free fatty acids in the seeds)

- Melon stored at 75% rh or above - results in moldiness of the seeds
- Seeds are kept in good condition both for consumption, sowing and marketing.
- There should be effective protection against pest access and harbourage.

Storage Requirements

- Storage facilities shall include dry, well-vented structures that provide protection from rain, drainage of ground water, protection from entry of rodents and birds, and minimum temperature fluctuations.
- Melon seeds shall be dried to discourage the growth of Aspergillus spores. The mycotoxin level in in-bound and out-bound seeds shall be monitored when warranted, using appropriate sampling and testing programs (Specification for melon seeds).

- For melon seeds in bags, bags should be clean and dry. Bags shall be stacked on pallets in a manner that allows the free circulation of air between stacked bags.
- Care shall be taken to prevent, so far as reasonably practicable, deterioration and spoilage through appropriate measures which shall include controlling temperature, humidity, and/or other controls

- Moisture content and temperature in the stored seed shall be monitored at regular intervals during the storage period.

- Infected melon seeds shall be separated and samples of such seeds subjected to analysis.
- When separated, the seeds shall be bagged and arranged in a manner that allows circulation of air between the bags and the air shall not be allowed to contaminate the uninfected seeds.

- Minimize the amount of foreign materials and damaged seeds in store.
- Standard Operating Procedures for processes in storage of melon seeds shall be developed.
- Records of activities performed in the storage of melon seeds shall be established.

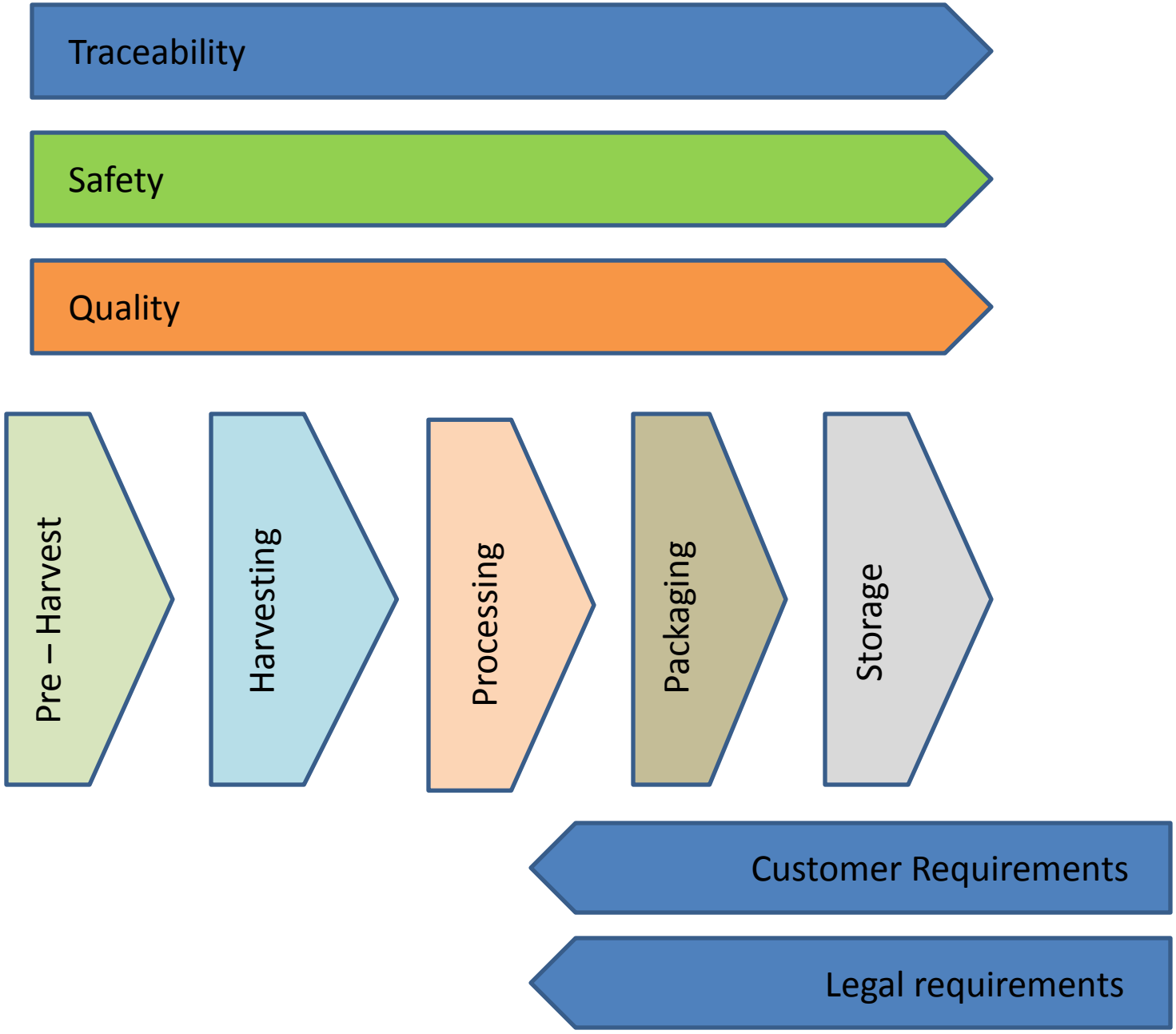
Transportation

- Transport containers shall be dry and free of visible fungal growth, insects and any contaminated material. Transport containers shall be cleaned and disinfected before use.

  The use of appropriate fumigants or insecticides is useful.
- Shipments of seeds shall be protected from moisture by using covered or airtight containers.
- Avoid temperature fluctuations and measures that cause condensation to form on the melon seeds, which could lead to moisture build-up and consequent fungal growth and mycotoxin formation.

- Insect, bird and rodent infestation shall be avoided during transport by the use of insect and rodent proof containers.
- Transportation of melon seeds shall be conducted in a manner that protects food from sources of contamination, damage likely to render melon seeds unsuitable for consumption.

- Transportation of melon seeds shall be conducted in a manner which effectively controls the growth of pathogenic or spoilage micro-organisms and the production of toxins in melon seed.
- Each container of melon seed shall be permanently marked to identify the producer/ processor and the lot.
- Recall products shall be held under supervision until they are destroyed or reprocessed in a manner to ensure their safety.


Traceability
Safety
Quality
Pre – Harvest
Harvesting
Processing
Packaging
Storage
Customer Requirements
Legal requirements

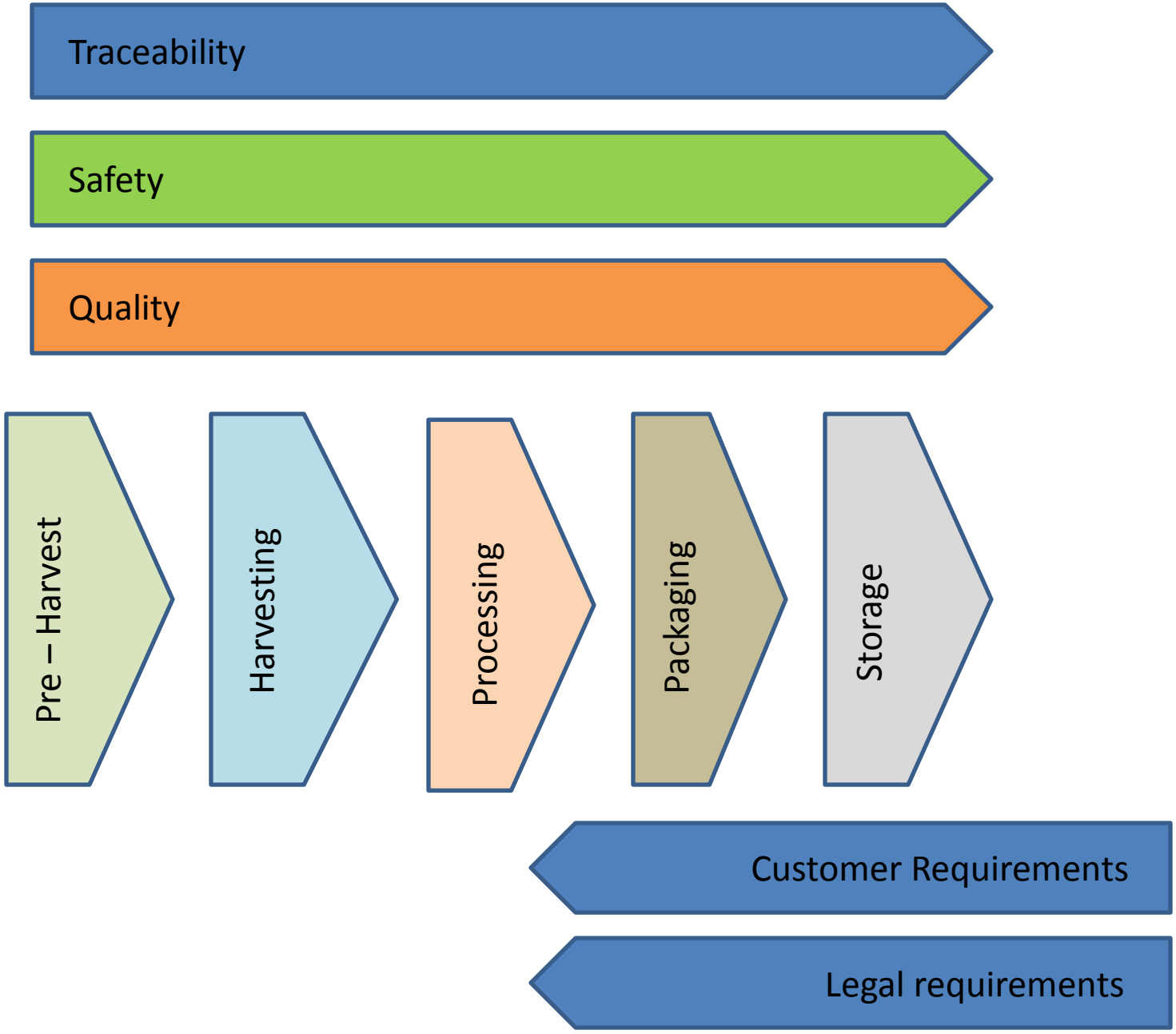
Labelling Requirement

- Peeled melon seeds shall be whole and labelled accordingly, a maximum of 5% broken seeds in a bag of 100kg shall be permitted.
- Broken seed shall be bagged separately and shall be indicated thus.
- Marking of packaged seeds peeled or unpeeled should have the following information.

✓ Name of product/Brand/

✓ Date marking: the date, month and year of packaging and best before date.

- ✓ Net Content shall be declared in metric system
- ✓ Temperature of storage
- ✓ Moisture content
- ✓ List of Preservatives used in descending order of proportion
- ✓ Condition of storage: Shall be stored in a cool dry place.
- ✓ MANCAP Logo and certificate Number (If product is certified)
- ✓ NAFDAC registration number and Bar coding
- ✓ Batch number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Safety
Quality
Pre – Harvest
Harvesting
Processing
Packaging
Storage
Customer Requirements
Legal requirements

PROCESSING OF GROUND MELON

- Egusi melon should be cleaned from extraneous material before grinding.
- Ensure that the moisture is not higher than 12%.
- Ensure that the seed to be ground is free from objectionable colour and odour

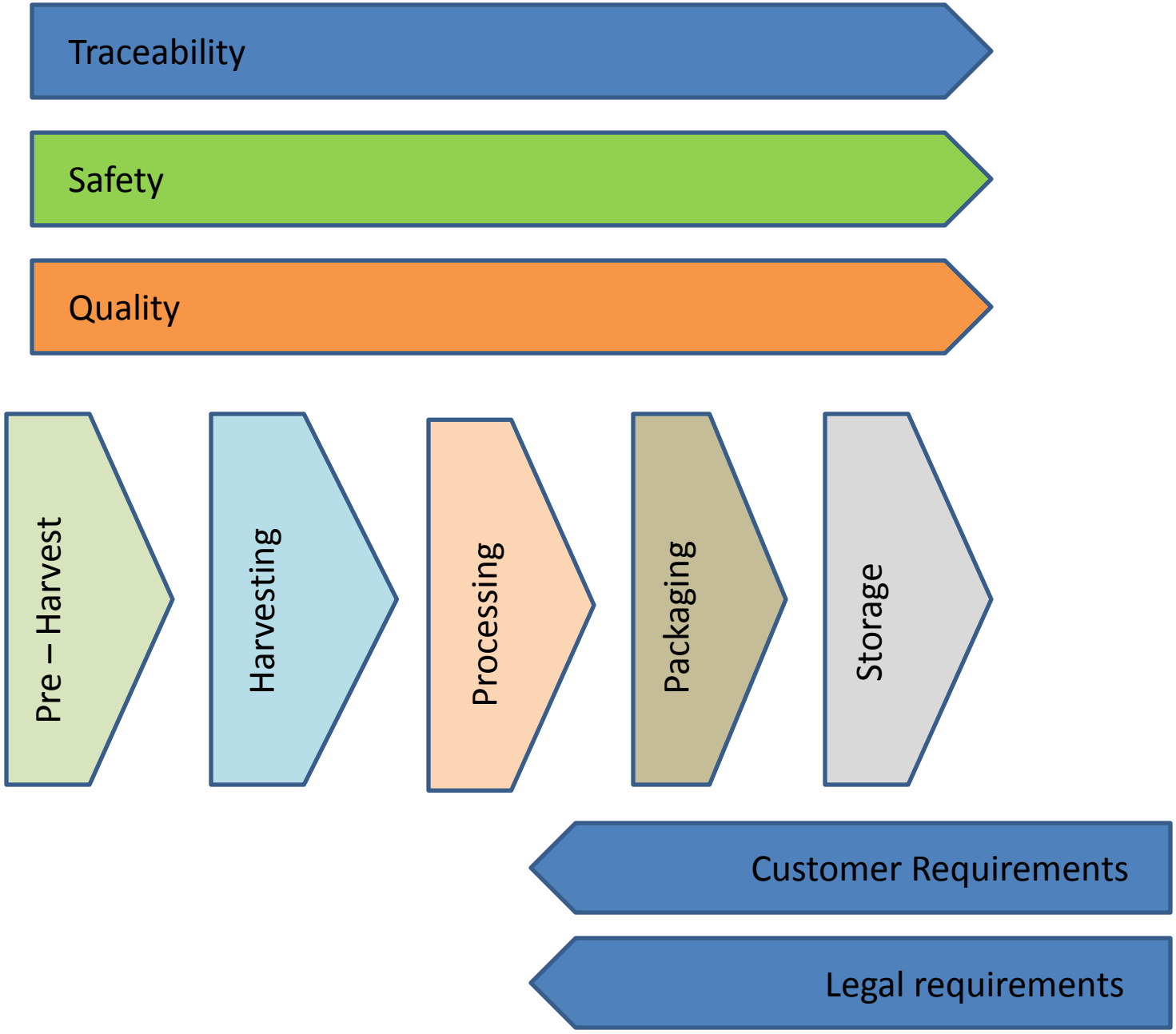
- Egusi melon should be blended smooth using stainless steel grinder to obtain ground melon.
- The receiving containers must be made of stainless steel or material that will not contaminate the product.
- To the extent possible in good manufacturing practice, the products shall be free from objectionable matters and odour

When tested by the referenced test method of sampling and examination, the product;

a) should be free of micro-organisms which may represent a hazard to health;

b) should not contain any substances originating from micro-organisms in amounts which may represent a hazard to health; and

c) should not contain any other poisonous substances in amounts which may represent a hazard to health.


Traceability
Safety
Quality
Pre – Harvest
Harvesting
Processing
Packaging
Storage
Customer Requirements
Legal requirements

Packaging, labelling, Storage and Transportation.

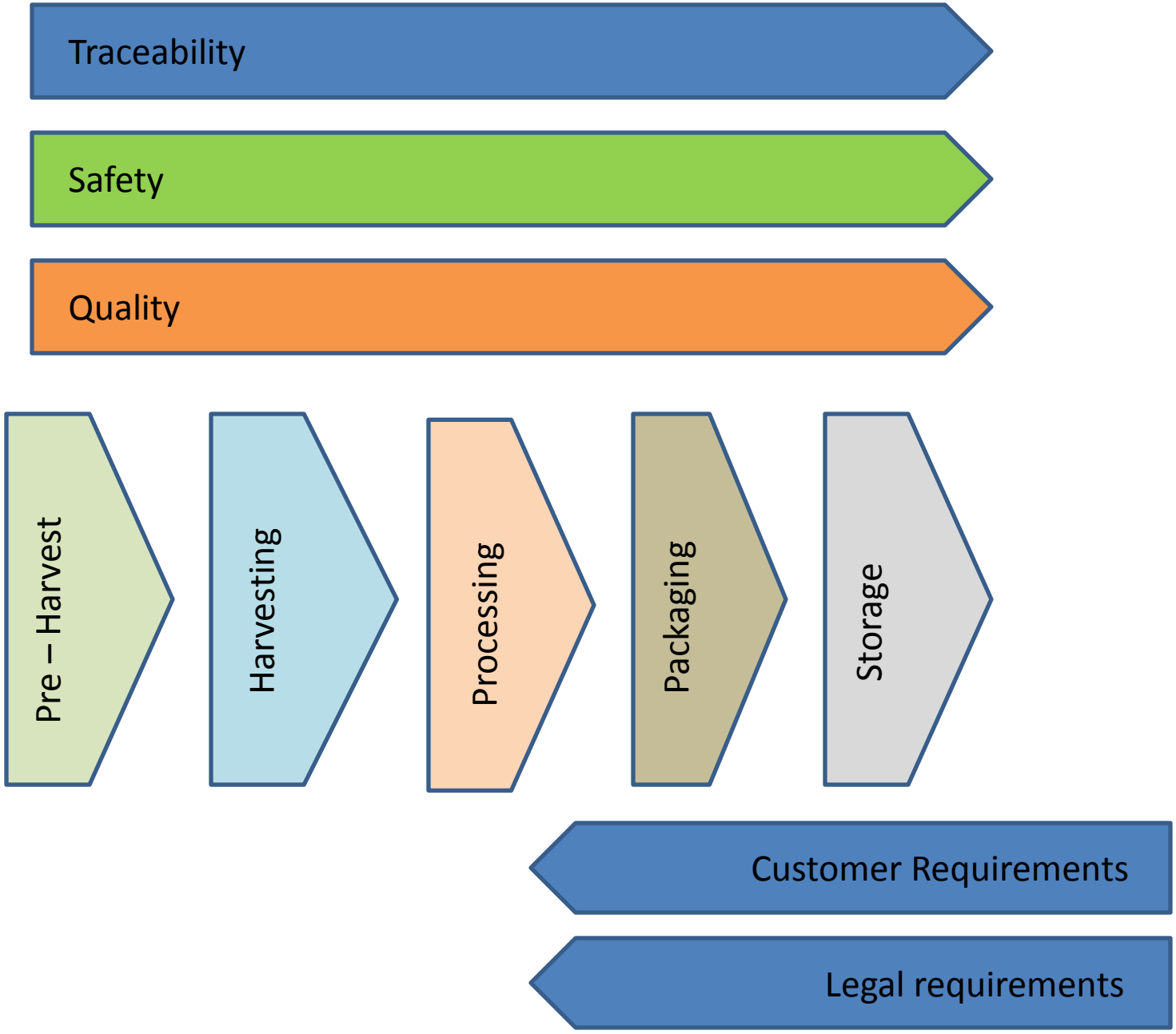
Packaging

- The product shall be packed in suitable hygienic containers so as to safeguard it against moisture, microorganisms, other contaminants and the packaging material shall not impart any odor, taste or colour to the product during storage and transportation.
- The packaging material shall also comply with any national legislation relating to environmental protection.

Labelling

- Name, variety and trade name if any.
- The complete list of ingredients and food additives in descending order of proportion.
- Name and address of the producer or packer or distributor or trademark if any
- Code or batch number

- Crop Year and packing date
- Net Weight in metric system
- Country of Origin
- MANCAP logo
- NAFDAC registration numbers shall be clearly indicated on the packet.


Traceability
Safety
Quality
Pre – Harvest
Harvesting
Processing
Packaging
Storage
Customer Requirements
Legal requirements

Storage and transportation

- Ground melon seeds shall be stored in a dry well ventilated environment, protected from direct sun rays, excessive heat, entrance of weevils, rodents and kept away from the underlisted volatile liquids.
- Ground melon seeds shall be handled and transported in such a way that they are protected from rain, direct sunshine excessive heat, unpleasant odour and any other source of contamination.

Conclusion

- Moisture content of melon in storage should be between 9 and 10%
- Melon shelling is an intermediate stage in melon processing and needs to be given much attention for most of the farmers still employ manual means of shelling which is time consuming, energy demanding, unhygienic and resulting in low income.

END

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