PROTOCOL FOR PINEAPPLE "KERALA MAURITIUS" VARIETY FOR EXPORT TO SHORTER DURATION (15-18 DAYS)

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1. **Pre-harvest Management** – Pre-harvest management is applied under field condition which plays an import role for the shelf life of the produce i.e. fertigation, soil management, water management, pests & disease management, and weed control. Hence, it is necessary to collect the information on the abovementioned practices implemented at farm.

The pre-harvest practices are subjected to the following provisions:

i) Whole fruit with crown.
ii) The crown should be free of dead or dried leaves.
iii) Healthy produce generally affected by rotting or deterioration to make the fruit unfit for consumption.
iv) Fruits should be clean, practically free from any visible foreign matter.
v) Fruits should be free from internal browning.
vi) Fruits should be free from damage caused by pests.
vii) Free from pronounced blemishes.
viii) Free from damage caused by low / higher temperature in field conditions.
ix) Free from external moisture, excluding condensation following removal from cold storage.
x) When a peduncle is present, it shall not be longer than two centimeters and the cut must be straight & clean.

2. **Maturity of the Fruit** – The fruit must be chemically ripe i.e. without evidence of unripeness (opaque, flavourless, exceedingly pours flesh) or over ripeness (exceedingly translucent or fermented flesh). Harvesting of pineapple can be started when fruit has started turning in colour i.e. base of fruit has just coloured, earliest a fruit of pineapple can be harvested i.e. when $1/8^{th}$ surface of the (bottom side) has become coloured. Therefore, different stages at which fruits are harvested are:

i) $1/8^{th}$ surface coloured.
ii) $1/4^{th}$ surface coloured
iii) $1/3^{rd}$ surface coloured
iv) 1/2 surface coloured
v) $2/3^{rd}$ surface coloured
vi) Fully coloured

However, for export purposes one has to harvest between $1/8^{th}$ surface colored to $1/4^{th}$ surface colored depending upon the time it will take to reach destination during which

time the color development also takes place. However, do not harvest before the fruit turn in colour stage. In the international trade fruit maturity index is measure as below:

i)	M0	-	Raw fruit
ii)	M1	-	$1/8^{th}$ turn color stage
iii)	M2	-	1/2 turn color stage
iv)	M3	-	Fully color turn stage

Moreover, the minimum TSS should be 12.0 to 13.0°B in the world market. This TSS in the fruit is attained if the fruits are harvested earliest only when the fruit has just started turning colour.

3. **Tests required / Carried out** – Certain tests are necessary at the field level while selecting the fruits for harvesting. The test equipment required are given below:

i)	TSS	-	Refractrometer
ii)	Firmness of fruit	-	Penetrometer
iii)	pH	-	pH meter
iv)	Pulp temp	-	Probe thermometer
v)	Weight	-	Weighing balance
vi)	Size	-	Plastic rings of different size

4. **Special considerations**

i) The fruit should be free of blemishes, bruises, sun scald, black rot, internal browning, mealy bug, mite, thrips, scale insects etc.
ii) The stem end must cut smooth and should not be more than 2.0 cm.
iii) The preference should be given to uniformity in color, weight, size and homogenous variety.

5. **Harvesting**

i) It should be carried out preferably in the early hours of the morning or late afternoon when the temperature is low.
ii) Harvesting should not be performed after rains, till complete removal of moisture from the fruits. If necessary or unavoidable, then fruit should be subjected to compulsory high-speed air-drying.
iii) Fruits should not bruise during harvesting.
iv) Do not put the fruit on the ground, harvested fruits should be put in crates or plastic baskets having cushioning of papers.
v) Use a sharp knife for harvesting, giving a smooth cut, the stem end should not be more than 2.0 cm long.
vi) After harvesting fruit should be kept in shade. Every care needs to be taken that crown leaves are not damaged or crown is not twisted.

6. **Transportation of fruits from field to Packhouse**

   i) Transport the fruits immediately to Packhouse without any loss of time.
   ii) Transport should be available on demand at the time of harvest so that there is no time gap between harvesting and transportation of pineapple
   iii) As far as possible there should not be any jerks or bumps during transportation to avoid any bruises to the fruits.
   iv) The vehicle should be clean to avoid any infection to the fruits.
   v) Preferably no other product should be transported along with pineapples.

7. **Processing of material at Packhouse**

   i) The material received and kept at 23-25˚C temperature in Packhouse.
   ii) **Cutting the stem end / Peduncle and sorting** – First action should be cutting the stem end smoothly, if not done properly as suggested above that it should not be more than 2.0 cm long. Long end will bruise the other fruits. During this operation no damage should be caused to the fruits. Before use of the sharp knife, this should be disinfected with 0.1% Sodium Hydrochloride solution quite frequently.

8. **Sorting:** All the fruits should be sorted out having sunspot or sunscald or having damaged crowns or having multiple fasciated fruits. Fruit having infestation of mealy bug, mite, thrips, scale insects and diseased one should be sorted out. The deformed fruit shape and twisted crowns etc. should be sorted out. Even under sized/oversized /immature fruits or damaged one should be rejected at this stage.

9. **Washing of the fruits**: After trimming, cutting the stem and sorting etc., the fruits are subjected to clean soft water washing. If fruits are quite dirty, then in washing water a disinfectant like sodium hypochlorite needs to be added @ 100-200 ppm to generate Chlorine in the water solution. After chlorine disinfection rinsing with clean water is absolutely essential. It is desired that no hard water with heavy minerals/metals or contaminated with chemicals used for washing of the fruit at any stage.

10. **Hot water treatments:** The fruit should be subjected to 53˚C temperature for 5-7 minutes. Hot water treatment to kill the mealybug, scale insects, thrips, mites and prevent from storage rots.

11. **Fungicidal treatment:** Usually 1000 ppm thiobendazole or Bavistin is applied for disinfecting the fruits from pathogens associated at pre-harvest stage with fruits. The fruit should be dipped for 3-5 minutes depending upon the size of the fruit.

12. **Air Drying:** Before taking the wax treatment it is essential that fruit should be subjected to air-drying to eliminate the excess of water adhering to the shell of the fruits.

13. **Waxing:** It should be carried out with edible wax solution e.g. starfresh wax 45/ having Thiabendazole @1000 ppm. Correct and effective fungicidal and wax treatment is absolutely essential otherwise it can result in heavy post harvest losses.

14. **Packaging:** Pineapples are packed along with crowns for prolonged shelf life and to avoid infection at the crown attachment point. Two methods are used i.e. Horizontal packing and vertical packing keeping the crown on the topside.

15. **Coding and labeling:** Each carton should be coded for date of packing, product & growers code for tracing the product's origin, etc. The boxes should be corrugated with required strength as adviced by the Indian Institute of Packaging, Mumbai and box should contain the following information:

    (i) Name of the Product
    (ii) Variety
    (iii) Grade/ class
    (iv) Origin of produce
    (v) Date of packing
    (vi) Name of Exporter
    (vii) Gross weight/ Net Weight
    (viii) Number of fruit per box
    (ix) Maturity stage (At the time of packing)
    (x) Recommended storage temperature & R.H.

16. **Pre-cooling:** Pineapples are very sensitive to temperature. The fruit defending upon mode of transport should be cooled as soon as possible at least with in 10 hours of harvest.

    Pre-cooling temp: 1/8th mature fruit – 13-15˚C for 6 to 8 hours. Depending upon the size of fruits when pulp center temp obtained about 13-13.5˚C.

17. **Reefer cold storage / Transportation by reefer container:** The fruit should be stored at 12˚C at 85% R.H. When the fruit pulp temperature attain 12-12.5˚C and RH 85% fruits may be transported to short distances (Journey period up to 10 days) anticipating 8-10 days for consumption.

18 – Steps have to followed for Export of Pineapples

Harvesting – 1/8th fruit turned color.

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Harvesting timing – Early morning or late afternoon (Temp 25-30˚C)

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Storing material after harvest in field under shade condition and put the product in plastic crates.

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Transportation in to packhouse.

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Receipt of the produce & record of the pre-harvest management

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Trimming / cut the stem at 2.0 cm long with sharp knife

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Sorting of the fruit

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Washing of the fruit with soft portable water

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Hot water treatment at 53˚C (5-7 minutes)

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Fungicidal treatment

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Air drying

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Waxing

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Packing labeling

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Palletization

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Pre-cooling (13-15°C for 6-8 hours)

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Store in reefer condition (12-12.5°C) 85% R.H.

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Transportation by Reefer Containers

Post harvest treatment and observation on shelf life of Mauritius Pineapples in CA lab APEDA

Observation on 16.0˚C Reefer Conditions: The fruits were received uneven size and varying maturity. The organoleptic tests carried out in the lab revealed that fruits were received of higher maturity i.e. TSS index 17˚B where as it desired about 12-13˚B. pH was 3.04 where as desired is 2.5 to 2.8. Fruit pressure was about the discussed firmness i.e. 8-10 kg/cm^2. Fruit temperature was also of desired level – 20-25˚C.

It was observed on 15th day after the harvest that there is no much change in TSS of the fruits and temperature was also at set temperature. pH was considerably increased it shows the higher sugar break down of the fruits which reduces the shelf life of the products. The 16°B at reefer temp has drastically changed the pH, taste & flavour of the fruits.

Reefer Condition, 10°C & R.H. 85%: The observation on 15th day of the trial revealed that pH was increased and TSS was also increased but after words observations revealed that there is no significant change in TSS and up to 19th day the flavour and taste was good & OK. Thus it is recommended that 12°C may be treated as protocol for the pineapple Mauritius variety at 85% R.H. for South East & Middle East Countries.