

Mango Supply Chain Monitoring Report

June – July 2007

Monitoring Studies of the Export and Domestic Supply Chains of Pakistani Mango under the auspices of Australia – Pakistan Agriculture Sector Linkages Program (ASLP)

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1. Introduction

The ASLP mango supply chain management project, “*Optimising Mango Supply Chains for More Profitable Horticultural Agri-enterprises in Pakistan and Australia*” has been initiated in Pakistan with the core objective of *addressing key constraints currently limiting the competitiveness of supply chains for Pakistan and Australian mangoes*. The specific objectives of this project are:

1. To improve and maintain mango quality from harvest to consumption.
2. To identify present market needs and likely future opportunities for Pakistan mangoes, using this information to inform the analysis of existing supply chains and the development of improved supply chain management systems and practices.
3. To work with selected mango supply chains so that they can demonstrate to the rest of the industry the impact of improved supply chain management on competitiveness.
4. To build capacity in Pakistan mango R,D&E institutions to conduct supply chain analysis and implement improved supply chain management practices.

The project team decided the work plan for year 2007 at the event of project initiation workshop in June 2007, and it was decided that monitoring of commercial consignments for export and domestic markets of Pakistani mangoes will be conducted, *inter alia*, to observe and analyze the constraints limiting the competitiveness of Pakistani mangoes.

In this reference, monitoring of seven export market consignments (five being by air and two by sea) and four domestic market consignments was conducted*. This report includes the determination of harvest maturity, temperature profile of the consignments from harvest till the consumption of the produce and mango quality evaluation at different levels of the supply chain.

2. Method of conducting Monitoring Studies

Harvest Maturity

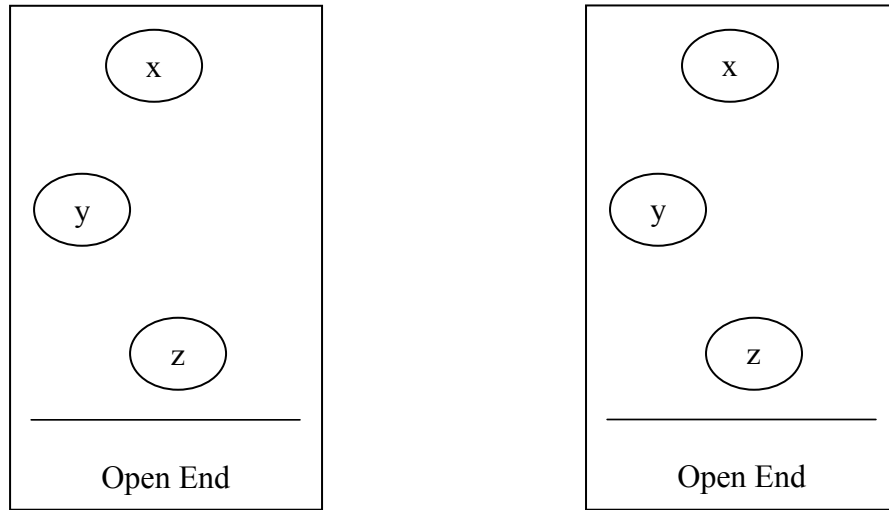
The harvest maturity of the fruit was determined by the use of refractometer and the colour guide of Australian Calypso variety. Nine fruits from three trees were harvested randomly and their flesh colour was compared with the Australian mango variety, Calypso. The TSS of the same fruits was recorded by the use of refractometer.

Temperature Profile

The atmospheric temperature and the pulp temperature at harvest were taken with a probe thermometer. To view the complete temperature profile, two or three data loggers were installed in different crates, which were placed at different locations in the supply chain.

* *the monitoring studies are being conducted by a postgraduate student of Horticultural Sciences, and will be a part of his research thesis*

The boxes were marked with identification numbers and printed tape was wrapped around the boxes to make the identification of experimental boxes at each level.



Position of Data Loggers in the Open Top Truck

Position of Data Loggers in the Reefer Container

x: 2nd Row; 3rd Box from Bottom; Middle Layer

y: Middle Row of Truck/Container; 2nd Box from Top; Middle Layer

z: 2nd Last Row; Middle of the Row; Middle Layer

Quality Assessment

Fruit quality was assessed at different levels of postharvest handling (harvest, packing, cold store and retail stores) for skin colour change, firmness, presence of rots and skin blemishes. The data of each component was recorded with the help of following guide.

Rate	Colour (yellow)	Firmness	Skin brown	Sap burn	Lenticel spots	Stem end rots	Body rots
0	0 %	Hard	< 3 cm ²	< 3 cm ²	< 25%	Nil	Nil
1	20 %	Rubbery	to 25%	to 25%	25-50%	< 5%	< 5%
2	40 %	Sprung	> 25%	> 25%	> 50%	5-10%	5-10%
3	60 %	Ripe				10-25%	10-25%
4	80 %	Soft				>25%	>25%
5	100 %						

A detailed guide for monitoring of commercial consignments is attached as annex 1.

3. Monitoring of Export Market Consignments

The monitoring studies of export market consignments were undertaken for air freight as well as for sea freight. The air freighted consignments were exported to Singapore, United Kingdom (UK), United Arab Emirates (UAE) and Germany; while the sea freighted consignments were exported to UAE only.

a. Monitoring of Air Freighted Export Market Consignments

As is given earlier, the air freighted consignments were exported to Singapore, UK, UAE and Germany. The consignments to Singapore, UK and UAE were exported from Sindh province, while the one exported to Germany was sent from Punjab province. The details of the monitoring of each consignment are given;

i. Iftikhar Ahmad & Co. (IAC), Karachi to Fresh Mart, Singapore

Consignment Details

Brand:	IAC	Grower/Packer:	Asim Agriculture Farm, Tando Soomro
Variety:	Sindhri	Packaging:	Single layer, 5 Kg Card Board Boxes
Count:	10-11	Packed Date:	01 June 2007
Departure from IAC:	01 June 2007 (4 p.m.)		
Destination:	Fresh Mart, Singapore		
Date of Arrival at Destination:	02 June 2007		

Key Findings

- The consignment was comprised of green hard unripe mangoes, and no stimulation for ripening was provided before export.
- The shipment arrived on Saturday (2 June) night in Singapore Changi airport and was collected between 6 and 7am Sunday morning.

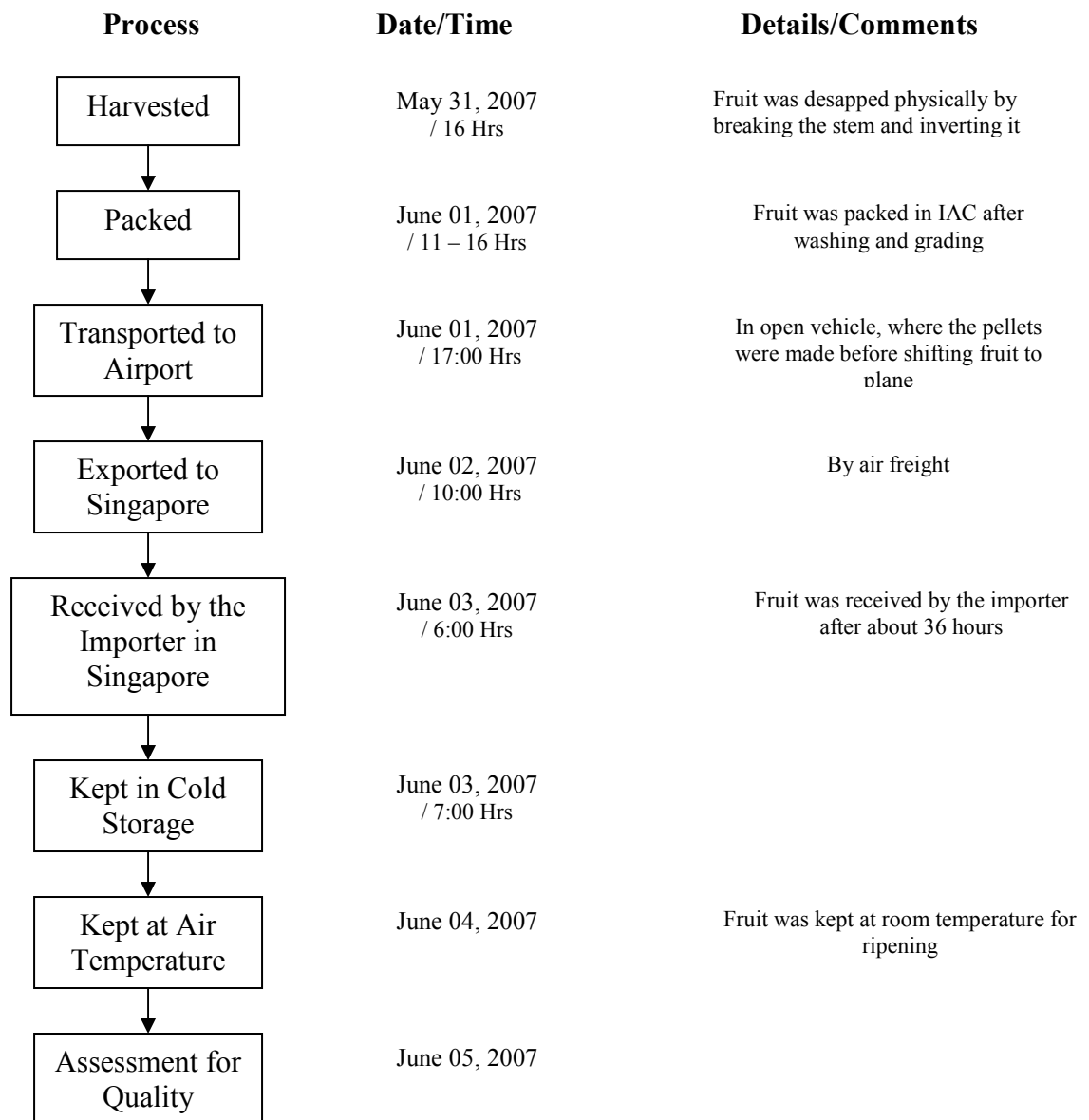


Consignment ready for export at IAC, Karachi

- It was transported by covered truck to Fresh Mart cool store where it was held for 24 hours at 18°C.
- Monday morning it was placed under cover at air temperature at wholesale business at Pasir Panjang Wholesale Centre. It remained there to ripen at 28-32°C (normal daily temperatures at this time of the year in Singapore).

- The importer made a decision to sell the fruit to the wet market retailers rather than supermarkets, so it was decided to made available to his buyers daily until the whole shipment is sold. (Buyers typically buy lots of 5-20 cartons).
- The importer was pleased that an effort had been made to strengthen the carton, but there was evidence of both bottoms and tops of cartons sagging. (Cross-stacking, a normal practice in the market, is one cause of this, as cartons are not supporting each other in columns. Smaller (2 to 4kg) cartons are one way to solve this problem).
- Strapping cartons in pairs was a good idea as the strapping helps to prevent tops sagging onto the fruit in the carton when another carton is cross-stacked on top of it.

Postharvest Process Flow



Marketability and price

- The market was well supplied with Thai mangoes, some Indian and Taiwanese mangoes.
- Prices were average, with good Thai mangoes of a similar size to our Sindhri selling for around USD1.66 (Rs100) each.
- Our shipment was definitely at the bottom end of the current market because of improper fruit immaturity and softening, blemish and poor flavour development.
- The importer expected that if he tried to sell them in their green state he would return to the exporter approximately USD4-5 (Rs240-300) per box. If he waits and the mangoes colour up fairly evenly in the next 3 days, he expects to return around USD 6 (Rs. 360) per box. These prices are below the exporters landed price of USD 6.20 per tray, so obviously we did not meet the market's requirements at this level of quality.
- Other Pakistani exporters were quoting the following landed Singapore prices on 5 June: 3kg box USD 4.35, 4kg box USD 5.80; 5kg box USD 7.25 but the importer said he would not buy at those prices because it was too early in the season and he would not trust the fruit to colour up and be attractive enough to buyers.

Temperature Profile

The fruit was harvested at 32°C and its temperature remained more than the same till the consignment reached Fresh mart, Singapore. The temperature of the consignment gradually decreased and reached 24°C, in the cold room, when it was again placed in warmer location. The temperature profile of the consignment is attached as annex 2.

Harvest Maturity and Quality Assessment

- The fruit was too immature and had begun to soften with minimal colour development.
- Sapburn and associated blemish were detracting from the visual appeal of the fruit.



Fruit Quality Analysis at Fresh Mart, Singapore

- Grading was quite uneven, with too much variation in fruit size in the same carton.
- The consignment had been held at room temperature which is around 28-30°C, and remained unsold due to serious breakdown that occurred from rots and mechanical damage.
- Out of 32 fruit in the 3 cartons with loggers, only 5 had no sapburn. The remaining 27 fruit has sapburn that ranged in surface area between 1 and 5 square centimetres per fruit (mostly 2-3).
- Five of 51 fruit had started to develop stem end rot and all fruit begun to soften.
- Colour was mostly green, with 10-20% yellow.
- Flesh colour was light yellow with more ripeness close to the seed.
- Taste was very sour, with Brix levels of 10-11.

Desapped (dipped) trial cartons

Two trays of fruit were treated with lime and mango wash at IAC, Karachi. These were held in the importer's office at 20-24°C (normal airconditioning) since last week. The feedback on these mangoes is as follows;



Desapped (dipped) at Fresh Mart, Singapore

- Fruit desapped by dipping were very different to the rest.
- There was 2 fruit out of 19 that showed only minor sap ooze with little burn.
- The fruit presented much better and Peter was pleased with the desapping result. He estimated that this fruit would sell for about USD1 (Rs60) more than the other cartons.
- This represents the 'value' we created by dipping, and in this case would make the difference between a profit and a loss.

Feedback:

Although the first trial consignment was sold for 500 USD only, however, it had been a good learning experience for the project team as well, because it showed a positive way forward. The results represented the 'benchmark' of current Pakistani best practice (apart from maturity) and will be used as a standard against which to evaluate the improvements over the time.

The importer was willing to remain involved in helping to improve the supply chain. He was ready to take another shipment of mature green Sindhri in 3 weeks when fruit can be guaranteed to be mature. He was only interested in fruit that has been desapped by the dipping methods, practiced at IAC, and it needs to be better graded. His preferred size range was 10-12 pieces per 5kg carton. Large fruit are more difficult to sell until the quality improves.

ii. *Iftikhar Ahmad & Co. (IAC), Karachi to Altaf Al Khammas & Co., UAE*

Consignment Details

Brand:	IAC	Grower/Packer:	Asim Agriculture Farm, Tando Soomro
Variety:	Sindhri	Packaging:	Single layer, 5 Kg Card Board Boxes
Count:	10-11	Packed Date:	01 June 2007
Departure from IAC:			04 June 2007 (afternoon)
Destination:			Altaf Al Khammas & Co., UAE
Date of Arrival at Destination:			04 June 2007
Retail Outlet:			Lu Lu supermarkets
Date of Analysis at Retail Outlet:			05 June 2007

Key Findings

- The temperature of the fruit was not brought down at any stage after harvest.
- There is an obvious rise in temperature during the ripening phase (while held at IAC – Jun 2-3).
- Temperature slightly decreased just prior to being shipped to the airport.
- Temperature increased dramatically at Karachi airport (40°C) and hence during flight.
- Fruit were subjected to the 10°C coolroom in Dubai which pulled the temperature down a little before loggers were removed. At time of logger removal the fruit still felt hot.

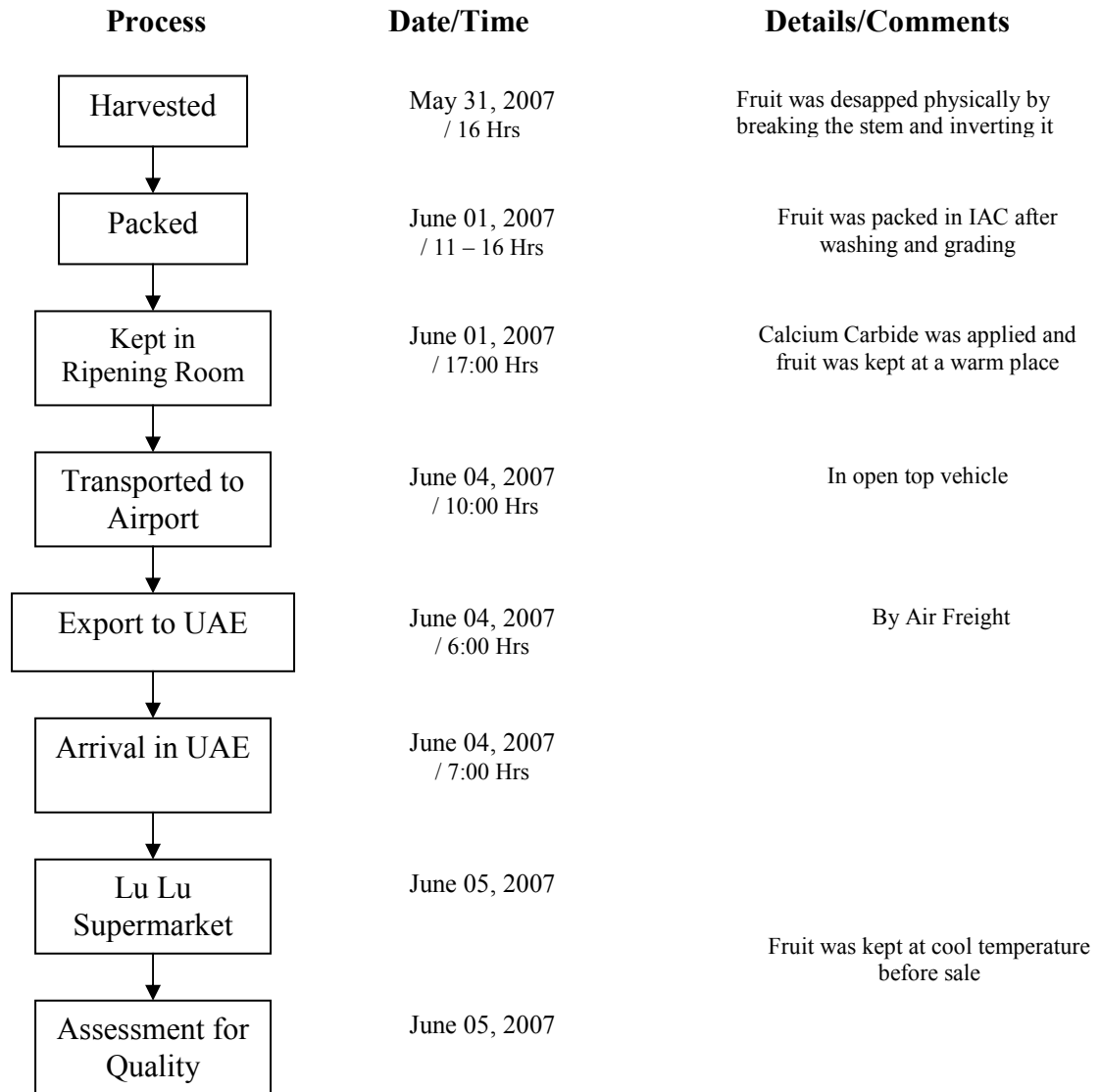
Recommendations

- As there is no forced air cooling available it may be wise to use rooms set at slightly lower temperatures (6-8°C) after packing to help pull the temperature down
- Ripening needs to take place in a cool room (set around 18-20°C) in clean plastic crates that are not lined with newspaper (to allow ventilation).
- Ripening using calcium carbide is not effective and requires high doses to really make a change (international research has shown this). The unevenness of colour on out turn in Dubai showed this to be the case.
- For long distance airfreight or for sea freight cooling (pulp temperature) needs to be to 10-12°C particularly if the sea container is set to 8°C.
- For short term air freight temperature can remain at 18-20°C.

Temperature Profile

The loggers were inserted in the consignment at 32°C, followed by application of Calcium Carbide, which increased the temperature of the consignment (36°C). The maximum temperature was recorded at airport (40°C). The temperature profile of the consignment is attached as annex 3.

Postharvest Process Flow



Feedback on Harvest Maturity and Quality Assessment

- Fruit maturity, (it demands maturity guide)
- Fruit Quality, (it demands three major chemicals one to control Anthracnose, other to control Stem end rot and to desapp mangoes 'Mango Wash' or Lime)

- Temperature Control & Ethylene Ripening, (it demands precooling it may with forced air-cooling or hydrocooling along with proper ripening room facility).

Currently, no one in supply chain from Pakistan has this facility & understanding to ripe mangoes with ethylene, and more importantly the temperature management throughout the chain till fruit reaches at last hand.

iii. Iftikhar Ahmad & Co. (IAC), Karachi to Khan Brothers, UK

Consignment Details

Brand:	IAC	Grower/Packer:	Mahmood Nawaz Shah, Hyderabad
Variety:	Sindhri	Packaging:	Single layer, 2 & 3 Kg Card Board Boxes
Count:	5-7	Packed Date:	05 June 2007
Departure from IAC:			05 June 2007 (afternoon)
Destination:			Khan Brothers, UK
Date of Arrival at Destination:			06 June 2007

Key Findings

- The trial consignment was sent along with a commercial consignment. Trial consignment being in 3 kg boxes and the commercial consignment in 2 kg boxes.
- The ripening initiation was given to the fruit by application of Calcium Carbide at IAC facility.
- The fruits were generally below average in quality - sap burn and abrasion damage, grading, sizing, disease, residue
- Short shelf life - the product has to be shifted quickly - therefore prone to discounting at both the wholesale and retail level
- Market coverage restricted mainly to Pakistani and Indian communities - where the product is well known and liked
- The product was sold by the carton - preferred 2-3 kg carton



Fruit Quality Analysis at Khan Brothers, UK

Feedback

The shipment was well received, its quality was far superior to anything else we saw in the market although there is much room for improvement - sizing, grading of blemishes. The product was sold immediately on release from evaluation.

Quality Analysis

Quality Attribute	Trial Shipment (3 kg)	Standard Shipment (2 kg)
Skin Colour	5.05	4.8
Fruit Firmness	2.95	3.6
Stem End Rots	0	20%
Browning	10%	30%
Sapburn	15%	40%
Lenticel	35%	0%
Abrasion	40%	40%
Immature	10%	70%
Bruising	10%	0%
Grading	Average	Poor
Residues	Minimum	Very high >40%
Appearance	Fair	Very Poor
Rots	nil	High
Wounds	nil	20%

Feedback from Retail Stores/ Markets

Retailer/ Wholesaler	Description							
	Customers	Price / Box	Quality	Volume	Source	Brands	Packaging	Comments
<i>Edgeware Road, Paddington</i>	Middle Easterns	2kg: £4.99 3kg: £7.00 5kg: £9.00	Fair to poor, immature fruit, 100% blemish, inconsistent sizing, rots, Carbide residues	10-12 boxes/day	Direct from Western International Market, daily	IQT, Raza Traders, Zakariya Exp. Co., Rizwan, Roshan, Kashmir	2, 3 & 5 Kg	Too many exporters undermine the market. The price can be £10-12 per 3 kg box if the quality was better
<i>Western International Market, South Hall</i>	<i>Wholesalers:</i> Khan Bros., Fruity Fresh, Saliko <i>Retailers:</i> Mr. Hajindar Mr. Shinda	2kg: £1.5-2 3kg: £4.00	Highly variable, immature, blemishes, residues, stem end rot, sap burn - little evidence of grading/sorting	Each exporter clears the consignment daily	specific exporter	IAC, Roshan, SMA	Generally good; newer boxes stronger and more attractive	Better quality earns high income, Shelf life is less, Stickers are used to hide the wounds,

								Poor grading, 2 kg boxes are popular
<i>The Broadway, South Hall</i>	Pakistani & Indians	2kg: £3.50 3kg: £5.00	Less immature fruit; poor sizing, blemish very high; residue high on some	50-60 boxes to a pellet/day	Direct from Western International Market, daily	IQT, Rizwan		Too many exporters undermine the market. The price can be £4-4.5 per 2 kg box if the quality was better
<i>Spitalfield Wholesale Market, Leyton</i>	<i>Wholesalers:</i> Al Hasnain Enterprises	2kg: £3.00 3kg: £4.10 4kg: £5.20	Quality of Roshan was fair to good, generally it is poor - poor sorting/sizing, blemishes (sap burn), residues variable	Each exporter clears the consignment daily	Specific exporters	IQT, Roshan, JMB, Akbar, Zulfiqar		No cold store facility, High heat in fruit, Market is flooded
<i>Queens Market, Green Street, Upton Park</i>	<i>Multicultural Retailers:</i> IQRA Foods, Pelhurst	2kg: £3.00	Minimal rots, high sap blemish, abrasion, some immature, sizing good on Roshan product, good colour	Pellet a day	Direct from Spitalfield Market each day	IQT, Roshan		Kiet was selling at £1.5/ 4kg Consumer is well informed about product

iv. **Roshan Enterprises, Karachi to Khan Brothers, UK**

Consignment Details

Brand: Roshan **Grower/Packer:** Abdul Haq Burt, Noshehro Feroz
Variety: Sindhri **Packaging:** Single layer, 2 Kg Card Board Boxes
Count: 5-6 **Harvest Date:** 30 June 2007
Arrival at Roshan, Enterprises, Karachi: 01 July 2007 (8 a.m.)
Date of Carbide Application: 01 July 2007
Packed Date: 03 July 2007
Departure from Roshan Enterprises, Karachi: 03 July 2007
Destination: Khan Brothers, UK
Date of Arrival at Destination: 04 July 2007

Key Findings

- The fruit was fully mature, as the harvest was too late in season.

- No practice (destemming, washing, etc.) was performed to desap the fruit after harvest.
- Fruit was graded in the orchard shed and exportable fruit was collected in plastic bins, which were placed in shade throughout the day.
- The fruit was transported to the pack house (Karachi) from orchard (Noshehro Feroz), almost 350 km distance, in a medium sized open top mazda truck. The transportation took about 12 hours.



Mango harvest, field grading and arrival in pack house

- Fruit bins were collected in pack house and Calcium Carbide was applied to start ripening of the fruit. The fruit was kept covered with a sheet for two days after Calcium Carbide application.



Application of Calcium Carbide to the fruit

- After ripening, the fruit was packed in 2 kg boxes. Each box was weighed and grading was based on fruit size. There were 5-6 fruits in each box.
- The boxes were marked for variety, weight and number of fruits; and strapped in groups of three each.
- The boxes were taken to the airport in an open top mazda, where pellets were made. The experimental boxes, with data loggers, were placed at different locations in the pellet.

Quality Analysis

Quality Attribute	Score at Harvesting	Score at Packing
Skin Colour	0	4
Fruit Firmness	0	3
Stem End Rots	0	1
Sapburn	1	2
Lenticel	0	0
Body Rots	1	3

- The fruit arrived its destination (UK) within five days after harvest.



Fruit before and after Calcium Carbide application

Temperature Profile

The data loggers were inserted in the fruit just prior to application of Calcium Carbide, which took its temperature up to 43°C. During the air travel, the temperature was recorded around 32°C and the loggers were removed in UK at 35°C. The temperature profile of the consignment is attached as annex 4a & 4b.

Feedback:

The consignment was good in condition and was sold immediately after arrival at the destination.



Fruit packing, strapping and pellet formation

v. **M.A. Links, Multan to Germany (Exposition of PHDEB)**

Consignment Details

Brand:	M.A. Links	Grower/Packer:	Mr. Asif Ali
Variety:	Chaunsa	Packaging:	Single layer (2 Kg box)
Count:	6-7	Packed Date:	15 July 2007
Calcium Carbide Application:			15 July 2007
Departure from M.A. Links:			16 July 2007
Destination:			Germany
Date of Arrival at Destination:			18 July 2007

Key Findings

- The fruit was harvested with stem and desapping was done by destemming the fruit under 1% lime solution, followed by washing with clean water.



Fruit desapping in the orchard

- Average TSS of fruit was recorded 9.6 by refractometer, and pulp scored 8 as per Calypso colour chart.
- The air temperature was 31°C while the fruit temperature was 29.6°C.
- Fruit harvesting, desapping, packing and application of Calcium Carbide was spontaneous, and whole the consignment (750 kg) was prepared in six hours.



Fruit packing, and application of Calcium Carbide

- Boxes were kept covered for twelve hours and then fruit were transported to airport (400 km) in open mazda. The Calcium Carbide was removed from the boxes..
- Fruit quality of lime treated mango was highly appreciated by the visitors of the exposition, compared with the other consignments – not desapped, however high temperature of the consignment was the major issue highlighted by the consumers.

Feedback

The fruit quality was very good at destination and the people appraised the cleanliness and freeness from blemishes of the fruit. It was the only desapped consignment among the six, and was admired for its quality. However, the high temperature of the fruit was a reservation, since no precooling or temperature management was done.

Areas of Improvement in Air Freight of Mangoes

Following the areas need improvement for air freight of mangoes.

- Fruit maturity
- Sapburn treatment
- Proper grading
- Packing
- Strapping
- Temperature management

b. Monitoring of Sea Freight Export Market Consignments

As stated earlier, the two sea freighted consignments were exported to UAE only, one being from Tando Allah Yar (Sindh province) to Dubai and the other from Multan (Punjab Province) to Dubai. The details of the monitoring of each consignment are given;

i. Iftikhar Ahmad & Co. (IAC), Karachi to Altaf Al Khammas & Co., UAE

Consignment Details

Brand:	IAC	Grower/Packer:	Bachani Farms, T.A. Yar
Variety:	Sindhri	Packaging:	Bi-layer white wood crates
Count:	18-22	Packed Date:	12 June 2007
Arrival at IAC:	13 June 2007	Departure from IAC: 14 June 2007 (5 a.m.)	
Destination:	Altaf Al-Khammas & Co., Dubai		
Date of Arrival at Destination:	18 June 2007		

Key Findings

- The precooling of fruit by storing in a cool store (13°C) prior loading into the reefer container was effective in reducing the fruit temperature from 32.5°C to 15°C.
- Cooling in the shipping container was effective for decreasing the temperature from 15°C to 11°C. However precooling the fruit to 12°C and setting the container to 10-12°C (instead of 8°C) would be more effective and stable.
- Average TSS of fruit with refractometer was found 7.7° and according to the Calypso colour chart, the average pulp colour score was recorded 7.
- Fruit quality at retail was generally considered to be good. Mangoes were backward in colour (83% fruit were 10-50% yellow) and still hard to rubbery (83% fruit). Minor (<25%) skin blemishes were present on 95% of the fruit. Only 6% of fruit developed postharvest rots.

Postharvest Process Flow

Process	Date/Time	Details/Comments
Harvested	June 12, 2007 / 9 – 16 Hrs	
Packed	June 12, 2007 / 11 – 17 Hrs	Fruit was packed at the orchard shed after some time of its harvest
Transported to Cold Store	June 12, 2007 / 20:00 Hrs	When enough fruit was packed to be loaded on a vehicle
Storage in Cold Store	June 13, 2007 / 9:00 Hrs	Immediately after reaching the cold store
Loading in 40' Reefer Container & Sent to Seaport	June 14, 2007 / 5:00 Hrs	Fruit was loaded into the container adjusted at 8° C after keeping in cold store for 20 hours
Departed for Dubai	June 14, 2007 / 15:00 Hrs	In the same evening, the consignment left for Dubai
Arrival in Dubai	June 18, 2007	Fruit was kept held in the reefer container until all the fruit was sold to retailers
Assessment at Retail Store	June 24, 2007 / 17:00 Hrs	

- The farm is contracted by the same contractor for last three years, who is responsible for farm operations as well as fruit harvest.
- The commission agent is also an exporter and he can get fruit according to his demands from the contractors.
- The fruit harvest was performed manually and with the aid of long poles having nets at their distant ends by the partially trained labour. The better quality fruit was harvested for export markets in the first picking.
- The criteria of fruit maturity was only the fruit size (middle sized fruits were being harvested for this consignment).
- The fruit was sorted by the skilled graders in the farm shed and was packed in wooden crates, using rough papers as filling material, (popular wood crates, specially

designed for export markets) followed by keeping it under shade, until the quantity of fruit boxes becomes sufficient to be loaded in a vehicle.



Postharvest fruit treatment



Fruit packing for export to Dubai

- The fruit was transported in an open top truck to the cold store facility (about 250 kilometers away from the orchard), and the distance was traveled in about 12 hours.
- The fruit coming from different orchards were labeled differently for traceability.
- The fruit was kept in cold store (adjusted at 13°C) for sixteen hours (usually the fruit from orchards is gathered in the cold store till the quantity of a container is collected, which usually does not take more than three days) followed by loading in a 40 feet reefer container and ship to the destination market (Dubai).
- The container was set at 8°C.
- The container reached the destination at sixth day of the harvest and the fruit was held in the container at the same conditions of temperature and RH till it was marketed to the retailers (different number of boxes were removed from the container at different times and the last boxes were kept in the container till twelfth day of the harvest).
- The fruit was allowed to ripe naturally without treatment of Calcium Carbide or Ethylene.



Set point of temperature and air temperature in a reefer container

Harvest Maturity

The fruit harvest maturity level was 7 on average according to the Australian Calypso mango variety, while the average TSS as determined by refractometer was 7.7° Brix.

Temperature Profile

The atmospheric temperature at the time of harvest was 37.2°C while the average pulp temperature of six fruits was recorded 35.3°C. The temperature was 33°C when the data loggers were inserted into the fruits. During the transportation from orchard to the cold store, the temperature was recorded 32.5°C. In cold storage (13°C) the fruit temperature decreased and reached around 15°C in sixteen hours. The temperature slightly increased (18°C) when the consignment was shifted from cold store to the reefer container, however it gradually decreased during the shipment and finally reached around 11°C before the removal of consignment from the reefer container. The temperature of retail store was set at 22°C but there was slight variation due to repeatedly opening the doors. The consignment was finally sold out to consumer at about 25°C. The graphical representation of the data recorded on data logger is attached as annex 5.



Fruit with data logger at a retail store in Dubai

Quality Assessment

The mango quality was assessed at different levels of supply chain. The extent of evaluated factors (%) at different levels was recorded as follows;



Imported fruit at retail store in Dubai

Factor	Score	Packing	Cold Store	Retail Outlet
Skin Colour (Yellow)	0	95%	95%	30%
	1	5%	4%	30%
	2		1%	25%
	3			12%
	4			3%
	5			
Firmness (Hardness)	0	100%	98%	63%
	1		2%	20%
	2			8%
	3			5%
	4			4%
Skin Browning	0	100%	100%	80%
	1			20%
	2			

Sap Burn	0	90%	35%	5%
	1	10%	60%	90%
	2		5%	5%
Lenticel Spots	0	100%	100%	82%
	1			16%
	2			2%
Stem End Rots	0	100%	99%	90%
	1		1%	5%
	2			3%
	3			2%
	4			
Body Rots	0	100%	98%	90%
	1		2%	4%
	2			3%
	3			3%
	4			

At the retail market

- Colour - 3% fruits got 70-90% colour, 12% fruits got 50-70% colour, 25% got 30-50% colour, 30% got 10-30% colour and 30% fruits got 0-10% colour.
- Firmness - 4% fruits were found soft, 5% fruits were ripe, 8% fruits were sprung, 20% fruits were rubbery and rest of the fruits were hard.
- Rots - Less than 5% fruits had got any type of rots (dendritic, stem, body).
- Skin blemish - the ratio of skin blemishes was recorded 20%, 25% and 18% for the browning, sap burn and the lenticels respectively.

Feedback:

According to the existing system of supply chains, the fruit reached at the destination in good quality and was marketed easily in the retail stores.

ii. *Iftikhar Ahmad & Co. (IAC), Karachi to Altaf Al Khammas & Co., UAE*

Consignment Details

Brand: MHA **Grower/Packer:** Muhammad Saleem, Multan
Variety: Chaunsa **Packaging:** Wooden crates
Count: 30-34 **Packed Date:** 19 July 2007
Departure from Orchard: 20 July 2007 (3:50 a.m.)
Arrival at IAC: 21 July 2007
Departure from IAC: 23 July 2007 (5 a.m.)
Destination: Altaf Al-Khammas & Co., Dubai
Date of Arrival at Destination: 29 July 2007

Key Findings

- The fruit was transported from Multan to Karachi (950 km) in an open truck at normal temperature (35°C). The consignment remained in transit for about 40 hours.
- The cooling of fruit in the cool store (10°C) before loading into the reefer container was effective in cooling the fruit from 38°C to 11.5°C.
- Cooling in the shipping container was effective for maintaining the temperature at 16°C.
- Average TSS of fruit with refractometer was found 9° Brix and according to the Calypso colour chart, the average pulp colour was recorded 9.5.
- Fruit quality at retail was considered to be poor.



High temperature of fruit at harvest time



Fruit harvest in net

- The fruit harvest was performed manually and with the aid of long poles having nets at their distant ends by the partially trained labour.
- The criterion of fruit maturity was only the fruit size. The larger fruits were considered export quality fruit.
- The fruit was sorted by the skilled graders in the farm shed and was packed in wooden crates, using rough papers as filling material, followed by keeping it under shade, until the quantity of fruit boxes becomes sufficient to be loaded in a vehicle.



Wooden crates prepared for packing the fruit



Fruit packing for export to Dubai

- The fruit coming from different orchards were labeled differently for traceability.
- The fruit was kept in cold store (adjusted at 10°C) for eighteen hours (usually the fruit from orchards is gathered in the cold store till the quantity of a container is collected, which usually does not take more than three days) followed by loading in a 40 feet reefer container and ship to the destination market (Dubai).
- The container was set at 8°C.
- The container reached the destination at sixth day of the harvest and the fruit was held in the container at the same conditions of temperature and RH till it was marketed to the retailers (different number of boxes was removed from the container at different times).
- The fruit was allowed to ripe naturally without treatment of Calcium Carbide or Ethylene.



Fruit kept under shade in the orchard



Fruit kept in reefer container for export to Dubai

Harvest Maturity

The fruit harvest maturity level was 9 on average according to the Australian Calypso mango variety while the average TSS as determined by refractometer was 9.5°.

Temperature Profile

The atmospheric temperature at the time of harvest was 41°C while the average pulp temperature of six fruits was recorded 36.8°C. The temperature was 34°C when the data loggers were inserted into the fruits. During the transportation from orchard to the cold store, the temperature was recorded around 35°C. In cold storage (10°C) the fruit temperature decreased and reached around 11.5°C in eighteen hours. The temperature slightly increased (16°C) when the consignment was shifted from cold store to the reefer container, and finally reached around 26°C at the retail store. The graphical representation of the data recorded on data logger is attached as annex 6a & 6b.



Fruit with data logger at a retail store in Dubai

Quality Assessment

The mango quality was assessed at different levels of supply chain. The extent of evaluated factors (%) at different levels was recorded as follows;



Fruit packed for export market



Fruit at destination

Percentages of Quality traits at different levels of Supply Chain

Factor		Packing	Retail Outlet
Skin Colour (Yellow)	0	94%	0%
	1	6%	28%
	2		42%
	3		20%
	4		10%
	5		
Firmness (Hardness)	0	100%	8%
	1		64%
	2		28%
	3		
	4		
Skin Browning	0	100%	75%
	1		15%
	2		10%
Sap Burn	0	60%	60%
	1	40%	30%
	2		10%
Lenticel Spots	0	100%	92%
	1		8%
	2		
Stem End Rots	0	100%	97.5%
	1		2.5%
	2		
	3		
	4		
Body Rots	0	80%	80%
	1	20%	2.5%
	2		10%

	3		7.5%
	4		
Dendritic Rots	0	100%	52.5%
	1		30%
	2		18%
	3		7.5%
	4		

At the retail market

- Colour - 10% fruits got 70-90% colour, 20% fruits got 50-70% colour, 42% got 30-50% colour and 28% got 10-30% colour.
- Firmness - 28% fruits were sprung, 64% fruits were rubbery and rest of the fruits were hard.
- Rots – 2.5% fruits had got stem end rot, 20% had got body rots while about 48% fruit had got dendritic rots.
- Skin blemish - the ratio of skin blemishes was recorded 25%, 30% and 25% for the browning, sap burn and the lenticels respectively.

Feedback:

According to the existing system of supply chains, the fruit reached at the destination in good quality and was marketed easily in the retail stores.

Areas of Improvement in Sea Freight of Mangoes

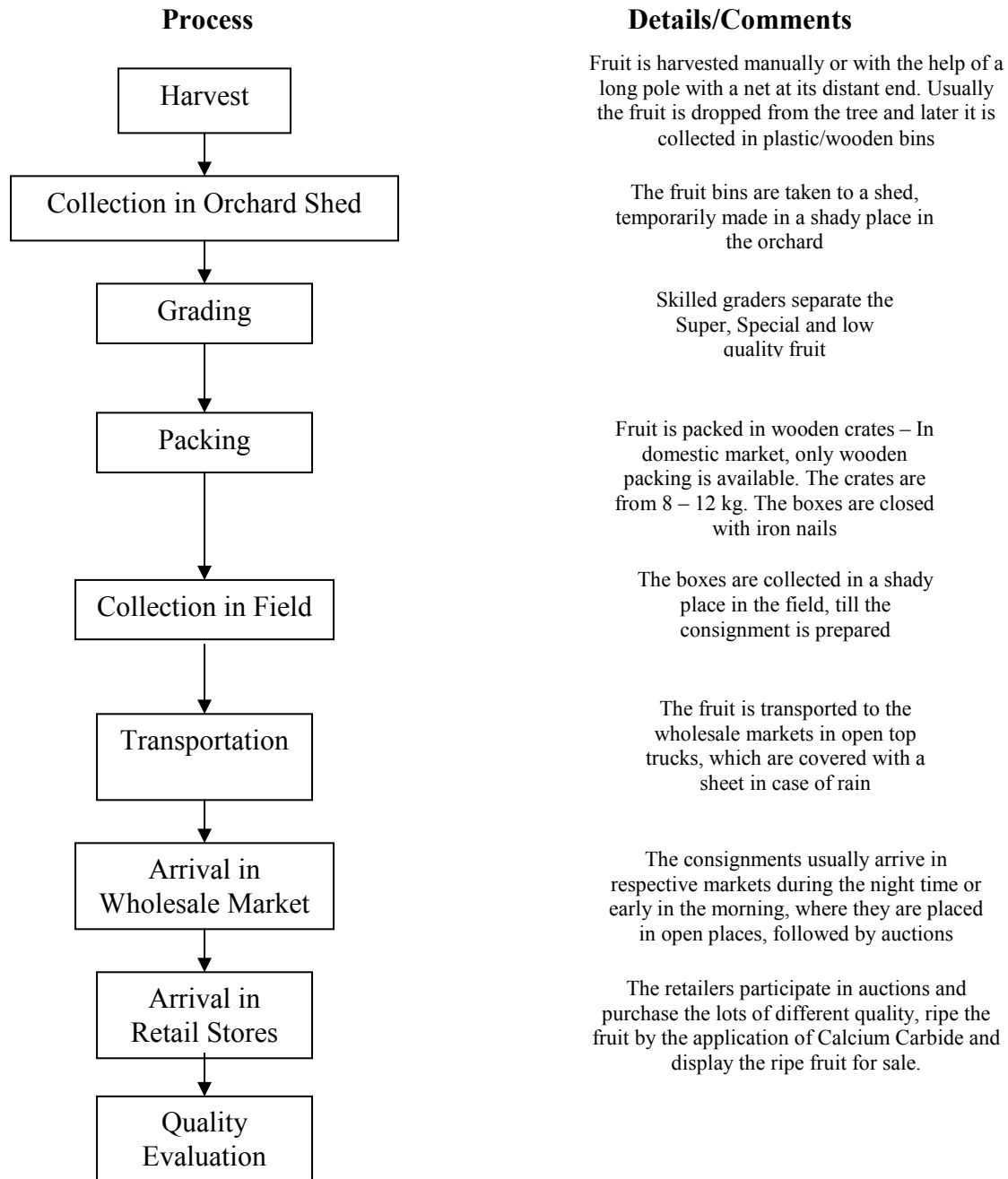
Following the areas need improvement for sea freight of mangoes.

- Fruit maturity
- Sapburn treatment
- Proper grading
- Packing
- Strapping
- Temperature management

4. Monitoring of Domestic Market Consignments

For monitoring studies of domestic market supply chains, two consignments were undertaken each from Sindh (Sindhri) and Punjab (Chaunsa) province, one being to the retail market of Faisalabad and the other to the retail market of Karachi.

Postharvest Process Flow of Domestic Consignments



Generally, the procedure of handling the consignment is similar in Sindh as well as Punjab and also for Sindhri mangoes as well as Chaunsa mangoes. The key findings of all four consignments collectively are outlined below;

Key Findings

- The fruit in orchard was harvested for export market first and the left over was harvested for domestic markets.
- Fruit was harvested with locally manufactured poles, which was causing the sap to spread over the fruit surface.
- The TSS of fruit harvested on same date from different orchards within the same vicinity was found different.
- Fruit is dropped on ground after harvest and later is collected in plastic or wooden baskets.
- The grading was based on fruit size and the appearance of the fruit – freeness from rots, other blemished was the criteria of good quality.
- Sap was considered no issue for the graders.
- The packers over fill the box (they have the view that the belly will become leveled after ripening of the fruit).
- Sometimes, poor quality and smaller fruit is filled in bottom layers of the crate, while the top layers are filled with better quality fruit.
- Different lots were made of the fruit categorized under different quality grades, (our consignment comprises of the super –top quality).
- All the fruit was packed in boxes, however, the boxes of different lots were marked differently.
- All the lots were kept under shade till the arrival of the vehicle – which is mostly open truck (Hino).
- The fruit is loaded in the truck, usually overloading is practiced.
- Fruit lots are kept separately in the wholesale markets in open area, where auction of the lots is conducted. Commonly, sun rises in due course and the temperature of the fruit goes higher.
- The retailers purchase fruit lots at variable prices in the auction.
- Calcium Carbide is applied to the fruit (mostly 2 packets of 2g in each box) to enhance the ripening process.
- Fruit is commonly not uniformly filled in the boxes, and retailers regarde the fruit on basis of size, appearance and freeness from postharvest problems before taking it to display for sale.
- Different grades of fruits are sold for different prices, even at one display.

a. Monitoring of Consignments from Sindh Province

Two monitoring studies were conducted from Sindh province for the postharvest handling of Sindhri mangoes, one each to the retail markets of Karachi and Faisalabad. The details of the monitoring of each consignment are given;

i. Tando Allah Yar, Sindh to MHA, Karachi

Consignment Details

Brand:	MHA	Grower/Packer:	Jamoth Farms, T.A. Yar
Variety:	Sindhri	Packaging:	Wooden crates
Count:	24-28	Packed Date:	17 June 2007
Arrival at Wholesale Market:	18 June 2007 (2 a.m.)		
Arrival at Retail Market:	20 June 2007 (10 a.m.)		
Destination:	Sohrab Goth, Karachi		

Harvest Maturity

The fruit harvest maturity level (pulp colour) was 11 on average according to the Australian Calypso mango variety, while the average TSS as determined by refractometer was 9.5° Brix.



Harvesting, Grading and Packing

The fruit is harvested, graded and packed as per traditional practices (expedited above).



Fruit harvest at Burti Farms, T.A. Yar



Fruit packing for Karachi market

Packing and Transportation

The fruit is packed in 10-12 kg wooden crates and is transported to the relevant market in the open top Hino trucks.



Fruit Packed for Domestic Market



Fruit at Wholesale Market, Karachi

Temperature Profile

The atmospheric temperature at the time of harvest was 37°C, The fruit temperature was 31°C when the consignment arrived the wholesale market. The temperature increased abruptly and reached 40°C after application of Calcium Carbide when the data logger was removed from it. The graphical representation of the data recorded on data logger is attached as annex 7.

Quality Assessment

The mango quality was assessed at different levels of supply chain. The extent of evaluated factors (%) at different levels was recorded as follows;



Quality Analysis in Orchard Shed



Fruit Quality Analysis at Destination

Percentage values of different Quality Traits

Factor	Score	Packing	Wholesale Market	Retail Outlet
Skin Colour (Yellow)	0	100%	100%	
	1			8%
	2			24%
	3			18%
	4			50%
	5			
Firmness (Hardness)	0	100%	100%	
	1			
	2			82%
	3			14%
	4			4%
Skin Browning	0	100%	100%	88%
	1			12%
	2			
Sap Burn	0	72%	65%	52%
	1	28%	35%	32%
	2			16%
Lenticel Spots	0	100%	100%	100%
	1			
	2			
Stem End Rots	0	100%	100%	78%
	1			22%
	2			
	3			
	4			
Body Rots/Injury	0	98%	96%	40%
	1	2%	4%	60%
	2			
	3			
	4			

Comparison of Consignments at Orchard and Destination



Fruit in Orchard Shed



Fruit at Destination

At the retail market

- Colour - 50% fruits got 80% colour, 18% fruits got 60% colour, 24% got 40% colour and 8% fruits got 20% colour
- Firmness - 4% fruits were found soft, 14% fruits were ripe, 82% fruits were sprung
- Rots – Stem end rot was found in 22% fruits, body rots were found less than 5% while about 55% fruit had got some sort of bruises
- Skin blemish - the ratio of skin blemishes was recorded 12% and 48% for the browning and sap burn respectively, while the problem of lenticels was rated zero.

Feedback:

The fruit quality was good at retail end.

ii. Tando Allah Yar, Sindh to MDR, Faisalabad

Consignment Details

Brand:	MDS	Grower/Packer:	Khokhar Farms, Tando Jam
Variety:	Sindhri	Packaging:	Wooden crates
Count:	20-22	Packed Date:	18 June 2007
Arrival at Wholesale market Faisalabad:	21 June 2007 (5 a.m.)		
Arrival at Retail Store:	24 June 2007 (3 p.m.)		
Destination:	Retail market, Faisalabad		

Harvest Maturity

The fruit harvest maturity level was 5 on average according to the Australian Calypso mango variety, while the average TSS as determined by refractometer was 6.5° Brix.



Harvesting, Grading and Packing

The fruit is harvested, graded and packed as per traditional practices (expedited above).



Fruit harvest at Khokhar Farm, T.A. Yar



Fruit packing for Faisalabad Market

Packing and Transportation

The fruit is packed in 10-12 kg wooden crates and is transported to the relevant market in the open top Hino trucks. It took three days to arrive Faisalabad from T.A. Yar.



Fruit Packed for Domestic Market



Fruit loaded in truck for transportation

Temperature Profile

The atmospheric temperature at the time of harvest was 36°C and the temperature of the fruit was 34°C. The maximum and minimum temperatures recorded during the travel were 37°C and 31°C respectively and after application of Calcium Carbide, the temperature raised to 41°C. The data logger was removed from the consignment at 39°C at retail store. The graphical representation of the data recorded on data logger is attached as annex 8.

Quality Assessment

The mango quality was assessed at different levels of supply chain. The extent of evaluated factors (%) at different levels was recorded as follows;



Quality Analysis in Orchard Shed



Fruit Quality Analysis at Destination

Comparison of fruit at orchard and destination



Fruit in Orchard Shed



Fruit at Destination

Percentage values of different Quality Traits

Factor	Score	Packing	Wholesale Market	Retail Outlet
Skin Colour (Yellow)	0	100%	63%	5%
	1		17%	
	2		6%	
	3		4%	
	4		4%	10%
	5		6%	85%
Firmness (Hardness)	0	100%	68%	
	1		17%	
	2		2%	5%
	3		8%	50%
	4		5%	45%
Skin Browning	0	100%	57%	48%
	1		17%	20%
	2		26%	32%
Sap Burn	0	95%	76%	65%
	1	5%	17%	25%
	2		7%	10%
Lenticel Spots	0	100%	93%	90%
	1		5%	5%
	2		2%	5%
Stem End Rots	0	100%	93%	85%
	1		7%	10%
	2			5%
	3			
	4			
Body Rots	0	98%	87%	83%
	1	2%	10%	10%
	2		3%	7%
	3			
	4			

At the retail market

- Colour - 84% fruits got 100% colour, 10% fruits got 80% colour and 6% fruits got 0 - 10% colour
- Firmness - 45% fruits were found soft, 50% fruits were ripe, 5% fruits were sprung
- Rots – Stem end rot was found in 15% fruits and body rots were found less than 17% fruits
- Skin blemish - the ratio of skin blemishes was recorded 68%, 35% and 10% for the browning, sap burn and lenticels respectively

Feedback:

The fruit quality was good at retail end.

b. Monitoring of Consignments from Punjab Province

Similar to the Sindh province, two monitoring studies were conducted from Punjab province to observe the postharvest handling of Chaunsa mangoes, one each to the retail markets of Karachi and Faisalabad. The details of the monitoring of each consignment are given;

i. Sabri & Co., Multan to MDS, Karachi

Consignment Details

Brand:	AD (MDS)	Grower/Packer:	Mr. Akram Chawan
Variety:	Chaunsa	Packaging:	Wooden crates
Count:	30-36	Packed Date:	17 July 2007
Arrival at Wholesale market Karachi:	20 July 2007		
Arrival in Retail Store:	24 July 2007		
Date of Evaluation at Destination:	26 July 2007		

Harvest Maturity

The fruit harvest maturity level was 7 on average according to the Australian Calypso mango variety, while the average TSS as determined by refractometer was 8.7° Brix.



Harvesting, Grading and Packing

The fruit is harvested, graded and packed as per traditional practices (expedited above).



Fruit laid under tree after harvest



Fruit collected in wooden basket

The fruit is packed in 10-12 kg wooden crates (over filling is common practice) and is transported to the relevant market in the open top Hino trucks.



Fruit Grading and Packing in Orchard Shed



Belly Packing was witnessed in all consignments

Temperature Profile

The atmospheric temperature at the time of harvest was 34°C, which remained below 34°C during the travel from Multan to Karachi. The temperature rose to 39°C after application of Calcium Carbide and when the data logger was removed it was 38.5°C. The graphical representation of the data recorded on data logger is attached as annex 9 a & b.

Quality Assessment

The mango quality was assessed at different levels of supply chain. The extent of evaluated factors (%) at different levels was recorded as follows;



Quality Analysis in Orchard Shed



Fruit boxes in wholesale market, Karachi

Percentage values of different Quality Traits

Factor	Score	Packing	Retail Outlet
Skin Colour (Yellow)	0	100%	
	1		
	2		8%
	3		16%
	4		36%
	5		40%
Firmness (Hardness)	0	100%	
	1		2.5%
	2		58%
	3		27.5%
	4		12%
Skin Browning	0	100%	68%
	1		32%
	2		
Sap Burn	0	44%	8%
	1	56%	80%
	2		12%
Lenticel Spots	0	100%	95%
	1		5%
	2		
Stem End Rots	0	100%	75%
	1		25%
	2		
	3		
	4		
Body Rots/Injury	0	92%	70%
	1	8%	30%
	2		
	3		
	4		

At the retail market

- Colour – 40% fruit got 100% colour, 36% fruits got 80% colour, 16% fruits got 60% colour and 8% got 40% colour
- Firmness - 12% fruits were found soft, 27.5% fruits were ripe, 58% fruits were sprung and 2.5% fruit were found rubbery
- Rots – Stem end rot was found in 25% fruits, body rots were found less than 5% while about 25% fruit had got some sort of bruises
- Skin blemish - the ratio of skin blemishes was recorded 32%, 80% and 5% for the browning, sap burn and lenticel spots respectively.

Feedback:

The retailer passed satisfactory remarks about the consignment in existing practices, however, he appreciated if any improvement could brought to the existing system.

ii. Sabri & Co., Multan to Al Sharif Traders, Faisalabad

Consignment Details

Brand:	AR	Grower/Packer:	Mian Zahid Kamboh, Multan
Variety:	Chaunsa	Packaging:	Wooden crates
Count:	30-34	Packed Date:	18 July 2007
Arrival at Wholesale market Faisalabad: 19 July 2007 (6 a.m.)			
Arrival at Retail Stores: 23 July 2007			
Date of Quality Evaluation: 23 July 2007			

Harvest Maturity

The fruit harvest maturity level was 9 on average according to the Australian Calypso mango variety, while the average TSS as determined by refractometer was 9.2° Brix.

Harvesting, Grading and Packing

The fruit is harvested, graded and packed as per traditional practices (expedited above).



Fruit harvest with hook attached at a net



Fruit grading and packing at Orchard Shed

The fruit is packed in 12 kg wooden crates and is transported to the relevant market in the open top Hino trucks.



Fruit Packed for Domestic Market



Fruit boxes are forcefully nailed

Temperature Profile

The atmospheric temperature at the time of harvest was 33.8°C and the fruit temperature was recorded 31°C. The temperature at wholesale market, Faisalabad was 35°C and after application of Calcium Carbide the temperature rose to 42°C. The graphical representation of the data recorded on data logger is attached as annex 10.

Quality Assessment

The mango quality was assessed at different levels of supply chain. The extent of evaluated factors (%) at different levels was recorded as follows;



Data logger inserted in fruit for temperature monitoring



Packing of fruit boxes for Faisalabad market

Percentage values of different Quality Traits

Factor	Score	Packing	Wholesale Market	Retail Outlet
Skin Colour (Yellow)	0	100%	100%	15%
	1			4%
	2			5%
	3			23%
	4			30%
	5			23%
Firmness (Hardness)	0	100%	100%	2%
	1			
	2			
	3			97%
	4			1%
Skin Browning	0	100%	84%	66%
	1		13%	29%
	2		3%	5%
Sap Burn	0	100%	100%	45%
	1			6%
	2			49%
Lenticel Spots	0	100%	98%	51%
	1		2%	53%
	2			14%
Stem End Rots	0	100%	100%	89%
	1			6%
	2			4%
	3			1%
	4			
Body Rots	0	100%	100%	93%
	1			2%
	2			5%
	3			
	4			

At the retail market

- Colour – 23% fruit had got 100% colour, 30% fruits got 80% colour, 23% fruits got 60% colour, 5% got 40% colour, 4% fruits got 20% colour and 15% fruit had got 0-10% colour
- Firmness - 1% fruits were found soft, 97% fruits were ripe and 2% fruits were hard
- Rots – Stem end rot was found in 11% fruits and 7% fruit was suffering from body rots
- Skin blemish - the ratio of skin blemishes was recorded 34%, 55% and 49% for the browning, sap burn and lenticel spots respectively.

Feedback:

According to the retailer, the fruit quality was found satisfactory.

Annex 1: Monitoring fruit and vegetable consignments

Introduction

Monitoring of fruit and vegetable consignments is used to identify the actual practices and handling conditions occurring in supply chains and the impact of these practices and conditions on produce quality. Often the practices and conditions are different to what people expect. By sampling and assessing quality at different steps in the supply chain, the points where quality is lost and the reasons for quality loss can be determined.

Monitoring is an important tool for improving knowledge and practices in supply chains but requires a collaborative effort by all participants in the supply chain to be successful. Monitoring of a consignment typically involves the following activities:

- mapping supply chain processes
- monitoring of practices and handling conditions
- monitoring produce quality
- communication of monitoring results

Planning a monitoring activity

Thorough planning is required to ensure that the monitoring activity is effective. This involves:

1. Establish clear objectives. Be clear about why you are monitoring and what you want to achieve.
2. Decide which steps in the supply chain are to be monitored. Are you monitoring all of the supply chain from production to purchase by consumers or segments of the supply chain – for example, packing to sale by wholesaler.
3. Assemble a team to undertake the monitor. It is unlikely that one person can do all of the monitoring as different locations are usually involved. Do not rely on the people working in the supply chain businesses to do the monitoring tasks as they are usually too busy doing their own job.

Typically, one person is required to monitor growing, harvesting and packing processes and another person to monitor wholesale and retail practices. If you are monitoring from different production districts to different markets, a person is required in each production district and market.

4. Develop and test the methods for monitoring and prepare the materials, tools and record sheets required.
5. Prepare clear instructions on the responsibilities and tasks for team members and the methods for doing the tasks.
6. Provide training to ensure people are aware of their responsibilities and capable of doing the tasks.
7. Ensure that the supply chain participants are informed about the monitoring activity. Do not keep the monitoring activity hidden from the participants as it may result in valuable information or equipment being lost.

Setting the date for the monitoring activity needs to be done in close consultation with the supply chain participants. It is best to plan the monitoring to suit typical commercial practice rather than when it suits you.

Participants in the supply chain need to be informed about when the monitoring is occurring, what is happening and what you expect from them. For example when monitoring packing, the farmer or packing shed manager needs to know when monitoring will start and what will be monitored. Similarly, wholesalers/ retailers/ exporters/ freight forwarders/ importers need to know when consignments are arriving, how to identify packages that are being monitored, whether there are any specific actions they need to take, and who they need to inform when the consignment arrives.

Mapping supply chain processes

The purpose for mapping the supply chain is to describe the processes that occur at each step and to identify where quality may be lost and where monitored of handling practices, conditions and quality is required. The actions involved in mapping a supply chain are:

1. Identify the steps and businesses involved in the flow of product through the supply chain and draw a diagram to represent the linking of these steps. This is completed by talking to key businesses involved in the supply chain.
2. Identify the processes occurring at each step and the critical practices and conditions for each process. This is completed by talking to key people in each business. For example, for precooling collect information on the precooling temperature and humidity, when it is done, the type of cooling system used (room cooling, forced-air etc), and the length of the cooling period. An example of a record form for collecting this information is attached.
3. Verify the supply chain map by observing commercial operations at each step in the supply chain.

Monitoring of practices and handling conditions

Monitoring of practices and handling conditions involves observing and recording what actually happens during processes and measuring specific conditions such as temperature.

Observing and recording the actual practices and conditions is important to help interpret monitoring results and identify possible causes for quality lost. Identify the information to collect at each step in the supply chain and develop a record sheet to collect the information. Separate record sheets are usually required for each step. Examples of record sheets for harvesting and packing, transport and market handling are attached.

Monitoring temperature

It is important to monitor the temperature of the produce (pulp) and the air surrounding the produce. Pulp temperature is slower to change than the air temperature conditions around the produce. A number of temperature data loggers are available to measure both pulp and air temperature at regular intervals (every 10-15 minutes) during extended periods in the supply chains. The data from the loggers is downloaded using computer software and the results are presented in graphical form.

The positioning of the loggers in the consignment must be planned to measure the potential variations in temperature. Temperature may vary within a stack or between separate stacks. The

produce may be stacked in handling units such as pallets or stacked loose in transport vehicles and containers. The positioning of the loggers will depend on the type of package used, type and size of handling unit and stacking pattern, the type and mode of transport and stowing pattern.

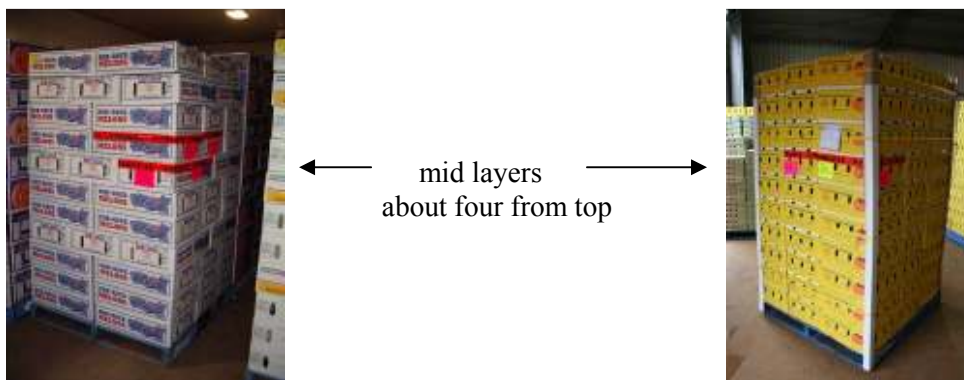
To gain an understanding of the temperature variations within a consignment, loggers are typically placed on the top, bottom, sides and middle of the stack. The number of stacks monitored will depend on the likely of temperature variations between stacks and the availability of loggers. Some compromise may be needed between the number of positions monitored within the stack and the number of stacks monitored.

To ensure that data loggers are retrieved, it is essential that the packages containing loggers are clearly labeled. The label must be bright and easily seen and contains the contact details for where to return the logger. Inform the person receiving the consignment (wholesaler, exporter, freight forwarder, importer, retailer) about when it is expected to arrive, the location and number of loggers, how the packages are labeled and when and who is to collect the loggers.

Provide clear instructions to the person collecting the loggers on when the consignment is expected to arrive, when to collect the loggers, the location and number of loggers, how the packages are labeled, information to collect and the contact details for return of the loggers. Including a prepaid courier package with the loggers will help improve the retrieval of loggers.

The examples below show typical logger placements for Australian handling systems:

Standard pallet



Airline pallet



Airline AV container



bottom layer

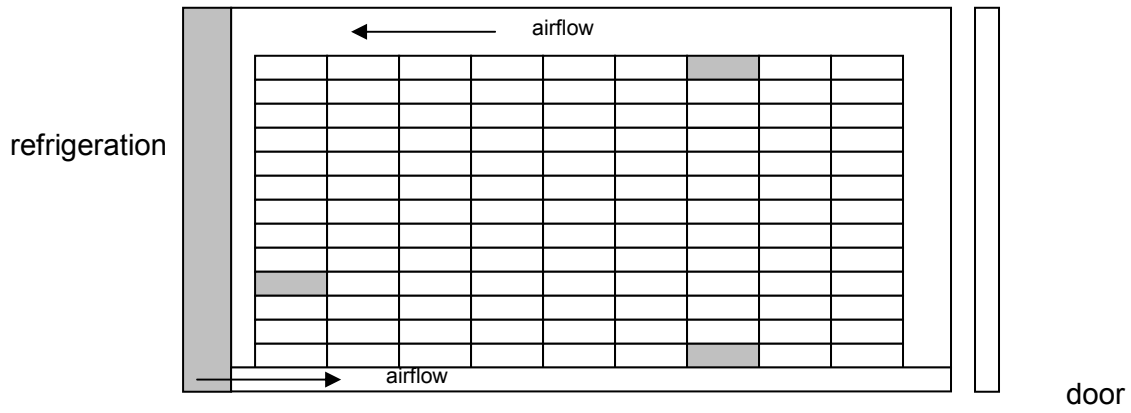


mid layer

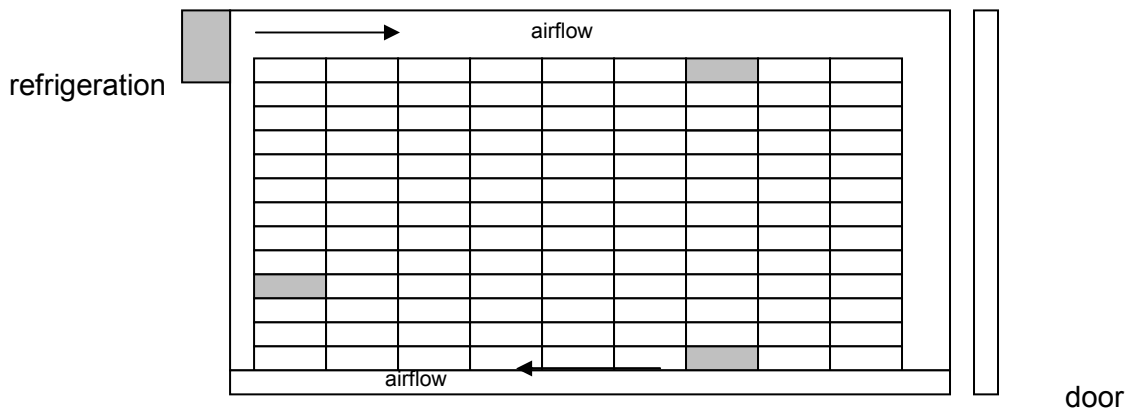


top layer

Shipping container



Refrigerated truck



Monitoring produce quality

The purpose for monitoring produce quality is to identify the points where quality is lost and the impact of handling practice and conditions on produce quality. Factors to consider are the number of monitoring points, sampling frequency and size, holding conditions before assessment and assessment methods.

It is best to start broad when deciding on the points to monitor quality. Once some monitoring has been completed, refining of the monitoring points may be needed for further investigations.

The sampling frequency and size will depend on the likely variation in quality within the consignment and the size of produce. The larger the variation, the higher the sampling frequency and size. For most produce, the number of units to sample should be at least 20. For large produce such as watermelon, it may not be possible to sample this number.

Produce is typically assessed for quality at the time of sampling and then held under specific conditions to simulate storage or retail handling. The produce is then assessed at defined intervals to measure storage or shelf life.

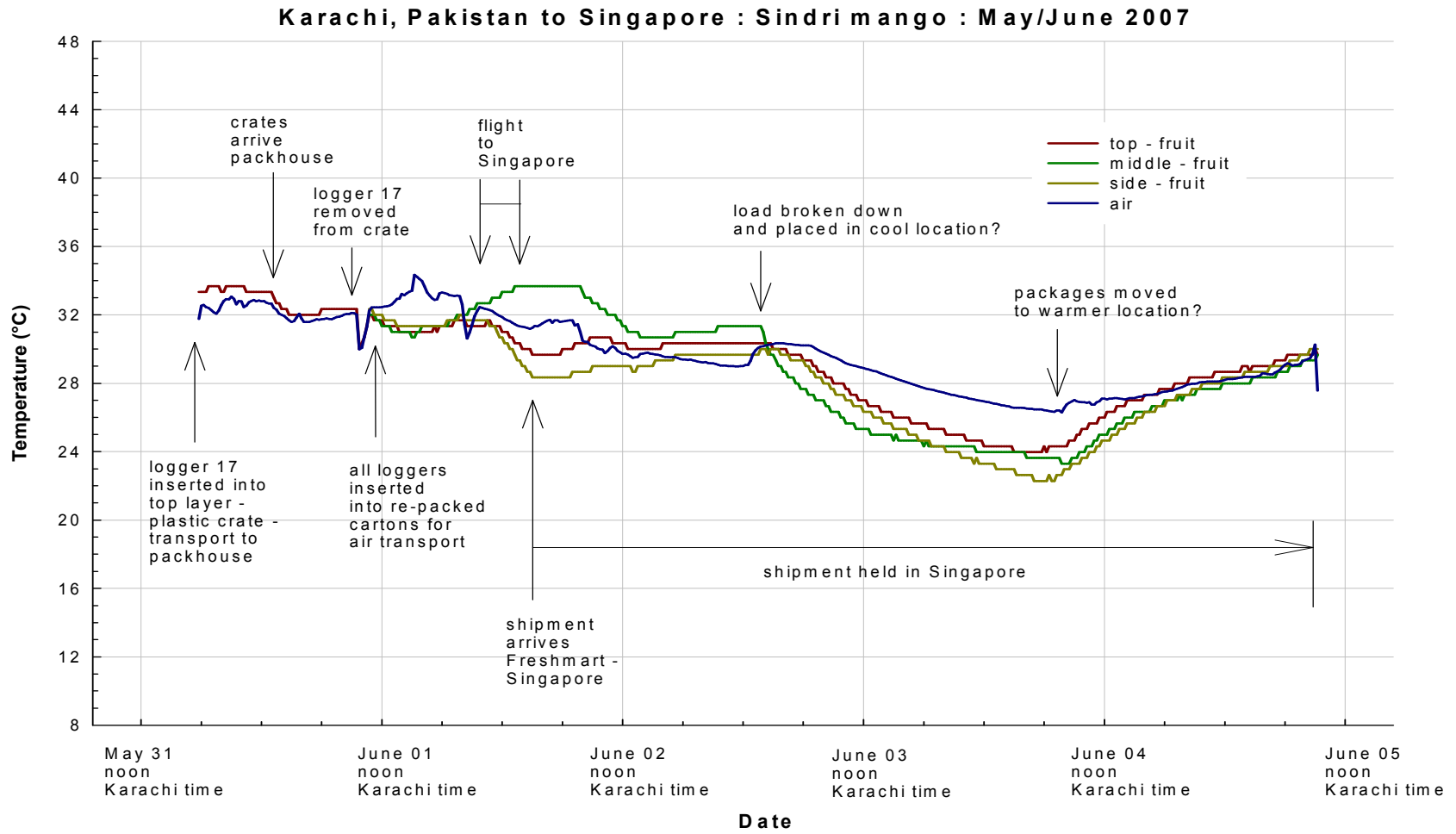
The methods used to assess quality must be objective and practical. The first step is to identify the critical quality attributes to measure. For some attributes, measuring instruments or tools will be available – for example, rulers or calipers to measure size, balances to measure weight, penetrometer to measure firmness. For other quality attributes, rating scales may be required for assessments – for example, colour charts for skin and pulp colour, rating scales for blemish and eating quality. Examples of rating scales are attached.

Record forms for quality assessments must contain sections to record the following information:

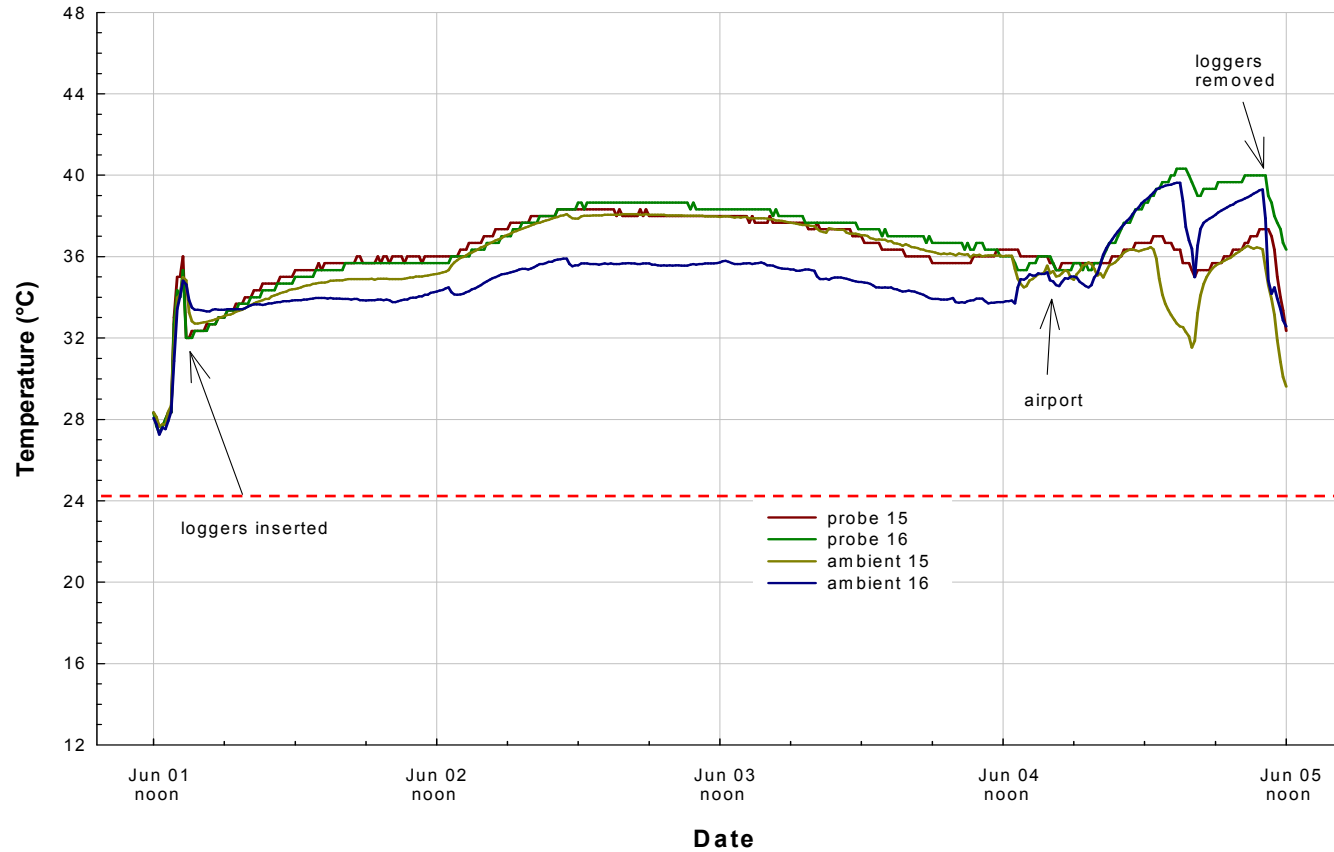
- the identity of the sample, where and when the sample was taken and when the assessment was done
- the sample number
- quality assessment measurement or rating
- name of the assessor

Photographing of produce at the time of quality assessment is useful in providing feedback on the monitoring results to the supply chain participants. Label each photograph to identify the consignment details, sample point, sample date, and assessment date. When taking photographs of the same sample under simulated conditions, ensure the produce is oriented in the same direction each time so that changes in produce quality can be easily observed.

Annex 2: Temperature profile of Air Freighted Consignment from IAC, Karachi to Fresh Mart, Singapore

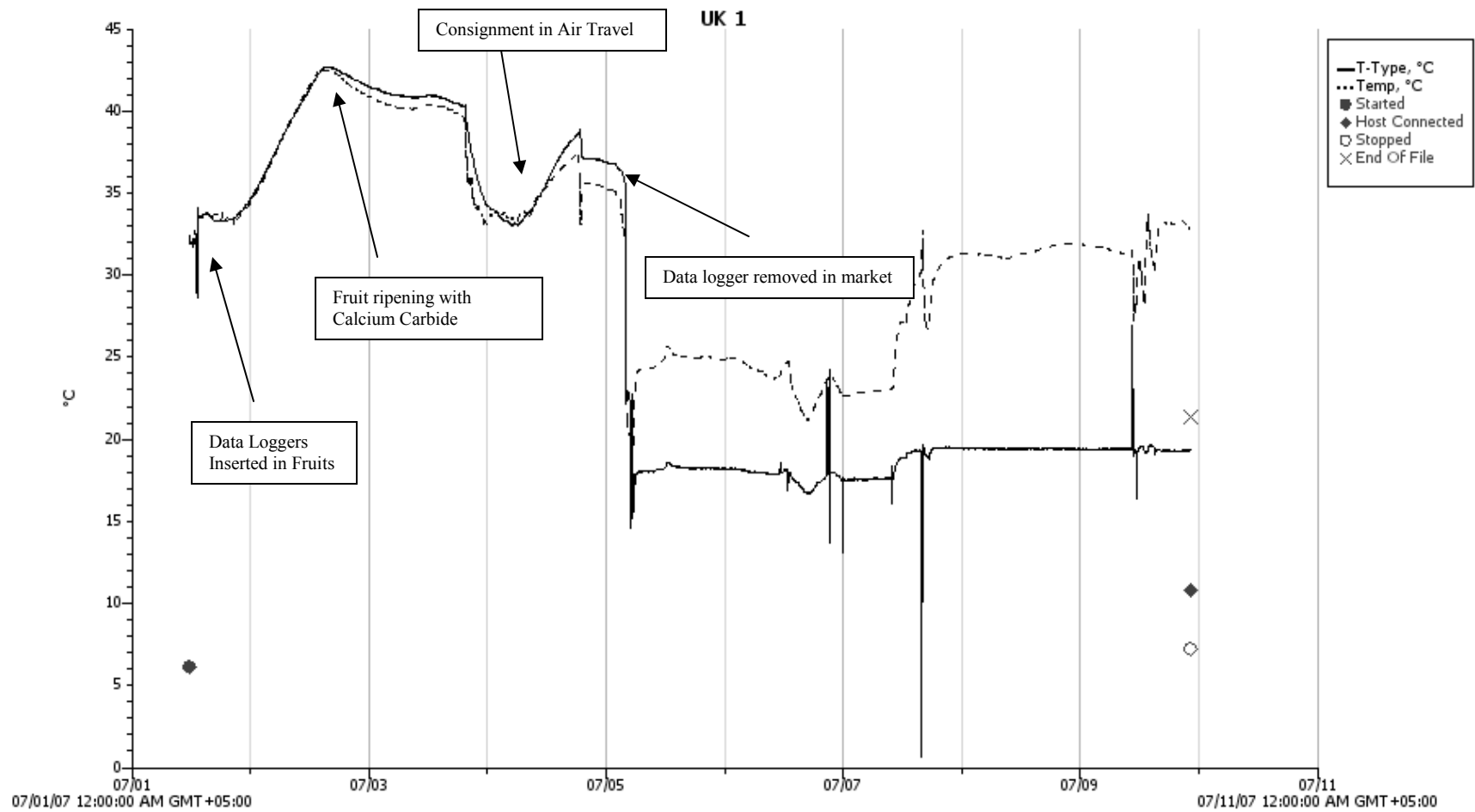


Annex 3: Temperature profile of Air Freighted Consignment from IAC, Karachi to Altaf Al Khammas & Co., UAE

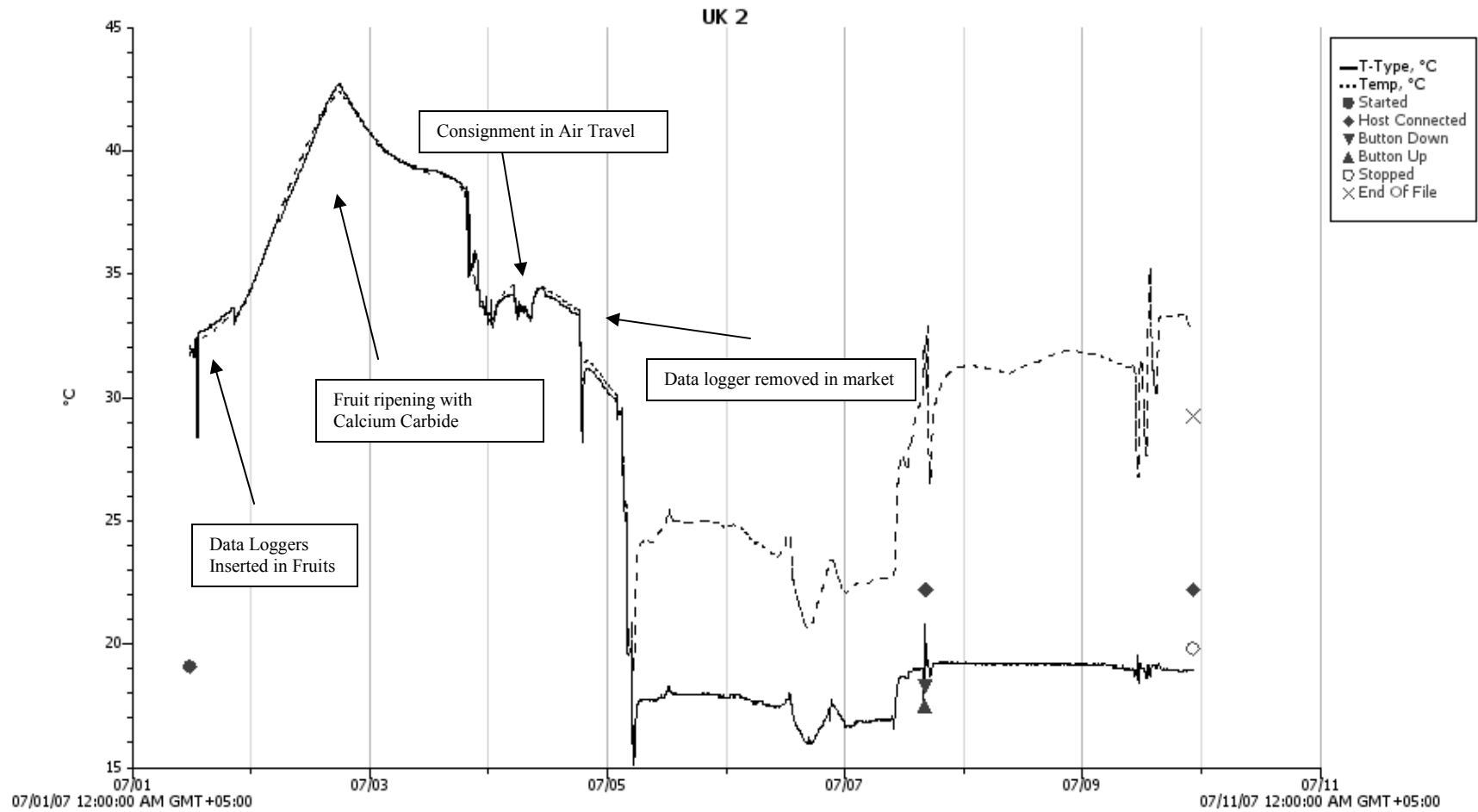


Temperature exceeding 24°C will affect correct ripening

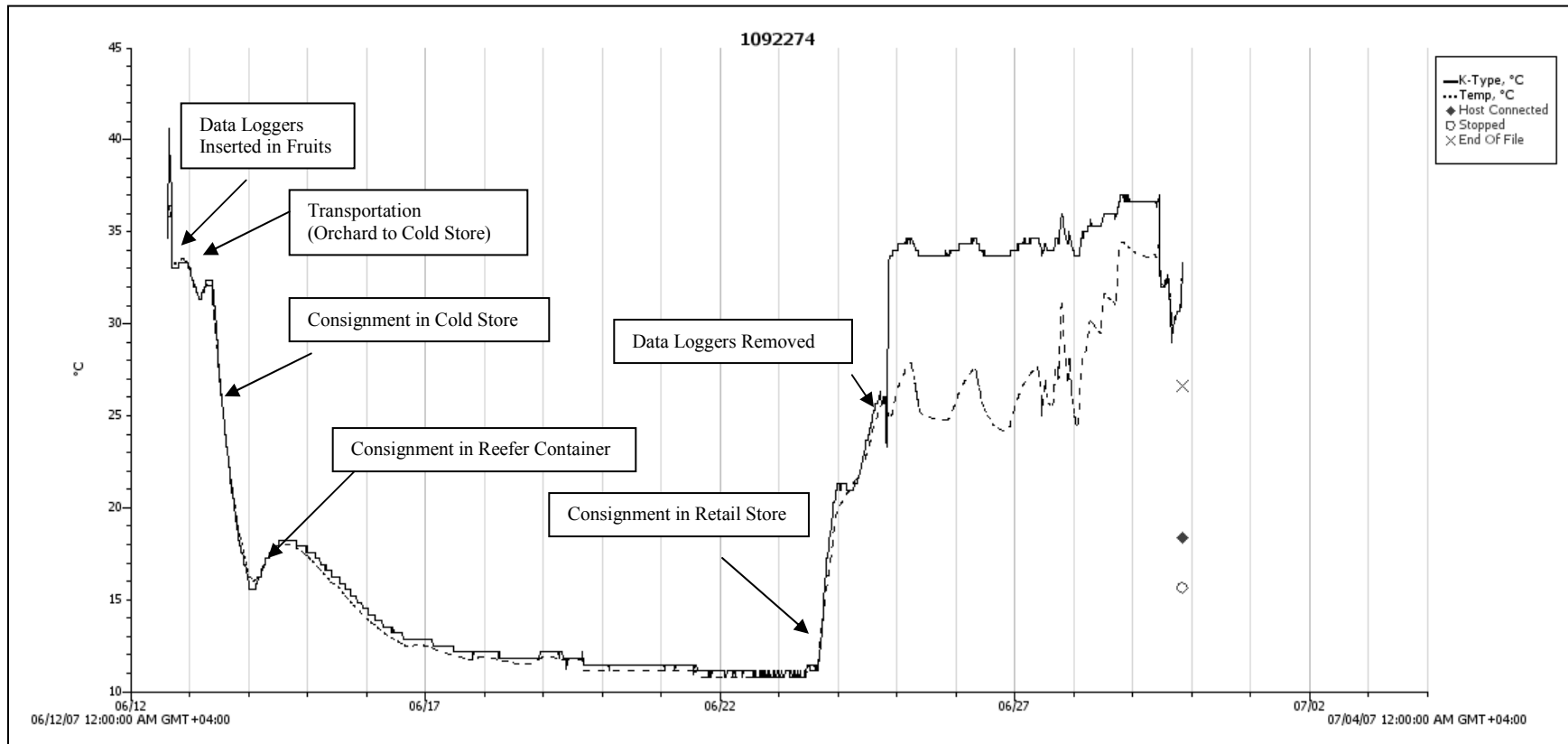
Annex 4a: Temperature profile of Air Freight Consignment from Roshan, Karachi to Khan Brothers, UK



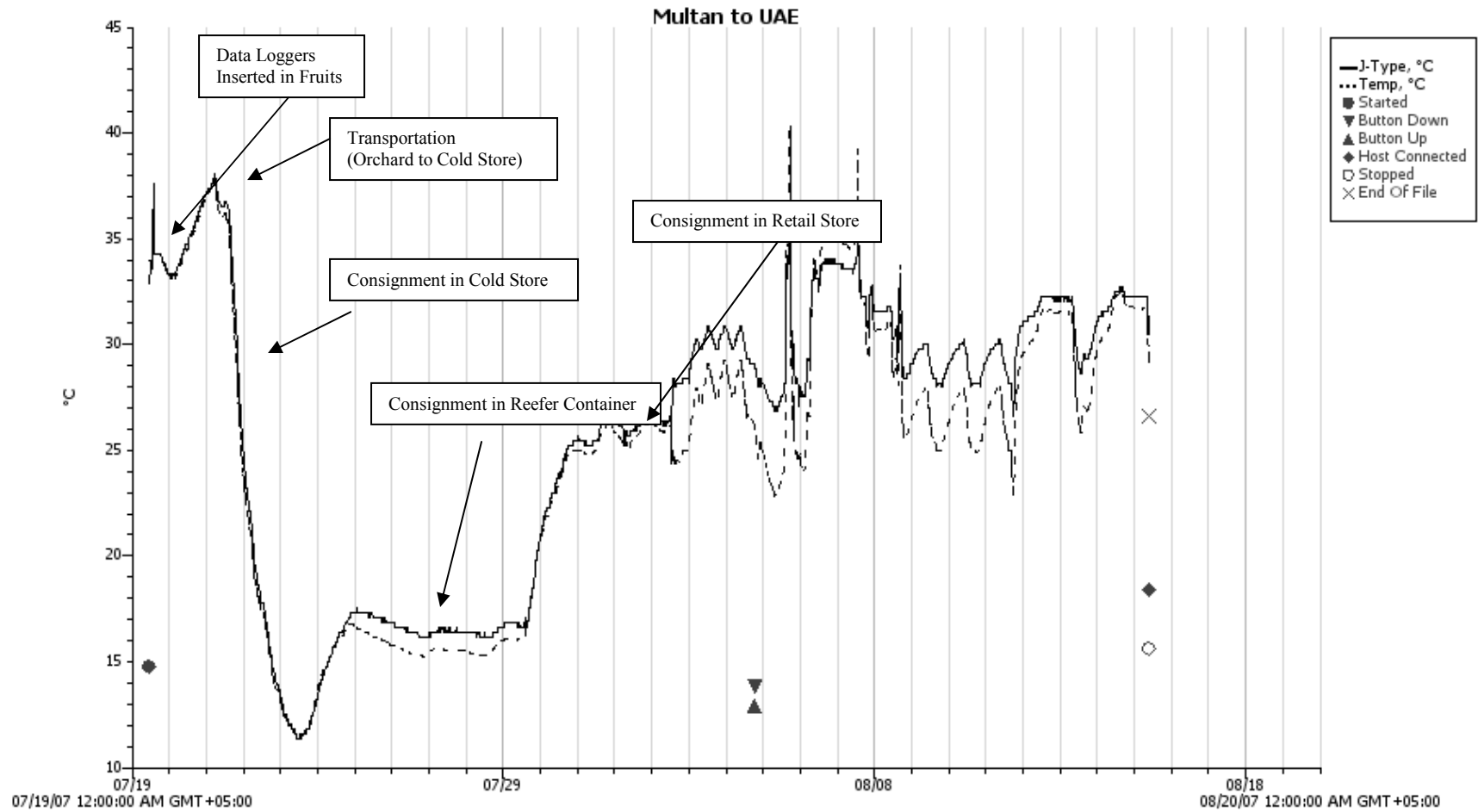
Annex 4b: Temperature profile of Air Freighted Consignment from Roshan, Karachi to Khan Brothers, UK



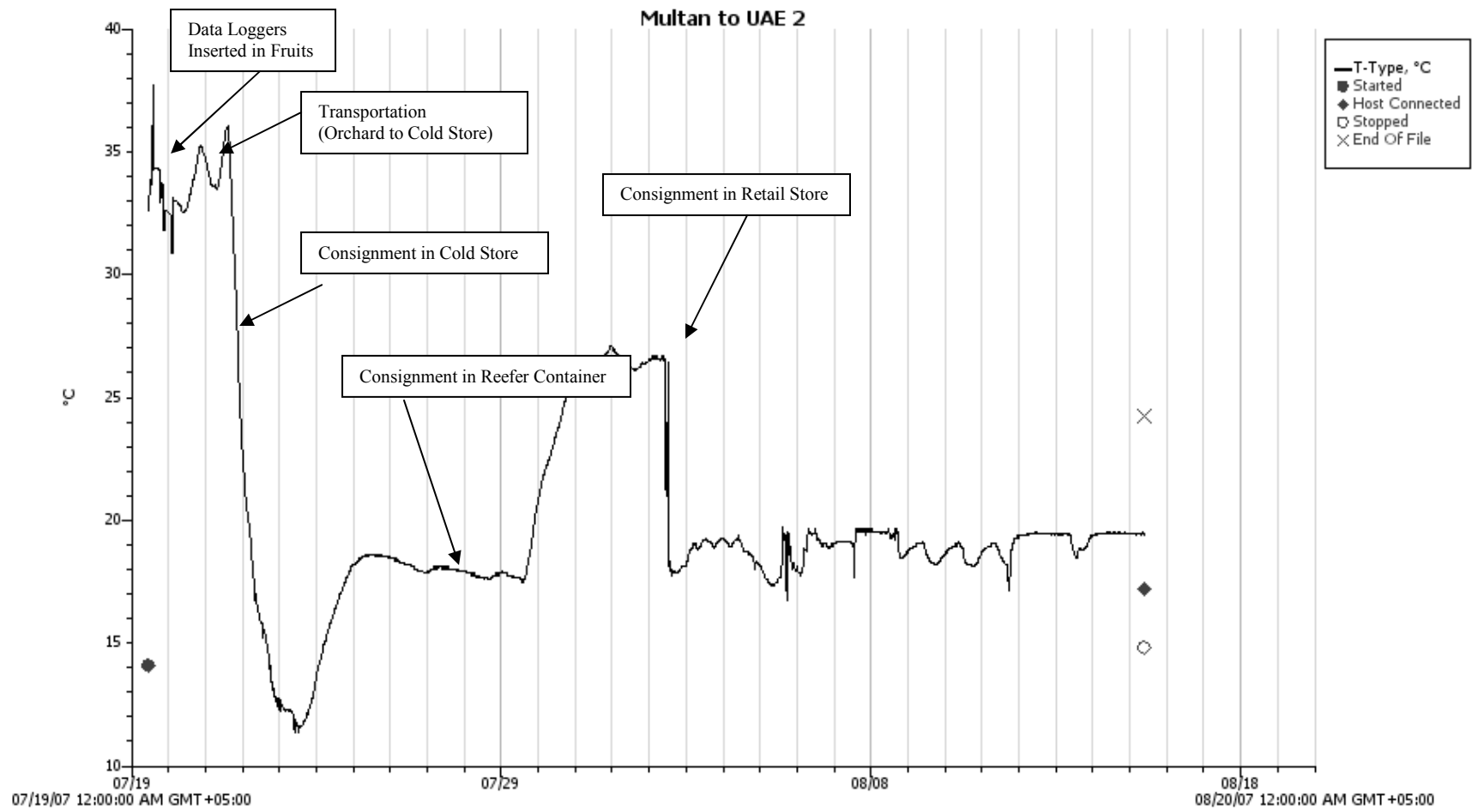
Annex 5: Temperature profile of Sea Freighted Consignment from IAC, Karachi to Altaf Al Khammas & Co., UAE



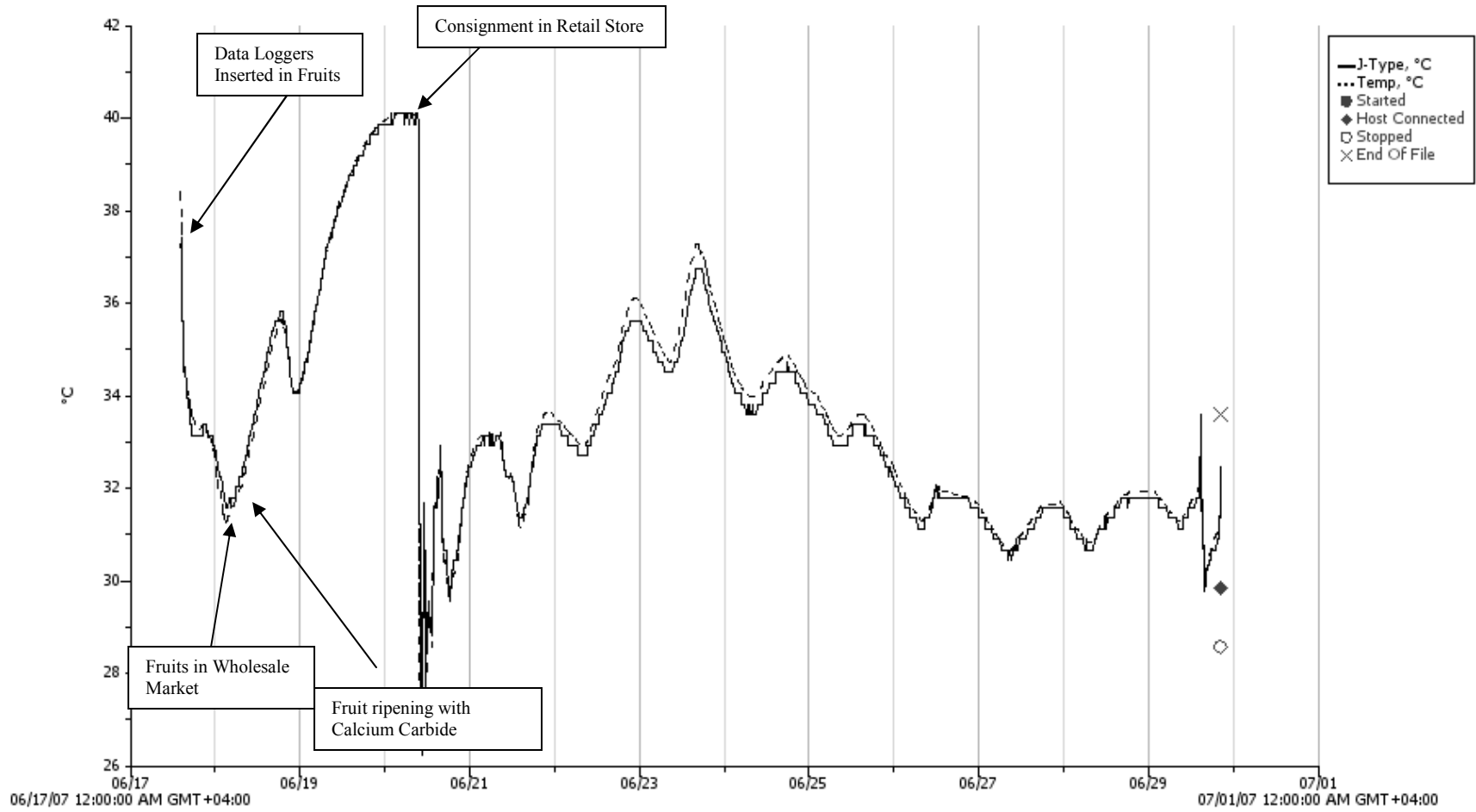
Annex 6a: Temperature profile of Sea Freight Consignment from IAC, Karachi to Altaf Al Khammas & Co., UAE



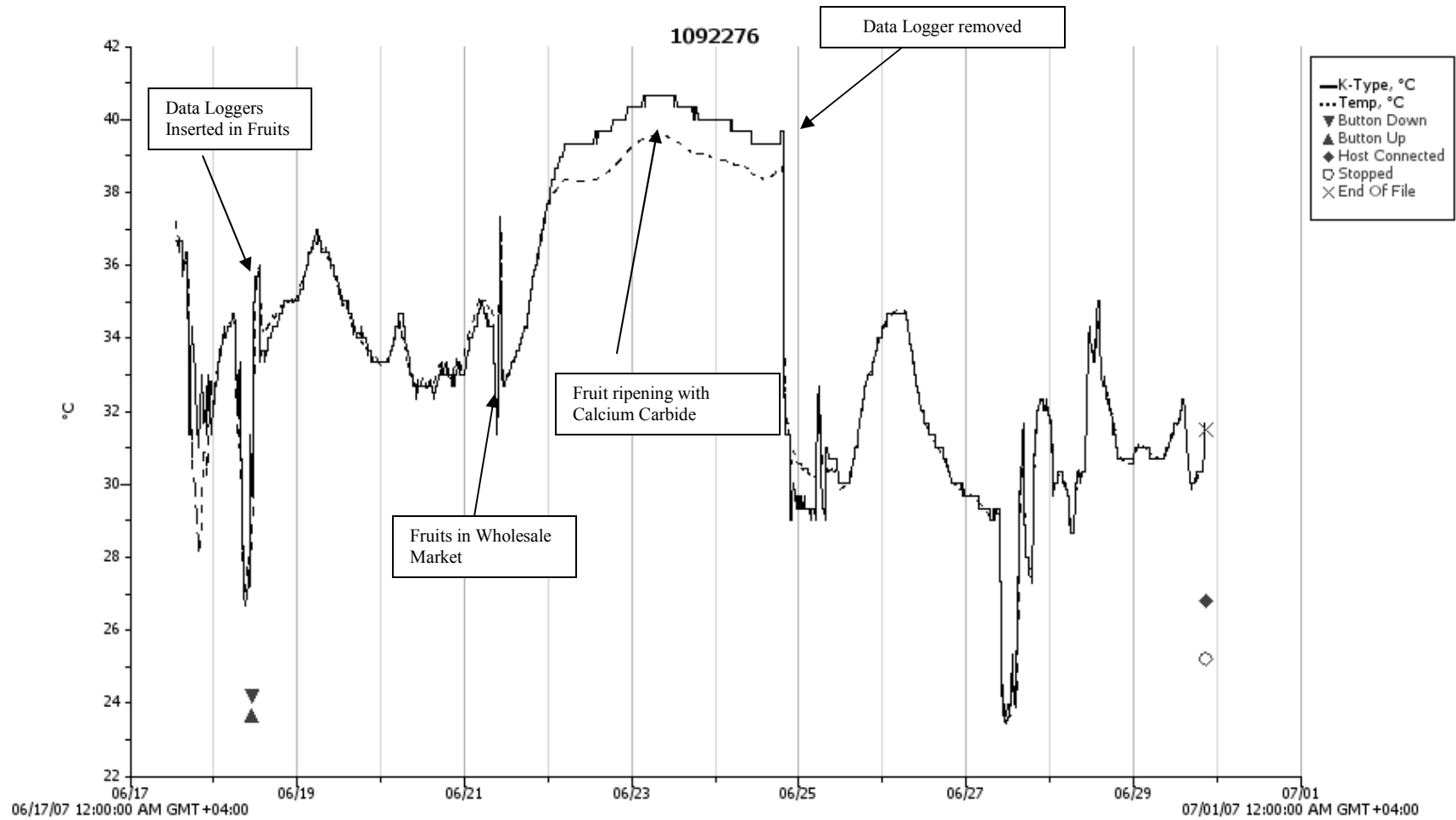
Annex 6b: Temperature profile of Sea Freight Consignment from IAC, Karachi to Altaf Al Khammas & Co., UAE



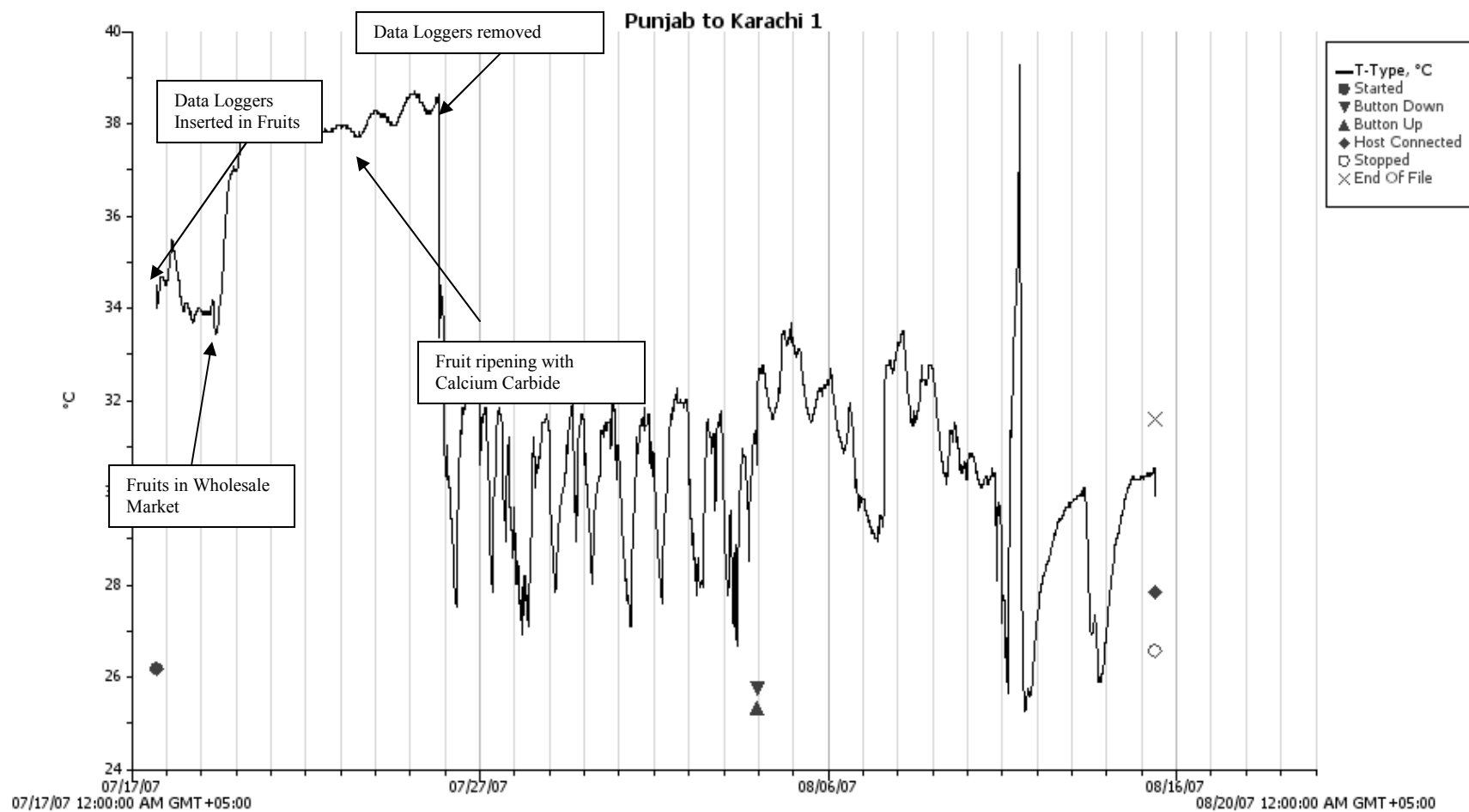
Annex 7: Temperature profile of Domestic Market Trial (Tando Allahyar to Karachi)



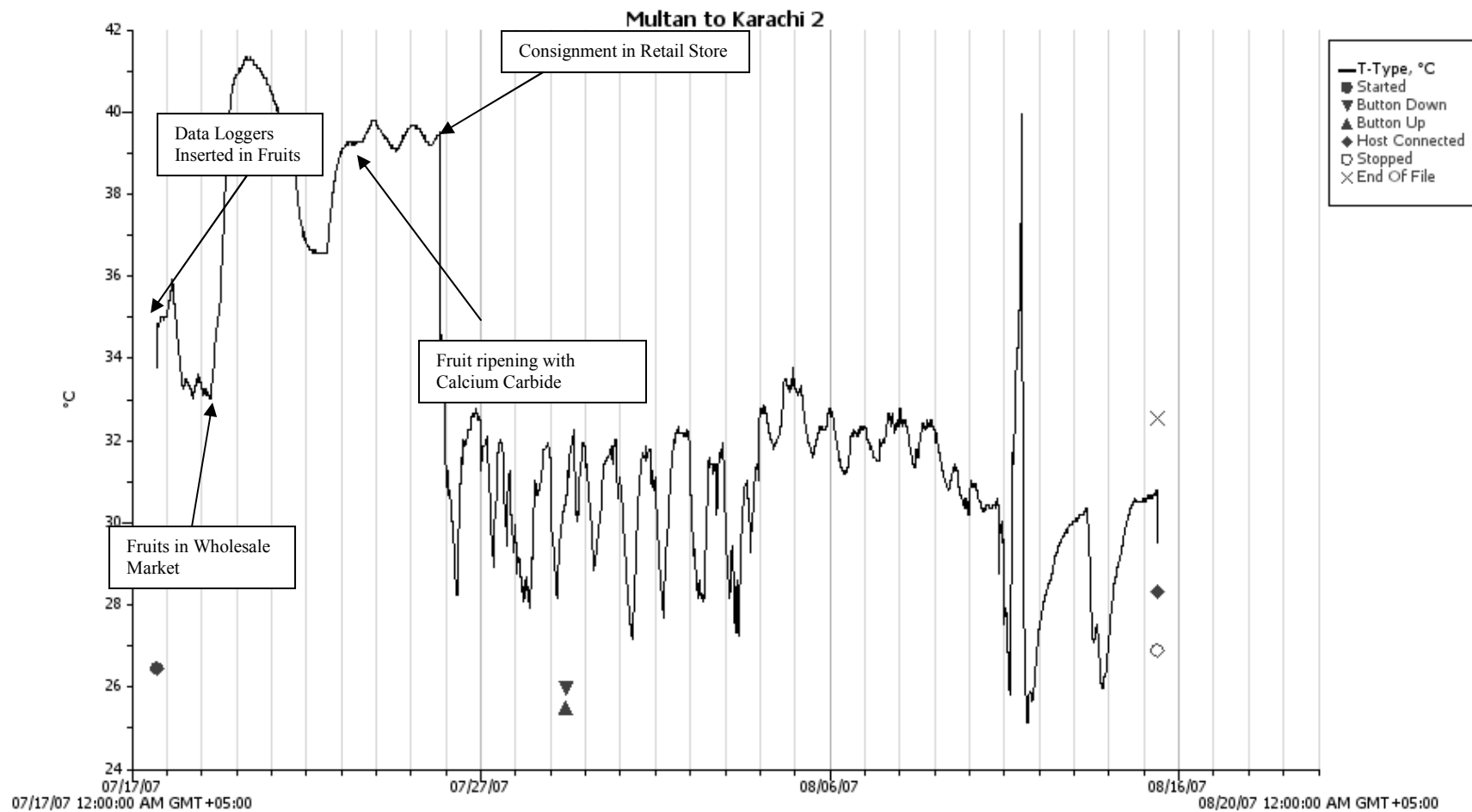
Annex 8: Temperature profile of Domestic Market Trial (Tando Allahyar to Faisalabad)



Annex 9a: Temperature profile of Domestic Market Trial (Multan to Karachi)



Annex 9b: Temperature profile of Domestic Market Trial (Multan to Karachi)



Annex 10: Temperature profile of Domestic Market Trial (Multan to Faisalabad)