

# MALAYSIAN CARAMBOLA: FROM A RISING STAR TO A GLOBAL LEADER

By

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# Scenario of Malaysian Carambola Industry

- **Starfruit (*Averrhoa carambola*):**

- » 1970's commercially grown
- » Mainly clone B10
- » Niche market (Europe)  
Extraordinary shape, perfect star when cut cross sectionally
- » Export – USD 10 mill
- » Recognised as the global leader





# THE RISING STAR

- **Carambola ‘Super fruit’?**
  - Unique- can be made to fruit at any time of the year
  - Heavy yielder 30-40 tons
  - No killer disease
  - Believe to reduce high blood pressure

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# THE RISING STAR

- Realising the potential of carambola and other tropical fruits in the local and export market the government developed the Fruit Industry Development Program (1986-2000)
- Carambola - included in the Food Production Programme (1987)- Import substitution and increase export



- **Strategies in the development of the carambola industry (1980-1990):**

- Expansion of local and export market through a strategic marketing plan
- Intensify research in crop management to reduce labour and production cost
- Coordinate production and export
- Develop a carambola working group in the Malaysian Fruit Council







# Research Supporting the Expanding Carambola Industry (1980-1990)



- **To support the expanding carambola industry MARDI carried out R&D programs:**
  - Clonal compatibility and understanding the floral biology
  - Mineral nutrition
  - Control of fruit fly
  - Post harvest handling





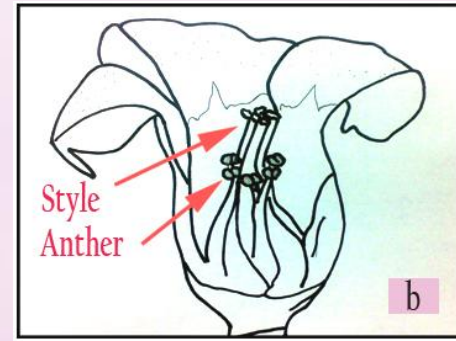
# The Floral Biology and Clonal Compatibility

- Floral biology – to understand the flowering and fruit set of carambola for yield optimization
- *Heterodistylous* ; styles of two different length
- Pollination usually conducted by insect such as bees





Thrum (Short style)



Pin (Long style)

Table 1: Style length of the various carambola clones

Length of style	Clones									
Short style	B3	B4	B8	B10	B13	B17				
Long style	B1	B2	B5	B6	B7	B11	B12	B14	B15	B16

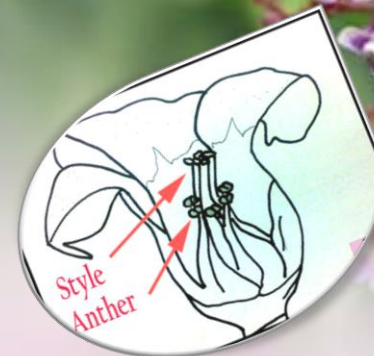




- Fruit set of carambola – low (2.97-2.98%)
- Good fruit set- cross pollination between two clones of short styles and long styles
- **Result:**
  - Higher percentage of well form straight fruit
  - Reduce the percentage of crooked fruit ( not marketable )

- **MARDI recommended:**

- Planting of pollinator clones, B2 or B 11 (long styled) in plot of commercial clones B10
  - Improve fruit set
  - Formation of well formed fruit
  - Increase yield
- Usually at least one plant of pollinator clone for every 10 plants of commercial clones



**B2**



**B11**







# Mineral Nutrition of carambola

- From field experiment in Serdang:-
  - » Application of high N and K fertilizer resulted in decrease in yield
  - » Further investigation - showed that application of heavy doses of fertilizer exposed the plants to intermittent shocks which were supported by measurement of leaf water potential, stomatal conductance and photosynthetic rate
  - » Conclusion – combination of low level of N and high level of K was beneficial for growth and yield



- **Applying large amount of fertilizer needs to be curtailed because :-**
  - it is not beneficial/ stress plant
  - contribute to ground water pollution
  - increase in the cost of production

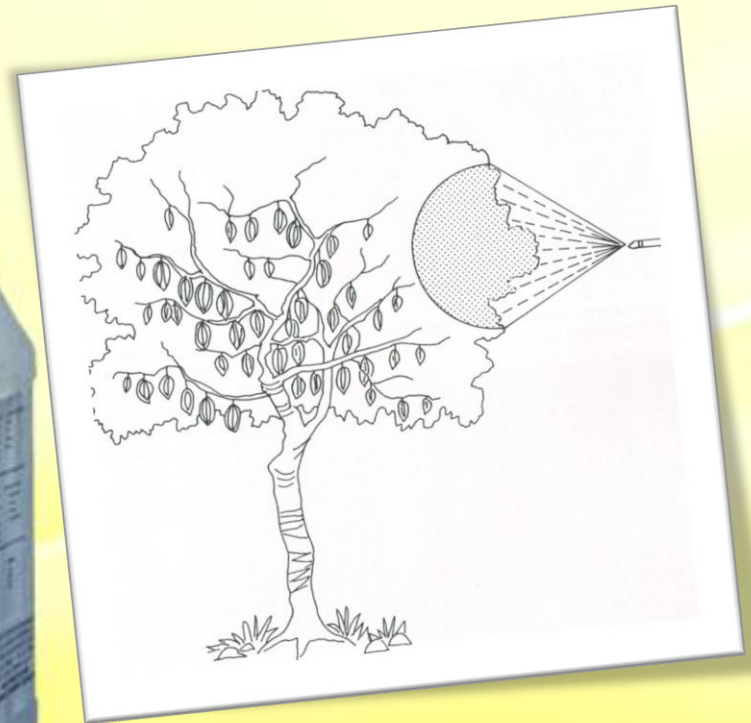


# Management of fruit fly

- Fruit fly Bactrocera (*Dacus dorsalis* complex) – most important insect pest of carambola
- Can damage all fruits and cause total crop loss
- The attacked fruit will drop early
- Thus, controlling fruit fly for the small carambola fruit is very important



- Together with the Australian Centre for International Agricultural Research (ACIAR), MARDI has developed **PROMAR** a protein bait to combat fruit fly menace in field
- **PROMAR** attracts the fruit fly





**Diagram 1: Method at PROMAR spot application**





# Post harvest handling

- Initially carambola was only exported by air freight but by 1989 they have been transported by sea shipment
- Sea shipment allows export of bigger volume with lower transport cost
- However, fruit handling is very critical to ensure the fruit arrive in excellent condition





- The post harvest storage duration and fruit quality is closely related to the fruit maturity at harvest
- MARDI developed the maturity index to guide farmers harvest fruits at the right maturity for the various markets



# Plate 1: Maturity index of carambola cv B10



Index 1

Index 2

Index 3



Index 4

Index 5

Index 6

Index 7



**Research and  
Development for Yield,  
Quality Enhancement,  
Breeding and  
Phytonutrient contents  
for Market Expansion  
(2000- date)**



# Constraint for Future Expansion

- Production area decreased from 1934 ha (1993) to 1071 ha (2009)
- High labour requirement
- Skilled labour for wrapping individual fruits (45% of labour cost)
- Stringent requirement of importing countries; EUREPGAP, fruit fly barriers



**EUREPGAP®**







# Conventional planting in the open





# R&D on Production of starfruit under netted structure

- To reduce the labour requirement
- The structure design and environment under netted structure
  - Netted structure is made of ultraviolet resistant netted material 800  $\mu\text{M}$
  - Has 1 or 2 double doors, strong and not prone to wind damage







## Climate change

— heavy rainfall/Extremely hot season

- Production in the open is low (2.2 ton/ha) in Nov-Feb due to monsoon- failure to set fruit
- Production under net not effected-fruit set high despite heavy rainfall (23 tons/ha)
- Advantage – price is good during the festive season and winter months



- Fruit quality improved-the crunchiness value was higher (4391 g compared to 3828g)
- Wrapping of individual fruits no longer necessary
- Harvesting of fruit easier
  - reduced wastage due to harvesting of immature or overripe fruits



- **Visual observation – carambola exposed to the sunlight turned yellow faster, but were rather bleached, lacked luster and less attractive.**
- **Best colour – under canopy, wrapped fruits in the open**



**Exposed fruit- bleached lack luster,  
less attractive**



**Under canopy**

Table: Pesticide residue analysis on carambola under netted structure

	Pesticide	Concentration* (mg/kg)
Organophosphates	Chlorpyrifos	Not detected
	Dimethoate	Not detected
	Monocrotophos	Not detected
	Acephate	Not detected
	Parathion-ethyl	Not detected
	Parathion-methyl	Not detected
	Diazinon, prothiophos	Not detected
	Methamidophos, sulfotep, fenthion, malathion	Not detected
Organochlorines and Cyclodiene	Profenofos, phethoate, dichlorvos, quinalphos	Not detected
	Lindane	Not detected
	Total DDT	Not detected
	Total endosulphan	0.053
	Dieldrin	Not detected
Synthetic pyrethroids	Aldrin	Not detected
	Chlorothalonil	Not detected
	Cypermethin	0.01
Dithiocarbamates	Permethrin	Not detected
	Deltamethrin	0.002
	Mancozeb, maneb, zineb, propineb (express in term of CS <sub>2</sub> )	Not detected



# Calcium for starfruit quality improvement

- The fruit microenvironment study confirmed that heat units, irradiance (PAR) and Ca significantly influenced fruit firmness
- Carambola is exported to distant market- fruit firmness is an important criteria
- Pre harvest calcium application confirmed the role of Ca in carambola quality improvement

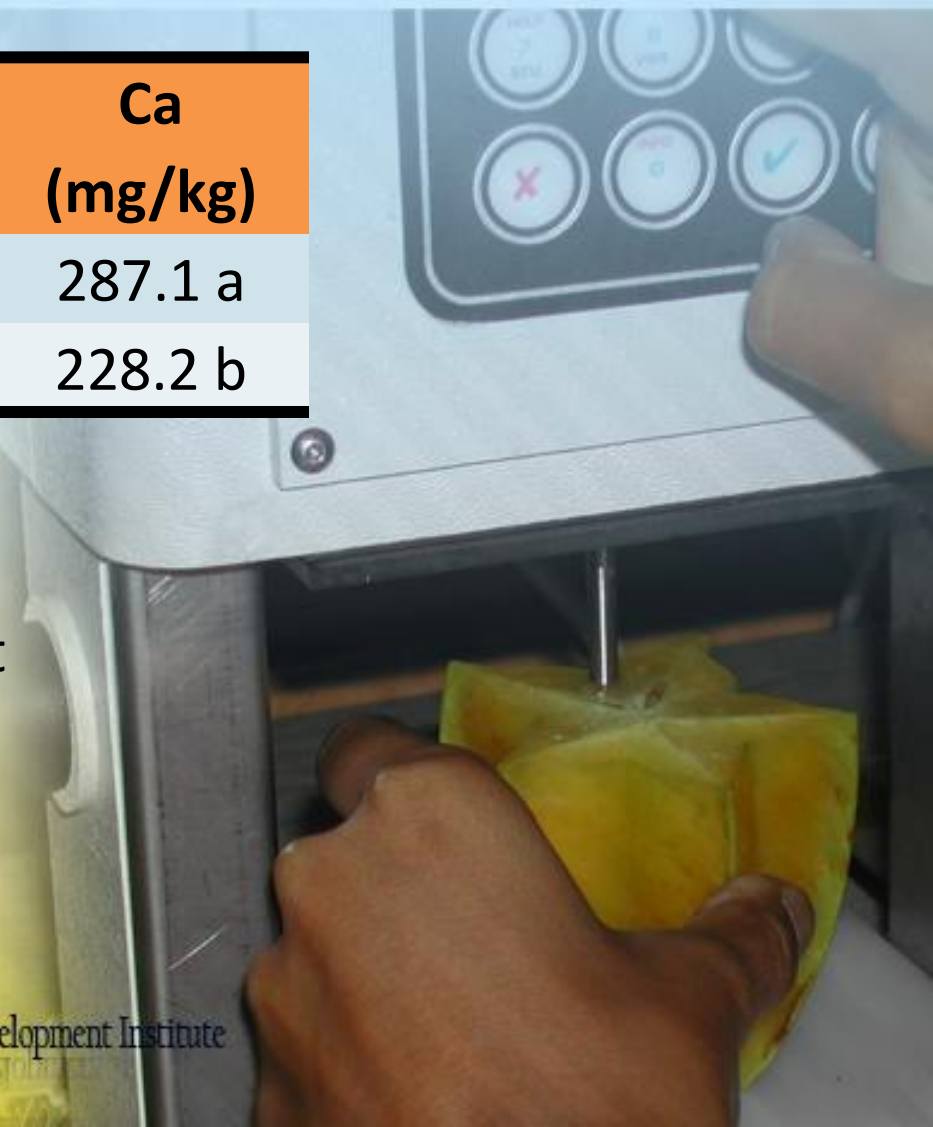


# Effect of pre harvest calcium (Ca) and crop load on fruit firmness and fruit Ca concentration

Treatment		Firmness (N)	Ca (mg/kg)
Calcium	+Ca	44.0 a <sup>y</sup>	287.1 a
	-Ca	35.4 b	228.2 b

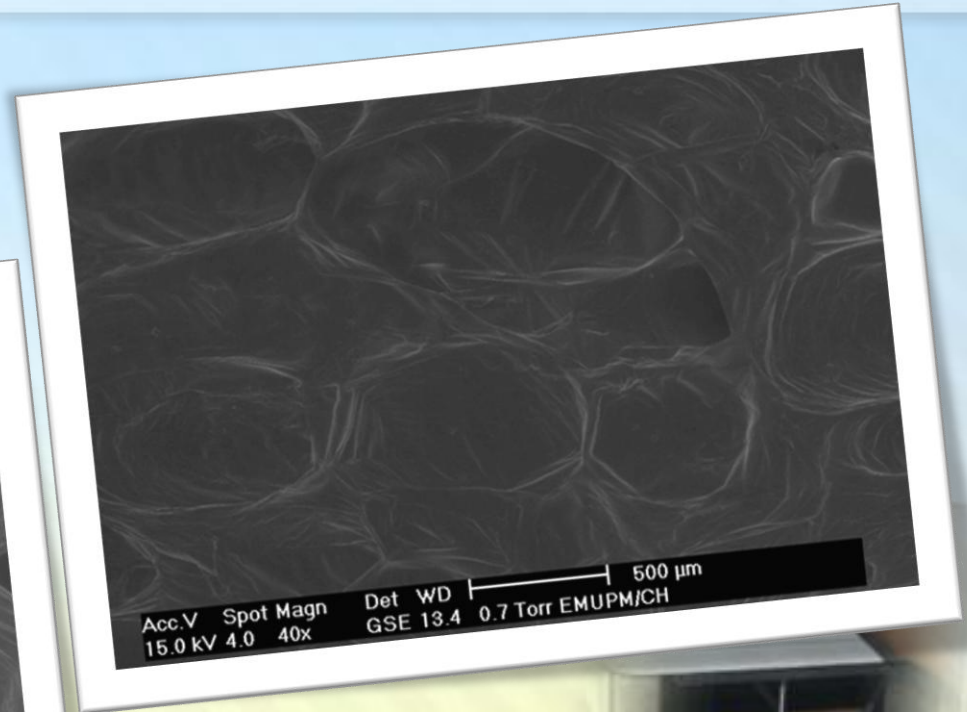
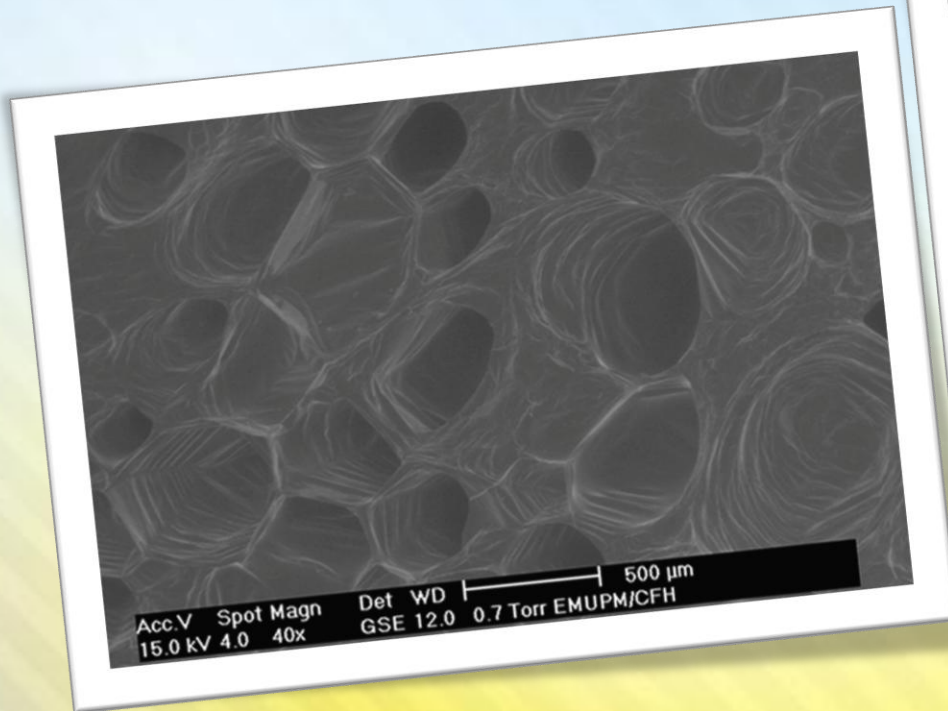
<sup>y</sup>Means followed by different letters in the same column within the same treatment are significant at  $P \leq 0.05$  by DMRT.

Interaction are not significant (NS)





# Carambola - calcium cells



# Table effect of pre harvest calcium (Ca) and crop load on wing tip thickness

Treatment		Wing tip thickness	Firmness 4 wks storage(N)
Calcium	+Ca	1.66 a <sup>z</sup>	39.0 a
	-Ca	1.55 b	30.0 b





# Breeding for quality improvement

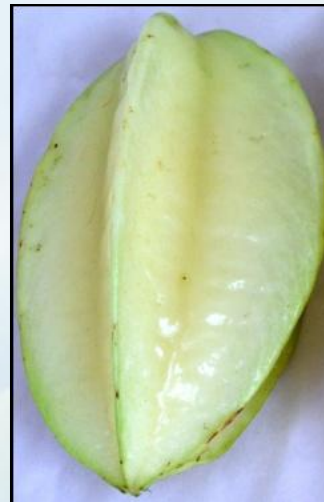
Commercial cultivar  
( B10 and B17 )

+

Pollinator cultivar  
( B2 and B11 )

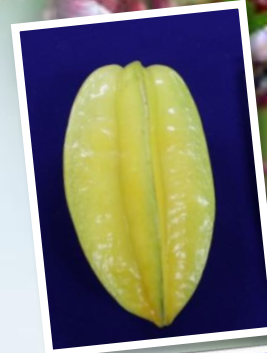


Diallel  
cross



**Hybrid seeds**

- Initially, 12 hybrids were selected based on fruit quality and self compatibility
- Finally, three hybrids (B1711, B1002 and B0217) were selected after sensory evaluation based on:
  - Their improved quality in term of high vitamin C content
  - High total soluble solids
  - Less astringency compared to the commercial cultivars B10 and B17





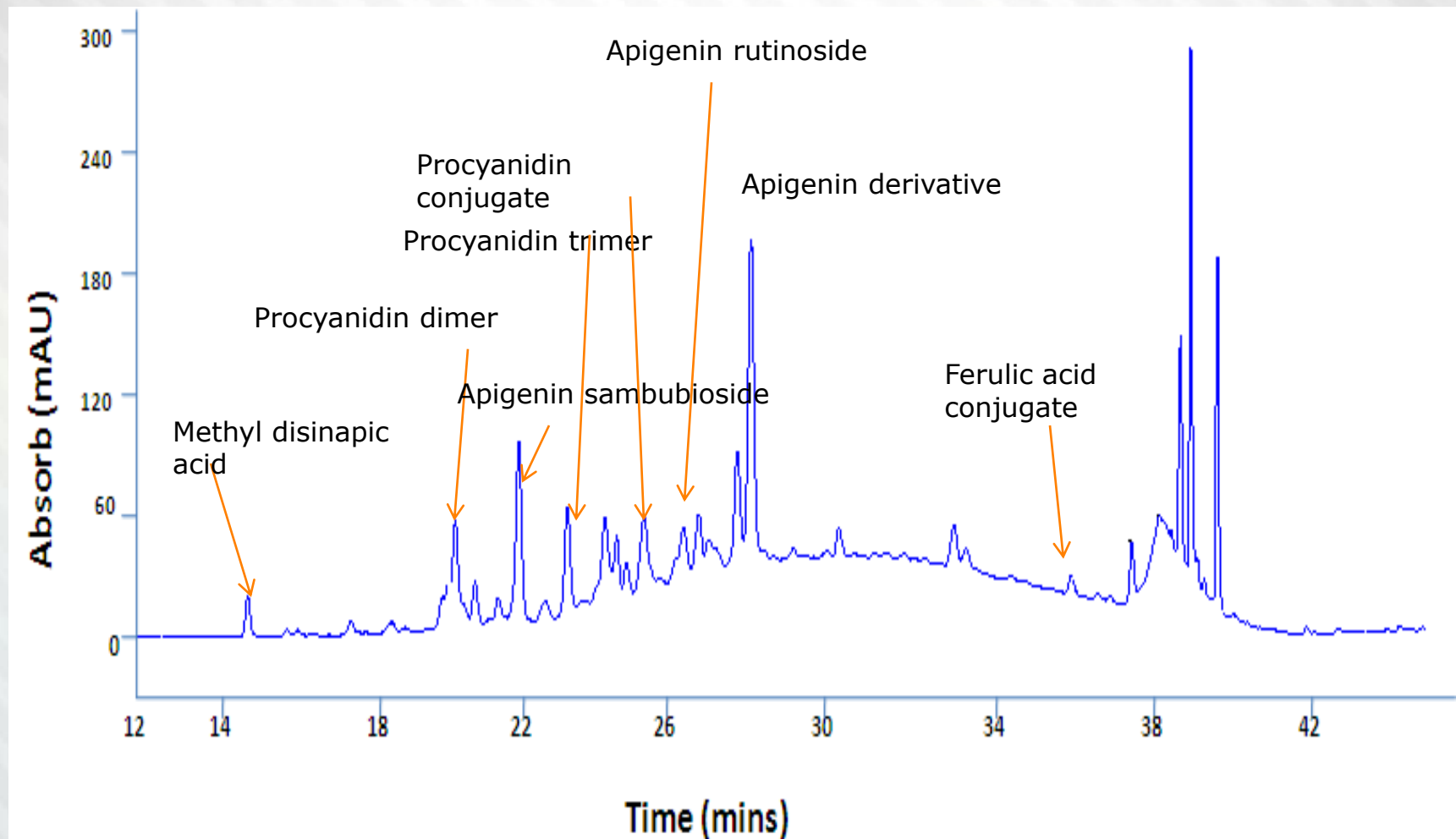
- These three hybrids have potential to exported at maturity (**Golden Carambola**) - fresh eating



- Location verification trials in Kluang, Bukit Tangga and Jeram Pasu
- Varieties will be released soon



# Chemical profile of Carambola



Rich source of procynadins and flavones



# Potential health benefiting properties



## Rich source of polyphenols

- Apigenin and its conjugates
- Procyanidins – dimer and trimer
- Phenolic acid – ferulic and sinapic acid

## POTENTIAL :

- ✓ Contains similar compounds that have been reported to possess anti-cancer and cholesterol reducing ability
- ✓ Good source of natural antioxidant and may be comparable to the health benefits of green tea
- ✓ Has the potential to be processed as a functional drink or ingredient

# Conclusion

- ➡ Carambola production is widespread
- ➡ Malaysia remains as benchmark although countries such as Israel and Brazil also exporting carambola to Europe
- ➡ **A Brazilian** supplier Hage' International has recently launched a very attractive carambola branded as **'The Carambola Gold'** sweet, juicy and fresh eating golden skin variety





# Conclusion

- ➔ Malaysia must produce new carambola variety matching these golden fresh eating varieties
- New variety should look characteristically different
- Attractive bright orange colour



# Conclusion

➔ In order to ensure Malaysia with its super carambola remains as benchmark and global leader:

- » Market expansion- Besides-‘green for ganishing’ should also export **‘golden for fresh eating’**
- » **New markets-** fruit fly barrier countries, lucrative markets USA, Japan and Korea.
- » Product development- **Functional drinks** and as ingredients in other **health products**





# Thank You

The rise of **carambola** from a rising star to a **'super fruit'** and global leader is due to the joint efforts of various agencies under the **Ministry of Agriculture**, the industry players – producers and exporters



# Acknowledgements

- The Director General of MARDI and all MARDI's senior management members
- Present and past directors of the Horticulture Research Centre
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