HORTIN II Co Innovation Programme

Towards cost effective, high quality value chains

Strengthening fresh rambutan supply chain by MA packaging

HORTIN-II Mission Report nr. 32

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Wageningen, The Netherlands, Bogor, Indonesia, August 2009

The purpose of the HORTIN-II programme is to contribute to the development of cost effective high quality value chains for vegetables and fruits. Among others this can be achieved when technology development takes place in close collaboration between public institutions, farmers and private companies.

On the Indonesian side the programme is carried out by the Indonesian Centre for Horticultural Research and Development **(ICHORD),** Jakarta, with the Indonesian Vegetable Research Institute **(IVEGRI)**, Lembang, and the Indonesian Centre for Agricultural Postharvest Research and Development **(ICAPRD)** in Bogor.

In the Netherlands the Agricultural Economics Research Institute **(AEI)**, Den Haag, the Agrotechnology and Food Sciences Group **(ASFG)**, Wageningen, Applied Plant Research **(APR)**, Lelystad, and WUR-Greenhouse Horticulture **(WUR-GH)**, Bleiswijk, all partners in Wageningen University and Research centre, are involved in the programme.

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Executive summary

First experiments have shown that the shelf life of rambutan can be greatly extended by these relatively cheap and proven processes, making them ideal for implementation in Indonesia. Processed rambutan can be stored at ambient temperatures (30˚C) for 2 months. Rambutan juice can have a storage life up to 4 months.

Experiments conducted by ICAPRD and AFSG have shown that by choosing optimal packaging and controlling the cold chain, shelf life of 21 days can be achieved. The packaging materials should answer to the following requirements:

- Relative humidity inside the bag around 95%.
- Condensation controlled by Antifog material or water free absorber
- Permeability properties of packaging material should avoid any anaerobic condition and assure a carbon dioxide concentration between 9 and 12%
- As the packaging facilities at the exporter location are non-existing or extremely limited, the MAP packaging shouldn't require high-tech equipment. The optimum gas concentrations should be reached by the natural respiration rate of the rambutan fruits.

Good handling of the products is necessary to assure the optimal initial quality and the maximum shelf life of rambutan. Gentle handling during harvest and transport minimizes mechanical damages and avoids any enzymatic decays of fruits.

1. Introduction

1.1. Context and purpose of mission

The purpose of the current mission is to discuss the results of the first experiments on processing and packaging of rambutan with the Indonesian project partners and to set-up and plan the combined experiment consisting and export trial and MA/CA packaging experiments.

A summary of the Terms of Reference of this mission is presented below and these excerpts were also used as official introduction of the mission team with Indonesian partners.

Two tracks for strengthening rambutan supply chains were jointly identified and are to be discussed and its feasibility evaluated with Indonesian counterparts during this mission;

1. Processing routes for preservation of rambutan for the development of alternative product market combinations and to create new and off-season markets for processed rambutan.
2. Development of Modified Atmosphere packaging methods for improved quality of rambutan and prolonged shelf life at export and high-end domestic markets.

1.2. Terms of reference mission

The objectives of the mission are the following (see Annex I for project desciption):

- To discuss research institutes' results on rambutan experiments on processing and packaging;
- Screen & discuss opportunities for rambutan supply chain development & product market innovations and to explore opportunities for cooperation with Indonesian producers and exporters in the export trial;
- Make arrangements for follow up experimental and applied research activities

The mission was conducted in week 33, 2009 (9 – 15 Augustus 2009).

1.3. This report

Only major conclusions and key observations are reported in this mission report. Action points are summarized, especially who should take which action and when. Most important the tentative proposal for the export and MA/CA packaging experiments for rambutan are presented.

Wageningen, Bogor, August 2009

2. Summaries and action points per meeting

2.1. Meeting with ICAPRD

Organization & Persons met	ICAPRD (Indonesian Centre for Agricultural Postharvest Research and Development) – dr. Wisnu Broto (director), dr. Sri Yuliani (international cooperation and relations), dr. Setyadjit and staff
Date	Wednesday afternoon, August 12, 2009, Bogor
Discussion & Key observations	• First experiments have shown that the shelf life of rambutan can be greatly extended by these relatively cheap and proven processes, making them ideal for implementation in Indonesia. Processed rambutan can be stored at ambient temperatures (30˚C) for 2 months. Rambutan juice can have a storage life up to 4 months. • Experiments conducted by ICAPRD and AFSG have shown that by choosing optimal packaging and controlling the cold chain, shelf life of 21 days can be achieved. The packaging materials should answer to the following requirements: o Relative humidity inside the bag around 95%. o Condensation controlled by Antifog material or water free absorber o Permeability properties of packaging material should avoid any anaerobic condition and assure a carbon dioxide concentration between 9 and 12% o As the packaging facilities at the exporter location are non-existing or extremely limited, the MAP packaging shouldn't require high-tech equipment. The optimum gas concentrations should be reached by the natural respiration rate of the rambutan fruits. • Good handling of the products is necessary to assure the optimal initial quality and the maximum shelf life of rambutan. Gentle handling during harvest and transport minimizes mechanical damages and avoids any enzymatic decays of fruits.
Action points	1. Sri Yuliani will send the results of their experiments and send an updated set-up for the export trial 2. Jeroen Knol will arrange the input from Wageningen UR for this trial

2.2. Thematic seminar 'Postharvest Science and Technology - Towards Future Food Trends'

Organization	IAARD
Date	Thursday afternoon, August 13, 2009, Bogor
Programme	14.00 – 14.45 • Keynote Speech Minister of Agriculture "Indonesian Food Development Policy 2014 - 2025" **Dr. Ahmad Dimyati, DG of Horticulture** 14.45 – 15.15 • **Panel Discussion (Chairman: Food Review Indonesia Magazine)** • Food Product Development: Towards Cost Effective, High Quality Value Chains" **Wageningen University** (see Annex II)

	• Science and Technology Status Supporting Food Product Development in Indonesia: Scientist Point of View **PATPI** • Nano-scaled Ingredients for Food Functionality **Masyarakat Nano Teknologi Indonesia** • Science and Technology Status Supporting Food Industries in Indonesia **PT. Indofood Sukses Makmur, Tbk** • Partnerships among Multinational Company and Local Producer in Developing Agriculture Practices **PT. Nestle Indonesia** 15.15 - 15.30 • Coffe Breaks 15.30 - 16.50 • Panel Discussion (Continued) 16.50 - 17.00 • Closing Ceremony

3. Project proposal and protocol – 1st draft versions

In order to contribute to the development of tropical fruit sector in Indonesia, new packaging concepts should be investigated to increase shelf life of these fruit. The extension of the shelf life will assure easier and longer distribution radius. The economical fall-out can have significant effects on the Indonesian fruit chain. The present study is processed to determine the potential opportunities of using modified atmosphere packaging for Rambutan fruits. The literature reports that modified atmosphere packaging has a positive effect on the quality of the rambutan fruit and an extension of the shelf life was observed. In order to determine if this packaging method is practical at small-scale farmer in Indonesia, the present set-up was established. Cooperation's with the farmer/cooperative and local research institutes are indispensable in order to determine the limits and further expectations of this technique on the export market and local market.

3.1. Local market test (Indonesia)

3.1.1. Rambutan cv. Binjai

Materials:
Rambutan cv. Binjai from east java (Blitar), will be packed and send them to Supermarket/fruit shops in Jakarta, will be for sale to the consumers. In parallel to the consumer acceptance test, Rambutan cv. Lebak Bulus will be graded, packed and stored under at room temperature and cold storage (10°C) to determine the shelf life period using MAP packaging.

Methods:
Rambutan CV. Binjai will be detached from the branch, to obtain Ca. 400 kg, washed, leave them dry, graded, MAP packed; place in the box, sending to Jakarta in refrigerated box at 15°C for 24 h. At Laboratory of ICAPRD 6 box will be separated and placed at 7°C for referenced storage. Sampling time will be 1, 2, 3, 4 weeks. Analyses for freshness scoring system.

The rest of the box will be distributed in supermarket/fruit shops (place will be determined); for preference test and market test for consumer. At the end there will be economic evaluation and freshness (see previous pre-schedule). Sampling will be made weekly for freshness.

3.1.2. Rambutan cv. Lebak Bulus

In order to compare the shelf life of the Rambutan sent to the Netherlands (by plane), a shelf life test is also needed in Indonesia as reference. We recommend using only one batch of Rambutan cv Lebak Bulus for the reference test (described below) and the transport trial test.

Rambutan cv Lebak Bulus will be detached from the branch, to obtain Ca. 30 kg, washed, leave them dry, graded, MAP packed; place in the box, stored at 10°C at Laboratory of ICAPRD. Sampling time will be 1, 2, 3, 4 weeks. Analyses for freshness scoring system (2 times per week for 4 weeks).

3.2. Second stage: transport trials

3.2.1. Air transport test (Indonesia → Netherlands)

The air transport will permit to send fresh Rambutan (maximum 2 days old after harvesting) to the Netherlands. The packaging moment will be studied within this test. One part of the Rambutan batch is packed under MAP (modified atmosphere packaging) in Indonesia and send within this packaging by plane to the Netherlands. The

second part of the batch is sent unpacked by plane. Once the importer receives the Rambutans, the Rambutans are packed under MAP.

The bag packaging, also called MAP (modified atmosphere packaging), assures optimum storage conditions during distributions and selling processes. MAP process requires a perfect control of the distribution temperature in order to assure quality retention for 2 to 3 weeks on the European market.

The 2 cultivars will be tested for the air transport. Both of them will be investigated for shelf life determination and for preference test by the importer. The Rambutans of the 2 cultivars are harvested on the same days than the ones destined for the first stage test. They are prepared and packed according to the standard protocol developed in the first stage experiment (Special attention should be given to the grading and sorting out phases in the preparation of the products).

- Per cultivar, 24 MAP bags are prepared in Indonesia and 12 kg of Rambutan are send un-packed (within cool box) are sent by plane to the Netherlands.
- Exporter and importer are needed to facilitate the administration and transport processes.
- Temperature during transport will be followed thanks to temperature loggers placed in the box.
- 24 bags and 12 kg of each cultivar of Rambutan are needed for the shelf life test. 2 boxes of each cultivar are also needed for the evaluation done by the importer.
- Samples are stored at 10°C until evaluation
- Evaluation of freshness 2 times of week (see previous pre-schedule)
- Cost, preparation and transport to Netherlands will bear by Hortin
- 2 boxes will be sent to private company: Comments from an importer in The Netherlands : 1 (like), (2) rather dislike, (3) dislike. Willing to buy : (yes/no), Quantity : Months : What price per kg.

3.2.2. Pre-test for sea transport: CA test (Netherlands)

In the last test proposal, it is proposed to send rambutan in sea reefer container under Control Atmosphere (CA) conditions. Knowing the long transport period needed (4 to 5 weeks Maerks Line container transport), we recommend to first determine the best CA for the two cultivars and determine the maximum storage period of the fruit. Fruit will be harvested, graded, cleaned and packed for air transport at the production area. The fruit will be sent by plane to the Netherlands (importer logistic should be used to facilitate the tax and sanitary controls at the airport). Optimum CA conditions for both cultivars will be investigated at A&F facilities at one temperature. The recommended temperature for Rambutan is 10°C.

The Rambutan will be stored for 4 weeks under several oxygen and carbon dioxide concentrations with high relative humidity (90-95%) and ethylene absorber (see matrix below)

Cultivars	Oxygen, [%]	Carbon dioxide, [%]	Total, [kilogram]
Binjai	3	7	4
	3	12	4
	5	7	4
	5	12	4
	1	15	4
	1	18	4
Total Binjai:			**24 + 2**
Lebak Bulus	3	7	4
	3	12	4
	5	7	4
	5	12	4
	1	15	4
	1	18	4
Total Lebak Bulus			**24 + 2**

Once the storage period under CA conditions is ready, one part of the fruits are judged to determine the quality loss due to CA storage, and the second part of the fruits are packed under Modified atmosphere packaging and stored 10 extra days at 10°C. Fruits packed with MAP are evaluated at different interval during the storage period.

The evaluation follows the standard evaluation protocol developed during the visit in Indonesia between experts of ICAPRD and A&F expert.
26 kg per cultivar are needed for this test.

3.3. Planning

Last week of January (22-29 January)

Saturday 23rd January:
- Arrival in Indonesia

Monday 25th January:
- Visit of Rambutan production area
- Discussion over grading and sorting out method
- Last logistic preparation

Tuesday 26th January:
- Preparation of the samples

Wednesday 27th January:
- Initial evaluation
- Send samples to supermarket for the local experiment and to the exporter

Thursday 28th January:
- Visit of the supermarket for initial evaluation by them

Friday 29th January:
- Travelling back to the Netherlands

Annex I. Project Description: Product diversification & quality improvement Rambutan

Horticultural Research Co-operation between Indonesia and The Netherlands - HORTIN-II

1. Project title : Product diversification and quality improvement Rambutan

2. Project leaders : Jeroen Knol, AFSG, Wageningen UR (Netherlands)

Sri Yuliani, Indonesian Centre for Agricultural Post Harvest Research and Development, Bogor

3. Executing agencies : AFSG, ICAPRD

4. Abstract :

5. Participating organisations and companies [1]:

- PT Masindo Mitra Mandiri
- PT Agrosari Sentraprima, Medan
- Directorate General (DG) Horticultural Fruit Crops, Jakarta
- HPSP (Horticultural Partnership Support Program)
- Fresh Studio Innovations Asia

6. Objectives:

Long-term objectives:

To contribute to the development of the fruit sector in Indonesia and generate employment and income for fruit producers by optimising the supply chain for fruit products.

Short-term objectives:

- To evaluate possible processing routes for preservation of rambutan for the development of alternative product market combinations and to create new and off season markets for processed rambutan
- To develop Modified Atmosphere packaging methods for improved quality of rambutan at export markets

7. Project description:

In this project, the following activities will be conducted:

- Reporting of project results: for the most promising processing options, including modified atmosphere treatment a short information sheet will be made, explaining the method, the potential impact for rambutan processing, the results of the first feasibility studies, the main advantages and disadvantages of the processing option, related to potential application in Indonesia.
- Feed back on short information sheets: local bottlenecks and potential problems by introduction and implementation in Indonesia (Indonesian partners).
- Joint workshops for implementation of results.

8. Project methodology:

- Joint project planning with stakeholders; creating commitment with local private parties and public partners
- Demonstrations and pilot with companies including economic analysis

[1] *This is a gross list of partners and contact persons per potential partner have been identified. Depending on the opportunities for and the mode of cooperation a selection of partners will be made.*

- Strengthening of producers / farmers associations

9. Expected outputs and impacts:

	Output	Impact
2010	▪ Experiments in collaboration with research & private partners in Indonesia and The Netherlands aiming at practical implementation of processing and MA packaging (continuation of work done in 2008-2009) ▪ Joint workshop	▪ First step towards implementation of optimising supply chain ▪ Knowledge transfer

10. Training and technology transfer/knowledge exchange:

Year	Subject	Participant Organisation	Location	Organisation involved
2010	• Rambutan processing and packaging: Leaflets for knowledge transfer • Rambutan processing and packaging: workshop	• A&F/ICAPRD	• Indonesia	• A&F • Indonesian partners

11. Work plan 2010:

Time	Activity	Deliverables
2010	• Feed back on short information sheets: local bottlenecks and potential problems by introduction and implementation in Indonesia (Indonesian partners). • Selection of most interesting improvements in processing and optimisation of supply chain • Joint workshops for implementation of results	• Leaflets • Report • Workshop

Annex II. Presentation Wageningen UR at Thematic Seminar 'Posthavest Science and Technology - Towards Future Food Trends', Bogor, 13 August 2009

Food Product Development: Towards Cost Effective, High Quality Value Chains

POSTHARVEST SCIENCE AND TECHNOLOGY
TOWARDS FUTURE FOOD TRENDS – Bogor, 13-08-09

Dr. Ir. Jeroen J. Knol

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Content

- Consumer trends
- Shelf life extension
- Novel processing techniques
- HORTIN II – Strengthening fruit supply chain in Indonesia

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Consumer trends

- Consumers are changing their food consumption and purchasing behaviour
- World wide increase in:
  - Premium product sales
  - Ready-to-eat food spending
  - Health and nutrition-driven product sales
  - Out of home consumption
- Consumers are willing to pay more for greater perceived value
- Need for technologies to extend shelf life and preserve fresh characteristics

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Methods for shelf life extension

- Freezing
- Drying
- Thermal treatments (canning, UHT-treatment)
- Novel processing techniques

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Options for preservation of fruits and vegetables

Ambient shelf life:
- High pressure sterilisation
- Ohmic heating

Refrigerated shelf life:
- High pressure pasteurisation
- PEF (juices)
- Improvements in packaging

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High pressure processing

- Batch, semi continuous process
- Isostatic: pressure is applied from 'all sides' and uniform
- Compression: water 10-20%
- Temperature: adiabatic temperature raise (about 3-6 ° C / 100 MPa)

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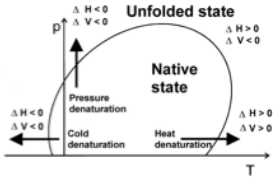
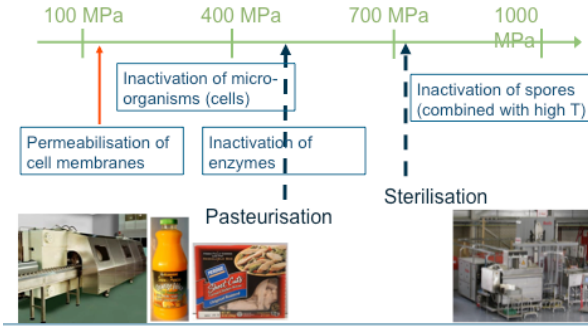
High pressure processing

- Pressure causes changes in volume: reactions are enhanced, e.g.:
  - Denaturation of proteins
  - Crystallization of lipids
  - Small molecules in general less affected
- Effects depend on:
  - Process factors: pressure, time, temperature
  - Product factors: composition



Hendrickx, KULeuven

Effects and applications of HP

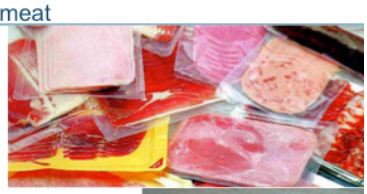


HP pasteurisation

Process and effects
- HP at 20 °C, 500-700 MPa
- Inactivation of vegetative micro-organisms and enzymes
- No effects on spores
- Refrigerated storage 3-6 weeks
- Fresh like quality

Legislation
- Novel Foods regulation (258/97/EC).
- Fruit and vegetable products approved.
- National regulations for other products.

Application of HPP: meat



- Treatment at 600 MPa at ambient and chilled temperatures results in shelf life extension of 120 days
- No *Listeria* and *E. coli* detected

Applications of HPP: guacamole

- Heat-sensitive product
- Enzymatic browning
- Shelf life of 30 days, refrigerated

Applications of HPP: oysters

- Extended shelf life of at least 4 weeks
- Shucking
- No loss of quality

Application of HPP: fish

Salmon, Tuna, Campofrio, Spain

Cod, Ghezzi, Italy

Sea fish, 21 days shelf life

Applications of HPP: fruit, juices and drinks

Fresh fruit
- Treatment at 500 MPa
- 1 month shelf life

Juices & Beverages
- Treatment at 600 MPa
- Shelf life 1-2 months
- Orange & Apple juices (Italy, France, Portugal, USA)
- Brocolli-apple juice (Czech Republic), first functional HP foods (2004)

Applications of HPP: ready to eat meals

Maple leaf, Canada

Carretilla, Spain

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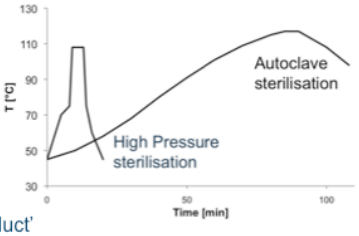
HP sterilisation

- 700-800 MPa
- Tstart 80-90°C
- Tmax 110-120 °C
- 1-5 minutes HP time

- Inactivates spores
- Inactivates enzymes
- 'Freshly cooked product'



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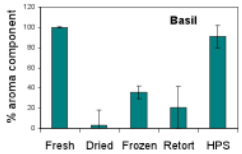
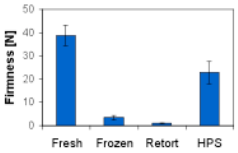
Product quality research

- Broad range of products evaluated
- Some examples:

Flavour of fresh basil



Firmness of green beans



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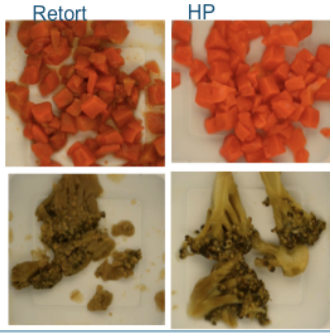
Product quality: colour

- Effects on colour largely dependent on product
- Orange, red colours of vegetables: well preserved
- Green colours: change towards olive green colour



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HP sterilisation

- Interesting results with respect to product quality, however:
- Research needed:
  - Safety of technology: which conditions necessary for inactivation of all spores
  - Effects on quality and shelf life of products
- Legislation: no approval
- Equipment: pilot scale available

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Other relevant novel technologies

- PEF: pulsed electric field treatment
- Volumetric heating: ohmic heating

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Pulsed Electric Fields (PEF)

- Low thermal pasteurization method
- Membrane electroporation by short high electric field pulses
  - 2-300 µs
  - 20-60 kV/cm
- Pasteurization of fluid foods
- Commercial equipment available
- Legislation: no approval
- Pilot equipment at WUR

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Ohmic heating

- Direct heating of product
  - Electric energy is dissipated into heat
- Continuous
- Fast heating
- Volumetric heating
- Product with particles
- Aseptic filling necessary
- Pilot equipment available at CTCPA, Avignon

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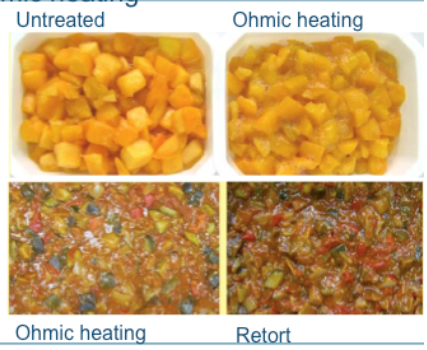
Examples ohmic heating



Conclusions

- Novel technologies can be interesting option for preservation of fruit and vegetables
- Different stages of development
- Commercial available: HP pasteurisation, Ohmic
- Idem: PEF (no legislation)
- Research needed: HP sterilisation

HORTIN II Programme

- The HORTIN-II programme is a pilot programme on how to make supply chains more competitive and on how to empower farmers and SME's in markets by means of innovations and contributions from research and development.

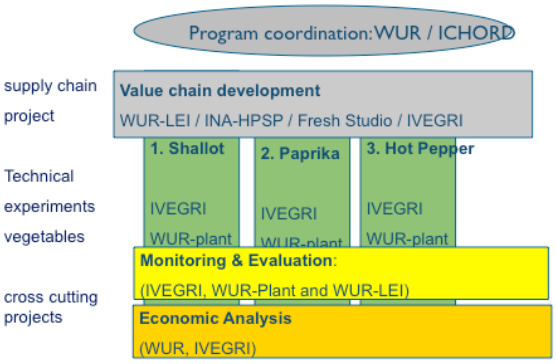
HORTIN II - Objectives

- The objective of the HORTIN-II programme is to attain competitive and sustainable vegetables and fruits supply chains and hence contribute to local economic development.
- To address this goal, the following purposes have been formulated:
  - Collaborative applied research results in competitive and sustainable horticultural supply chains
  - The position of participating SME's and farmers in supply chains is strengthened
  - Capacity is built with stakeholders on the co-innovation approach

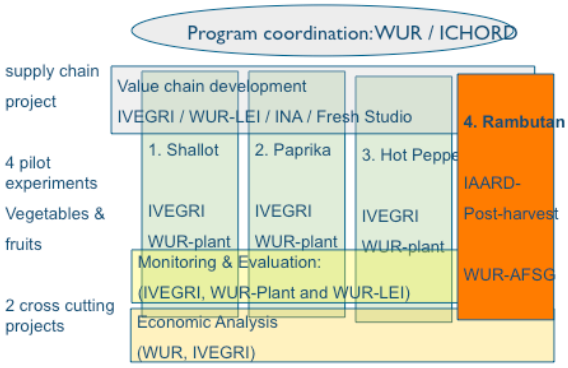
HORTIN II Co-Innovation Programme

- Cooperation of researchers and private companies (entrepreneurs).
- Innovative / technical solutions for problems & opportunities faced by supply chain partners.
- Connecting farmers with modern markets through improved value chains.

HORTIN II co-innovation program 2007 - 08



HORTIN II co-innovation program 2008 - 09



Objectives rambutan project

- Long-term
  - To contribute to the development of the fruit sector in Indonesia and generate employment and income for fruit producers by optimising the supply chain for fruit products
- Short-term
  - To evaluate possible processing routes for **preservation** of rambutan for the development of alternative product market combinations and to create new and off season markets for processed rambutan
  - To develop **Modified Atmosphere Packaging** methods for improved quality of rambutan at export markets

Three tracks

- Processing opportunities and opportunities for new product market combinations (for processed rambutan)
- Opportunities for Modified Atmosphere Packaging (MAP) to extend the export and transport opportunities for fresh rambutan.
- *Feasible opportunities to spread the harvest of rambutan over a longer period or to influence the time of flowering and ripening of rambutan*

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For more information:

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