Working Paper Series

This working paper forms part of the ACIAR Project AGB/2012/061
Improving smallholder farmer incomes through strategic market development in mango supply chains in southern Vietnam

Study: A2.4 Mango Processing Study supply chains

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Summary

Aim

- The aim was to optimise the returns for effort for small-holder farmers by bulk freezing excess mangoes at the height of the season for later on-processing.
- At the height of the season volumes of mangoes reach overwhelming proportions.
- Processors frequently do not have the capacity to handle the bulk of product available.
- By partial processing by freezing it is possible to increase the uptake of a high volume of the product which can be later further processed into marketable products.
- Thus there are opportunities to minimize waste and to make greater use of expensive processing facilities out of season thereby spreading the annual fixed costs.

Methodology

- Freezing trials were undertaken using facilities at SIAEP and at selected, convenient processing facilities to confirm commercial relevance.
- Consideration was given to the most prospective bulk freezing system., and mangoes were peeled and then frozen which were then compared to mangoes frozen after stone removal.
- Freezing techniques were documented and form the essence of a guide for extant and prospective mango processors.

Recommendations and Next Steps

- The technique has been broadly defined by trials and this must be related to fully commercial setting using the solid relationships that have been established with the existing processors.
- Full cost benefit analysis for the trial must be completed and extrapolated to the commercial context.
- An estimate of the saving in waste and loss is required.
- From this the benefits to the farmers in increased demand and loss reduction is to be quantified.
- It must be confirmed that the frozen bulk material has equivalent value to the processors as fresh mangoes in their established product portfolios.

Context

Introduction

A dilemma facing all processors of highly seasonal crops is that equipment and factory facilities are rarely able to cope with the enormous influx of raw material. Out of season these same facilities are underused or idle. Facilities and personnel work at capacity during the seasons. This is particularly the case for mangoes, which are produced in prodigious volumes at season height. Mangoes are also highly perishable. Partial processing at season surfeit for on-processing, as supplies dwindle, can reduce waste and optimise the use of expensive equipment that would otherwise lie idle thus impeding fixed cost recovery.

The trials reported here represent the first stage in the development of a series of procedures to be incorporated in a code of practice that will be available to processors that would enable them to:

- Maximise the use of high-season mangoes.
- Reduce waste.
- Extend the use of factory facilities, including expensive equipment.
- Augment the demand for mangoes, leading to increased return for farmers' efforts.

The processor interviews were conducted to define the demand and quality imperatives of mangoes to meet market standards required in finished products.

Three joint mango freezing trials with the processors were conducted to defined quality characteristics of incoming mangoes suitable for processing. A realistic processing protocol was designed by SIAEP staff that was relevant to the processors. The techniques were documented and processing losses quantified. Sufficient data was accumulated to prepare a draft Guide for Bulk Freezing for current and intending processors. This will be a forerunner for a more obligatory Code of Practice.

Activities

1. **Conducted interviews with three processors:**

   These interviews were carried out on three processing companies, including one company in Cu Chi, Ho Chi Minh city and two companies in Lai Vung and Cao Lanh, Dong Thap province. These interviews conducted in March and April 2021.

2. **Conducted three freezing mango trials with the processors**

   – Mangoes that were collected by the staff of each processors using their commercial quality criteria.

Keo mango: Using mixed mangos with big fruits have unsatisfactory appearance as damaged skin or have the sign of pests and disease or the weight of fruit is less than 300g. The skin colour of the fruit is slightly yellow green. The head of the fruit is yellow with a hard seed. The flesh is yellow and characteristic aroma of the variety. The structure is firm.

Cat Chu mango: Using mixed mangos with big fruits have bad appearance as damaged skin or have the sign of pests and disease or the weight of fruit is less than 230g. The skin colour of the fruit is yellow. The flesh is yellow and characteristic aroma of the variety. The structure is soft.

   – Then the experiments were designed in the lab of SIAEP

     o Sample 1: Mangoes were peeled (with 2 replications N1, N2).

     o Sample 2: Mangoes were peeled and discarded seeds (with 2 replications M1, M2).

− Mangoes in each sample were contained in 2 bags of 10 kg each bag.

Table 1. Experimental design

Samples	Name of bag	Weight (kg)		
		Processor 1	Processor 2	Processor 3
Sample 1	N1	10.27	10.06	10.02
	N2	10.20	10.00	10.00
Sample 2	M1	10.04	10.04	10.00
	M2	10.04	10.00	10.00

− Four bags of mangoes were washed and peeled at each processing company.

− They were then frozen to -18°C with took between 24 - 36 hours for the cores to reach equilibrium.

− The mangoes were held at -18°C for seven days and following which they were thawed at ambient temperature.

− When the mangoes were thawed and reached the room temperature, the samples were subjected to sensory assessment using a seven point Hedonic scale.

− Samples S1 including bag N1 and bag N2 were flesh only.

− Samples S2 including bag M1 and bag M2 were flesh including the stone.

− Thawed water from mango flesh was collected, weighed and recorded.

− Evaluated the stability of mango samples for processing: After thawing, mangoes were blended, then the structure (fineness, uniformity) of the mango puree was evaluated.

− Sensory assessment was assessed at room temperature and included taste, color, and texture of mango pieces..

− The sensory evaluation board include 07 SIAEP staffs

3. **A draft Guide for Bulk Freezing for further and intending processors as a forerunner of a Code of Practice has been prepared**

Results and discussion

Results

Table 1. Coming mango quality standard for processing

Mango varieties	Interview	The result of the trials		
		Average weight	Brix	Appearance
Keo mango	Using mixed mangos with big fruits have bad appearance as damaged skin or have the sign of pests and desease or the weight of fruit is less than 300g The head of the fruit is yellow and hard seed	475 g	18,27 %	
Cat Chu mango	The skin is relatively good, the flesh is yellow and firm The weight of the fruit is less than 230g. Or the weight of the fruit is over than 230g and the appearance is bad.	297 g - 325 g	13,87% -15.63%	

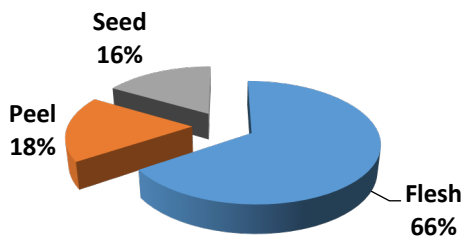**The proportion of parts in Keo mango (Sao Khue Company)**

Seed 12%
Peel 19%
Flesh 69%
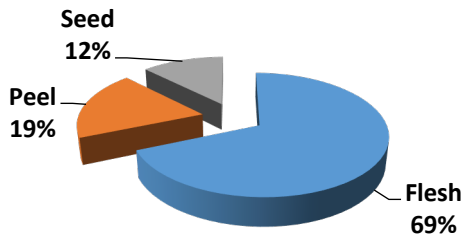
Graph 1. The proportion of each part in Keo mango (Sao Khue Company)

The proportion of parts in Cat Chu mango (Hung Hau)

Seed 15%
Peel 17%
Flesh 68%
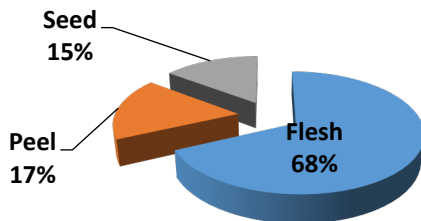
Graph 2. The proportion of each part in Cat Chu mango (Hung Hau Company).

The proportion of parts in Cat Chu mango (Western Farm)

Seed 16%
Peel 18%
Flesh 66%

Graph 3. The proportion of each part in Cat Chu mango (Western Farm Company).

The Graph 1, graph 2, graph 3 show that the ratio of mango flesh for using and the ratio of waste in both Keo mango and Cat Chu mango is relatively equal.

Table 2. Ratio of thawed water of frozen mango

Mango varieties	Sample	Thawed water/ mango flesh (%)
Keo mango (Processor 1)	Sample 1	13.5
	Sample 2	6.4
	Sample 1	37.8

Cat Chu mango (Processor 2)	Sample 2	29.1
Cat Chu mango (Processor 3)	Sample 1	28.5
	Sample 2	24.1

The table show that the ratio of thawed water of frozen mango for Keo mango is much less than Cat Chu mango. This mean that the quality of frozen Keo mango is good for processing. Reducing the loss in processing process.
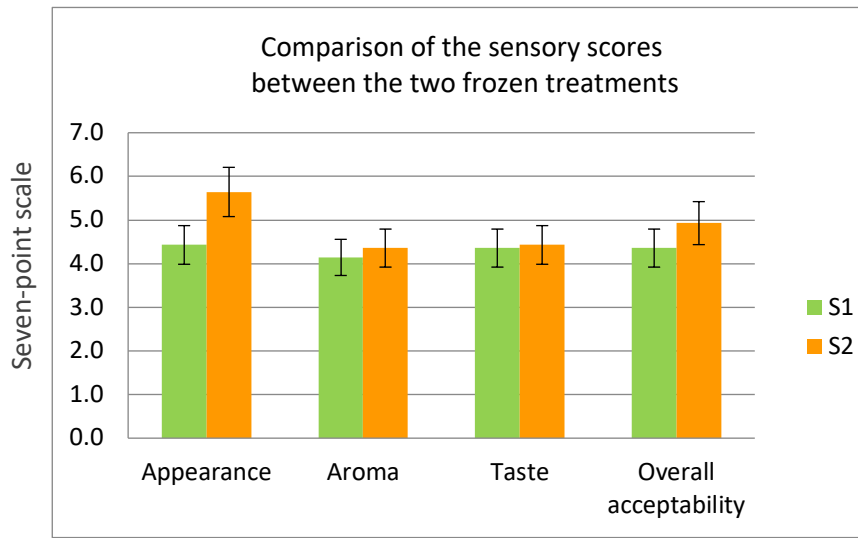
Note:

S1: Sample 1, Mangoes were peeled

S2: Sample 2, Mangoes were peeled and discarded seeds

Graph 4. Comparison of the sensory scores of the thawed Keo mango samples

Note:

S1: Sample 1, Mangoes were peeled

S2: Sample 2, Mangoes were peeled and discarded seeds

Graph 5. Comparison of the sensory scores of the thawed Cat chu mango samples (Hung Hau Compa

Comparison of the sensory scores between the two frozen treatments
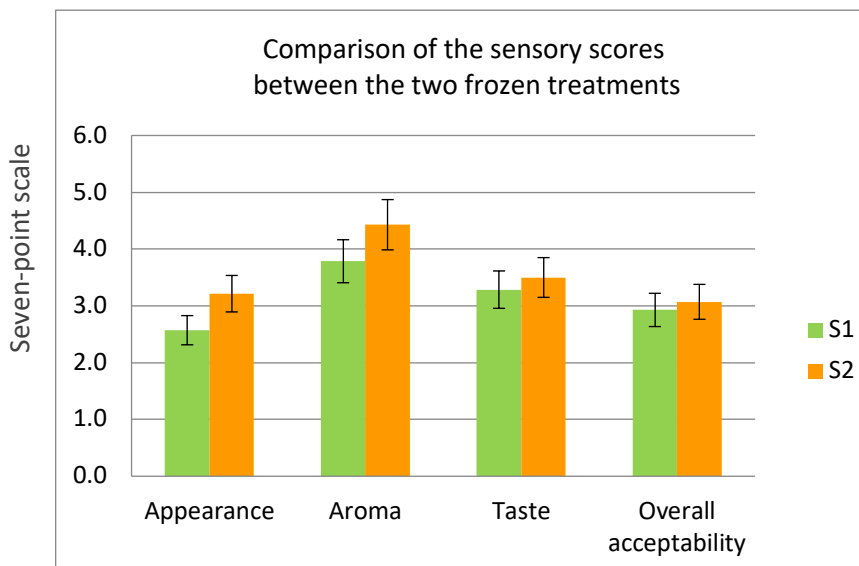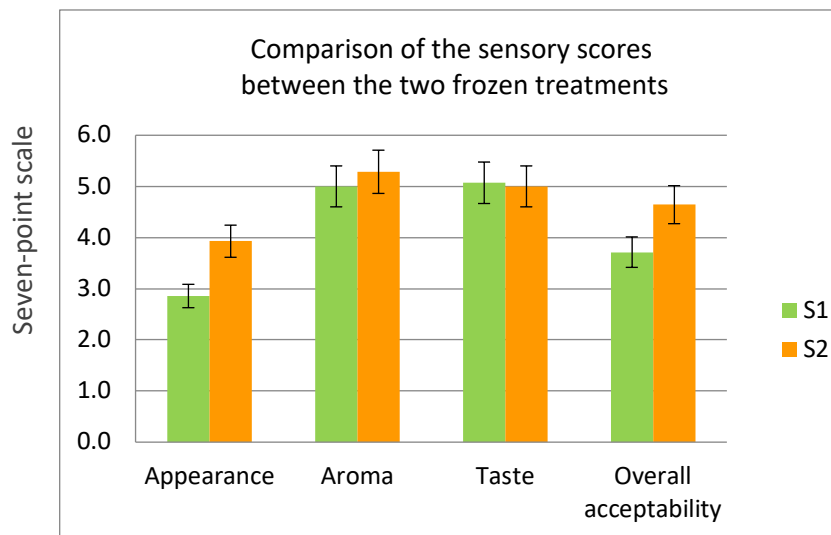
Seven-point scale

Note:

S1: Sample 1, Mangoes were peeled

S2: Sample 2, Mangoes were peeled and discarded seeds

Graph 6. Comparison of the sensory scores of the thawed Cat chu mango samples (Western Farm Company)

The quality of Keo mango after thawing: Bright orange colour, the taste is sour, *c*haracteristic aroma of the variety is good*.*
Sample 1 (S1): Structure is intact, flesh is soft and non-sticky, homogenous flesh puree
Sample 2 (S2): structure is intact, flesh is soft and slightly sticky, homogenous flesh puree

The quality of Cat Chu mango after thawing: Dark orange color, the sweetness is slightly sour, *c*haracteristic aroma of the variety is good*.*
Sample 1 (S1): Structure is non-intact, flesh is soft and slightly sticky, homogenous and slightly liquid flesh puree.
Sample 2 (S2): Structure is broken, flesh is soft and sticky, homogenous and slightly liquid flesh puree.

Comparison of the statistical difference in the sensory scores between the two frozen methods (Method S1: mangoes were peeled, method S2: mangoes were peeled and discarded seeds). There was no statistically significant difference (95% confidence interval) when comparing the sensory scores for evaluation criterias such as appearance, aroma, taste, and overall acceptability between two frozen methods. This result is the same for all trials at tree companies as so as for both Keo mango and Cat chu mango.

Indicative mango processing costs

Trial	Price/ 1000 kg	Ripening cost/1000 kg (VND)	Chemical cost/1000 kg (VND)	Packaging cost/1000 kg (VND)	Labour cost/1000 kg (VND)	Utility cost/1000 kg (electricity) (VND)	Processing cost/1000 kg (VND)	Trial success rate (%)	Price of 1kg Processed flesh (VND)	Raw material turnover/ 1000 kg (VND)	Raw material profit/ 1000 kg (VND)
Sample 1	6,000,000	40,000	3,600,000	3,500,000	1,500,000	1,000,000	9,640,000.00	62.01	40,000	24,804,469.27	9,164,469.27
Sample 2	6,000,000	40,000	3,600,000	3,500,000	1,500,000	1,000,000	9,640,000.00	68.62	40,000	27,448,979.59	11,808,979.59

- Quality partial processing and degree of maturity. It is recommended that trials are repeated to test trends and economic imperatives, and to include up to 15 other processors.
- That work is directed towards the preparation of a recommended Code of Practice.
- Using the relationship now nurtured between SIAEP and the processors the final cost benefit analysis will be completed incorporating the following:

  - The cost of extra staff to process the substandard or blemished fruit for bulk freezing.
  - The extra cost of power for additional freezing
  - The cost of on-processing to satisfy additional markets
  - The savings in reduction in fixed costs resulting from increased usage of equipment and machinery.
  - The feasibility of extending the season by using blemished fruit that continues to be available at season end.

Appendices

APPENDIX A: Pictures of frozen mango trial

**Conduct frozen mango trial at SIAEP laboratory with
Keo mango material supply by Sao Khue Company (COMPANY 1)**

Collecting mango samples in cold storage of Sao Khue company for frozen mango trial

Collecting mango samples in cold storage of Sao Khue company for frozen mango trial

Mango input material of frozen mango trial

Mango input material of frozen mango trial

Whole peeled mango

Mango peel

Mango seed

Mangoes were put in plastic bags and put in cold store

Thawed mango assessment

Thawed whole peeled mangoes N1

Thawed whole peeled mangoes N2

Thawed flesh-cut mangoes M1

Thawed flesh-cut mangoes M2

Puree of mango samples N1 and N2

Puree of mango samples M1 and M2

Conduct frozen mango trial at SIAEP laboratory with Cat Chu mango material supply by Hung Hau Company (COMPANY 2)

Mango input material of frozen mango trial

Whole peeled mango

Mango peel

Mango flesh-cut

Mango seed

Mangoes were put in plastic bags and put in cold store

Thawed mango assessment

Thawed whole peeled mangoes N1

Thawed whole peeled mangoes N2

Thawed flesh-cut mangoes M1

Thawed flesh-cut mangoes M2

Puree of mango samples N1 and N2

Puree of mango samples M1 and M2

**Conduct frozen mango trial at SIAEP laboratory with
Cat Chu mango material supply by Western Farm Company (COMPANY 3)**

Mango input material of frozen mango trial

Whole peeled mango

Mango peel

Mango flesh-cut

Mango seed

Mangoes were put in plastic bags and put in cold store

Thawed mango assessment

Thawed whole peeled mangoes N1

Thawed whole peeled mangoes N2

Thawed flesh-cut mangoes M1

Thawed flesh-cut mangoes M2

Puree of mango samples N1 and N2

Puree of mango samples M1 and M2

APPENDIX B

BẢNG ĐÁNH GIÁ CẢM QUAN XOÀI ĐÔNG LẠNH
(FROZEN MANGO EVALUATION FORM)

Các mẫu xoài đông lạnh được rã đông ở nhiệt độ phòng và đánh giá cảm quan theo phương pháp chấm điểm trên thang điểm 7.

(Frozen mango samples are thawed at room temperature and conduct sensory evaluation using a scoring method on a seven-point scale.)

1. **Chất lượng bên ngoài** *(Appearance)*

Mô tả *(Description)*	Điểm *(Score)*
Chất lượng bên ngoài tuyệt vời *(Excellent appearance):* Màu cam, cấu trúc nguyên vẹn, thịt trái mềm không nhão *(Orange color, structure is intact, flesh is soft and non-sticky).*	7
Chất lượng bên ngoài rất tốt *(Very good appearance):* Màu vàng cam, cấu trúc nguyên vẹn, thịt trái mềm không nhão *(Orange-yellow color, structure is intact, flesh is soft and non-sticky).*	6
Chất lượng bên ngoài tốt *(Good appearance):* Màu vàng sáng, cấu trúc nguyên vẹn, thịt trái mềm không nhão *(Light yellow color, structure is intact, flesh is soft and non-sticky).*	5
Chất lượng bên ngoài bình thường *(Neither like nor dislike)*: Màu vàng không đặc trưng cho giống, cấu trúc nguyên vẹn, thịt trái hơi nhão *(Yellow color does not characterize for variety, the structure is intact, flesh is slightly sticky).*	4
Chất lượng bên ngoài xấu *(Poor appearance):* Màu vàng nhạt, cấu trúc không nguyên vẹn, thịt trái nhão *(Light yellow color, not intact structure, sticky flesh).*	3
Chất lượng bên ngoài rất xấu*(Very poor appearance):* Màu vàng nhạt, cấu trúc vỡ nhiều, thịt trái rất nhão *(Light yellow color, with much broken structure, flesh is very sticky).*	2
Chất lượng bên ngoài hoàn toàn không thể chấp nhận *(Totally unacceptable):* Màu nâu vàng hoặc trắng, cấu trúc vỡ nhiều, thịt trái rất nhão *(Yellow or white brown color, with very broken structure, and very sticky flesh).*	1

(Source: Richard Beyer and SIAEP, 2020)

2. **Mùi hương***(Aroma)*

Mô tả *(Description)*	Điểm *(Score)*
Hương thơm tuyệt vời*(Excellent aroma):* Giữ được hương thơm đặc trưng ban đầu *(Retains the original signature aroma).*	7
Hương rất thơm *(Very good aroma):* Có hương thơm đặc trưng của giống *(Characteristic aroma of the variety).*	6
Hương thơm nhẹ *(Good aroma).*	5
Mùi hương bình thường *(Neither like nor dislike)*: không rõ mùi *(not clear aroma).*	4
Mùi hương không chấp nhận được ở mức độ vừa phải *(Moderately unacceptable).*	3
Mùi hương không thể chấp nhận *(Unacceptable).*	2
Có mùi khó chịu, không thể chấp nhận *(Very unacceptable).*	1

3. **Mùi vị** *(Taste)*

Mô tả *(Description)*	Điểm *(Score)*
Vị ngon tuyệt vời *(Excellent taste):* Vị chua ngọt hài hòa *(Harmonious sweet and sour taste).*	7
Vị rất ngon *(Very good taste):* Vị chua ngọt đặc trưng của giống *(The characteristic sweet and sour taste of the variety)*	6
Có vị ngon *(Good taste):* Vị ngọt hơi chua *(The sweetness is slightly sour).*	5
Vị bình thường *(Neither like nor dislike):* Vị ít ngọt, chua nhiều *(Less sweet, more sour).*	4
Vị không ngon *(Poor taste):* Vị chua hoặc nhạt *(Taste sour or faint).*	3
Vị rất tệ *(Very poor taste):* Vị rất nhạt *(Taste is very faint).*	2
Vị khó chịu, không thể chấp nhận *(Totally unacceptable).*	1

(Source: Richard Beyer and SIAEP, 2020)

4. **Mức độ chấp nhận tổng thể** *(Overall acceptability)*

Mô tả *(Description)*	Điểm *(Score)*
Sản phẩm tuyệt vời *(Excellent product):* Màu cam, cấu trúc nguyên vẹn, thịt trái mềm không nhão, vị chua nọt hài hòa, có mùi thơm đặc trưng, puree của thịt trái đồng nhất *(Orange color, intact structure, soft and non-sticky flesh, harmonious sweet and sour taste, characteristic aroma, and homogeneous flesh puree).*	7
Sản phẩm rất tốt *(Very good product):* Màu vàng cam, cấu trúc nguyên vẹn, thịt trái mềm không nhão, vị chua ngọt đặc trưng, có mùi thơm đặc trưng, puree của thịt trái đồng nhất *(Orange color, intact structure, soft and non-sticky flesh, characteristic sweet and sour taste, characteristic aroma, and homogenous flesh puree).*	6
Sản phẩm tốt *(Good product):* Màu vàng sáng, cấu trúc nguyên vẹn, thịt trái mềm không nhão, vị ngọt hơi chua, có mùi thơm đặc trưng, puree của thịt trái đồng nhất *(Light yellow color, intact structure, soft and non-sticky flesh, slightly sour sweet taste, characteristic aroma, and homogenous flesh puree).*	5
Sản phẩm bình thường *(Neither like nor dislike):* Màu vàng không đặc trưng, cấu trúc nguyên vẹn, thịt trái mềm không nhão, vị ít ngọt hơi chua, không rõ mùi, puree của thịt trái hơi lỏng *(Unspecified yellow color, intact structure, soft and non-sticky flesh, less sweet taste, slightly sour, not clear aroma, and slightly liquid flesh puree).*	4
Không thích sản phẩm ở mức độ vừa phải *(Dislike moderately):* Màu vàng nhạt, cấu trúc không nguyên vẹn, thịt trái mềm hơi nhão, vị chua nhiều hoặc	3

nhạt, mùi không thơm, puree của thịt trái lỏng *(Light yellow color, structure is not intact, flesh is soft and slightly sticky, slightly sour or faint, odorless, and liquid flesh puree).*	
Không ưa thích sản phẩm *(Dislike):* Màu vàng nhạt, cấu trúc vỡ nhiều, thịt trái mềm nhão, vị rất nhạt, mùi không thơm, puree của thịt trái rất lỏng *(Light yellow color, heavily broken structure, flesh is soft and sticky, the taste is very faint, the aroma is not fragrant, and very liquid flesh puree).*	2
Hoàn toàn không thể chấp nhận sản phẩm *(Totally unacceptable):* Màu vàng nâu, cấu trúc vỡ nhiều, thịt trái mềm rất nhão, mùi vị lạ, puree của thịt trái rất lỏng *(Brown yellow color, broken structure, very soft and sticky flesh, strange taste and aroma, and very liquid flesh puree).*	1

(Source: Richard Beyer and SIAEP, 2020)

PHIẾU ĐÁNH GIÁ CẢM QUAN
(EVALUATION FORM)

Người đánh giá *(Assessor)*:   Ngày đánh giá *(Date)*:

Sản phẩm đánh giá *(Product)*:   Giống *(Variety)*:

Mẫu thử *(Samples)*		Thuộc tính đánh giá *(Evaluation criteria)*	Điểm *(Score)*
Sample 1	N1	Chất lượng bên ngoài *(Appearance)*	
		Mùi hương *(Aroma)*	
		Mùi vị *(Taste)*	
		Mức độ chấp nhận tổng thể *(Overall acceptability)*	
	N2	Chất lượng bên ngoài *(Appearance)*	
		Mùi hương *(Aroma)*	
		Mùi vị *(Taste)*	
		Mức độ chấp nhận tổng thể *(Overall acceptability)*	
Sample 2	M1	Chất lượng bên ngoài *(Appearance)*	
		Mùi hương *(Aroma)*	
		Mùi vị *(Taste)*	
		Mức độ chấp nhận tổng thể *(Overall acceptability)*	
	M2	Chất lượng bên ngoài *(Appearance)*	
		Mùi hương *(Aroma)*	
		Mùi vị *(Taste)*	
		Mức độ chấp nhận tổng thể *(Overall acceptability)*	

❖ **Nhận xét chung của người đánh giá** *(Comments of assessor)*

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❖ **Thói quen ăn xoài** *(Mango eating habit)*

o Bạn có ăn xoài không? *(Do you eat mangoes?)* ☐ Có *(Yes)* ☐ Không *(No)*
o Bạn có thường xuyên ăn xoài không? *(How often do you eat it?)*

☐ Mỗi ngày *(Every day)*
☐ Bao nhiêu lần một tuần? *(How many times a week?)* ....
☐ Bao nhiêu lần một tháng? *(How many times a month?)* ....

The sensory scores of the thawed Keo mango samples at Sao Khue Company

Samples	Evaluation criteria	Score						
		A1	A2	A3	A4	A5	A6	A7
Sample 1	Appearance	5	4	4	4	6	5	3
	Aroma	5	4	4	4	4	5	3
	Taste	4	4	4	5	6.5	4	3
	Overall acceptability	5	3	4	4.5	6	5	3
Sample 2	Appearance	6	5	5	5.5	7	7	4
	Aroma	5	4	4	5	5	5	2.5
	Taste	5	4	4	5	6	4	3
	Overall acceptability	6	3	4	5.5	6	6	4
	Mango eating habit							
	Do you eat mangoes?	Y	Y	Y	Y	Y	Y	Y
	How often do you eat it?							
	o Every day							
	o How many times a week?	1				1	1	3
	o How many times a month?		2	3	3-4			

The sensory scores of the thawed Cat chu mango samples at Hung Hau Company

Samples	Evaluation criteria	Score						
		A1	A2	A3	A4	A5	A6	A7
Sample 1	Appearance	2	1	2	4	4	3	2
	Aroma	5	4	4	5	4	2.5	2
	Taste	5	1	3.5	5	4	2.5	2
	Overall acceptability	2	1	3	5	5	2.5	2
Sample 2	Appearance	3	2	3	4	4.5	4	2
	Aroma	5	4	5	5	5	4.5	2.5
	Taste	5	1	4	4	4.5	4	2

		A1	A2	A3	A4	A5	A6	A7
	Overall acceptability	3	1	3	4	5	3.5	2
	Mango eating habit							
	Do you eat mangoes?	Y	Y	Y	Y	Y	Y	Y
	How often do you eat it?							
	o Every day							
	o How many times a week?	1				1	1	3
	o How many times a month?		2	3	3-4			

The sensory scores of the thawed Cat chu mango samples at WESTERN FARM Company

Samples	Evaluation criteria	Score						
		A1	A2	A3	A4	A5	A6	A7
Samples1	Appearance	3	3	3	1	3	4	3
	Aroma	6	5	5	6	5	5.5	2.5
	Taste	6	5	5	6	4.5	6	3
	Overall acceptability	5	2	5	4	3	4	3
Samples2	Appearance	3.5	4	4	3	4	5	4
	Aroma	6	5	6	6	5	5	4
	Taste	6	4	5	5.5	5.5	4.5	4.5
	Overall acceptability	6	3	6	4.5	4	5	4
	Mango eating habit							
	Do you eat mangoes?	Y	Y	Y	Y	Y	Y	Y
	How often do you eat it?							
	o Every day							
	o How many times a week?	1				1	1	3
	o How many times a month?		2	3	3-4			

Note: *A*   *Assessor*

           Assessor 1 - 7   *SIAEP staffs*

           A1   *Tran Thi Kim Oanh*

           A2   *Lam Dong Pho*

           A3   *Dang Thi Sau*

           A4   *Nguyen Vinh Phuc*

A5	*Nguyen Hoai Nam*
A6	*Ngo Van Binh*
A7	*Tran Ngoc Linh*
N1, N2	*Mangoes were peeled, 10 kg each bag*
M1, M2	*Mangoes were peeled and discarded seeds, 10 kg each bag*

APPENDIX C

❖ **The mango freezing trial at processor 1- Sao Khue company**

Comparison of the statistical difference in the sensory scores between the two frozen methods
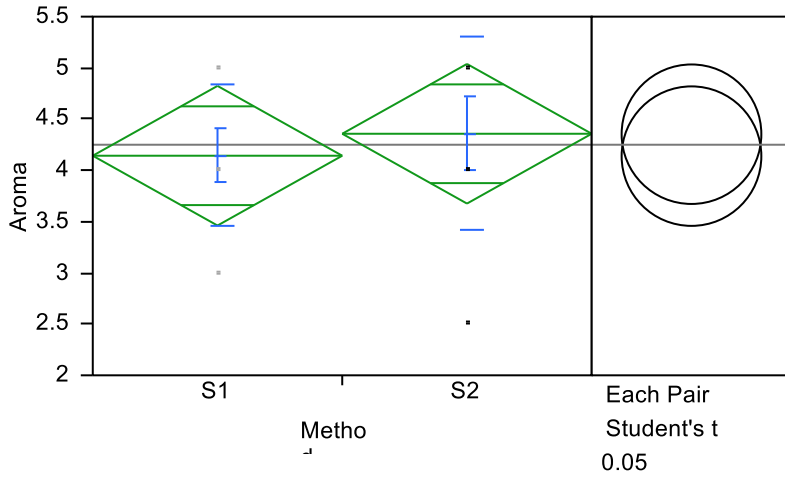
Oneway Analysis of Appearance By Method
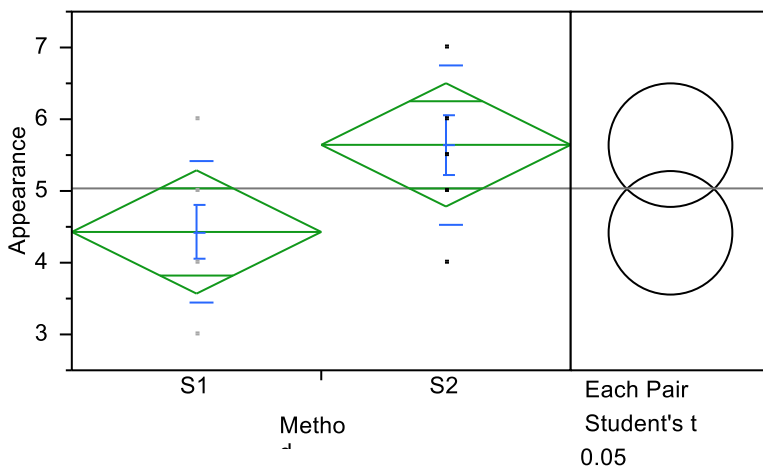
Comparisons for each pair using Student's t

t	Alpha
2.17881	0.05

Abs(Dif)-LSD	**S2**	**S1**
S2	-1.2155	-0.0012
S1	-0.0012	-1.2155

Positive values show pairs of means that are significantly different.

Oneway Analysis of Aroma By Method

Comparisons for each pair using Student's t

t	Alpha
2.17881	0.05

Abs(Dif)-LSD	S2	S1
S2	-0.96356	-0.74928
S1	-0.74928	-0.96356

Positive values show pairs of means that are significantly different.
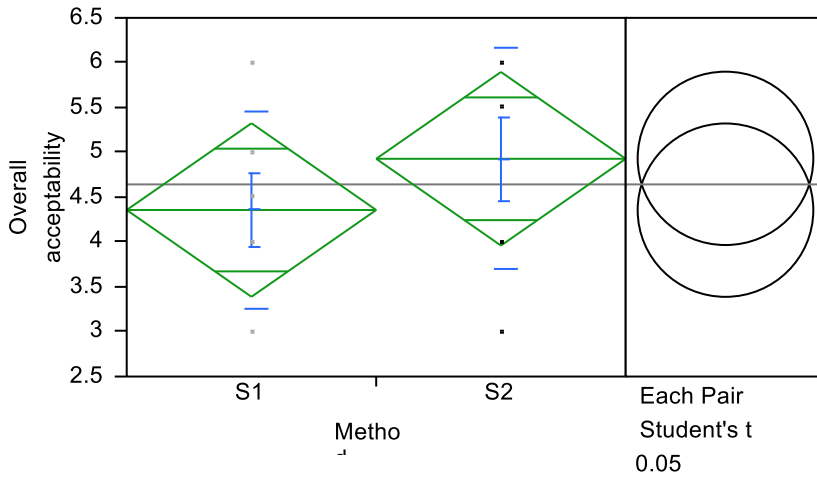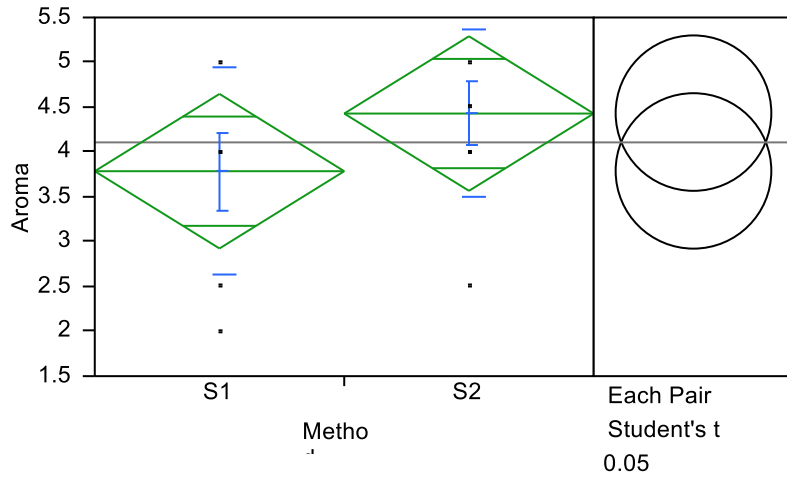
Oneway Analysis of Taste By Method
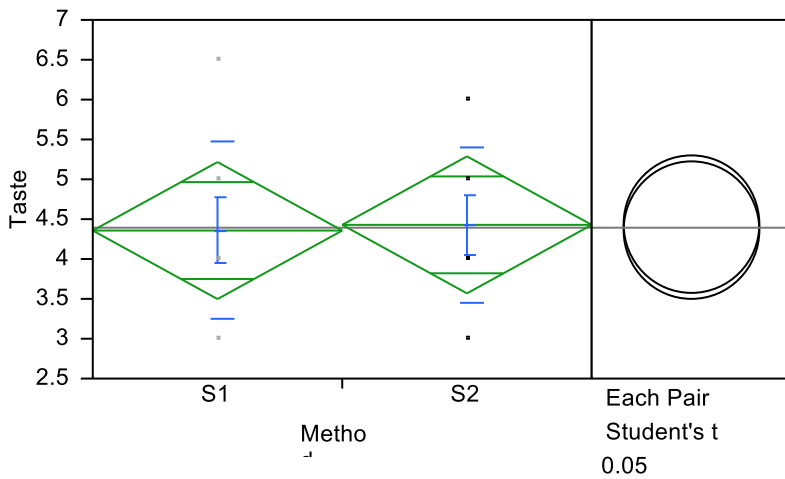
Comparisons for each pair using Student's t

t	Alpha
2.17881	0.05

Abs(Dif)-LSD	S2	S1
S2	-1.2155	-1.1441
S1	-1.1441	-1.2155

Positive values show pairs of means that are significantly different.

Oneway Analysis of Overall acceptability By Method

Comparisons for each pair using Student's t

t	Alpha
2.17881	0.05

Abs(Dif)-LSD	**S2**	**S1**
S2	-1.3686	-0.7972
S1	-0.7972	-1.3686

Positive values show pairs of means that are significantly different.

❖ **The mango freezing trial at processor – Hung Hau company**

Comparison of the statistical difference in the sensory scores between the two frozen methods

Oneway Analysis of Appearance By Method
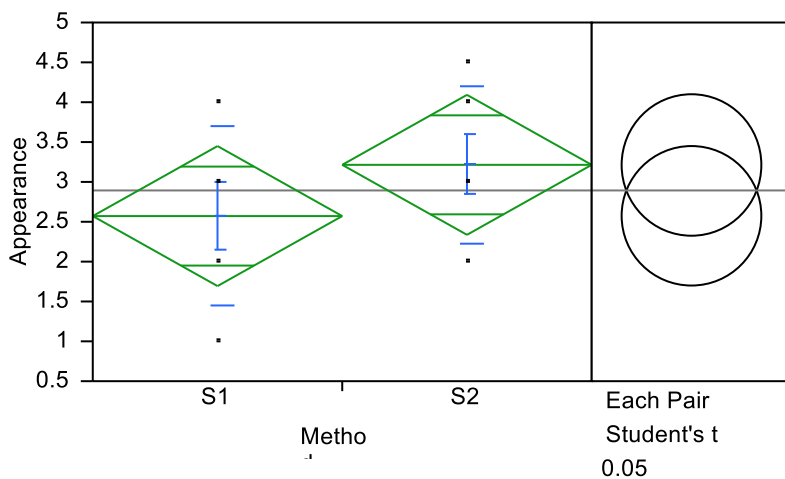
Comparisons for each pair using Student's t

t	Alpha
2.17881	0.05

Abs(Dif)-LSD	S2	S1
S2	-1.2418	-0.5989
S1	-0.5989	-1.2418

Positive values show pairs of means that are significantly different.
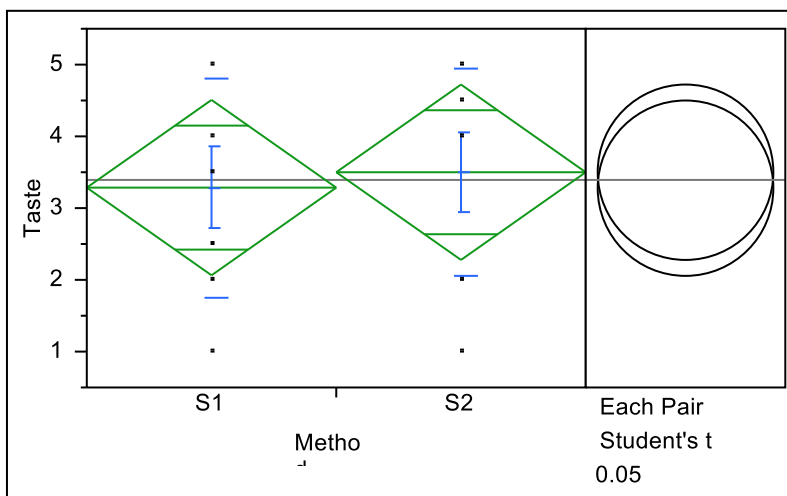
Oneway Analysis of Aroma By Method

Comparisons for each pair using Student's t

t	Alpha
2.17881	0.05

Abs(Dif)-LSD	S2	S1
S2	-1.2188	-0.5760
S1	-0.5760	-1.2188

Positive values show pairs of means that are significantly different.

Oneway Analysis of Taste By Method

Comparisons for each pair using Student's t

	t	Alpha
	2.17881	0.05

Abs(Dif)-LSD	S2	S1
S2	-1.7284	-1.5141
S1	-1.5141	-1.7284

Positive values show pairs of means that are significantly different.

Oneway Analysis of Overall acceptability By Method
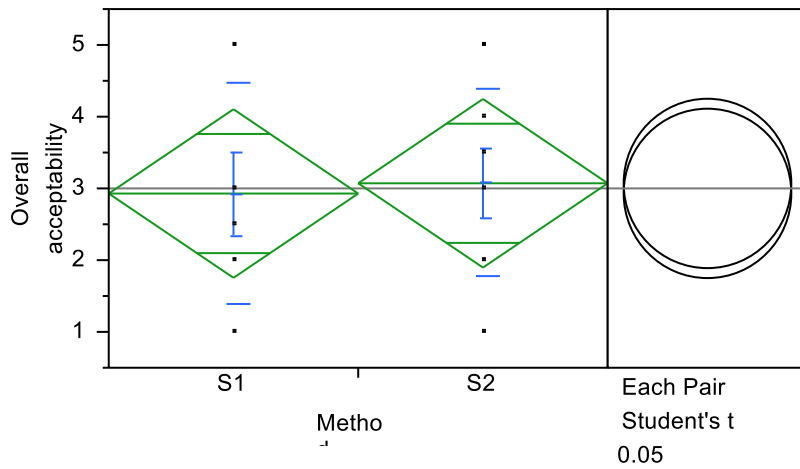
Comparisons for each pair using Student's t
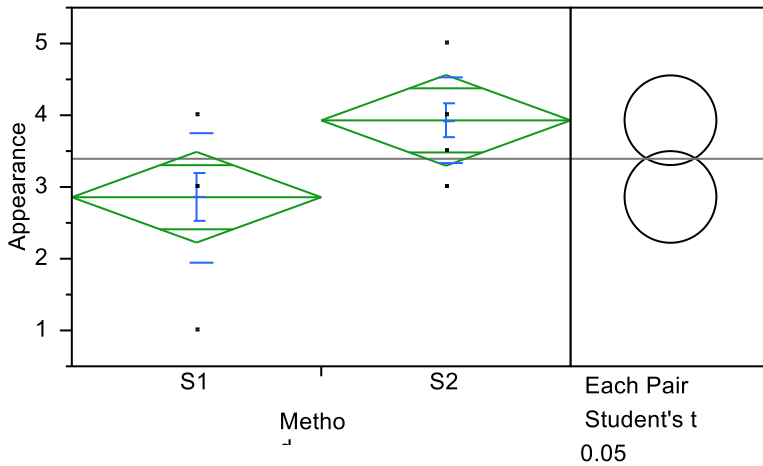
	t	Alpha
	2.17881	0.05

Abs(Dif)-LSD	S2	S1
S2	-1.6617	-1.5188
S1	-1.5188	-1.6617

Positive values show pairs of means that are significantly different.

❖ **The mango freezing trial at processor – Western Farm company**

Comparison of the statistical difference in the sensory scores between the two frozen methods
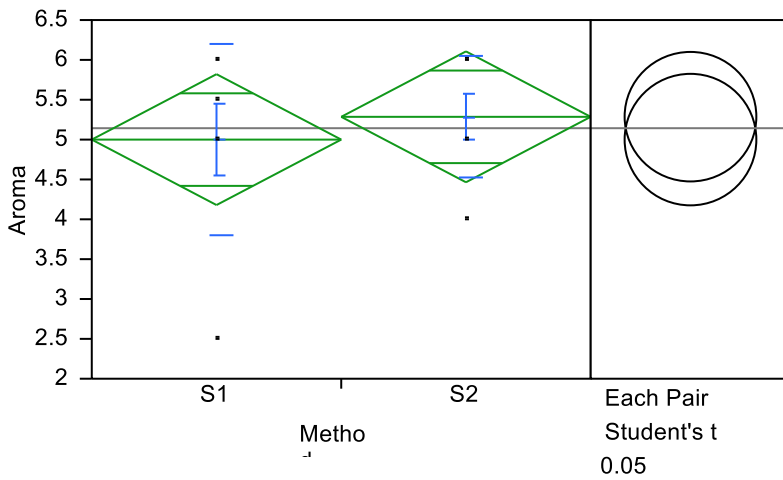
Oneway Analysis of Appearance By Method

Comparisons for each pair using Student's t

t	Alpha
2.17881	0.05

Abs(Dif)-LSD	S2	S1
S2	-0.89402	0.17741
S1	0.17741	-0.89402

Positive values show pairs of means that are significantly different.
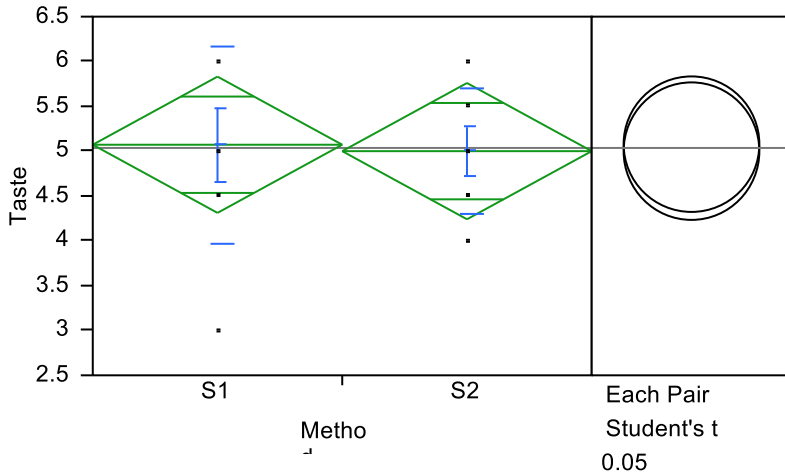
Oneway Analysis of Aroma By Method

Comparisons for each pair using Student's t

t	Alpha
2.17881	0.05

Abs(Dif)-LSD	S2	S1
S2	-1.1612	-0.8754
S1	-0.8754	-1.1612

Positive values show pairs of means that are significantly different.
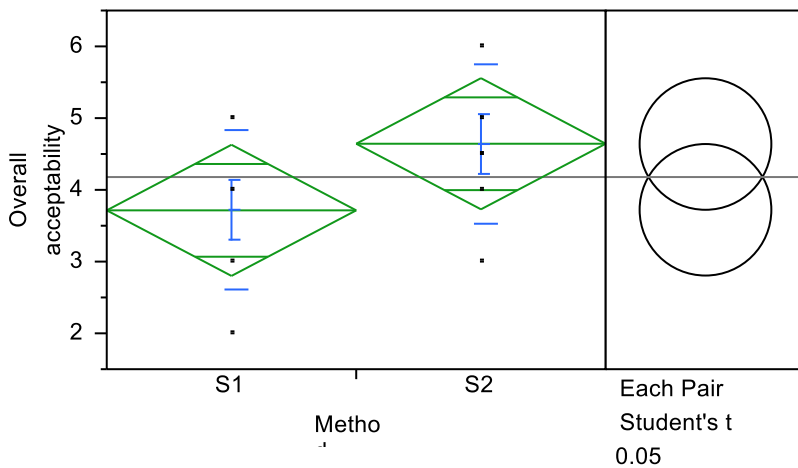
Oneway Analysis of Taste By Method

Comparisons for each pair using Student's t

t	Alpha
2.17881	0.05

Abs(Dif)-LSD	S1	S2
S1	-1.0745	-1.0031
S2	-1.0031	-1.0745

Positive values show pairs of means that are significantly different.

Oneway Analysis of Overall acceptability By Method

Comparisons for each pair using Student's t

t	Alpha
2.17881	0.05

Abs(Dif)-LSD	S2	S1
S2	-1.2928	-0.3642
S1	-0.3642	-1.2928

Positive values show pairs of means that are significantly different.