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APPENDICES

APPENDIX A

ANALYTICAL METHODS

A.1 Moisture content analysis, AOAC Official Methods 925.09B (AOAC, 1995)

Equipments and apparatus

1. Hot air oven (WTB Binder, model 7200, Germany)
2. Aluminum pan
3. Desiccator

Determination

Two grams of sample, accurately weighed, were placed into a preweighed aluminum pan. The sample was heated at 130°C for 4 hours or until its constant weight was obtained. The sample was then transferred to a desiccator and weighed soon after its temperature reached room temperature. Moisture content of the sample was calculated from the following formula.

$$\text{Moisture content (\% wb)} = \frac{\text{weight of sample (g)} - \text{weight of dried sample (g)}}{\text{weight of sample (g)}} \times 100$$

A.2 Crude protein analysis, AOAC Official Methods 979.09 (AOAC, 1995)

Equipments and apparatus

1. Digestion unit (Buchi, model K-424, Switzerland)
2. Distillation unit (Buchi, model B-324, Switzerland)

Chemical reagents

1. conc. sulfuric acid (A.R. grade, J. T. Baker Neutrasorb, USA)
2. 0.1 N standard hydrochloric acid (A.R. grade, Ajax Finechem, Australia)
3. Sodium hydroxide (A.R. grade, Carlo Erba, France), 50% w/v solution
4. Boric acid (A.R. grade, Merck, Germany), 4% w/v solution was prepared
5. Selenium reagent mixture (A.R. grade, Merck, Germany)

6. Indicator (dissolved 0.125 g of methyl red (A.R. grade, Fisher Scientific, UK) and 0.0825 g of methylene blue (A.R. grade, Ajax Finechem, Australia) in 100 ml of 90% ethanol)

Determination

One gram of sample was placed into a digestion flask. Five grams of selenium mixture and 25 ml of sulfuric acid were added into the flask. In case of blank, one milliliter of distilled water was used instead of the sample. The flask was placed in an inclined position and heated gently until frothing ceased, approximately 30 minutes. The digested sample was placed into Buchi distillation unit and distilled with the following program.

| | |
|---------------------------------------|-------|
| - 50% (w/v) sodium hydroxide solution | 60 ml |
| - 4% (w/v) boric acid | 50 ml |
| - distilled water | 50 ml |
| - distillation time | 5 min |

The distilled solution was titrated with 0.1 N hydrochloric acid until reaching the end point. Methyl red/methylene blue was used as an indicator. Crude protein was calculated from the following formula.

$$\% \text{ Nitrogen} = \frac{(V-B) \times N \times 1.4}{\text{weight of sample (g)}}$$

$$\text{Crude protein (\% db)} = \% \text{ Nitrogen} \times 5.95$$

where V represents the volume of 0.1 N standard hydrochloric acid titrated with the sample (ml), B represents the volume of 0.1 N standard hydrochloric acid titrated with blank (ml), and N represents the exact concentration of standard hydrochloric acid (N).

A.3 Crude fat analysis, AOAC Official Methods 920.39C (AOAC, 1995)

Equipments and apparatus

1. Soxhlet (Gerhardt, model HC61, Germany)
2. Rotary evaporator (Eyela, model SB-651, Japan)

Chemical reagents

1. Petroleum ether (A.R. grade, Fisher Scientific, UK)

Determination

Two grams of dried sample, accurately weighed, were placed into a porous thimble. The thimble was placed into a Soxhlet apparatus and 250 ml of petroleum ether was added. Crude fat was extracted from the sample for 3 hours. The solvent was evaporated from the extraction using a rotary evaporator. The crude fat residue in the preweighed rounded-bottom flask was dried at $100 \pm 5^{\circ}\text{C}$ for 30 minutes or until its constant weight was obtained. The sample was then transferred to desiccator and weighed soon after its temperature reached room temperature. Crude fat was calculated from the following formula.

$$\text{Crude fat (\% db)} = \frac{\text{weight of crude fat residue (g)}}{\text{weight of sample (g)}} \times 100$$

A.4 Dietary fiber analysis, AOAC Official Methods 992.16 (AOAC, 1995)

The dietary fiber was examined using the enzymatic method, AOAC Official Methods 992.16 (AOAC, 1995), by Institute of Nutrition, Mahidol University.

A.5 Ash content analysis, AOAC Official Methods 923.03 (AOAC, 1995)

Equipments and apparatus

1. Muffle furnace (Fisher Scientific, model Isotemp, Germany)
2. Crucible
3. Hot plate
4. Desiccator

Determination

Three to five grams of sample, accurately weighed, were placed into a preweighed crucible. The sample was heated on a hot plate in a fume hood until the smoke ceased. The sample was then ignited in a furnace at 550°C until the gray ash turned white. The crucible was transferred to desiccator and weighed soon after its temperature reached room temperature. Ash content of the sample was calculated from the following formula.

$$\text{Ash content (\% wb)} = \frac{\text{weight of ash (g)}}{\text{weight of sample(g)}} \times 100$$

A.6 Calculation of carbohydrate content (AOAC, 1995)

The carbohydrate content was calculated from the following formula.

$$\text{Carbohydrate content (\%db)} = 100 - (\% \text{protein} + \% \text{lipid} + \% \text{dietary fiber} + \% \text{ash})$$

A.7 Amylose content analysis (Juliano, 1981)

Equipments and apparatus

1. Spectrophotometer (Genesys Spectronic® 20, USA)
2. Water bath (Heto Lab Equipment, model DT-1, Denmark)
3. Magnetic stirrer (Framo-Geratetechnik, model M21/1, Thailand) and magnetic bar

Chemical reagents

1. 95% ethanol (A.R. grade, Liquor Distillery Organization Excise Department, Thailand)
2. Sodium hydroxide (A.R. grade, Carlo Erba, France), 1 N solution
3. Iodine solution (dissolved 0.2 g of iodine and 2.0 g of potassium iodide (A.R. grade, Fisher Scientific, UK) in 100 ml of distilled water)
4. Standard amylose from potatoes (A.R. grade, Fluka, USA)

Determination of amylose content in flour sample

One hundred milligrams of sample, accurately weighed, were placed into a dried 100 ml volumetric flask. One milliliter of ethanol was added into the flask. The solution was gently shaken and 9 ml of sodium hydroxide was subsequently added. The solution was then stirred on a magnetic stirrer for 10 minutes. The magnetic bar was taken out from the volumetric flask. The final volume of the sample solution was then adjusted with distilled water. This solution will be subsequently called "prepared sample solution".

To determine the amylose content of the sample, 70 ml of distilled water, 2 ml of acetic acid and 2 ml of iodine solution were added into 100 ml volumetric flask. Five milliliters of the prepared sample solution was then pipetted into this solution and the final volume of the solution was adjusted with distilled water. Blank was prepared by the same procedure using distilled water instead of the prepared sample solution. The solution was let stand for 10 minutes and the absorbance at 610 nm of the sample was subsequently measured by spectrophotometer. The amylose content of the sample was calculated from standard curve of amylose.

Preparation of standard curve of amylose

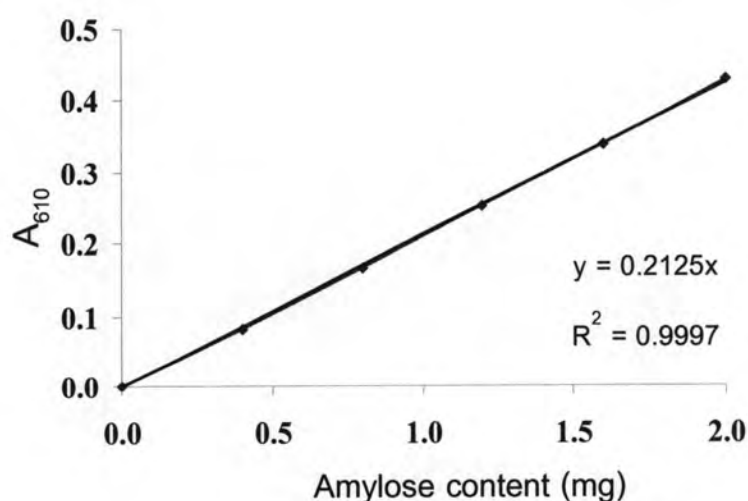
The amylose standard solution was prepared with the similar procedure as used for the preparation of the sample solution but using 0.0400 g of potato amylose instead of the sample. The standard solution was prepared in 100-milliliter flask. The serial dilution was prepared as listed in Table A.1. Final volume in each flask was adjusted to 100 ml with distilled water. The solution was let stand for 10 minutes and the absorbance at 610 nm was measured by spectrophotometer. The standard curve was created (Fig. A.1)

Table A.1 Preparation of standard amylose solution

| Distilled water (ml) | Iodine solution (ml) | Acetic acid (ml) | Standard stock solution ^A (ml) | Amylose content ^B (mg) |
|-------------------------|-------------------------|---------------------|--|--------------------------------------|
| 70 | 2 | 0.4 | 1 | 0.4 |
| 70 | 2 | 0.8 | 2 | 0.8 |
| 70 | 2 | 1.2 | 3 | 1.2 |
| 70 | 2 | 1.6 | 4 | 1.6 |
| 70 | 2 | 2.0 | 5 | 2.0 |

^A Standard stock solution was prepared by adding 0.0400 g of amylose, 1 ml of 95% ethanol and 9 ml of 1 N sodium hydroxide to 100-milliliter volumetric flask, stirred on magnetic stirrer for 10 minutes and the final volume was adjusted to 100 ml with distilled water.

^B Final weight of potato amylose in 100 ml of standard solution

**Figure A.1** Standard curve for the determination of amylose content

A.9 Thermal properties

Equipments and apparatus

1. DSC (Perkin-Elmer, model Diamond DSC, USA) equipped with an Intracooler unit (Perkin-Elmer, model 2P, USA) and nitrogen gas purge
2. 4-digit balance (Ohaus, model Explorer, Switzerland)
3. Aluminum volatile sample pan (Perkin-Elmer, kit number 0219-0062, USA)

Chemical reagents

1. 2-mercaptoethanol (A.R. grade, Bio Basic Inc., Canada)

Determination

A known weight of the rice flour was directly placed in a DSC volatile sample pan. Calculated amount of distilled water was added using the ratio of water to rice flour as 3:1 (w/w, db). The pan was hermetically sealed, reweighed and equilibrated overnight at room temperature before the experiment. The total weight of the sample in DSC pans was approximately 15 mg. An empty volatile sample pan was used as a reference. The sample and reference pan were scanned from 30°C to 85°C at a heating rate of 10°C/min. The DSC parameters, gelatinization temperature reported as T_p (°C), the range of gelatinization temperature (ΔT_g , °C) calculated by the difference between T_o and T_c , and ΔH_g (J/g) calculated from the area of the gelatinization peak from the DSC thermogram, were reported.

To determine effects of 2-mercaptoethanol treatment on thermal properties of the samples, solution of 0.5%v/v of 2-mercaptoethanol in distilled water was used instead of distilled water. The final concentration of 2-mercaptoethanol in the samples was 0.36% v/w.

A.10 Pasting properties

Equipments and apparatus

RVA (Newport Scientific, model Super 3, Australia)

Chemical reagents

1. 2-mercaptoethanol (A.R. grade, Bio Basic Inc., Canada)

Determination

Rice flour (3.000 ± 0.010 g) was mixed with distilled water (25 ± 0.010 ml) in a canister. The RVA temperature program started with holding at 50°C for 1 min, heating to 95°C with a heating rate of 12°C/min, holding at 95°C for 2.5 min, cooling at 50°C with a cooling rate of 12°C/min and then holding at 50°C for 1.5 min. PT, PV, BD and SB were automatically reported by the instrument.

To determine effects of 2-mercaptoethanol treatment on pasting properties of the samples, 100 μ l of 2-mercaptoethanol was added into the sample suspension prior to immediate running of RVA analysis. The final concentration of 2-mercaptoethanol in the samples was 0.36% v/w.

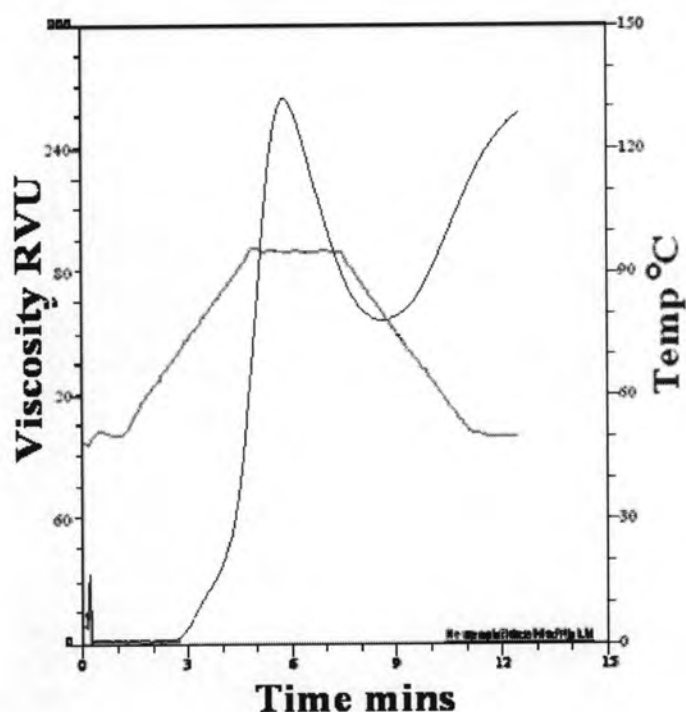


Figure A.2 RVA curve of fresh shade-dried hulled red jasmine rice

A.11 Swelling power (modified form Schoch, 1964)

Equipments and apparatus

1. Water bath (Heto Lab Equipment, model DT-1, Denmark)
2. Centrifuge (Thermo IEC, model IEC Multi-EF, USA)
3. Hot air oven (WTB Binder, model 7200, Germany)

Determination

Half grams of sample, accurately weighed, were placed into a preweighed centrifugal tube. Fifteen-milliliter of distilled water was then added and the sample was heated at 70°C and 90°C in a water bath for 30 minutes with continuous stirring. The sample was subsequently centrifuged at 6000Xg for 30 minutes. The supernatant was gently poured into a preweighed porcelain pan and dried at 130°C. The porcelain pan

was transferred to desiccator and weighed soon after its temperature reached room temperature. The constant weight of the dried supernatant was measured and used to calculate for solubility of the sample. The precipitated paste was weighed and calculated for swelling power according to the following formula.

$$\% \text{ Solubility} = \frac{\text{weight of dried supernatant (g)} \times 100}{\text{weight of sample (g)}}$$

$$\text{Swelling power (g/g sample db)} = \frac{\text{weight of precipitated paste (g)} \times 100}{\text{sample weight (g) (100 - \% solubility)}}$$

APPENDIX B

FLUIDIZED BED DRYER

B.1 Calculation of the weight of paddy samples in each batch of FB drying

In this experiment, the drying chamber of the FB dryer was cylindrical with 20-centimeter diameter. Soponronnarit and Prachayawarakorn (1994) suggested that for the size of the cylindrical drying chamber, suitable height of sample in the chamber should be approximately 9.5 cm. Therefore, the volume of paddy samples in each batch was approximately 2,984 cm³. The density of paddy samples containing the moisture content of 30% wb was approximately 0.60 g/cm³. The amount of paddy samples loaded in FB dryer in each batch could be calculated from the following formula;

$$W = \rho \times V$$

where W represents the weight of paddy samples loaded in FB dryer in each batch (g), ρ represents the density of paddy samples (g/cm³), and V represents the volume of drying chamber of FB dryer (cm³) when the height of the samples was 9.5 cm.

Therefore, weight of the paddy samples was approximately 1,800 g in each batch.

B.2 Setting of air velocity

Before the operation, the FB dryer was switched on for 30 minutes. The temperature of the FB dryer was set at 35°C. To set air velocity, the samples were loaded into the chamber by the following procedure. Before sample loading, the fan motor was switched off. The samples were then loaded. Subsequently, the drying chamber was closed and the fan motor was switched on immediately. The fan motor was then adjusted until the air velocity reached 2.0 m/s. After that, the paddy samples were unloaded. During the setting of the air velocity, the temperature was maintained at 35°C.

B.3 Operation of FB dryer

Before the operation, the FB dryer should be switched on for 30 minutes. When the FB dryer was ready to operate, drying temperature was set at 115 °C. After the temperature was constant, a new batch of the samples was loaded into the chamber with the procedure previously mentioned in B.2. The samples were dried for 215 seconds to reduce the moisture of the samples to 18% wb. The samples were then unloaded and randomly collected to measure paddy temperature and moisture content immediately. The rest of the unloaded samples were placed into plastic baskets to shade dry.

B.4 Shutting down of the FB dryer

Before shutting down, the FB dryer should be cooled down and waited until the temperature reaches 35°C.

APPENDIX C

FIGURES OF HULLED RED JASMINE RICE SAMPLE

C.1 Raw and cooked hulled red jasmine rice

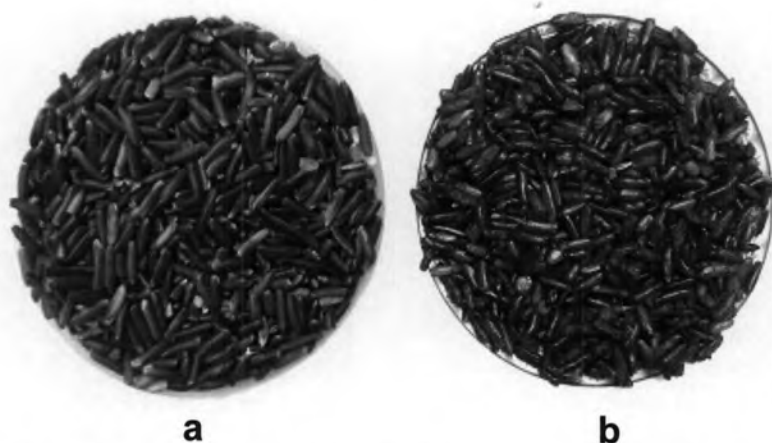


Figure C.1 Raw (a) and cooked (b) freshly hulled red jasmine rice subjected to sun drying

C.2 Shade-dried hulled red jasmine rice packed in Nylon/LLDPE and OPP/AL/LLDPE pouch

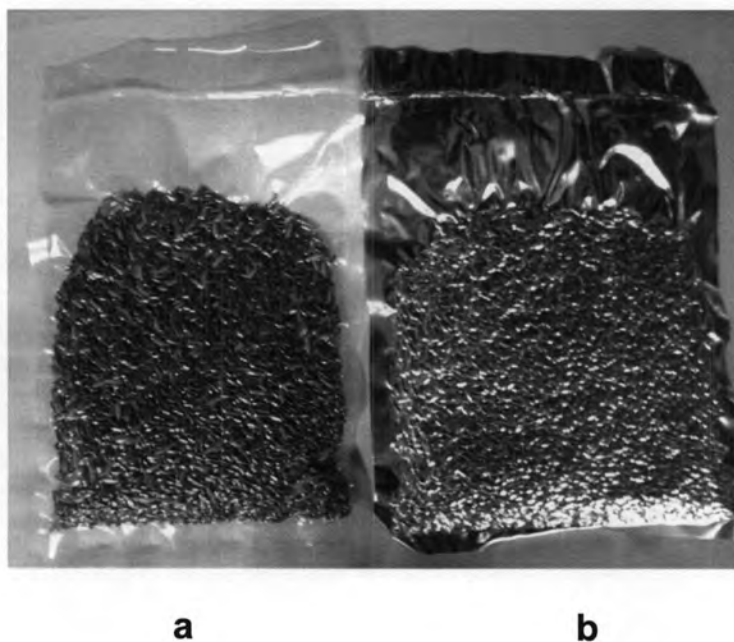


Figure C.2 Shade-dried hulled red jasmine rice packed in Nylon/LLDPE pouch (a) and OPP/AL/LLDPE pouch (b).

APPENDIX D

SENSORY ANALYSIS

D.1 Quantitative and Descriptive Analysis (QDA)

D.1.1 Panelists

A 8-member panel consisted of 5 females and 3 males with aged 23–30. All panelists were graduate students of Department of Food Technology, Faculty of Science, Chulalongkorn University.

D.1.2 Training the panelists

A training session was divided into 2 parts. In the first part, the panelists familiarized themselves with the cooked hulled rice and recognized characteristics and intensity of tested sensory attributes. The sensory attributes and their references are summarized in Table D.1. The second part was calibrating session. For each panelist, intensity rating of each attribute was calibrated using 10-point scale intensity rating (D.1.4). This 2-hour training session was performed twice before starting the actual evaluation.

D.1.3 Evaluation procedure

Five-gram portion of each cooked sample was served. Temperature of each served sample was approximately 40-50°C. Each sample was coded with 3-digit number. Each panelist evaluated one sample at a time and marked their responses on a questionnaire with 10-point intensity scale (D.1.4). Panelists had to drink water to clean their mouth before evaluating a following sample.

Table D.1 Sensory attributes and reference standards

| Sensory attribute | Standard | |
|-------------------|--|--|
| | Intensity rating = 0 | Intensity rating = 10 |
| Fragrance | Cooked hulled red jasmine rice prepared from the sample which was shade dried, packed in Nylon/LLDPE pouch and stored at ambient temperature for 13 months | Cooked hulled rice prepared from commercial organic brown rice (Manufacturing date 12/02/08) which was purchased from local supermarket in March 2008. |
| Rancidity | Cooked hulled red jasmine rice prepared from the freshly shade-dried sample | Cooked hulled red jasmine rice prepared from the sample which was shade dried, packed in Nylon/LLDPE pouch and stored at ambient temperature for 13 months |
| Hardness | Cooked hulled rice prepared from commercial organic brown rice (Manufacturing date 12/02/08) which was purchased from local supermarket in March 2008. | Cooked hulled red jasmine rice prepared from the sample which was shade dried, packed in Nylon/LLDPE pouch and stored at ambient temperature for 13 months |

D.1.5 Questionnaire for QDA

Sensory evaluation of cooked hulled red jasmine rice

Name.....Age.....Gender.....
 3-digit sample code.....Date.....

Instructions Please evaluate the following attributes of each cooked hulled red jasmine rice sample. For each attribute, please check (✓) in the box representing the intensity level which was the most corresponded to your opinion.

1. Aroma

1.1 Fragrance

| | | | | | | | | | | |
|-------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|---|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| minimum intensity (no fragrance) | | | | moderate intensity | | | | maximum intensity (strong fragrance) | | |

1.2 Rancidity

| | | | | | | | | | | |
|--|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| minimum intensity (no rancid aroma) | | | | moderate intensity | | | | maximum intensity (strong rancid aroma) | | |

2. Hardness

| | | | | | | | | | | |
|----------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|----------------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| minimum intensity (very soft) | | | | moderate intensity | | | | maximum intensity (very hard) | | |

Suggestions.....

Thank you for your participation 😊

D.2 Affective test

D.2.1 Panelists

A 34-member panel consisted of 21 females and 13 males with aged 11-43, all untrained. The panelists were students and staff of Chulalongkorn University. All panelists used to consume cooked hulled rice.

D.2.2 Evaluation procedure

Five-gram portion of each cooked sample was served. Temperature of each served sample was approximately 40-50°C. Each sample was coded with 3-digit number. Each consumer evaluated one sample at a time and marked their responses on a questionnaire with 5-point hedonic scale (D.2.3). Consumers had to drink water to clean their mouth before evaluating a following sample.

D.2.3 Questionnaire for affective test

การประเมินคุณภาพทางด้านประสาทสัมผัสของข้าวกล้องหอมมะลิแดง

เพศ.....อายุ.....วันที่ทำแบบทดสอบ.....

คำชี้แจง โปรดชิมตัวอย่างข้าวกล้องหอมมะลิแดงทีละตัวอย่าง แล้วให้คะแนนที่ตรงกับความรู้สึกของท่านมากที่สุดแก่ตัวอย่างในคุณภาพทางด้านประสาทสัมผัสตามที่ระบุในตาราง

1 = ไม่ชอบมากที่สุด 2 = ไม่ชอบ 3 = เฉยๆ 4 = ชอบ 5 = ชอบมาก

| คุณภาพทาง ประสาทสัมผัส | รหัสตัวอย่าง | | |
|----------------------------|--------------|--|--|
| | | | |
| สีของข้าวกล้องหุงสุก | | | |
| ความแข็งของข้าวกล้องหุงสุก | | | |
| กลิ่นของข้าวกล้องหุงสุก | | | |
| การยอมรับโดยรวม | | | |

ข้อเสนอแนะ.....
.....

ขอบคุณมากค่ะ ☺

APPENDIX E

STATISTICAL ANALYSIS

Table E.1 The ANOVA table showing the effect of drying methods on moisture content and water activity of fresh hulled red jasmine rice at the 95% confidence

| Dependent variable | Source of variation | Sum of Squares | df | Mean Square | F | Sig. |
|--------------------|---------------------|----------------|----|-------------|--------|------|
| Moisture content | Between Groups | 6.288 | 2 | 3.144 | 34.400 | .000 |
| | Within Groups | 1.097 | 6 | .091 | | |
| | Total | 7.385 | 8 | | | |
| Water activity | Between Groups | .009 | 2 | .005 | 30.982 | .001 |
| | Within Groups | .001 | 6 | .000 | | |
| | Total | .010 | 8 | | | |

Table E.2 The ANOVA table showing the effect of drying methods on thermal properties of fresh hulled red jasmine rice at the 95% confidence

| Dependent variable | Source of variation | Sum of Squares | df | Mean Square | F | Sig. |
|---|---------------------|----------------|----|-------------|---------|------|
| Onset temperature (T_o) | Between Groups | 3.396 | 2 | 1.698 | 116.028 | .000 |
| | Within Groups | .088 | 6 | .015 | | |
| | Total | 3.484 | 8 | | | |
| Peak temperature (T_p) | Between Groups | 1.473 | 2 | .736 | 20.819 | .002 |
| | Within Groups | .212 | 6 | .035 | | |
| | Total | 1.685 | 8 | | | |
| Range of gelatinization (ΔT_g) | Between Groups | .414 | 2 | .207 | 10.076 | .012 |
| | Within Groups | .123 | 6 | .021 | | |
| | Total | .537 | 8 | | | |
| Enthalpy of gelatinization (ΔH_g) | Between Groups | 1.960 | 2 | .980 | 6.569 | .031 |
| | Within Groups | .895 | 6 | .149 | | |
| | Total | 2.855 | 8 | | | |

Table E.3 The ANOVA table showing the effect of drying methods on pasting properties of fresh hulled red jasmine rice at the 95% confidence

| Dependent variable | Source of variation | Sum of Squares | df | Mean Square | F | Sig. |
|--------------------------|---------------------|----------------|----|-------------|--------|------|
| Pasting temperature (PT) | Between Groups | 1.410 | 2 | .705 | .990 | .400 |
| | Within Groups | 8.547 | 6 | .712 | | |
| | Total | 9.957 | 8 | | | |
| Peak viscosity (PV) | Between Groups | 5.579 | 2 | 2.790 | .148 | .864 |
| | Within Groups | 226.227 | 6 | 18.852 | | |
| | Total | 231.806 | 8 | | | |
| Breakdown (BD) | Between Groups | 648.933 | 2 | 324.466 | 12.959 | .001 |
| | Within Groups | 300.448 | 6 | 25.037 | | |
| | Total | 949.380 | 8 | | | |
| Setback (SB) | Between Groups | 5.642 | 2 | 2.821 | .698 | .517 |
| | Within Groups | 48.492 | 6 | 4.041 | | |
| | Total | 54.134 | 8 | | | |

Table E.4 The ANOVA table showing the effect of drying methods on swelling power of fresh hulled red jasmine rice at the 95% confidence

| Dependent variable | Source of variation | Sum of Squares | df | Mean Square | F | Sig. |
|------------------------|---------------------|----------------|----|-------------|-------|------|
| Swelling power at 70°C | Between Groups | 1.182 | 2 | .591 | .315 | .741 |
| | Within Groups | 11.266 | 6 | 1.878 | | |
| | Total | 12.447 | 8 | | | |
| Swelling power at 90°C | Between Groups | 4.085 | 2 | 2.043 | 2.783 | .115 |
| | Within Groups | 6.605 | 6 | .734 | | |
| | Total | 10.691 | 8 | | | |

Table E.5 The ANOVA table showing the effect of drying methods on color in Hunter L, a, b system of cooked hulled rice prepared from fresh hulled red jasmine rice at the 95% confidence

| Dependent variable | Source of variation | Sum of Squares | df | Mean Square | F | Sig. |
|--------------------|---------------------|----------------|----|-------------|--------|------|
| L | Between Groups | 8.621 | 2 | 4.310 | 1.144 | .334 |
| | Within Groups | 101.740 | 27 | 3.768 | | |
| | Total | 110.361 | 29 | | | |
| A | Between Groups | 7.921 | 2 | 3.961 | 16.578 | .000 |
| | Within Groups | 6.450 | 27 | .239 | | |
| | Total | 14.372 | 29 | | | |
| B | Between Groups | 4.565 | 2 | 2.283 | 7.214 | .003 |
| | Within Groups | 8.543 | 27 | .316 | | |
| | Total | 13.108 | 29 | | | |

Table E.6 The ANOVA table showing the effect of drying methods on fragrance aroma of cooked hulled rice prepared from fresh hulled red jasmine rice at the 95% confidence

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|-----------------|-------------------------|----|-------------|---------|------|
| Corrected Model | 11.688(a) | 9 | 1.299 | 1.360 | .240 |
| Intercept | 595.021 | 1 | 595.021 | 623.030 | .000 |
| Panelist | 6.146 | 7 | .878 | .919 | .503 |
| Drying method | 5.542 | 2 | 2.771 | 2.901 | .067 |
| Error | 36.292 | 38 | .955 | | |
| Total | 643.000 | 48 | | | |
| Corrected Total | 47.979 | 47 | | | |

a R Squared = .244 (Adjusted R Squared = .064)

Table E.7 The ANOVA table showing the effect of drying methods on rancidity of cooked hulled rice prepared from fresh hulled red jasmine rice at the 95% confidence

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|-----------------|-------------------------|----|-------------|---------|------|
| Corrected Model | 16.979(a) | 9 | 1.887 | 2.240 | .040 |
| Intercept | 130.021 | 1 | 130.021 | 154.400 | .000 |
| Panelist | 8.813 | 7 | 1.259 | 1.495 | .199 |
| Drying method | 8.167 | 2 | 4.083 | 4.849 | .013 |
| Error | 32.000 | 38 | .842 | | |
| Total | 179.000 | 48 | | | |
| Corrected Total | 48.979 | 47 | | | |

a R Squared = .347 (Adjusted R Squared = .192)

Table E.8 The ANOVA table showing the effect of drying methods on hardness of cooked hulled rice prepared from fresh hulled red jasmine rice at the 95% confidence

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|-----------------|-------------------------|----|-------------|---------|------|
| Corrected Model | 26.521(a) | 9 | 2.947 | 3.071 | .007 |
| Intercept | 638.021 | 1 | 638.021 | 665.000 | .000 |
| Panelist | 22.479 | 7 | 3.211 | 3.347 | .007 |
| Drying method | 4.042 | 2 | 2.021 | 2.106 | .136 |
| Error | 36.458 | 38 | .959 | | |
| Total | 701.000 | 48 | | | |
| Corrected Total | 62.979 | 47 | | | |

a R Squared = .421 (Adjusted R Squared = .284)

Table E.9 The ANOVA table showing the effect of storage condition on color in Hunter L, a, b system of cooked hulled rice prepared from sun-dried hulled red jasmine rice at the 95% confidence

| Dependent variable | Source of variation | Sum of Squares | df | Mean Square | F | Sig. |
|--------------------|---------------------|----------------|----|-------------|-------|------|
| L | Between Groups | 98.522 | 8 | 12.315 | 4.015 | .000 |
| | Within Groups | 248.429 | 81 | 3.067 | | |
| | Total | 346.951 | 89 | | | |
| A | Between Groups | 21.349 | 8 | 2.669 | 6.750 | .000 |
| | Within Groups | 32.022 | 81 | .395 | | |
| | Total | 53.371 | 89 | | | |
| B | Between Groups | 10.305 | 8 | 1.288 | 4.126 | .000 |
| | Within Groups | 25.286 | 81 | .312 | | |
| | Total | 35.592 | 89 | | | |

Table E.10 The ANOVA table showing the effect of storage condition on fragrance of cooked hulled rice prepared from sun-dried hulled red jasmine rice at the 95% confidence

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|-------------------|-------------------------|-----|-------------|----------|------|
| Corrected Model | 64.667(a) | 15 | 4.311 | 4.651 | .000 |
| Intercept | 1834.694 | 1 | 1834.694 | 1979.460 | .000 |
| Panelist | 6.861 | 7 | .980 | 1.057 | .395 |
| Storage condition | 57.806 | 8 | 7.226 | 7.796 | .000 |
| Error | 118.639 | 128 | .927 | | |
| Total | 2018.000 | 144 | | | |
| Corrected Total | 183.306 | 143 | | | |

a R Squared = .353 (Adjusted R Squared = .277)

Table E.11 The ANOVA table showing the effect of storage condition on rancidity of cooked hulled rice prepared from sun-dried hulled red jasmine rice at the 95% confidence

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|-------------------|-------------------------|-----|-------------|----------|------|
| Corrected Model | 343.243(a) | 15 | 22.883 | 25.649 | .000 |
| Intercept | 945.563 | 1 | 945.563 | 1059.876 | .000 |
| Panelist | 11.493 | 7 | 1.642 | 1.840 | .085 |
| Storage condition | 331.750 | 8 | 41.469 | 46.482 | .000 |
| Error | 114.194 | 128 | .892 | | |
| Total | 1403.000 | 144 | | | |
| Corrected Total | 457.437 | 143 | | | |

a R Squared = .750 (Adjusted R Squared = .721)

Table E.12 The ANOVA table showing the effect of storage condition on hardness of cooked hulled rice prepared from sun-dried hulled red jasmine rice at the 95% confidence

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|-------------------|-------------------------|-----|-------------|----------|------|
| Corrected Model | 199.903(a) | 15 | 13.327 | 17.568 | .000 |
| Intercept | 4225.000 | 1 | 4225.000 | 5569.675 | .000 |
| Panelist | 15.778 | 7 | 2.254 | 2.971 | .006 |
| Storage condition | 184.125 | 8 | 23.016 | 30.341 | .000 |
| Error | 97.097 | 128 | .759 | | |
| Total | 4522.000 | 144 | | | |
| Corrected Total | 297.000 | 143 | | | |

a R Squared = .673 (Adjusted R Squared = .635)

Table E.13 The ANOVA table showing the effect of storage condition on consumers' preference in color, aroma and hardness of cooked hulled rice prepared from sun-dried hulled red jasmine rice packed in Nylon/LLDPE pouches at the 95% confidence

| Dependent variable | Source of variation | Sum of Squares | df | Mean Square | F | Sig. |
|--------------------|---------------------|----------------|-----|-------------|-------|------|
| Color | Between Groups | 2.020 | 2 | 1.010 | 1.573 | .213 |
| | Within Groups | 63.559 | 99 | .642 | | |
| | Total | 65.578 | 101 | | | |
| Aroma | Between Groups | .765 | 2 | .382 | .459 | .633 |
| | Within Groups | 82.382 | 99 | .832 | | |
| | Total | 83.147 | 101 | | | |
| Hardness | Between Groups | 5.353 | 2 | 2.676 | 3.339 | .040 |
| | Within Groups | 79.353 | 99 | .802 | | |
| | Total | 84.706 | 101 | | | |
| Overall acceptance | Between Groups | 3.314 | 2 | 1.657 | 2.496 | .088 |
| | Within Groups | 65.706 | 99 | .664 | | |
| | Total | 69.020 | 101 | | | |

VITA

Ms. Yuwares Malila was born on July 23, 1982, in Bangkok. She obtained Bachelor of Science from Department of Food Technology, Faculty of Science, Chulalongkorn University with first class honor in 2005. Subsequently, she was working as a research assistant at Institute of Nutrition, Mahidol University for one year. In 2006, she enrolled in master degree program in Food Technology at Department of Food Technology, Faculty of Science, Chulalongkorn University. During master study, she was granted Chulalongkorn University Graduate Scholarship to Commemorate the 72nd Anniversary of His Majesty King Bhumibol Adulyadej from Graduate School of Chulalongkorn University. After achieving her master study, she was granted Full Science and Technology Scholarship by Royal Thai Government to pursue Ph.D. study in Food Chemistry program in USA.

Publication from this thesis

Malila, Y., Tangsrianugul, N., and Tananuwang, K. 2007. Thermal and pasting properties of hulled red jasmine rice *Oryza sativa* L. as affected by different drying methods and storage conditions. Kamphaengsaen AcademicJournal [CD-ROM] 5: 778-786.