CHAPTER III

MATERIALS AND METHODS

3.1 Materials

3.1.1 Red jasmine rice

Organic red jasmine rice (*Oryza sativa* L.) was cultivated in Amphur Trakan Phuet Phon, Ubon Ratchathani Province. The paddy was harvested in November 2006. Suddenly after harvesting, the paddy was sun-dried by local farmers, packed in gunny sacks and transported to Department of Food Technology, Chulalongkorn University, Bangkok, not more than 2 weeks after harvesting. Upon receiving, the paddy was immediately stored in a cold room (4-5^{o}C). After one month storage, the paddy was taken out of the cold room and placed in an ambient temperature for 8 hours to let its temperature increase up to room temperature prior to the sample preparation step (3.2.2).

3.1.2 Packaging

Packaging pouches used in this study were purchased from JANJARAS Chem Supply Co., Ltd., Bangkok. Characteristics of the pouches are shown in Table 3.1.

Table 3.1 Characteristics of pouches.

Type	Composition	Total thickness (μm)	Size (mm^2)	Water vapor transmission rate ($g/m^2 \cdot 24$ hr)	Price (baht/unit)
OPP/Al/LLDPE	oriented polypropylene/ aluminum/ linear low density polyethylene	100	230 X 300	≈ 0	3.00
Nylon/LLDPE	oriented nylon/ linear low density polyethylene	70	200 X 300	17.4	2.45

3.2 Methods

3.2.1 Investigation of chemical compositions of raw materials

The paddy was dehusked. Chemical compositions, including moisture content, crude protein, crude fat, dietary fibers, ash and amylose content, of hulled red jasmine rice were investigated (Appendix A).

3.2.2 Preparation of hulled red jasmine rice

The paddy samples were rewetted by adding calculated amount of water. Moisture content of the paddy was increased from 14% to 26-30% wb. The amount of adding water was calculated from the following formula.

$$W_f = \frac{W_i \times (1 - X_i)}{(1 - X_f)} \quad (1)$$

$$W_w = W_f - W_i \quad (2)$$

where W_f represents the final paddy weight, W_i represents the initial paddy weight, X_i represents the water fraction of initial paddy weight (X_i in this study was 0.14.), X_f represents the water fraction of final paddy weight (X_f in this study was 0.28.), and W_w represents the added water weight.

During the rewetting, the paddy samples were kept in 56-liter plastic boxes and stored in a cold room (4-5^{o}C) with occasionally mixing for 7 days to get uniform moisture content.

3.2.3 Paddy drying

Before each drying treatment, the rewetted paddy was taken out of the cold room and placed in an ambient temperature for 8 hours. The samples were then divided into 3 sets. Each set was dried by one of the following drying methods: shade drying, sun drying and FB drying.

3.2.3.1 Shade drying (control method)

The rewetted paddy samples were spread in plastic baskets (28X40X12 cm^3). The height of the samples in each basket was 2.5 cm. The samples were then shade dried at ambient temperature (27-33^{o}C) for 7 days or until the final moisture content reached 13-14% wb. The samples in each basket were mixed everyday to get a uniform distribution of moisture content. After the desirable moisture content was obtained, the samples from every basket were pooled together and mixed uniformly.

3.2.3.2 Sun drying

The rewetted paddy samples were spread in plastic baskets (28X40X12 cm^3). The height of the samples in each basket was 2.5 cm. The samples were then sun dried for 6 hours. The final moisture content of the paddy was 13-14% wb. The samples in each basket were mixed every 2 hours to get a uniform distribution of moisture content. After the desirable moisture content was obtained, the samples from every basket were pooled together and mixed uniformly.

3.2.3.3 FB drying

Two-stage drying process was performed for FB drying. Firstly, the 1.8-kg portions of the rewetted paddy samples were dried in the FB dryer at 115^{o}C for 215 seconds. The moisture of the samples was decreased to 18-20% wb. The grain temperature was 72.3$\pm$1.6^{o}C. Secondly, the samples were shade dried in plastic baskets at ambient temperature for 2 days or until the final moisture content reached 13-14% wb. After the desirable moisture content was obtained, the samples from every basket were pooled together and mixed uniformly. Details of the procedure were listed in Appendix B.

3.2.4 Determination of qualities of the freshly hulled rice from each drying methods

Dried paddy from each drying method was dehusked using a rubber roll husk (JIRCAS, Japan). Approximately 300 g of hulled rice from each drying treatment were then randomly collected. Approximately 40 g of each collected sample were ground by an electric blender (Panasonic, model MX-795N, Japan) and sieved through 70-mesh screen to obtain rice flour. Following properties of each sample in the form of rice kernel or rice flour were investigated.

3.2.4.1 Physicochemical properties of freshly hulled rice

a) Moisture content of rice kernel using hot air oven method (AOAC, 1995, Appendix A.1)

b) Water activity of rice kernel using water activity meter (AquaLab series 3, Decagon, USA)

c) Thermal properties of rice flour using a DSC (Perkin-Elmer, model Diamond DSC, USA) equipped with an Intracooler unit (Perkin-Elmer, model 2P, USA) and nitrogen gas purge (Appendix A.9).

d) Pasting properties of rice flour using RVA (Newport Scientific, model Super 3, Australia, Appendix A.10).

e) Swelling power of rice flour using methods modified from Schoch, 1964 (Appendix A.11)

Completely Randomized Design (CRD) was used in this part of the experiment. All analyzes were run in triplicate. Analysis of variance was performed. The differences of means were reported at 5% significance level using Duncan's New Multiple Range Test.

3.2.4.2 Quality characteristics of cooked freshly hulled rice kernels

a) Preparation of the cooked rice kernels

For each sample, 130 g (approximately 1 cup) of hulled red jasmine rice kernels were cooked in a rice cooker with 260 ml of potable water. The

hulled rice to water ratio was 1:2 w/w. Each sample was cooked with automatic rice cooker (Panasonic, model SR-G06, Japan). After the hulled rice was cooked, the cooker was unplugged and the sample was held in the cooker for an additional 10 minutes before the sensory test. Appearance of raw and cooked hulled red jasmine rice kernels is shown in Appendix C.1.

b) Color measurement of the cooked rice kernels

Cooked hulled red jasmine rice was left until its temperature reached room temperature. Each sample was placed into a glass Petri-dish (3.5-inch diameter) with 1-cm thickness. Color of the samples was measured in the Hunter L, a, b scale using Chroma meter (Minolta Chroma Meter, model CR 300 Series, Japan) where "L" value represented lightness, positive "a" represented redness, negative "a" value represented greenness, positive "b" value represented yellowness and negative "b" value represented blueness. Five points of measurements were done for each sample in a Petri-dish. Completely Randomized Design (CRD) was used in this part of the experiment. All analyzes were run in duplicate. Analysis of variance was performed. The differences of means were reported at 5% significance level using Duncan's New Multiple Range Test.

c) Sensory characteristics of the cooked rice kernels (Appendix D)

(1) Quantitative and Descriptive Analysis (QDA) of the cooked rice kernels

Five-gram portion of each cooked sample was served. Each panelist received one sample at a time. Temperature of each served sample was approximately 40-50°C. Eight trained panelists were members of both male and female with age among 23-30 years old. Aroma (fragrance and rancidity) and hardness were evaluated using ten-point intensity rating scale (Appendix D.1.4). Randomized Completely Block Design (RCBD) was used in this part of the experiment. All analyzes

were run in duplicate. Analysis of variance was performed. The differences of means were reported at 5% significance level using Duncan's New Multiple Range Test.

(2) Affective test

Five-gram portion of each cooked sample was served. Each panelist received one sample at a time. Temperature of each served sample was approximately 40-50°C. Sensory characteristics, including color, aroma and hardness, were evaluated by 34 untrained panelists (consumers) consisting of 11-43 years old males and females. Five-point hedonic scale was used (Appendix D.2.3). Completely Randomized Design (CRD) was applied to in this part of the experiment. Analysis of variance was performed. The differences of means were reported at 5% significance level using Duncan's New Multiple Range Test.

3.2.5 Hulled rice storage

The remaining hulled rice samples were divided into 300-g portions. Each portion was vacuum-packed in OPP/AL/LLDPE or Nylon/LLDPE pouches (Appendix C.2) and stored at ambient temperature (27-35°C) or 15°C for 12 months. The storage duration was from February 2007 to February 2008. Following properties of each sample in the form of rice kernel and rice flour were investigated.

3.2.5.1 Physicochemical properties of aged hulled rice

Measurements of physicochemical properties, as listed in 3.2.4.1, were performed every 2 months in April 2007, June 2007, August 2007, October 2007, December 2007 and February 2008. Effects of 2-mercaptoethanol on thermal and pasting properties of hulled red jasmine rice packed in Nylon/LLDPE and stored at ambient temperature for 12 months were also investigated (Appendix A.9, Appendix A.10). All analyzes were done in triplicate. Each replicate referred to one pouch of samples.

3.2.5.2 Quality characteristics of cooked aged hulled rice kernels

a) Color measurement of the cooked rice kernels

Color of cooked rice prepared from samples stored at ambient temperature for 2, 4, 6 and 12 months was measured in the Hunter L, a, b scale using Chroma meter (Minolta Chroma Meter, model CR 300 Series, Japan. Detailed procedure and statistical analysis as described in 3.2.4.2b.

b) Sensory characteristics of the cooked rice kernels (Appendix D)

QDA of the samples stored at ambient temperature for 2, 4, 6 and 12 months was evaluated. As for affective test, the samples packed in Nylon/LLDPE pouches and stored at ambient temperature for 6 and 12 months were analyzed. Detailed procedure and statistical analysis were described in 3.2.4.2c.