CHAPTER 8
SUMMARY AND CONCLUSIONS

Change in cooking and eating properties of cooked rice from stored paddy is associated with time of storage (aging levels). Aging can improve some of eating properties of rice that is preferred by Asian consumer but aging, at the same time, can reduce some desirable characteristics including aroma of fragrant rice. The main goals of this study were to investigate the effectiveness of accelerated aging treatments on the modification of physico-chemical properties which are related to quality factors of a freshly harvested aromatic rice cultivar, KDML 105, and to determine how these treatments could influence on the changes in rice properties.

This study was conducted in three experiments. The first experiment was conducted to determine the range of exposure temperatures (100, 110 and 120^{o}C) and durations (15, 30, 45 and 60 min, except for 100^{o}C an addition of 90 min treatment was included) that could affect pasting property, textural property and color of the fresh rice. The second experiment was done using the information from the first study to narrow the treatment range. In this trial, an addition factor (grain moisture content, 13.4 and 16.6% MC) was incorporated into the treatment set and more of physico-chemical properties including aroma quality of the rice were determined to assess for the treatment effects. Changes due to natural aging (12-month storage) of paddy were also investigated in this study. For the final experiment, the changes in starch granule, protein property, thermal property, rice volatile component and storage stability of the rice were investigated in greater detail to explain the foundation of changes caused by the accelerated aging treatments.

In the first experiment, temperature and exposure duration changed pasting property, textural property and color of the freshly harvested rice cv. KDML 105. The magnitude of change depended on the levels of exposure temperature and time. Higher temperature and/or longer exposure time increased hardness and decreased adhesiveness of cooked rice, increased RVA viscosity and yellow color (*b**value) of fresh rice sample.

In the second experiment, the exposure durations were narrowed (100^{o}C for 60, 90 and 120 min; 110^{o}C for 30 and 45 min; 120^{o}C for 15 and 30 min) and grain

MC (13.4 and 16.6%MC) was included in the study. Accelerated aging using higher grain MC showed pronounced effects of the aging treatments. Accelerated aging increased hardness and springiness, and decreased adhesiveness values of cooked rice; increased yellowness of milled rice; decreased solid loss; increased cooked kernel elongation; reduced 2-acetyl-1-pyrroline and *n*-hexanal quantities; and changed RVA viscosity by increasing pasting temperature, final viscosity and setback and decreasing peak viscosity and breakdown as did in the natural aged rice samples. Results from 12-month stored paddy in this experiment confirmed these changes. Storage time affected pasting property, textural property, kernel elongation, color, 2-acetyl-1-pyrroline content and relative amount of *n*-hexanal of the stored KDML 105 rice.

For final experiment, the observation of starch granule morphology using SEM clearly indicated that exposure of milled rice having ordinary moisture content (moisture equilibration to storage environment) to high temperature condition of this accelerated aging practice could bring the freshly harvested rice to be an aged status without disruption of its starch granular structure. The accelerated aging treatments caused change on fresh rice by altering rice starch thermal property and protein property. These changes occurred at the molecular level of the rice starch granule components and exerted their influences on the physico-chemical properties that related to cooking characteristics of the rice. This study revealed that formation of disulfide bond was enhanced by accelerated aging and caused changes in the aging rice.

The study also revealed that changes in the rice physico-chemical properties occurred consistently during storage and these changes could not be stabilized by the accelerated aging treatments. However, the loss of aroma quality could be reduced by suitable protective packaging, and aluminum laminated bag packed with reduced pressure was found to be most efficient.

Investigation of rice volatile component based on GC-MS results indicated that accelerated aging treatments did not affect the volatile components that make up the KDML 105 odor character. There was no new volatile compound formed after the accelerated aging. All the identified volatile compounds found in fresh rice were present in the accelerated-aged rice samples, though there were decrease in peak area

of the volatile compounds. Similar in volatile component between fresh and accelerated-aged rice samples could translate to similar volatile compounds, if determined, in their cooked rice. Moreover, the accelerated-aged rice samples had greater aroma quality than that of 6-month naturally-aged rice as compared in terms of the amount of 2-acetyl-1-pyrroline and *n*-hexanal present in their samples.

Results from this study indicated that freshly harvested aromatic rice could be aged within a short time to mild, medium and severe degree, depending on the level of the three aging factors (MC, temperature and duration) assigned for the accelerated aging operation. The technique is proved to be a potential mean to modify freshly harvested aromatic rice to be rice of having physical appearance, cooking, eating and functional characteristic identical to the naturally-aged milled rice while still maintaining its aroma quality.

From the results, this technique can be an alternative to conventional rice storage. This aging process improves cooking and eating qualities as well as aroma over that of the conventional aged rice. The process is economical since it takes shorter time so that less energy was required. Moreover, the process involves in milled rice which can eliminate broken grain problem after heating as occurred when paddy is used. Precision sensory evaluation by high performance instruments showed satisfactory acceptance of the milled rice product as compared to that of the high quality reference aged rice. Considering the huge demands of this rice, either nationwide or worldwide, and the dispersion of small and medium rice mill plants covering the area of this fragrant rice production, this uncomplicated accelerated aging technique therefore has the potential to be adopted for those small and medium rice entrepreneurs for the production of high-quality aged rice. Future research should therefore be conducted to adopt for usage of the finding.