

สมบัติทางกายภาพและเคมีของข้าวกล้องหอมใบเตยระหว่างเก็บรักษา
Physical and Chemical Properties of Hom Bai Toei Brown Rice during Storage

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บทคัดย่อ

ข้าวหอมใบเตย (พันธุ์ C85) เป็นพันธุ์ข้าวของไทยที่มีกลิ่นหอมของใบเตยเป็นกลิ่นเฉพาะตัว งานวิจัยนี้จะติดตามการเปลี่ยนแปลงสมบัติทางกายภาพและเคมีของข้าวกล้องหอมใบเตยในระหว่างเก็บรักษา ข้าวกล้องหอมใบเตยถูกนำมาบรรจุในถุง Nylon/LLDPE ที่สภาวะบรรยากาศปกติและสุญญากาศ แล้วเก็บรักษาที่อุณหภูมิห้อง นาน 6 เดือน และตรวจสอบสมบัติทางกายภาพ (น้ำหนัก ความหนาแน่น และ ค่าสี) และสมบัติทางเคมี (ความชื้น โปรตีน ไขมัน เถ้า เยื่อใย อะไมโลส และค่าความหืน) ทุกเดือน จากการทดลองพบว่า ข้าวกล้องที่บรรจุถุงในสภาวะบรรยากาศปกติมีค่าความสว่าง (L^*) ลดลง ค่าสีแดง (a^*) และค่าความหืนเพิ่มสูงขึ้นกว่าการบรรจุในสภาวะสุญญากาศตลอดระยะเวลาเก็บรักษา ($p < 0.05$) โดยข้าวกล้องเริ่มต้นมีค่าความหืนเท่ากับ 0.55 มิลลิกรัมมาลอลนัลดีไฮด์/กิโลกรัมตัวอย่าง ขณะข้าวกล้องที่บรรจุในถุงที่สภาวะบรรยากาศปกติและสภาวะสุญญากาศในเดือนที่ 6 มีค่าความหืนสูงขึ้นโดยเท่ากับ 1.15 และ 0.97 มิลลิกรัมมาลอลนัลดีไฮด์/กิโลกรัมตัวอย่าง ตามลำดับ อย่างไรก็ตามพบว่าข้าวกล้องที่บรรจุถุงที่สภาวะบรรยากาศปกติและสภาวะสุญญากาศมีน้ำหนัก ความหนาแน่น ความชื้น โปรตีน ไขมัน เถ้า เยื่อใย และอะไมโลสไม่แตกต่างกันตลอดระยะเวลาเก็บรักษา ($p \geq 0.05$)

คำสำคัญ: ข้าวหอมใบเตย, การเก็บรักษา, สมบัติ

Abstract

Hom bai toei rice (cultivar 85) from southern Thailand has specific-pandan flavor. In this research, the changes in physical and chemical properties during storage were monitored. Hom bai toei rice was packed in vacuum and non-vacuum nylon/LLDPE plastic bags and then stored at room temperature for 6 months. The physical properties such as weight, density, color and the chemical properties such as moisture, protein, lipid, ash, fiber, amylose content and TBA value were determined monthly. It was found that non-vacuum Hom bai toei rice had lower lightness (L^*), but higher redness (a^*) and TBA value than the vacuum Hom bai toei rice during storage for 6 months ($p < 0.05$). Thiobarbituric acid value (TBA) of fresh Hom bai toei rice was 0.55 mg. of malonaldehyde/kg sample, while the TBA values of non-vacuum and vacuum Hom bai toei rice stored for 6 months were 1.15 and 0.97 mg. of malonaldehyde/kg sample, respectively. However, there were no significant differences in weight, density, moisture, protein, lipid, ash, fiber and amylose content of Hom bai toei rice between packing in non-vacuum and vacuum nylon/LLDPE plastic bags throughout storage period ($p \geq 0.05$).

Keywords: Hom bai toei, Storage, Property

Introduction

Rice is one of the major cereal grains of commerce worldwide. Rice indicates an important role of energy requirements and nutrient intakes, especially as a primary dietary source of carbohydrates (Yang *et al.*, 2006). Brown rice is obtained from de-hulling process. Changes in the chemical and physical properties of rice have been reported during storage (Zhou *et al.*, 2002; Kim *et al.*, 2004; Park *et al.*, 2012). These changes including protein, ash, lipid, fiber, amylose and TBA value affected rice quality. The conditions during storage such as temperature, light and packaging also affected its quality (Zhou *et al.*, 2002; Park *et al.*, 2012).

Hom bai toei rice (C85) is cultivated in Phatthalung province, Southern part of Thailand and now it is becoming popular. This rice characterized by its strong pandan flavour, high nutritional value and soft texture

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formation after cooking. However, no scientific report on its changes in physical and chemical properties during storage is available. Therefore, the objective of this study was to determine the physical and chemical properties of Hom bai toei rice during storage in both vacuum and non-vacuum conditions.

Material and Methods

Material

Hom bai toei rice, was harvested in Phatthalung province, from the Southern Thailand, in the 2014 growing season. After harvested, paddy rice was dried by sun light to reduce the moisture content of grain until less than 14%. Then, the paddy rice was de-hulled to obtain brown rice by using a commercial de-hulling process. The brown rice was stored in a vacuum and non-vacuum nylon/LLDPE plastic bags at room temperature for 6 months. The brown rice was analyzed monthly for physical and chemical properties. Before analysis, the sample was ground by a grinder to obtain rice flour for chemical properties analysis. The size of Hom bai toei rice flour was ranged from 40 to 60 meshes sieve (420-250 μ m).

Methods

Physical properties

Grain weight and bulk density were determined by a method of Wadsworth et al. (1982). Color of rice grain was measured by colorimeter (Hunter Lab Reston, USA) in CIE L*, a*, b*.

Chemical properties

Proximate analysis of Hom bai toei rice such as, moisture, lipid, protein, fiber, ash contents were determined according to A.O.A.C. method (A.O.A.C., 2000). Amylose content was determined by iodine colorimeter at 620 nm using amylose from potato starch as a standard mixture (Juliano, 1985). Thiobarbituric acid (TBA value) was determined (Wood and Aurand, 1977).

Statistical analysis

The experimental design in this study was 2 \times 7 factorial in completely randomized design (CRD). Three replications were done for each experiment. The analysis in chemical and physical properties was determined in three replications. Only the analysis in size grain, weight grain and color was done in ten replications. Then data were subjected to analysis of variance (ANOVA). A comparison of means was carried out by Duncan's multiple-range test. Analysis was performed using a SPSS package (SPSS for windows, SPSS Inc, Chicago, IL).

Results and Discussion

The changes in physical properties of Hom bai toei brown rice during storage for 6 months were determined. The result is shown in Table 1. Hom bai toei brown rice was slightly decreased in weight and bulk density in both vacuum and non-vacuum nylon/LLDPE plastic bags during storage ($p \geq 0.05$). Color of rice was indicated by lightness (L*), yellowness (b*), redness (a*), hue and chroma values. The lightness (L*) is indicating brightness. It represents the brightness as white at L* = 100 and the darkness as black at L* = 0. The yellowness (b*) is indicated from positive b* value and redness is indicated from positive a* value. In addition, Hue is indicating gradation or variety of color and chroma is indicating saturation of color (Munsell, 1912). Lightness (L*), yellowness (b*), hue and chroma values of rice grain were decreased but redness (a*) was slightly increased in both vacuum and non-vacuum nylon/LLDPE plastic bags during storage ($p < 0.05$). Hom bai toei brown rice in a non-vacuum nylon/LLDPE plastic bags had lower in lightness (L*) than in a vacuum nylon/LLDPE plastic bags ($p < 0.05$). Lightness has been found to be an important factor affecting the quality of rice (Park *et al.*, 2012). Lightness (L*) of fresh Hom bai toei brown rice was 71.53, while lightness (L*) of non-vacuum and vacuum Hom bai toei brown rice stored for 6 months were 70.47 and 71.29, respectively ($p < 0.05$). Under non-vacuum condition, oxygen affected color of rice. In general, lipid oxidation under oxygen condition is leading to the

formation of carbonyl compound, which undergoes maillard reaction with free amino acid in rice and yields the yellow or brown color (Kim *et al.*, 2004; Shahidi and Zhong, 2005).

Table 1 Grain weight, density and color of Hom bai toie brown rice in vacuum and non vacuum packaging during storage for 6 months at room temperature

Storage period (Months)	Package	Weight (g)	Density (g/cm ³)	Color				
				L*	a*	b*	Hue	Chroma
0	Non-vacuum	2.34±0.03 ^{NS}	0.1009±0.0006 ^{NS}	71.53±0.38 ^a	1.50±0.16 ^{cd}	18.62±0.24 ^{abcd}	1.49±0.01 ^{ab}	19.23±0.33 ^a
1		2.30±0.02 ^{NS}	0.1007±0.0006 ^{NS}	71.06±0.53 ^{bcd}	1.59±0.15 ^{abcd}	19.06±0.23 ^a	1.49±0.01 ^{abc}	19.12±0.24 ^{ab}
2		2.28±0.02 ^{NS}	0.1006±0.0007 ^{NS}	71.04±0.54 ^{bcde}	1.60±0.14 ^{abc}	18.97±0.22 ^{abc}	1.49±0.01 ^{abcd}	19.04±0.23 ^{abc}
3		2.27±0.00 ^{NS}	0.1006±0.0006 ^{NS}	70.93±0.34 ^{cde}	1.64±0.18 ^{abc}	18.97±0.49 ^{abc}	1.48±0.01 ^{bcd}	19.04±0.47 ^{abc}
4		2.25±0.01 ^{NS}	0.1004±0.0002 ^{NS}	70.79±0.32 ^{def}	1.68±0.18 ^{ab}	19.02±0.52 ^a	1.48±0.01 ^{bcd}	19.09±0.50 ^{ab}
5		2.24±0.05 ^{NS}	0.1004±0.0001 ^{NS}	70.64±0.57 ^{ef}	1.70±0.19 ^a	18.95±0.46 ^{abcd}	1.48±0.01 ^{cd}	19.02±0.46 ^{abc}
6		2.24±0.05 ^{NS}	0.1004±0.0001 ^{NS}	70.47±0.43 ^f	1.72±0.20 ^a	18.51±0.56 ^d	1.48±0.01 ^d	18.59±0.56 ^{abcd}
0	Vacuum	2.34±0.03 ^{NS}	0.1009±0.0006 ^{NS}	71.53±0.38 ^a	1.50±0.16 ^{cd}	18.72±0.24 ^{abcd}	1.49±0.01 ^{ab}	19.23±0.33 ^a
1		2.25±0.03 ^{NS}	0.1007±0.0007 ^{NS}	71.41±0.46 ^{ab}	1.54±0.07 ^{bcd}	18.73±0.44 ^{abcd}	1.49±0.00 ^{abc}	18.79±0.43 ^{abcd}
2		2.24±0.01 ^{NS}	0.1007±0.0007 ^{NS}	71.37±0.43 ^{ab}	1.55±0.16 ^{bcd}	18.70±0.74 ^{abcd}	1.49±0.01 ^{abc}	18.77±0.74 ^{abcd}
3		2.24±0.01 ^{NS}	0.1006±0.0006 ^{NS}	71.35±0.32 ^{ab}	1.44±0.07 ^d	18.61±0.17 ^{abcd}	1.49±0.00 ^a	18.67±0.17 ^{bcd}
4		2.24±0.00 ^{NS}	0.1006±0.0003 ^{NS}	71.33±0.32 ^{abc}	1.47±0.12 ^d	18.63±0.16 ^{abcd}	1.49±0.01 ^a	18.68±0.17 ^{bcd}
5		2.24±0.00 ^{NS}	0.1006±0.0004 ^{NS}	71.31±0.35 ^{abc}	1.51±0.17 ^{cd}	18.59±0.20 ^{abcd}	1.49±0.01 ^{abc}	18.65±0.20 ^{cd}
6		2.24±0.00 ^{NS}	0.1006±0.0004 ^{NS}	71.29±0.34 ^{abc}	1.56±0.18 ^{cd}	18.57±0.20 ^{ab}	1.49±0.01 ^{abc}	18.63±0.20 ^d

Note: Means with different letters in the same column are significantly different (p<0.05); NS is non-significantly different (p≥0.05).

Table 2 Chemical properties of Hom bai toie brown rice in vacuum and non vacuum packaging during storage for 6 months at room temperature

Storage period (Months)	Package	Moisture (%)	Ash (%)	Protein (%)	Lipid (%)	Fiber (%)	Amylose (%)
0	Non-vacuum	11.05±0.23 ^{NS}	1.51±0.04 ^{NS}	10.75±0.40 ^{NS}	2.89±0.12 ^{NS}	0.32±0.13 ^{NS}	19.75±0.85 ^{NS}
1		11.08±0.65 ^{NS}	1.52±0.10 ^{NS}	10.74±0.21 ^{NS}	2.86±0.63 ^{NS}	0.32±0.11 ^{NS}	18.89±0.87 ^{NS}
2		10.82±0.49 ^{NS}	1.52±0.23 ^{NS}	10.71±0.40 ^{NS}	2.85±0.34 ^{NS}	0.36±0.19 ^{NS}	18.90±0.32 ^{NS}
3		10.45±0.19 ^{NS}	1.51±0.35 ^{NS}	10.73±0.29 ^{NS}	2.86±0.39 ^{NS}	0.36±0.10 ^{NS}	18.88±0.55 ^{NS}
4		10.42±0.66 ^{NS}	1.50±0.35 ^{NS}	10.71±0.29 ^{NS}	2.86±0.10 ^{NS}	0.35±0.08 ^{NS}	18.89±0.97 ^{NS}
5		10.40±0.80 ^{NS}	1.50±0.05 ^{NS}	10.70±0.14 ^{NS}	2.84±0.21 ^{NS}	0.36±0.07 ^{NS}	18.87±0.21 ^{NS}
6		10.39±0.03 ^{NS}	1.50±0.17 ^{NS}	10.70±0.09 ^{NS}	2.62±0.17 ^{NS}	0.35±0.03 ^{NS}	18.90±0.31 ^{NS}
0	Vacuum	11.05±0.23 ^{NS}	1.51±0.04 ^{NS}	10.75±0.40 ^{NS}	2.89±0.12 ^{NS}	0.32±0.13 ^{NS}	19.75±0.85 ^{NS}
1		11.01±0.43 ^{NS}	1.51±0.08 ^{NS}	10.73±0.50 ^{NS}	2.88±0.43 ^{NS}	0.36±0.08 ^{NS}	18.81±0.68 ^{NS}
2		10.81±0.40 ^{NS}	1.52±0.08 ^{NS}	10.71±0.38 ^{NS}	2.87±0.88 ^{NS}	0.36±0.42 ^{NS}	18.80±0.10 ^{NS}
3		10.73±0.65 ^{NS}	1.50±0.06 ^{NS}	10.70±0.27 ^{NS}	2.85±0.14 ^{NS}	0.35±0.33 ^{NS}	18.82±0.12 ^{NS}
4		10.72±0.09 ^{NS}	1.51±0.39 ^{NS}	10.72±0.23 ^{NS}	2.85±0.55 ^{NS}	0.35±0.23 ^{NS}	18.81±0.31 ^{NS}
5		10.71±0.27 ^{NS}	1.50±0.02 ^{NS}	10.70±0.05 ^{NS}	2.90±0.16 ^{NS}	0.35±0.05 ^{NS}	18.83±0.54 ^{NS}
6		10.70±0.27 ^{NS}	1.52±0.31 ^{NS}	10.71±0.25 ^{NS}	2.65±0.06 ^{NS}	0.36±0.01 ^{NS}	18.81±0.08 ^{NS}

Note: Means with different letters in the same column are significantly different (p<0.05); NS is non-significantly different (p≥0.05).

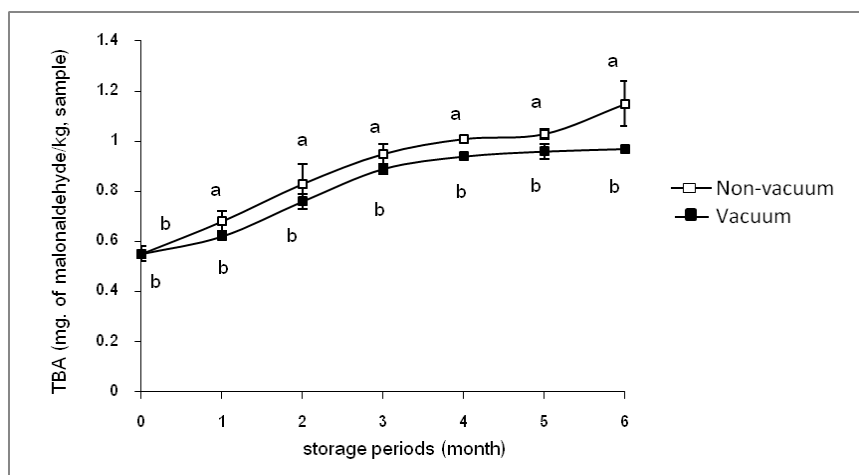


Figure 1. TBA value of brown rice in non- vacuum and vacuum nylon/LLDPE plastic bags during storage for 6 months under room temperature

Note: Means with the different letters in each month are significantly different within two packaging conditions ($p < 0.05$)

The chemical properties of Hom bai toi brown rice during storage for 6 months are shown in Table 2. The chemical properties of Hom bai toi including moisture, ash, lipid, protein, amylose and fiber contents were not changed during storage either in non-vacuum or vacuum nylon/LLDPE plastic bags ($p \geq 0.05$). However, TBA value of brown rice increased in both non-vacuum and vacuum nylon/LLDPE plastic bags during storage ($p < 0.05$). TBA value of fresh brown rice was 0.55 mg. of malonaldehyde/kg sample, while the TBA values of non-vacuum and vacuum Hom bai toi rice after storage for 6 months were 1.15 and 0.97 mg. of malonaldehyde/kg sample, respectively ($p < 0.05$). Hom bai toi rice in a non-vacuum nylon/LLDPE plastic bag had higher TBA value than in a vacuum nylon/LLDPE plastic bag ($p < 0.05$) (Figure 1). Therefore, it can be concluded that oxygen promote lipid oxidation (Zhou *et al.*, 2002; Shahidi and Zhong, 2005).

Conclusion

The vacuum, non-vacuum nylon/LLDPE plastic bags and storage time had influenced on the changes in physical and chemical properties of Hom bai toi brown rice. Hom bai toi brown rice kept in a vacuum condition is the a better condition to minimize the TBA value during storage under room temperature.

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