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อิทธิพลของการอบแห้งด้วยอากาศร้อนต่อการเปลี่ยนแปลงคุณภาพของชาโมโรเฮยะ
Effect of Hot Air Drying on Changes in the Qualities of Moroheiya (*Corchorus olitorius* L.) Tea

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Abstract
The objective of this study was to study the effect of hot-air drying on changes in the qualities of moroheiya (*Corchorus olitorius* L.) tea. Moroheiya leaves were dried at hot-air temperatures of 40 -70 °C at constant air velocity of 0.4 m/s for 120 minutes. The samples were taken every 3 minutes in order to determine moisture ratio, color, antioxidant activity (2, 2-diphenyl- 1-picryl hydrazyl (DPPH assay)) and total phenolic content (Folin-Ciocalteu). The experimental results showed that moisture ratios of moroheiya leaves were dependent on the hot-air temperature. Darker color of moroheiya leaves was observed at higher drying air temperatures. The moroheiya tea dried at 40 °C had the highest total phenolic content and was significantly higher ($p<0.05$) than other samples, while the antioxidant activities was found no significant different.
Keywords: antioxidant, hot-air drying, moroheiya tea

บทคัดย่อ
วัตถุประสงค์ของการศึกษานี้ เพื่อศึกษาอิทธิพลของการอบแห้งด้วยอากาศร้อนต่อการเปลี่ยนแปลงคุณภาพของชาโมโรเฮยะ โดยนำใบชาโมโรเฮยะอบแห้งที่อุณหภูมิอากาศร้อน 40 – 70 องศาเซลเซียส และความเร็วของอากาศ 0.4 เมตรต่อวินาที เป็นเวลา120 นาที และทำการบันทึกข้อมูลทุกๆ 3 นาที ต่อจากนั้นนำใบชาโมโรเฮยะหาค่าอัตราส่วนความชื้น สี กิจกรรมต้านอนุมูลอิสระ และสารประกอบฟีนอลิก จากผลการทดลองพบว่า อัตราส่วนความชื้นของใบชาโมโรเฮยะจะขึ้นอยู่กับอุณหภูมิ สีของใบชาโมโรเฮยะพบว่าจะมีสีคล้ำ เมื่ออุณหภูมิสูงขึ้น ใบชาโมโรเฮยะที่อบแห้งด้วยอุณหภูมิ 40 องศาเซลเซียส มีสารประกอบฟีนอลิกสูงที่สุดอย่างมีนัยสำคัญ ($p<0.05$) นอกจากนั้นพบว่า กิจกรรมต้านอนุมูลอิสระไม่มีความแตกต่างอย่างมีนัยสำคัญ
คำสำคัญ: กิจกรรมต้านอนุมูลอิสระ การอบแห้งด้วยอากาศร้อน ชาโมโรเฮยะ

Introduction
Moroheiya (*Corchorus olitorius* L.) is an important green leafy vegetable in many tropical areas; leafy vegetables are used to complement such staple foods. It has high protein content, along with other leafy species (Artemio et al, 2002; Opondo et al, 2003; Palada et al, 2003). Food drying is the most important process for preserving agricultural products, but it also has a great effect on the quality of the dried products. Most cereals, vegetables and fruits can be well preserved after drying. The major objective in drying agricultural products is the reduction of the moisture content to a level which allows safe storage over an extended period. Because of the short season and the sensitivity to storage artificial drying is often used as a preservation method (Doymaz, 2004). Due to its high moisture content. Moroheiya needs to be dehydrated through some drying process for a better preservation (Park et al, 2002). The tea leaves, after being plucked from the tea bush, go through various processing stages, such as roasting and curling (CTC), drying, and finally packing (Panchariya et al, 2002). The tea production in the community mostly has low quality of tea leaves due to the moisture levels at harvest are not

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safe for holding and tea leaf deteriorates quite rapidly. It is, therefore, the purpose of this work was to study the effect of hot-air drying on changes in the qualities of moroheiya tea.

Materials and Methods

Moroheiya leaves were dried at hot air temperatures of 40, 50, 60 and 70 °C, and constant air velocity of 0.4 m/s for 120 minutes. Tea leaves were positioned on a tray and thermocouple (type K) was inserted into the bulk of tea leaves to measure the product temperature. All measurements of temperature were recorded by data logger (accuracy ± 0.1). The sample weight was continuously recorded by balance (accuracy ± 0.01) at 3 minute interval. All the tests were performed in three replicates. The initial moisture content (Mo) of the sample was not the same for all the drying treatments. In order to normalize the dying curves, the data on moisture content (M) was transformed to dimensionless moisture ratio (MR) defined by equation. MR = (M-Me)/ (Mo-Me), or MR = M/Mo when equilibrium moisture content, Me, has been numerically set to zero. The color of moroheiya leaves were measurements by hunter Lab model miniscan XE Plus and the displayed in L (darkness/whiteness), a (greenness/redness) and b (blueness/yellowness).

The antioxidant activity was determined by DPPH radical scavenging activity, the percentage inhibition of the activity was calculated as [(Ao — Ae)/Ao]*100 (Ao = absorbance without extract; Ae = absorbance with extract). The total phenolic content (TPC) of each extract was determined by using the Folin–Ciocalteu reagent. The reaction mixture contained 1 mL of moroheiya tea extract, 0.5 mL of the Folin–Ciocalteu reagent, 3 mL of 20% sodium carbonate and 10 mL of distilled water. After 2 h of reaction at ambient temperature, the absorbance at 765 nm was measured and used for calculating the phenolic contents, using gallic acid as a standard. The total phenolic contents were then expressed as gallic acid equivalent (GAE), in mg/g dry sample (Wanyo et al., 2009).

Results and Discussions

The effect of drying air temperatures on moisture ratio and product temperatures, obtained in moroheiya leaves drying carried out at 40 -70 °C as presented in Figure 1. It could be seen that the moisture ratio curves in all drying conditions were in the forms exponentially decay. The product temperature increased with the increase of drying air temperatures and drying time.

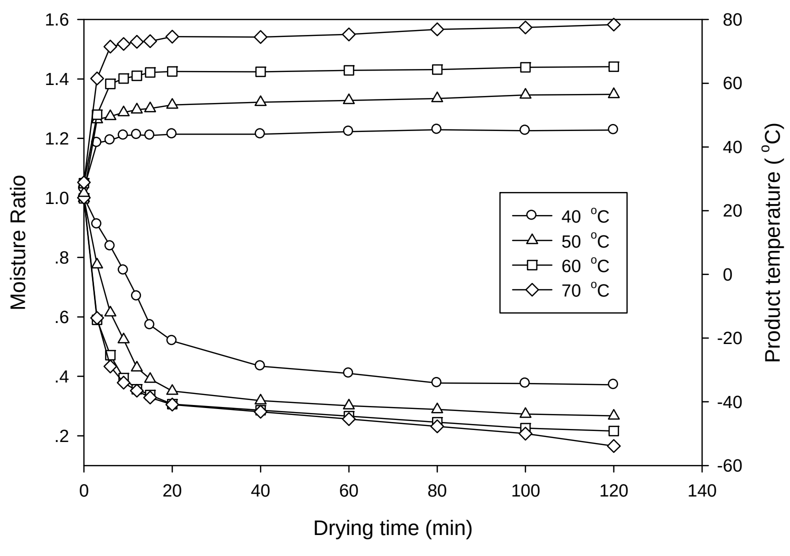

Figure 1 Changes of moisture ratio (lower set curves) and product temperature (upper set curves) of moroheiya leaves

Color, Antioxidant activity and Total phenolic content

The changes of Hunter parameters L, a, and b during moroheiya leaves drying are as shown in Figure 2. It can be seen that the L- and b-value was slightly lower than the initial values before drying. In the case of a-value found that the values are higher than the initial value. Total phenolic content (TPC) and antioxidants activities were determined and results are as shown in Table 1. It was found that the drying air temperature at 40°C had the highest total phenolic content and it was significantly higher ($p<0.05$) than others samples while the antioxidant activity found no significant different.

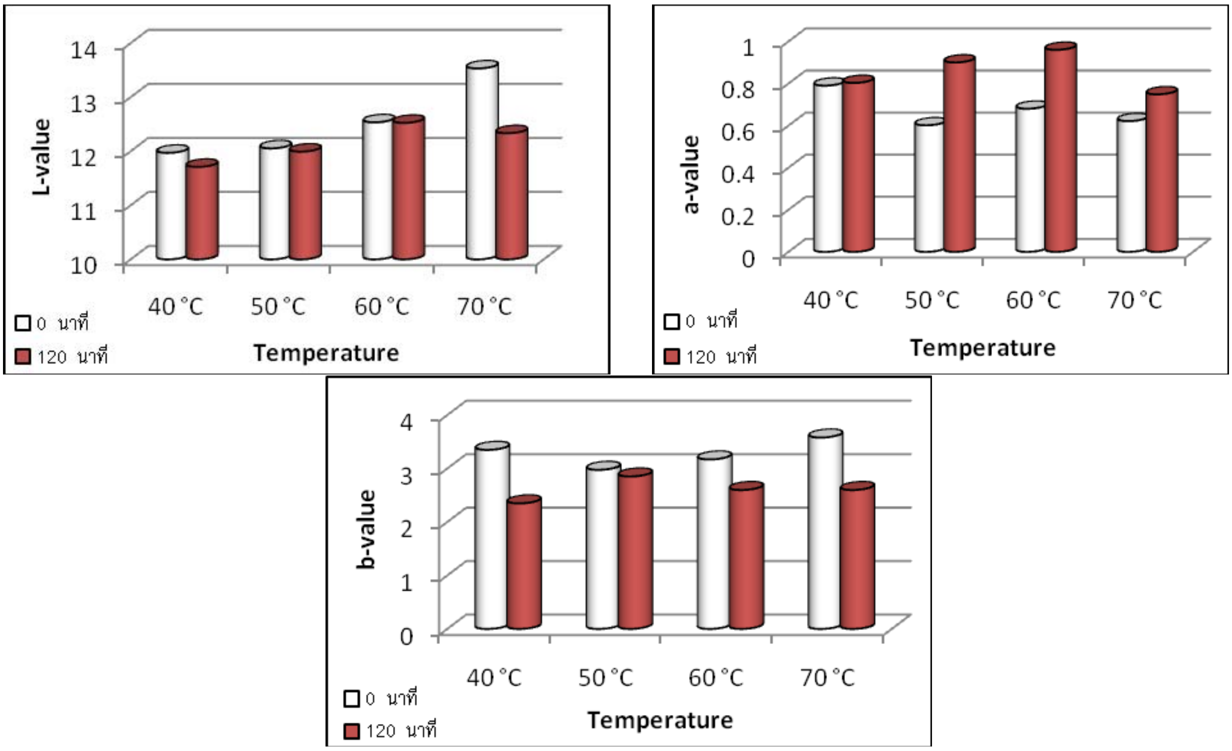

Figure 2 Color parameters (L-, a- and b-values) changes of moroheiya leaves

Table 1 Effect of drying air temperatures on the total phenolic content and antioxidant activity

Temperature (°C)	Antioxidant (% inhibition)		Total phenolic content (ppm)	
	0 min	120 min	0 min	120 min
40	86.12 ± 0.99	85.16 ± 0.35	72.85 ± 1.02	68.4 ± 1.89a
50	86.12 ± 0.99	85.68 ± 0.37	72.85 ± 1.02	55.4 ± 0.40b
60	86.12 ± 0.99	85.36 ± 0.56	72.85 ± 1.02	54.5 ± 0.20b
70	86.12 ± 0.99	84.57 ± 0.66	72.85 ± 1.02	55.6 ± 0.14b

Means with different small letters in the same column are significantly different at $p<0.05$ within the same parameter.

Summary

This study has demonstrated that drying air temperatures was affected on the moisture ratio, color and phenolic content of moroheiya tea, excepted antioxidant activity. The optimum drying process should be further studied to achieve better quality of moroheiya tea. We suggest that drying air temperature at 40 °C provided better qualities of moroheiya tea in terms of phenolic content.

Acknowledgements

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