Effect of drying temperature on sensory and flavor of perilla

Chao Zhang[a], Jiangchangmei Lu[b], Yubin Wang[c], Yue Ma[d], Xiaoyan Zhao[e]

Beijing Vegetable Research Center, Beijing Academy of Agriculture and Forestry Sciences; Beijing Key Laboratory of Fruits and Vegetable Storage and Processing; Key Laboratory of Biology and Genetic Improvement of Horticultural Crops (North China), Ministry of Agriculture; Key Laboratory of Urban Agriculture (North), Ministry of Agriculture, 9 Shuguanghuayuan Road, Haidian District, Beijing, China

[a]zhangchao@nercv.org, [b]lujiangchangmei@nercv.org, [c]wangyubin@nercv.org, [d]mayue@nercv.org, [e]zhaoxiaoyan@nercv.org

Keywords: perilla, drying, flavor, sensory, microstructure

Abstract. The effect of drying temperature on sensory and flavor of perilla was evaluated. The color, microstructure and flavor was evaluated. The drying temperature of 55 ^oC hold the color and microstructure of the dehydrated perilla as the control, while the temperature of 95 ^oC was effective to keep the flavor of the perilla. Hence, the drying temperature of 75 ^oC was an option to hold the sensory and flavor of dehydrated perilla.

Introduction

Perilla (*Perilla frutescens* L.) is an annual herbal crop belong to labiatae, that has been cultivated for a long time as a traditional oil crop in Asia [1]. Most perilla are dehydrated and consumed as a spice in daily life. Recently, health benefits of perilla have drew more and more attentions from the researchers, such as anti-allergic [2], anti-oxidation[1], anti-cancer[3], anti-tumor [4], antibacterial [5], and anti-HIV [6].

Perilla is usually dehydrated in an air-circulated over[7, 8]. The key criterion of the dehydrated perilla is the moisture content that is lower than 7 %. The sensory and flavor of the perilla was neglected in most case. The drying temperature was an important factor influencing the final quality of the products. Hence, the effect of drying temperature on sensory and flavor of perilla was evaluated.

Material and Methods

Dehydration of perilla. Perilla was picked from our Tongzhou farm (Tongzhou District Beijing, 2014). The fresh leaf of the perilla was stored at 4 ^oC before use. The perilla was washed by the tap water at 4 ^oC to remove the soil and some inclusion. The washed perilla was heated at 55, 65, 75, 85 and 95 ^oC in a air-circulated oven respectively. The moisture content of 7% was the termination for each treatment. During each treatment, the products were sampled for 7~9 times for the quality determination. The fresh perilla was designated as the control.

Color determination. The sample was powdered and measured by a reflective mode in a 0.5 cm cuvette, followed the recently reported method[9]. The color of samples was assessed in a LAB space with the dimension ***L**** for lightness and ***a**** and ***b**** for the color-opponent dimensions by a spectrophotometer (CM3700d, Konica Minolta Sensing INC., Japan). Specifically, the value ***L**** represents the lightness of the color (***L**** = 0 yields black and ***L**** = 100 indicates diffuse white); the negative value ***a**** indicates green while positive values indicate magenta; the negative value ***b**** indicates blue and positive values indicate yellow. The fresh perilla was measured as the control.

Microstructure. Microstructure of the samples was imaged by a scanning electron microscopy (S-4800, Hitachi Co., Japan). The specimens were attached with a double side tape and sputtered with gold. The cross-section and surface of the specimens were captured at an acceleration voltage of 5 kV. The perilla that was frozen dried was named as the control.

Flavor comparison. The flavor of the samples was compared by an electronic nose PEN2 (Airsense Analytics GmbH, Schwerin, Germany), followed the recently method [10]. The electronic nose was turned on for 30 min and flushed the testing system for 180 s. The sample of 2 ml was put in the testing tube. And then the electronic sensor was put into the testing tube to collect the results for 60 s. The response of the sensor in 48~52 s were evaluated by a principal component analysis. The fresh perilla was designated as the control.

Statistical Analysis. Analysis of variance (ANOVA) was used to compare mean differences of the results. If the differences in mean existed, multiple comparisons were performed using Duncan's Multiple Range Test. All analysis was conducted using SPSS for Window Version 19. All experiments were done in triplicates or more.

Results and Discussion

Effect of drying temperature on color of perilla. The effect of drying temperature on color of perilla is shown in **Figure 1**. The color of the samples was expressed by the LAB system. the value ***L**** represents the lightness of the color (***L**** = 0 yields black and ***L**** = 100 indicates diffuse white) [11, 12]. The ***L**** of the samples was decreased significantly after drying at each temperature. The ***L**** of the samples dried at 55, 65, and 75 ^{o}C was significant lower than that dried at 85 and 95 ^{o}C.

The negative value ***a**** indicates green while positive values indicate magenta [13]. The *a** value is closely related to the greenness of a sample. The greenness of the perilla was mainly came from the chlorophyll. Consequently, the *a** value was an indicator of the chlorophyll content. The chlorophyll content is decrease due to its degradation. The chlorophyll degradation of the spinach [14] and kiwifruit puree [15] is found to follow the first-order kinetics. The *a** of the perilla dried at 75, 85 and 95 ^{o}C was significant higher than that dried at 55 and 65 ^{o}C. Consequently, the chlorophyll content of the perilla dried at 55 and 65 ^{o}C was higher than that dried at the other temperature. The phenomenon proved that a higher temperature leaded to the degradation of the chlorophyll as well as the color variety.

The negative value ***b**** indicates blue and positive values indicate yellow [13]. The *b** value was increased when the drying temperature was enhanced. The *b** of the perilla dried at 95 ^{o}C was significant higher than dried at the other temperature.

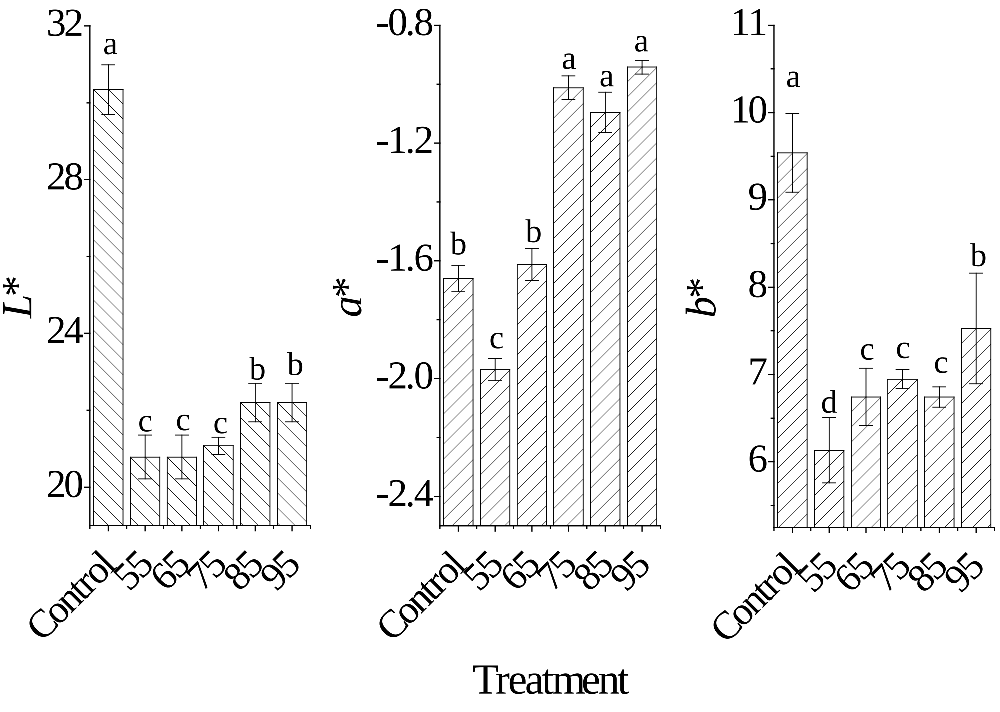

Figure 1 Effect of drying temperature on color of perilla

Effect of drying temperature on flavor of perilla. The effect of drying temperature on flavor of perilla is shown in **Figure 2**. The principal component analysis showed that the flavor of the samples was mainly contributed by the main component 1 and main component 2. The main component 1 and main component 2 contributed 99.32 % and 0.63 % for the flavor of the perilla. The main component 1 and 2 accounted 99.95 % of the total flavor, which was effective to reflect the flavor of the perilla. Each treatment leaded to a significant difference compared with the flavor of the fresh perilla. Remarkably, the flavor of perilla dried at 95 °C was more similar to that dried at the other temperature. Consequently, a higher heating temperature resulted in a better flavor. The flavor of spearmint and peppermint also present in a similar manner [16, 17].

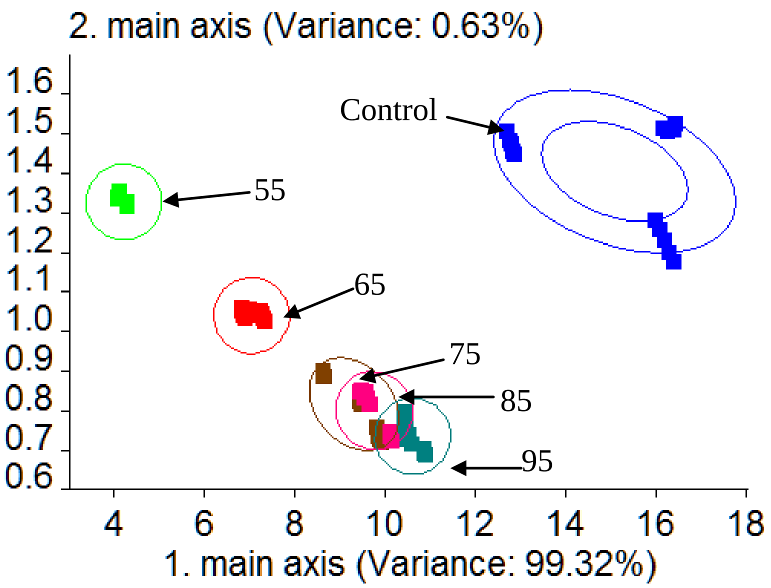

Figure 2 Effect of drying temperature on flavor of perilla

Effect of drying temperature on microstructure of perilla. The effect of drying temperature on microstructure of p[13]erilla is shown in **Figure 3**. The surface of the control was smooth with a few flat blowhole, while the dehydrated perilla became shrink. Moreover, the ruga of the perilla was clear when being heated at 55, 65 and 75 °C, while that was blurry when being heated at 85 and 95 °C. Hence, a higher temperature destroyed surface structure of the perilla.

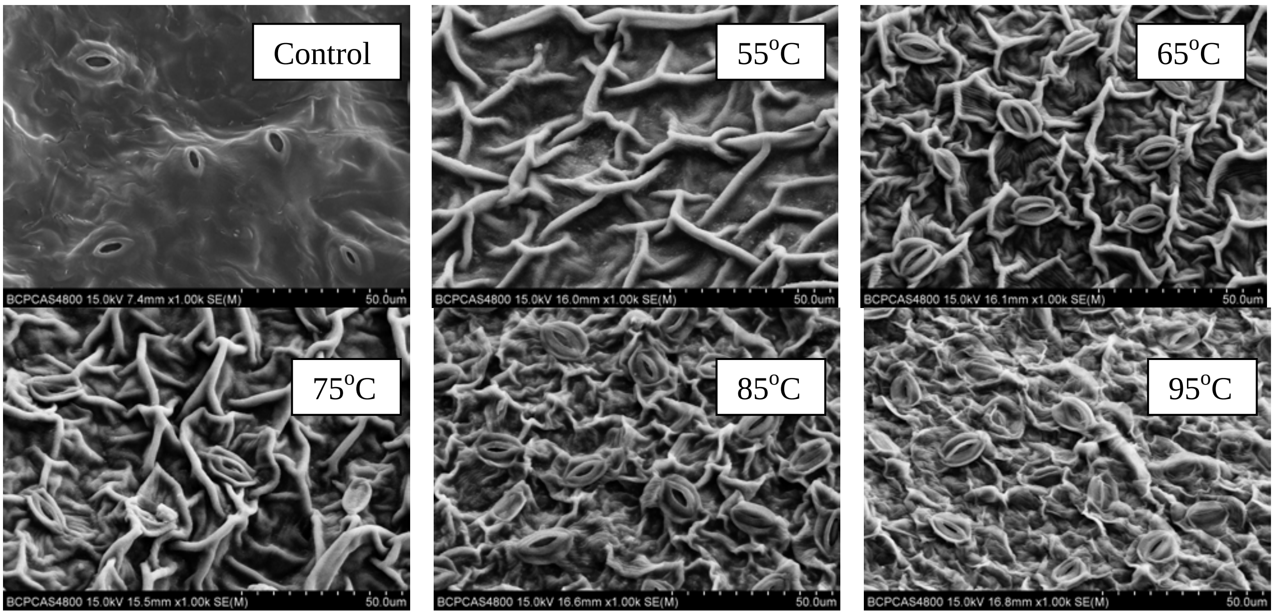

Figure 3 Effect of drying temperature on microstructure of perilla

Conclusions

A lower temperature, for instants 55 ^{o}C, was effective to hold the greenness of the original color of perilla. Meanwhile, a lower temperature well hold the blowhole and shrink surface of the perilla, while a higher temperature destroyed the surface structure of the cell wall. The drying temperature of 95 ^{o}C kept the original flavor of the flavor.

Acknowledgements

The authors are grateful to financial support of the earmarked fund for Modern Agro-industry Technology Research System (CARS-26-22 & CARS -25) and Beijing Academy of Agricultural and Forestry Sciences, New Discipline Breeding (KJCX20140204).

References

[1] I. Gülçin, D. Berashvili, A. Gepdiremen: J. Ethnopharmacol. Vol 101 (2005), p. 287.

[2] R. Guo, M. H. Pittler, E. Ernst: Ann. Allergy Asthma Immunol. Vol 99 (2007), p. 483.

[3] N. Banno, T. Akihisa, H. Tokuda, K. Yasukawa, H. Higashihara, M. Ukiya: Biosci. Biotechnol. Biochem. Vol 68 (2004), p. 85.

[4] H. Ueda, C. Yamazaki, M. Yamazaki: Biol. Pharmaceut. Bull. Vol 26 (2003), p. 560.

[5] H. Yamamoto, T. Ogawa: Biosci. Biotechnol. Biochem. Vol 66 (2002), p. 921.

[6] T. Kawahata, T. Otake, H. Mori, Y. Kojima, I. Oishi, S. Oka: Antiviral Chem. Chemotherapy Vol 13 (2002), p. 283.

[7] J. Wu, C. Yang, Y. Rong, Z. Wang: Procedia Eng. Vol 37, p. 202.

[8] T. Nakatsu, A. T. Lupo Jr, J. W. Chinn Jr, R. K. L. Kang, R. Atta ur, in *Studies in Natural Products Chemistry*, Vol. Volume 21, Part B, Elsevier, **2000**, 571.

[9] J. Tian, X. Zeng, S. Zhang, Y. Wang, P. Zhang, A. Lu, X. Peng: Indust. Crops Prod. Vol 59 (2014), p. 69.

[10] M. Laureati, S. Buratti, A. Bassoli, G. Borgonovo, E. Pagliarini: Food Res. Int. Vol 43 (2010), p. 959.

[11] S. A. Osmani, E. H. Hansen, C. Malien-Aubert, C. E. Olsen, S. Bak, B. L. Mller: J. Agric. Food Chem. Vol 57 (2009), p. 3149.

[12] T. P. Labuza: J. Food Sci. Vol 51 (1986), p. ii.

[13] L. Rolle, S. Guidoni: J. Int. J. Sci. Vine. Wine. Vol 41 (2007), p. 193.

[14] F. M. Lajolo, U. M. Lanfer Marquez: J. Food Sci. Vol 47 (1982), p. 1995.

[15] M. Benlloch-Tinoco, A. Kaulmann, J. Corte-Real, D. Rodrigo, N. Martinez-Navarrete, T. Bohn: Food Chem. Vol 187 (2015), p. 254.

[16] R. Baranauskienė, E. Bylaitė, J. Žukauskaitė, P. R. Venskutonis: J. Agric. Food Chem. Vol 55 (2007), p. 3027.

[17] M. C. Díaz-Maroto, M. S. Pérez-Coello, M. A. G. Viñas, M. D. Cabezudo: J. Agric. Food Chem. Vol 51 (2003), p. 1265.