

Appearance, microstructure and bioactive components of *Bletilla striata* tuber as affected by different drying methods

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Abstract

Bletilla striata tuber is widely used as healthy food and herbal medicine for its hemostasis, anti-ulcer, promoting wound healing, antibacterial and anti-inflammatory and immune regulation functions. Drying method will affect the qualities of *B. striata* tuber including appearance and more importantly the content of bioactive components, which play decisive roles of the medical and tonic functions. To investigate the effects of drying method on the qualities of *B. striata* tuber, samples were treated with five drying methods containing hot-air drying (HD), infrared drying (ID), microwave drying (MD), vacuum drying (VD), and freeze drying (FD) in this study. After drying, samples were evaluated for their appearances, microstructures and the contents of bioactive components. Results showed that FD-dried samples kept most of the appearances and microstructures of fresh *B. striata* tuber. Samples treated with other methods were deformed and discolored to various degree. The contents of bioactive components containing *B. striata* polysaccharides (BSP), phenols and militarine were disproportionately influenced by different drying methods, which had been discussed in detail in the article. The research results will provide useful suggestion for production, development and further research of *B. striata*.

1. Introduction

Bletilla striata (Thunb.) Reixchb.f., generally known as Baiji in China, belongs to Orchidaceae. Such plant is used as ornamental plant in Europe and North America, as well as East Asia (Masuhara & Katsuya, 1989; Wiart, 2012; Xu, Chen, Aci, Pan, Shangguan, Ma, et al., 2018; Yamamoto, Miura, Fuji, Nagata, Otani, Yagame, et al., 2017). As the tuber of *B. striata* has high edible and nutritional value, it was listed into healthy diet by the Health Ministry of PRC (the Health Ministry of PRC, 2002). In addition, the dried tuber of *B. striata* has been widely used as herbal medicine in East Asia for thousands of years (Chinese Pharmacopoeia Commission, 2015; Park, Woo, Choi, Lee, & Lee, 2014), showing a wide range of medicinal functions such as hemostasis (C. Zhang, Zeng, Liao, Fu, Luo, Yang, et al., 2017; Q. Zhang, Qi, Wang, Xiao, Zhuang, Gu, et al., 2019), anti-ulcer (Liao, Zeng, Hu, Maffucci, & Qu, 2018; C. Zhang, Gao, Gan, He, Chen, Liu, et al., 2019), promoting wound healing (C. Zhang, He, Chen, Shi, Qu, & Zhang, 2019; H. Zhou, Jin, Gu, Chen, & Xia, 2019), antibacterial (Guo, Binling, Chen, Jin, Jiang, Ding, et al., 2016; S. Jiang, Wan, Lou, Yi, Zhang, Zhou, et al., 2019), anti-inflammatory (Yue, Wang, Wang, Du, Shen, Tang, et al., 2016; D. Zhou, Chang, Liu, Chen, Yang, Hao, et al., 2020; Zu, Liu, Tian, Jin, Jiang, Li, et al., 2019) and immune regulation (Y. Wang, Han, Li, Cui, Ma, Qi, et al., 2019).

The chemical components of *B. striata* tuber play decisive roles of the medical and tonic functions. To date, more than 150 components have been isolated, including *B. striata* polysaccharides (BSP), bibenzyls, phenanthrenes, triterpenoids, steroids and saponins (Xirui He, Wang, Fang, Zhao, Huang, Guo, et al., 2016; Xu, Pan, & Chen, 2019). BSP accounts for 20–40% of the dry weight of *B. striata* tuber, often used as one of the quality evaluation indexes of *B. striata* (Y. Zhang, Sun, He, Wang, Wang, Yuan, et al., 2018). Polyphenols are another kind of important active ingredients of *B. striata*, including bibenzyls, phenanthrenes, militarine, etc (X. Wang & Lou, 2004; Y. Zhang, et al., 2018). The militarine content is high

among them, and it can be detected by HPLC or UPLC as an indicator component of *B. striata* quality evaluation (Xun He, Wang, Li, Wang, & Zhou, 2009; A. Wang, Yan, Lan, Liao, Wang, & Li, 2014).

After harvesting, fresh *B. striata* tuber is always cut into pieces and dried for storing and using. Therefore, drying methods is the crucial factor affecting the quality of *B. striata* tuber, in addition to the planting and harvesting process. As an important part of herbal medicine processing, drying methods not only directly affects the appearance of the medicine, but also affects its components. In this study, *B. striata* tubers were treated by hot-air drying (HD), infrared drying (ID), microwave drying (MD), vacuum drying (VD) and freeze drying (FD). The effects of different drying methods on the appearance, microstructure and bioactive components of *B. striata* tuber were evaluated to provide a scientific basis for the production and processing of *B. striata* tuber.

2. Materials And Methods

2.1. Samples and Reagents

Fresh *B. striata* tubers used in this study were collected from Jiangshan, Zhejiang province, China in October 2017, and identified by Professor Qingsong Shao, Department of Traditional Chinese medicine, Zhejiang A&F University. All the reagents were commercially available and used directly without further purification.

2.2. Drying experiments

The tubers of *B. striata* were washed and cut into 5 mm thick slices, and immediately dried using one of the following five drying methods. Hot-air drying (HD) was conducted in an electric thermostatic drying oven (DGG-9070A, Shanghai Senxin Experimental Instrument Factory Co., Ltd., China) at $60 \pm 2^{\circ}\text{C}$ with maximum air speed. Infrared drying (ID) was carried out in an infrared drying oven (404-1, Shanghai Experimental Instrument Factory Co., Ltd., China) under the power of 1500W. Microwave drying (MD) was performed in a microwave oven (G70F20CN1L-DG, Galanz, China) at 350W. Vacuum drying (VD) was conducted in a vacuum drying oven (DZF-6020, Jinghong, China) at the vacuum degree of 0.1 MPa and temperature of 60°C . For the freeze drying (FD) method, the tuber slices were previously frozen in a -80°C refrigerator for 24 h and then dried in a freeze dryer (GAMMA1-16LSC, GHRIST, Germany) at -85°C and 45 Pa. Drying lasted and the samples were weighed repeatedly until obtaining a constant weight. After drying, the tubers slices treated with different drying methods were ground into powder, passed through a 50-mesh sieve, and stored hermetically.

2.3 Color measurements

Dried tubers of *B. striata* were ground into powder and measured using a colorimeter (CR-10 Plus, KonicaMinolt, Japan) to obtain Hunter's color values. The Hunter's color values L^* , a^* , b^* , and ΔE^* indicate lightness coefficient, redness coefficient, yellowness coefficient and relative color difference index, respectively (Jin, Bu, Li, Zheng, Song, & Li, 2017; Liu, Zhang, Ji, Zhang, Hong, & Gao, 2012). Values were tested from three parallel samples with the blank plate of the instrument as comparison.

2.4 Scanning electronic microscope (SEM) observation

The dried samples were fixed on a metal sample table. After spraying with a layer of gold by ion sputtering under vacuum condition, the samples were observed and recorded using a scanning electron microscope (TM3030, Hitachi, Japan).

2.5 Determination of bioactive component contents

B. striata polysaccharides (BSP) contents of dried tuber samples were determined by anthrone-sulfuric acid method using glucose as the standard. The absorbances of sample solutions were measured on an enzyme-labeled instrument (Epoch2, BioTek, USA) at 625 nm to calculate the BSP content (A. Wang, Wang, Zheng, & Li, 2009).

The total phenol contents of samples were tested by Folin-Ciocalteu method and the absorbances were measured on the enzyme-labeled instrument at 760 nm with gallic acid as the standard.

The militarine content was determined by HPLC (e2695, Waters, USA) using militarine as the standard (Xun He, Wang, Li, Wang, & Zhou, 2009; Tang, Zhang, Wen, Yang, Tian, & Liu, 2014).

2.6 Statistical analysis

Excel 2010 was used to summarize the data and calculate the average value of parallel experiment. The data were subjected to ANOVA analysis, Duncan multiple comparison and LSD method for significant analysis using SPSS 24.0 (Statistical Product and Service Solutions).

3. Results

3.1 Appearance of dried tuber

The photographs of dried *B. striata* tubers slices with five drying methods are displayed in Fig. 1 (a–e). FD treated samples looked close to fresh *B. striata* tuber. The surface is white and smooth without cracks, the shape remains intact, and the texture is soft. Samples dried by HD, ID, MD and VD methods were hardened and darkened with curled surface and shrunken volume in varying degrees. Amongst them, MD method displayed deepest appearance with fragrance. Although the color of VD treated samples changed slightly, there was severe deformation of shape and size.

ID: Infrared drying; MD: Microwave drying; VD: Vacuum drying; FD: Freeze drying.

Hunter's color values were measured to objectively evaluate the color changes of samples dried in different ways. The lightness coefficient (L^*), redness coefficient (a^*) and yellowness coefficient (b^*) of the samples are showed in Table 1. Different drying ways caused different color values. Amongst five groups, samples dried with FD displayed the highest L^* value, while a^* value and b^* value were relatively lower than others. On the contrary, MD treated samples had the lowest L^* value and the highest a^* and b^* values. ΔE^* value is widely used to indicate color changes during food processing (Meng, Fan, Li, &

Zhang, 2018). It is considered that $\Delta E^* = 2$ is the threshold for visual discrimination. When ΔE^* is in the range of 0 ~ 2, the color difference can hardly be distinguished by naked eye, and if $\Delta E^* > 2$, the color difference is clearly visible (L. Zhou, Wang, Hu, Wu, & Liao, 2009). It's found that FD treated sample showed indistinguishable color changes with the ΔE^* value of 0.53, while other drying methods caused obvious color difference with $\Delta E^* > 6$. Therefore, comparing with other methods, FD kept most of the appearance of fresh *B. striata* tuber, while HD, ID and VD are better than MD.

Table 1 Effect of drying methods on Hunter's color values of <i>Bletilla striata</i> tuber slices				
Drying method	L*	a*	b*	ΔE^*
HD	65.90 ± 0.40 ^c	6.67 ± 0.06 ^d	13.70 ± 0.26 ^d	7.70 ± 0.23 ^b
ID	66.20 ± 0.36 ^c	7.17 ± 0.06 ^b	16.13 ± 0.12 ^b	7.77 ± 0.23 ^b
MD	63.53 ± 0.15 ^d	7.60 ± 0.00 ^a	16.73 ± 0.21 ^a	10.53 ± 0.21 ^a
VD	67.50 ± 0.17 ^b	6.83 ± 0.06 ^c	14.33 ± 0.21 ^c	6.20 ± 0.17 ^c
FD	73.70 ± 0.36 ^a	4.87 ± 0.12 ^e	13.83 ± 0.32 ^d	0.53 ± 0.47 ^d

HD: Hot-air drying; ID: Infrared drying; MD: Microwave drying; VD: Vacuum drying; FD: Freeze drying. Values are the means ± SE of triplicate assays, n = 3. Data in columns with the different letters (a, b, c, d, e) are significantly different P < 0.05.

3.2 Microstructure of the dried tuber

In order to study the changes of *B. striata* tuber microstructure after treatment by five different drying methods, dried samples were observed by scanning electron microscope (SEM) (Fig. 2). Comparing five groups, it's found that the microstructures of samples dried by HD, ID and MD were denser, while VD and FD treated samples showed looser microstructures. Compared with VD, the microstructure of FD dried sample has larger aperture and less collapse. Hence, FD is the optimal drying method for *B. striata* tubers in terms of microstructure.

3.3 Bioactive component contents

As can be seen from Fig. 3, *B. striata* polysaccharides (BSP) contents of samples treated with different drying methods were significantly different. The ID sample had the highest BSP content (26.03%), followed by FD sample (23.43%). The BSP contents of HD and VD samples were 21.76% and 20.84% respectively. Sample treated with MD had the lowest BSP content (18.42%).

The total phenolic contents of *B. striata* tuber samples treated with different drying methods were shown in Fig. 4. VD sample had the highest total phenol content (1.26%). There was no significant difference of

total phenol content between FD, MD, HD and ID treated samples, as the contents were 1.08%, 1.06%, 1.03% and 1.01%, respectively.

Figure 5 presents the results of the militarine content of *B. striata* tuber samples treated with different drying methods. The militarine content in the FD treated sample was the highest (1.70%), followed by the ID treated sample (1.61%). The militarine content of the HD, MD and VD treated samples were 1.47%, 1.47%, and 1.50%, respectively.

4. Discussion

The enzymatic browning reaction is the main reason for the color degradation or deepening of plant sample after drying (Artnaseaw, Theerakulpisut, & Benjapiyaporn, 2010). Among the five groups of dried samples, FD samples showed the highest L* value and the lowest a*, b* value, followed by VD samples. This may be due to the fact that the enzymatic browning reaction was relatively weak in the condition of low temperature and oxygen during FD process. And in HD, ID and MD processes, the samples were exposed to high temperature and oxygen. Compared to the other four groups of dried samples, the MD samples showed the lowest L* values and the highest a*, b* values, which may be due to the uniformity of drying (N. Jiang, Liu, Li, Zhang, Liu, Wang, et al., 2017). Excessive local temperature is the most common problem in MD, which often leads to hot spots (H. Jiang, Zhang, Mujumdar, & Lim, 2014).

Microstructural difference of samples may be caused by the removing process of moisture. During the FD process, the ice crystals in the aperture sublimed directly to form a highly porous microstructure. Therefore, the FD sample showed the lowest shrinkage rate. The porous microstructure of VD sample may be caused by the expansion of the sample under vacuum (N. Jiang, et al., 2017). In the HD process, the surface temperature of the sample was higher than the internal temperature. As the internal moisture migrated to the surface, the inorganic salts dissolved in the water may precipitate out and harden the surface. Rapid heating and local overheating of MD and ID resulted in cell damage, compact structure and low porosity.

The influence of drying process on BSP content may generate by affecting the metabolism of carbohydrates. The ID dried sample retained the highest BSP content, which may be because infrared influenced the metabolic balance of carbohydrates and caused the accumulation of polysaccharide (Yan, Wu, Qiao, Cai, & Ma, 2019). The BSP content of the FD sample was second only to ID sample, probably because the low-temperature, low-oxygen and coagulation of water reduced the activity of enzyme responsible for BSP decomposition (Busk & Lange, 2015). The BSP content of the MD sample is only 70.75% of the ID, which may be due to the excessive hot spots caused by MD leading and promoting the decomposition of BSP (Meng, Fan, Li, & Zhang, 2018).

Phenols are unstable especially in long-time drying process (N. Jiang, et al., 2017; Routray, Orsat, & Garipey, 2014). The total phenolic content of VD sample was higher than those of other drying methods which probably because the combination of vacuum and heated condition obviously shortened the drying time. For FD sample, although it experienced a long-time drying process, low-temperature and low-

oxygen could delay the oxidation of phenols. And the formation of ice crystals under low temperature cause the rupture of plant cell, which might result in an increase of extraction ratio of total phenol (Asami, Hong, Barrett, & Mitchell, 2003). Thus, the total phenolic content of FD samples was second only to VD. ID sample has the lowest total phenolic content, possibly because the infrared heating is intense, rapid and non-selective, leading to severe thermal degradation of phenolic compounds (Meng, Fan, Li, & Zhang, 2018).

Militarine is an important quality indicator of *B. striata* tuber. There has been research showing different drying methods can significantly affect the militarine content of *B. formosana*, the kin of *B. striata* (Wu & Lay, 2013). According to previous research, the militarine content of *B. formosana* flowers treated with FD was higher than that of other drying methods. In this study, we got consistent result but for the *B. striata* tubers, that is FD is more advantageous to the accumulation of militarine in *B. striata* tubers.

5. Conclusion

In summary, the present study demonstrated that drying methods (HD, ID, MD, VD, and FD) had noticeable influences on the product quality of *B. striata* tubers. It was found that FD sample retain most characters of fresh *B. striata* tubers including whole shape, loose texture, and light color. For samples treated with other drying methods, there were obvious changes of appearance and microstructure which might be caused by enzymatic browning reaction and different removing process moisture. The contents of bioactive components of *B. striata* tubers were also in different level, possibly due to the metabolic balance and chemical stability of these components. As a result, the BSP content of MD sample is the highest, followed by FD; the total phenol content of VD sample is the highest, followed by FD; and the militarine content of FD sample is the highest. On the whole, FD dried *B. striata* tubers was better in appearance and microstructure, and had relatively high contents of BSP, total phenols and militarine. Considering the cost of industrial production, we can select an appropriate drying method according to the production purpose and the result of this study to manufacture dried *B. striata* tubers with high-quality.

Declarations

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Declaration

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Author's contribution

Man Zhang and Lihong Li researched the relevant literature and wrote the body of the article.

Ding Lin provided overall direction for the program of work and edited the article.

Hailing Fang and Tingting Han provided some suggestions for the article.

Jie Wang edited the final version of the article.

Conflict of Interest Statement

All authors disclosed no relevant relationships

References

1. Artnaseaw, A., Theerakulpisut, S., & Benjapiyaporn, C. (2010). Drying characteristics of Shiitake mushroom and Jinda chili during vacuum heat pump drying. *Food and Bioprocess Technology*, *88*(2), 105–114.
2. Asami, D. K., Hong, Y.-J., Barrett, D. M., & Mitchell, A. E. (2003). Comparison of the total phenolic and ascorbic acid content of freeze-dried and air-dried marionberry, strawberry, and corn grown using conventional, organic, and sustainable agricultural practices. *Journal of Agricultural and Food Chemistry*, *51*(5), 1237–1241.
3. Busk, P. K., & Lange, L. (2015). Classification of fungal and bacterial lytic polysaccharide monooxygenases. *BMC Genomics*, *16*(1), 1–13.
4. Chinese Pharmacopoeia Commission. (2015). *Chinese Pharmacopoeia* (Vol. Part II). Beijing: China Medical Science Press.
5. Guo, J., Binling, D., Chen, N., Jin, L., Jiang, F., Ding, Z., & Qian, C. (2016). The anti-Staphylococcus aureus activity of the phenanthrene fraction from fibrous roots of *Bletilla striata*. *BMC complementary and alternative medicine*, *16*(1), 491–498.
6. He, X., Wang, A., Li, Y., Wang, Y., & Zhou, S. (2009). Determination of militarine in Rhizoma Bletillae by HPLC. *China Journal of Chinese Materia Medica*, *34*(16), 2076–2078.
7. He, X., Wang, X., Fang, J., Zhao, Z., Huang, L., Guo, H., & Zheng, X. (2016). *Bletilla striata*: Medicinal uses, phytochemistry and pharmacological activities. *Journal of Ethnopharmacology*, *195*, 20–38.
8. Jiang, H., Zhang, M., Mujumdar, A., & Lim, R. (2014). Comparison of drying characteristic and uniformity of banana cubes dried by pulse-spouted microwave vacuum drying, freeze drying and microwave freeze drying. *Journal of the Science of Food and Agriculture*, *94*(9), 1827–1834.
9. Jiang, N., Liu, C., Li, D.-j., Zhang, Z., Liu, C., Wang, D., Niu, L., & Zhang, M. (2017). Evaluation of freeze drying combined with microwave vacuum drying for functional okra snacks: Antioxidant properties, sensory quality, and energy consumption. *LWT - Food Science and Technology*, *82*, 216–226.
10. Jiang, S., Wan, K., Lou, H.-Y., Yi, P., Zhang, N., Zhou, M., Song, Z.-Q., Wang, W., Wu, M.-K., & Pan, W.-D. (2019). Antibacterial bibenzyl derivatives from the tubers of *Bletilla striata*. *Phytochemistry*, *162*,

216-223.

11. Jin, Y., Bu, T., Li, M., Zheng, L., Song, Z., & Li, H. (2017). Effects of Drying Methods on Qualities and Microstructure of Cuttlefish Food Science, *38*(15), 189–195.
12. Liao, Z., Zeng, R., Hu, L., Maffucci, K. G., & Qu, Y. (2018). Polysaccharides from tubers of *Bletilla striata*: Physicochemical characterization, formulation of buccoadhesive wafers and preliminary study on treating oral ulcer. International Journal of Biological Macromolecules, *122*, 1035–1045.
13. Liu, S., Zhang, C., Ji, H., Zhang, C., Hong, P., & Gao, J. (2012). Effects of drying methods on qualities and microstructure of tilapia fillet. Transactions of the Chinese Society of Agricultural Engineering, *28*(15), 221–227.
14. Masuhara, G., & Katsuya, K. (1989). Effects of mycorrhizal fungi on seed germination and early growth of three Japanese terrestrial orchids. Scientia Horticulturae, *37*(4), 331–337.
15. Meng, Q., Fan, H., Li, Y., & Zhang, L. (2018). Effect of drying methods on physico-chemical properties and antioxidant activity of *Dendrobium officinale*. Journal of Food Measurement and Characterization, *12*(1), 1–10.
16. Park, J. E., Woo, K. W., Choi, S. U., Lee, J. H., & Lee, K. R. (2014). Two New Cytotoxic Spirostane-Steroidal Saponins from the Roots of *Bletilla striata*. Helvetica Chimica Acta, *97*(1), 56–63.
17. Routray, W., Orsat, V., & Gariepy, Y. (2014). Effect of Different Drying Methods on the Microwave Extraction of Phenolic Components and Antioxidant Activity of Highbush Blueberry Leaves. Drying Technology, *32*(16), 1888–1904.
18. Tang, X., Zhang, Y., Wen, Y., Yang, Q., Tian, Z., & Liu, A. (2014). Different Effect with Different Processing Methods on Chemical Constituents of Bletillae ¼hizoma. Chinese Journal of Experimental Traditional Medical Formulae, *20*(7), 67–69.
19. the Health Ministry of PRC. (2002). Notice of the Health Ministry on further regulating the management of raw materials for health foods. Chinese Journal of Food Hygiene, *14*(3), 58–59.
20. Wang, A., Wang, Y., Zheng, L., & Li, Y. (2009). Determination of polysaccharides in Bletillae ¼hizoma. China Journal of Chinese Materia Medica, *34*(22), 2963–2965.
21. Wang, A., Yan, Y., Lan, B., Liao, S., Wang, Y., & Li, Y. (2014). Simultaneous determination of nine chemical markers of Bletillae ¼hizoma by ultra performance liquid chromatography. China Journal of Chinese Materia Medica, *39*(11), 2051–2055.
22. Wang, X., & Lou, H. (2004). Phenolic compounds from bryophytes. Natural Product Research and Development, *16*(4), 353–358.
23. Wang, Y., Han, S., Li, R., Cui, B., Ma, X., Qi, X., Hou, Q., Lin, M., Bai, J., & Li, S. (2019). Structural characterization and immunological activity of polysaccharides from the tuber of *Bletilla striata*. International Journal of Biological Macromolecules, *122*, 628–635.
24. Wiart, C. (2012). *Medicinal plants of China, Korea, and Japan: Bioresources for Tomorrow's Drugs and Cosmetics*. Boca Raton, America: CRC Press.

25. Wu, T.-Y., & Lay, H.-L. (2013). Effect of growth stages, culture media, and processing methods on the component variations of *Bletilla formosana* and comparison of its component contents to commercial Rhizoma Bletillae crude drugs. *Journal of Food and Drug Analysis*, *21*(4), 404–413.
26. Xu, D., Chen, H., Aci, M., Pan, Y., Shangguan, Y., Ma, J., LiD, L., Qian, G., & Wang, Q. (2018). *De Novo* assembly, characterization and development of EST-SSRs from *Bletilla striata* transcriptomes profiled throughout the whole growing period. *PLoS ONE*, *13*(10), 1–13.
27. Xu, D., Pan, Y., & Chen, J. (2019). Chemical Constituents, Pharmacologic Properties, and Clinical Applications of *Bletilla striata*. *Frontiers in pharmacology*, *10*, 1168.
28. Yamamoto, T., Miura, C., Fuji, M., Nagata, S., Otani, Y., Yagame, T., Yamato, M., & Kaminaka, H. (2017). Quantitative evaluation of protocorm growth and fungal colonization in *Bletilla striata* (Orchidaceae) reveals less-productive symbiosis with a non-native symbiotic fungus. *BMC Plant Biology*, *17*, 50.
29. Yan, J.-K., Wu, L.-X., Qiao, Z.-R., Cai, W.-D., & Ma, H. (2019). Effect of different drying methods on the product quality and bioactive polysaccharides of bitter melon (*Momordica charantia* L.) slices. *Food Chemistry*, *271*, 588–596.
30. Yue, L., Wang, W., Wang, Y., Du, T., Shen, W., Tang, H., Wang, Y., & Yin, H. (2016). *Bletilla striata* polysaccharide inhibits angiotensin II-induced ROS and inflammation via NOX4 and TLR2 pathways. *International Journal of Biological Macromolecules*, *89*, 376–388.
31. Zhang, C., Gao, F., Gan, S., He, Y., Chen, Z., Liu, X., Fu, C., Qu, Y., & Zhang, J. (2019). Chemical characterization and gastroprotective effect of an isolated polysaccharide fraction from *Bletilla striata* against ethanol-induced acute gastric ulcer. *Food and Chemical Toxicology*, *131*, 1–10.
32. Zhang, C., He, Y., Chen, Z., Shi, J., Qu, Y., & Zhang, J. (2019). Effect of Polysaccharides from *Bletilla striata* on the Healing of Dermal Wounds in Mice *Evidence-based Complementary and Alternative Medicine*, *2019*, 1–9.
33. Zhang, C., Zeng, R., Liao, Z., Fu, C., Luo, H., Yang, H., & Qu, Y. (2017). *Bletilla striata* Micron Particles Function as a Hemostatic Agent by Promoting Rapid Blood Aggregation. *Evidence-based Complementary and Alternative Medicine*(2), 1–8.
34. Zhang, Q., Qi, C., Wang, H., Xiao, X., Zhuang, Y., Gu, S., Zhou, Y., Wang, L., Yang, H., & Xu, W. (2019). Biocompatible and degradable *Bletilla striata* polysaccharide hemostasis sponges constructed from natural medicinal herb *Bletilla striata*. *Carbohydrate polymers*, *226*, 1–8.
35. Zhang, Y., Sun, W., He, Y., Wang, S., Wang, Q., Yuan, F., Yang, L., & Liang, Q. (2018). Current situation and prospect of resource evaluation and sustainable utilization on *Bletilla*. *China Journal of Chinese Materia Medica*, *43*(22), 4397–4403.
36. Zhou, D., Chang, W., Liu, B., Chen, G., Yang, Y., Hao, Y., Hou, Y., & Lia, N. (2020). Stilbenes from the tubers of *Bletilla striata* with potential antineuroinflammatory activity. *Bioorganic Chemistry*, *97*, 1–6.
37. Zhou, H., Jin, Y., Gu, C., Chen, Y., & Xia, J. (2019). *Bletilla striata* promotes the healing of enterocutaneous fistula: A case report. *Medicine*, *98*(27), e16288.
38. Zhou, L., Wang, Y., Hu, X., Wu, J., & Liao, X. (2009). Effect of high pressure carbon dioxide on the quality of carrot juice. *Innovative Food Science & Emerging Technologies*, *10*(3), 321–327.

39. Zu, Y., Liu, Q., Tian, S., Jin, L., Jiang, F., Li, M., Zhu, B., & Ding, Z. (2019). Effective fraction of *Bletilla striata* reduces the inflammatory cytokine production induced by water and organic extracts of airborne fine particulate matter (PM2.5) in vitro. BMC complementary and alternative medicine, 19(1), 369–380.

Figures

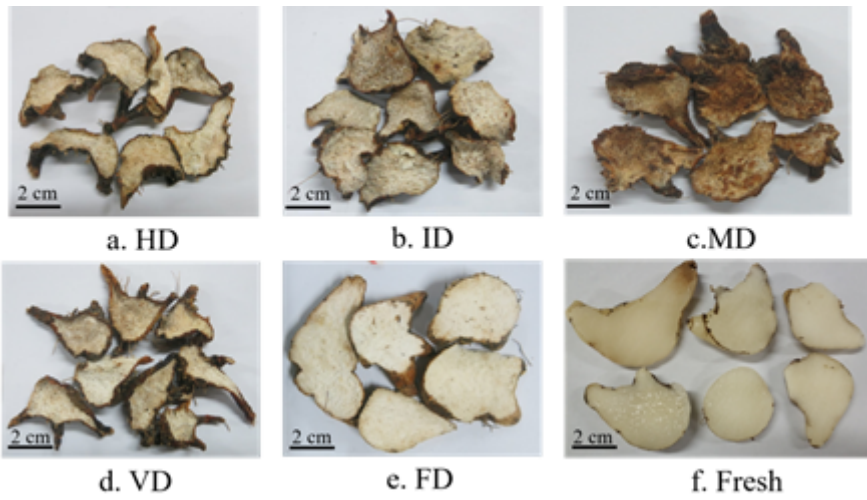


Figure 1

Effects of drying methods on appearance of *B. striata* tuber. HD: Hot-air drying;

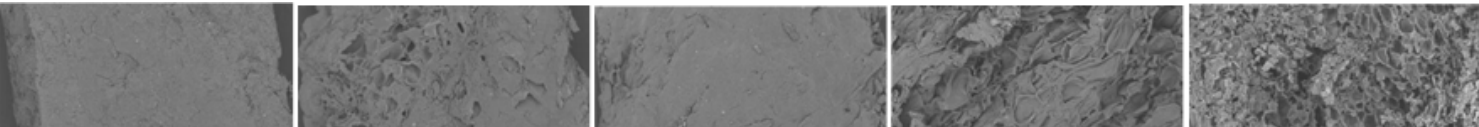


Figure 2

Figure 3

Effects of different drying methods on BSP content of *B. striata* tubers.

Figure 4

Effects of different drying methods on total phenolic content of *B. striata* tubers.

Figure 5

Effects of different drying methods on militarine content of *B. striata* tubers.