Petal Secretory Stucture of *Osmanthus fragrans* Lour.

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Abstract: To reveal the features of secretory structure of *Osmanthus fragrans* Lour., the petals of *O. fragrans* were studied thoroughly by paraffin sectioning and electronic scanning microscope. The petal of *O. fragrans* is comprised of epidermis, fundamental tissues and vascular bundles. The petal epidermis consists of one layer of cells with obvious and regular tubercles, plentiful brush-shaped hairs and a small amount of stomas. The fundamental tissue includes many layers of parenchyma cells which contain much prolific oil substances and arrange irregularly. The secretory structure of *O. fragrans* can be named as Osmophores. The aromatic substances are produced, accumulated and stored temporarily in the petal fundamental tissues, and then secreted outside from the petal epidermis. [Life Science Journal. 2006;3(4):81-84] (ISSN: 1097-8135).

Keywords: *Osmanthus fragrans*; petal; secretory structure; Osmophores

1 Introduction

Osmanthus fragrans Lour., Oleaceae, is a kind of traditional and famous flower in China. The Chinese people favour it because of its strong perfume, especial culture, and widely used in food, spice and gardens[1,2]. There are many studies on aroma ingredients of *O. fragrans*[3-8]. The authors also studied secretory structure of other plant species[9-13]. Some papers on the differentiation of flower bud of *O. fragrans* have been published[14-16]. However, there are no reports on the morphology and anatomy of petal and the features of secretory structures of *O. fragrans*. This paper filled these studying gaps, and defined the type of secretory structure of *O. fragrans* firstly.

2 Materials and Methods

2.1 Materials

Petals was from *O. fragrans* "Huangchuanjingui" cultivated in Henan University in October, 2002.

2.2 Methods

Each part of fresh petals of *O. fragrans* and its secretory structure of free-hand sectioning and paraffin sectioning were observed under dissecting microscope. Free-hand section was dyed by Sudan Ⅲ, Sudan Black, dimethyl diaminophenazine chloride and KI-I_2 solution. Paraffin sectioning, which are 10-15 μm thick, were made through FAA fixing petals, then dyed by safranine-fast green, and iron vitriol-hematoxylin, lastly cuffed by Canada gums. Free-hand sectioning and paraffin sectioning were observed and taken photos under an Olympus BH-2.

The petal samples were made as follows: buffer solution flushing fresh petal, air drying, fixation on board, vacuum drying, gold metallic-membrane plating. The samples were observed and taken photos under HITACHI-450 electronic scanning microscope.

3 Results and Analysis

3.1 External shapes of petals

The petals of *O. fragrans* have often four pieces, seldom three, five or even six(variation). The petals were separated from style, stamina and pistils. The bottoms of petals coalesce to a corolla tube that is about 1 mm long. Only petals are scent (stamina lies on the corolla tube). The surfaces of petals are slightly rough and have white spotted tubercles of longitudinal range observed under dissecting microscope(Figure 1). The petals are full and fleshy, which have relation with secretory function. Under electronic scanning microscope were observed large number of protrudent and tidy ridges of longitudinal range on surface of petals(Figure 2) and stomas distribute in it randomly. These stomas can not close and the shapes of guard cells isn't typical(Figure 3). There are pollen grains on the surface of petals(Figure 2).

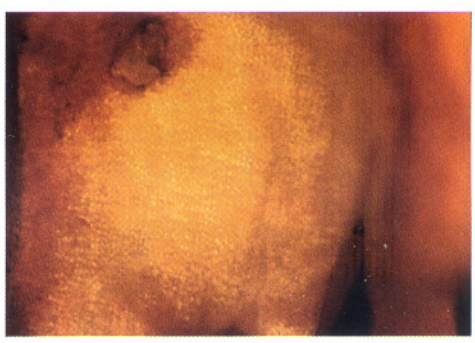

Figure 1. Spotted state tubercles of petal(×30)

Figure 2. Regular tubercles of longitudinal range on surface of petals(×550)

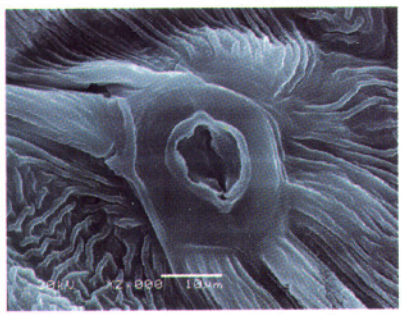

Figure 3. Guard cells of stomas in epiderm(×2000)

3.2 Anatomic structures of petals

Under optical microscope, the petal consists of epidermis, fundamental tissues and vascular bundles. There have plenty of one-layer-cell epidermis and less of two-layer-cell epidermis. The ectotheca of epidermal cell is thin and has rich epidermal trichome, which has no cuticle layer or only has thin cuticle layer. Those trichomes, which are brush-shaped and orgin from the ectotheca of epidermis cell, have the similarity with root hairs, but are straighter. They are denser than root hairs. Epidermal cells are alive and have obvious nucleus and cytoplasm(Figures 4 and 5). Most of epidermal cells own excretion. After dyed by Sudan Ⅲ, cells contain yellow substances(Figure 5); after dyed by Sudan Black, epidermal trichomes are black-grey (Figure 6); after dyed by dimethyl diaminophenazine chloride, cells are brick-red, and the drips in cells are obvious(Figure 4); after dyed by KI-I_2, cells are orange, and the color of drips in cells are deeper(Figure 5).

Fundamental tissues of petals locating under epidermis, are loose parenchyma cells, and have obvious gaps of internal cells. Most of cells are claviform irregularly. The long axis of parenchyma cell is vertical to epidermis(Figures 7, 8 and 9). There is prolific lipid in cells, which was dyed orange by Sudan Ⅲ(Figure 9), and can't be dyed by hematine. Vascular bundles which are simple in structure distribute in fundamental tissues(Figure 7). After stained by KI-I_2 solution, the fundamental tissues didn't become blue(Figures 7 and 8), which illustrated that no starch exists in them. Cells became brick-red after stained by dimethyl diaminophenazine chloride, which was consistent with epidermis.

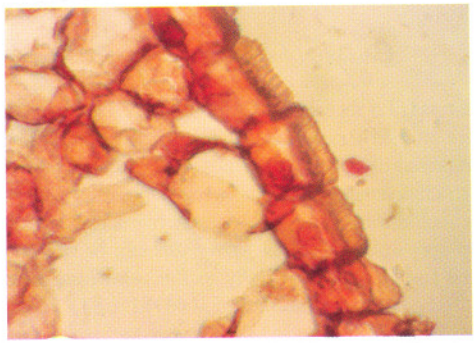

Figure 4. Obvious nucleus and cytoplasm of epidermal cells (×400)

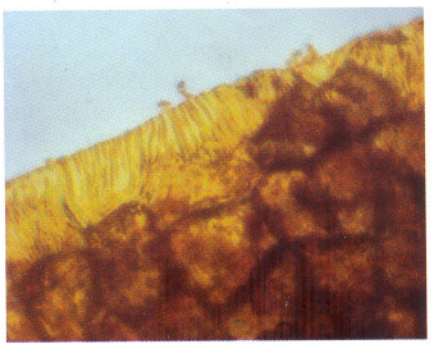

Figure 5. Epidermal cells and the excretion after dyed by KI-I_2(×600)

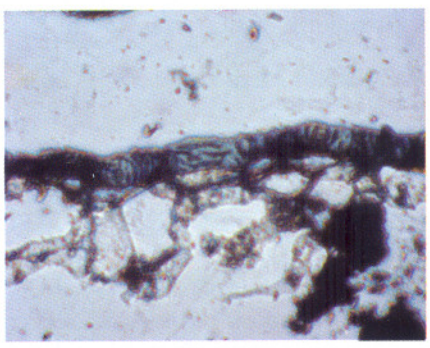

Figure 6. Epidermal cells and the excretion after dyed by Sudan Black(×400)

4 Discussion

According to the opinion of Ding[3], *O. fragrans* "Latifolius Group" has the most fragrant flavor and is the best cultivar group. *O. fragrans* "Thunbergii Group" has the soft and sweet scent and is the better one. *O. fragrans* "Aurantiacus

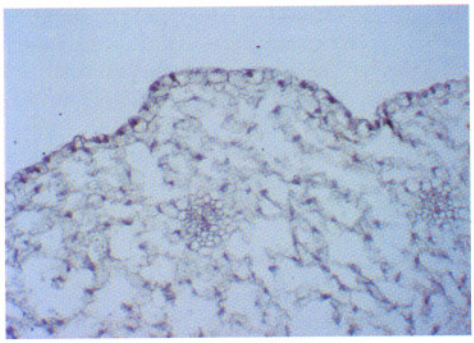

Figure 7. Vascular bundle of petals(×300)

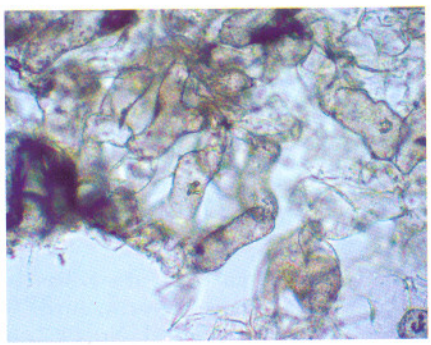

Figure 8. Parenchyma cells of fundamendal tissue of petals which arrange irregularly(×600)

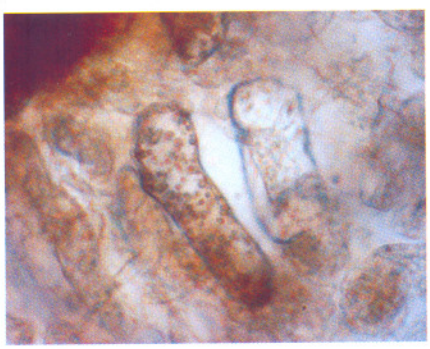

Figure 9. Parenchyma cells of fundamendal tissue of petals and excretion after dyed by Sudan Ⅲ(×800)

Group" has the light scent and is the inferior one. *O. fragrans* "Fragrans Group" is the most inferior one. *O. fragrans* "Huangchuan jingui", one cultivar of *O. fragrans* "Thunbergii Group", was studied by author. The features of secretory structure of *O. fragrans* were found. Scent of *O. fragrans* concentrates in petals, and epidermis of petal has obvious and regular tubercles observed under scanning electronic microscope. Brush structure, among which is overflowed by secretory substance was observed from the cross section of petals, and can be dyed black-grey by Sudan black. Parenchyma cells filled with lipid form fundamental tissue of petals. Vogel[17] held the opinion that scent of some plants came from a kind of special gland named Osmophores, which can be found in Asclepiadanceae, Araceae, Aristolochiaceae and Burmanniaceae. The flowers of those plants can be differentiated according to Osmophores, which can develop to cilium, valve or brush of kernel. For example, spadix of Acreae and some structures inducing insects in plants of Orchidaceae belong to Osmophores, which can be identified through the method of dimethyl diaminophenazine chloride coloration. The gland usually has secretory tissue only comprised of several cells thick, which arrays tightly or loosely. Volatile oil produced by the gland can be given off quickly, however, or stored temporarily in cells, which was studied by Fahn[9]. The author held the views that secretory structure of petal of *O. fragrans* can be named as Osmophores, because it possesses the features of Osmophores. So we can draw the conclusion that total petals of *O. fragrans* are a big Osmophores. Lipid is in epidermis not in fundamental tissues through the dyed Free-hand sectioning of fading petals. Results showed fundamental tissues of petal could produce and temporarily store lipid, then give off through epidermis and its brush-hairs. That can be proved by the fact that the total petal becomes brick-red after dyed by dimethyl diaminophenazine choride. The author firstly answered the reason why *O. fragrans* has strong and enjoyable fragrance.

There are plenty of stomas distributing in petal. A definite conclusion hasn't been drawn on whether those stomas have association with release of aromatic substances.

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References

1. Shang FD, Yi YJ, Xiang QB. The culture of sweet osmanthus in China. Journal of Henan University (Social Science) 2003; 43(2): 136－9(in Chinese with English abstract).

2. Yang KM, Zhu WJ. Sweet Osmanthus. Shanghai: Shanghai Science and Techonology Press 2000; 1 – 50(in Chinese).
3. Ding CB, Xiong GT. Study on components of neat oil of osmanthus in Guizhou. Guizhou Science 1993; 11(3): 40 – 5(in Chinese with English abstract).
4. Feng JY, Zhao J, Huang QQ. Study on aroma components of *Osmanthus* by absorption wire gas chromatography/mass spectrometry. Journal of Zhejiang University (Science Edition) 2001; 28(6): 672 – 5(in Chinese with English abstract).
5. Liu H, He ZH, Shen MY. Study on aroma components of *Osmanthus* by supercritical extraction of CO_2. Guangxi Forestry Science 1996; 25(3): 127 – 31(in Chinese with English abstract).
6. Wen GP, Kang ZQ. Study on components of neat oil of *Osmanthus*. Acta Botanica Sinica 1983; 25(5): 468 – 71 (in Chinese with English abstract).
7. Wu HM, Chen X, He XY, Yu Z, Ding JK. The chemical constituents of absolute oils from *Osmanthus fragrans* flowers. Acta Botanica Yunnanica 1997; 19(2): 213 – 6 (in Chinese with English abstract).
8. Zhu ML. Study on components in headspace of various mutants of *Osmanthus*. Acta Botanica Sinica 1985; 27 (4): 412 – 8 (in Chinese with English abstract).
9. Fahn A. Secretory tissue in plant. London: New York Academic Press 1979; 51 – 161
10. Liu WZ, Hu ZH. The secretory structure of *Hypericum perforatum* and its relation to hypericin accumulation. Acta Botanica Sinica 1999; 41(4): 369 – 72(in Chinese with English abstract).
11. Liu WZ. Secretory structures and their relationship to accumulation of camptothecin in *Camptotheca acuminate* (Nyssaceae). Acta Botancica Sinica 2004; 46(10): 1242 – 8.
12. Lu HF, Hu ZH. Comparative anatomy of secretory structures of leaves in *Hypericum* L. Acta Phytotaxonomica Sinica 2001; 39(5): 393 – 404(in Chinese with English abstract).
13. Lu HF, Shen ZG, Li JY, Hu ZH. The patterns of secretory structure and their relation to hypericin content *Hypericum*. Acta Botanica Sinica 2001; 43(10): 1085 – 8.
14. Wan YX. A study on differentiation of floral buds of *Osmanthus fragrans*. Journal of Huazhong Agruicultural University 1988; 7(4): 364 – 6(in Chinese with English abstract).
15. Wang CY, Gao L, P, Lu DF. A study on morphological differentiation of flower bud of *Osmanthus fragrans* "Houban Jingui". Acta Horticulturae Sinica 2002; 29 (1): 52 – 6(in Chinese with English abstract).
16. Yang QJ, Huang YW, Li HP. Studies on formation and development of embryo and endosperm of *Osmanthus fragrans*. Journal of Huazhong Agricultural University 2003; 22(2): 175 – 8 (in Chinese with English abstract).
17. Vogel S. Duftdrüsen im Dienst der Bestaubung. Uber Bau und Funktion der Osmophoren, Arad. Wiss. Lit. Mainz, Abb. Matb. naturwiss. KI. Nr. 1962; 10: 598 – 763.

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