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Study on dust-catching and inhibiting microorganism ability of *Jacaranda mimosifolia* under the same condition of compare experiment*

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The study made a research on *Jacaranda mimosifolia* and other four common plant species in areas with heavy traffic in Chengdu, Zigong and Suining similarly to find an objective law aiming at the haze pollution. The results showed: the average quantity of unit leaf area's dust was *L. chinense* > *F. altissima* > *B. papyrifera*> *J. mimosifolia*> *C. pedunculatum*, which was 6.2690, 4.9561, 4.6474, 3.927, 1.0825g/m^2 respectively; From bacteria culture test, the bacterial colonies area of leaves dust of each plant increased over time in 24, 48 , 72hrs, and the outbreak point was in 48hrs； The area also increased with the increasing temperature (10,20,25,30,37˚C) , but there were some differences in different levels. It was shown that there were significant differences ($P < 0.05$) and extreme difference ($P < 0.01$) between 10-20˚C, especially on *L. chinense* and *C. pedunculatum*. And the relevant data of *J. mimosifolia* increased while others reduced or held steadily between 20-30˚C, but the increment was much less than other plants in other times. From a general view, the bacterial colonies area of unit leaves dust-catching quantity was *C. pedunculatum*> *B. papyrifera*> *L. chinens*e> *F. altissima*> *J. mimosifolia*. Thus it can be seen that *Jacaranda mimosifolia* has a certain ability of dust-catching, while there's a much stronger capability of inhibiting microorganism than other control plants. Therefore the contemporary plant configuration should be combined with the specific habitat, following the objective law. However, the specific secretion of Pythoncidere, producing by *Jacaranda mimosifolia*, as well as microorganism types need to further explore.

Keywords: *Jacaranda mimosifolia*, Pythoncidere, inhibite microorganism.

INTRODUCTION

Recent years, environmental problems have been increasing prominently while the process of urbanization was accelerating. The urban air pollution has caused API [1], PM2.5 and PM10 problems in more and more cities [2], which has seriously affected the physical and mental health of urban residents. However, the garden plants not only beautify the environment and reduce the light pollution or the noise [3], but also have a strong capacity of dust-catching and microorganism-inhibiting [4]. Dr. B.P.Toknnh has put forward the concept of *Pythoncidere* [5], the plant leaching solution to inhibit other biological growth, which mainly present in chemical materials, such as phenol and alkaloid, by changing the biofim and protein structure of microorganism [6]. Thus it plays a significant role in improving the regional air quality.

It was reported that *Jacaranda mimosifolia*, which had the thick foliage and contains a variety of bioactive substances, could well cure the diseases on skin, gastrointestinal and cardiovascular system [7-9].But there has not been reported [10-14] about the ability of dust-catching and inhibiting microorganism of *Jacaranda mimosifolia* in the same condition contrast other plants. Thus, the goal of this study was to explore the ability of dust-catching and inhibiting microorganism of *Jacaranda mimosifolia* under the same condition of compare experiment to heal the haze pollution in the future.

EXPERIMENTAL

Experimental material

Five common plants species, *Jacaranda mimosifolia, Broussonetia papyrifera , Ficus altissima, Cinnamomum pedunculatum* and *Loropetalum chinens*e, at the intensive traffic places [15] in Chengdu, Zigong and Suining, which had similar habitats, were taken as research objects which had the same DBH, height and growth status [16]. Chengdu, Zigong and Suining all belong to subtropical monsoon

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humid climate of which the average annual rainfall is greater than 900mm, and the annual average temperature of 17℃, while the annual frost-free period is greater than 300 days. The bacterial culture medium (Table 1) was improved (Number 2N-5N) on the basis of Beef Extract Peptone solid medium [8, 17] in inhibiting microorganism test.

Table 1. Beef extract peptone medium with different concentrations of formula（1L distilled water, pH7.0~7.2）

number	Beef extract (g)	Peptone (g)	NaCl (g)	Agar powder (g)
1N	5.00	10.00	5.00	20.00
2N	6.00	10.00	5.00	20.00
3N	4.00	10.00	5.00	20.00
4N	5.00	8.00	5.00	20.00
5N	5.00	12.00	5.00	20.00

Treatments

The dust-catching test was performed on days with sunny and windless weather after seven days of 5mm's rainfall above [18] in two seasons, which have the biggest dust-catching ability [19], winter and spring (December 2015 to February 2016). In each season, five plant species were collected at Riyue Road in Chengdu, Dangui Road in Zigong and Heping Road in Suining, respectively.

Measurement of Leaves dust

The test sampled from the perimeter of crown leaves on the upper, middle and lower parts [20] by lopper, and the samples were carefully sealed in plastic bags. Then leaves were immersed in distilled water for 3 hours and gently brushed with a small brush, and also the plastic bag. The leaves were removed with tweezer. The test weighed the amount of leaves dust by *Weight difference method* [21]. And then, the amount of dust per unit leaf area was calculated with AutoCAD.

Bacteria culture

The inhibiting microorganism test was improved on the basis of *Natural sedimentation method* [8] with the five plant species collected from Riyue Road in Chengdu. The test cultivated bacterial colonies of the leaves dust and recorded the amount of them by setting different concentrations of medium, temperature(10, 20, 25, 30,37℃) and time periods(24, 48, 72h). The bacterial colonies area per unit dust-catching quantity of different plant species leaves was calculated by the formula of:

$$C2 = C1 / W3 \qquad (1)$$

Where, C1 is the average bacterial colonies area per dish; W3 is the average dust-catching quantity in December per dish). And the data were analyzed by Excel and DPS.

RESULTS AND DISCUSSION

Comparison of plant species dust-catching ability

The test data showed (Fig. 1) that the amount of dust-catching in December was much more than it in February. According to the survey (Fig. 2), it was known that comparison of dust-catching quantity per leaf area in December was *L. chinense* > *F. altissima* > *B. papyrifera* > *J. mimosifolia* > *C. pedunculatum*, which was 6.2690, 4.9561, 4.6474, 3.927, 1.0825 g/㎡ respectively. It reflected the ability of dust-catching of these five plant species.

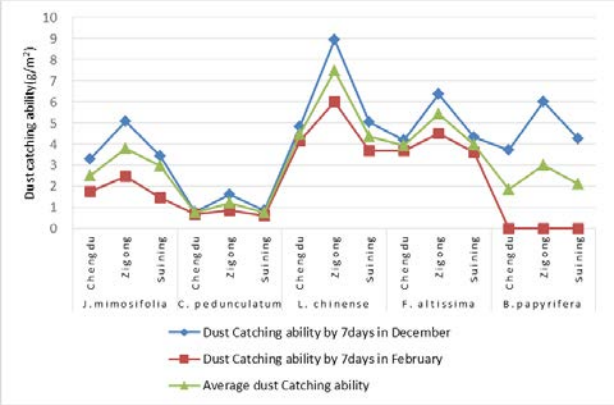

Fig. 1. Different species in December, February and average dust catching ability (experimental conditions: 25 ºC, pH: 7, reaction time: 24h).

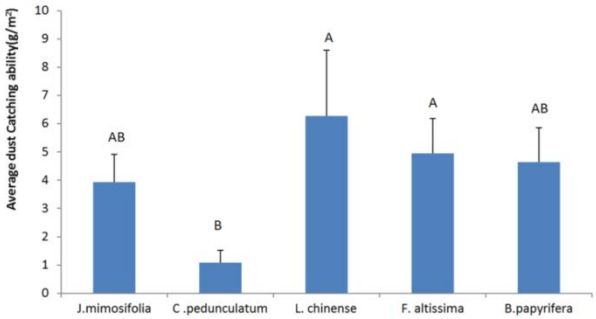

Fig. 2. The average dust catching ability of three different experimental locations in December and the letters P <0.01 significant level (experimental conditions: 25 ºC, pH: 7, reaction time: 24h)

Bacterial colonies of inhibiting microorganism test

The inhibit microorganism test showed (Fig. 3&4) the bacterial growth of leaves dust, which collected from five plant species in December at Riyue Road in Chengdu. It was visible that sterilization ability of *J. mimosifolia* was higher than others species during 0-72h.

According to the data of bacterial growth trend (Fig. 5, table 2) in different culture period (24, 48, 72h), the bacterial colonies area of leaves dust spreads with time. It was shown that, the area existed extreme differences ($P < 0.01$) or significant differences ($P < 0.05$) in 48-72h, except for *B. papyrifera*. So that, the outbreak stage of total

bacterial colonies was in 48-72h, and the point was on 48h.

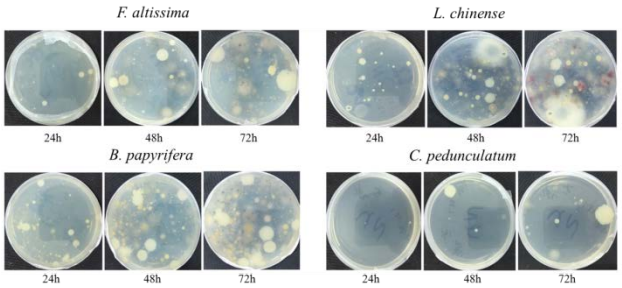

Fig. 3. Four compared plant species leaves bacteria culture growth (experimental conditions: 25 ºC, pH: 7, reaction time:24-72h).

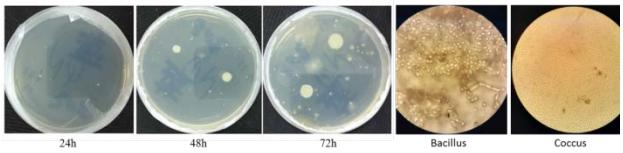

Fig. 4. *J. mimosifolia* leaves bacteria culture growth and the observation under OLYMPUS,CX21 microscope (experimental conditions: 25 ºC, pH: 7, reaction time:24-72h).

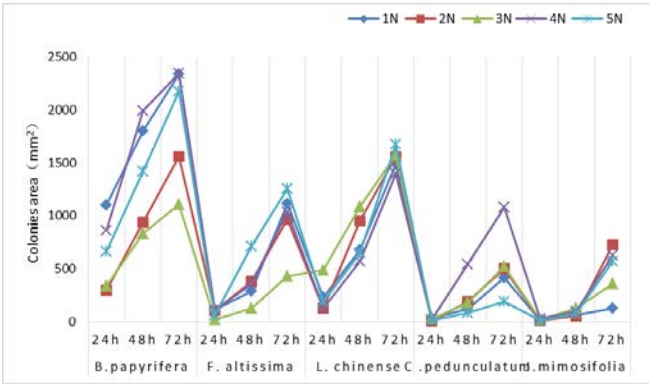

Fig. 5. Different species of different media bacterial growth trend (experimental conditions: 25 ºC, pH: 7, reaction time: 24-72h, in 1N-5N medium).

According to the survey of bacterial culture at different temperatures during 72h, the maximum of each bacterial colonies area distributed at 25,30,37℃ respectively, while the minimum was at 10℃(Fig. 6), which was the outdoor temperature when we collected the leaves. By analysis of variance, there were significant difference ($P < 0.05$) and extreme difference ($P < 0.01$) between 10-20℃, especially *L. chinense* and *C. pedunculatum*. The relevant data of *J. mimosifolia* increased while others reduced or hold between 20-30℃, but the increment was much less than other plant species in other period of time. So that, temperature has a great influence on the bacterial cultivate, but there was an exception on *J. mimosifolia.*

It was shown in Fig. 7 that the bacterial colonies area per dish of *J. mimosifolia* was greater than other plant species, which was *B. papyrifera*>*L.chinense*>*F. altissima*>*C. pedunculatum*> *J. mimosifolia.* And the average dust-catching quantity in December in single culture dish (6358.5mm^2 each dish) could be calculated as 0.0300, 0.0400, 0.0315, 0.0069g and 0.0250g respectively, combined with Fig. 2.

Table 2. Bacterial colonies growth level single factor statistical analysis of different time periods about each species (species, Processing, Mean, 5% significance level and 1% significant level)

species	Processing (h)	Mean	5% signifycance level	1% significant level
B.papyrifera	72	1906.5900	a	A
	48	1395.3201	a	AB
	24	649.8420	b	B
F. altissima	72	960.3000	a	A
	48	373.4100	b	B
	24	79.2940	b	B
L. chinense	72	1539.2280	a	A
	48	786.6440	b	B
	24	229.2800	c	C
C .pedunculatum	72	540.8340	a	A
	48	219.8780	b	AB
	24	18.9820	b	B
J.mimosifolia	72	482.4060	a	A
	48	82.1380	b	B
	24	14.3820	b	B

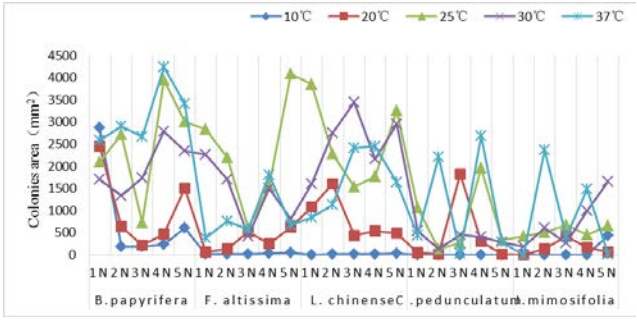

Fig. 6. The different temperatures of different species of bacterial growing line graph (experimental conditions: 10- 37˚C, pH: 7, reaction time: 72h, in 1N-5N medium).

Therefore, the bacterial colonies area per unit dust-catching quantity of different plant species leaves was *C. pedunculatum*> *B. papyrifera*> *L. chinense*> *F. altissima*> *J. mimosifolia* (Fig. 8). In terms of the different formulations of the bacterial culture medium, 4N had more bacterial colonies than 3N, however, it was not particularly evident. Therefore, the demand of Beef Extract is more than Peptone in culture medium for bacteria relatively.

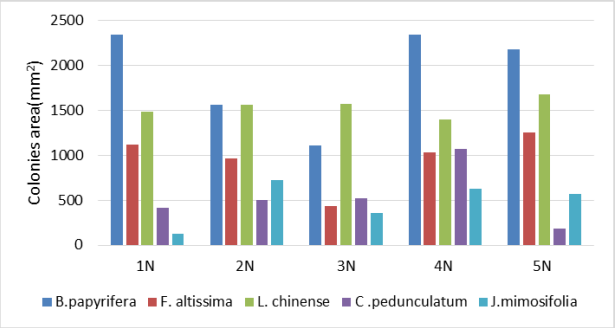

Fig.7. The average bacterial colonies area of the different plant species(experimental conditions: 10-37℃,pH: 7, reaction time:72h, in 1N-5N medium).

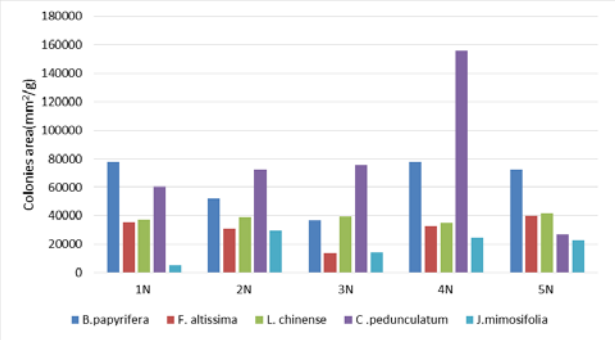

Fig.8. The average bacterial colonies area of unit dust-cathing quatity(experimental conditions: 10- 37℃, pH: 7, reaction time:72h, in 1N-5N medium).

Discussion

From experimental results and analysis concluded above, the dust-catching ability of the same plant species was significantly higher in December than in February (Fig. 1). It could be seen that the dust-catching capacity of *Jacaranda mimosifolia* was affected by phenophase. The amount of dust-catching per leaf area was only 54% in February for the reason that the leaves of *Jacaranda mimosifolia* was very thin from November to February because of its dormancy [22]. So it was the same as *B. papyrifera* [23]. In addition, the ability of dust-catching of *Jacaranda mimosifolia* had a close relationship with the surface structure of leaves [24, 25]. The ability of dust-catching was weakened because of the bipinnate leaves, which reflected the positive correlation between leaf areas and dust quantity on each leaf [26], though there was fluff on the surface.

According to inhibiting microorganism test, the bacterial colonies area of each plant species' leaves dust had various trends in different times, temperatures and media. Under the condition of the same amount of dust-catching, the smaller the bacterial area was, the stronger bactericidal ability of the plant was [27]. So, the comparison of these five plant species were *J. mimosifolia*> *F. altissima*> *L. chinense*> *B. papyrifera*> *C. pedunculatum*.

In summary, *Jacaranda mimosifolia* has a certain ability of dust-catching , while there's a much stronger capability of inhibiting microorganism than other control plants. In general, the amount of leaves dust is in proportion to the microorganism theoretically. But the result was not the case, the ability of dust-catching was *L. chinense* > *F. altissima* > *B. papyrifera* > *J. mimosifolia* > *C. pedunculatum*, while the inhibiting microorganism was *J. mimosifolia*> *F. altissima*> *L. chinense*> *B. papyrifera*> *C. pedunculatum*. The appearance of this kind of phenomenon may be related to the structure of the leaf surface and its secretion.

CONCLUSION

Therefore, the ability of inhibiting microorganism of *Jacaranda mimosifolia* is more obvious than others species while the ability of dust-catching is not that effective, which shows that different plants had different sterilization. In this case, it is urgent to do further research on the specific secretion of *Jacaranda mimosifolia* to inhibit the microorganism.

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ПРОУЧВАНЕ НА ПРАХОУЛАВЯНЕТО И СПОСОБНОСТТА ЗА ИНХИБИРАНЕ НА МИКРООРГАНИЗМИ НА *Jacaranda mimosifolia* ПРИ ЕДНАКВИ УСЛОВИЯ НА ЕКСПЕРИМЕНТ ЗА СРАВНЕНИЕ

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(Резюме)

Направено е проучване на Jacaranda mimosifolia и други четири растителни видове в райони с интензивен трафик в Чънду, Зигон и Суйнин за да се намери обективен закон, насочен към праховото замърсяването на въздуха. Резултатите от изследването показаха : средното количество прах на единица листна площ беше *L. chinense> F. altissima> B. papyrifera> J. mimosifolia> C. pedunculatum*, съответно 6,2690, 4,9561, 4,6474, 3,927, 1,0825 г / m^2; От теста на бактериални култури, площта на бактериалните колонии на прашни листа на всяко растение се увеличава с течение на времето за 24, 48, 72 часа, а най-високата точка е в 48 час; Площта също се увеличава с повишаване на температурата (10, 20, 25, 30, 37 ˚C), но има и някои разлики в различните нива. Показано е, че са налице значителни разлики (P <0.05) и екстремна разлика (P <0.01) между 10-20 ℃, особено на *L. chinense* и *C. pedunculatum*. Съответните данни за *J. mimosifolia* се увеличават, докато другите намаляват или остават постоянни между 20-30 ˚C, но увеличението е много по-малко в сравнение с други растения по друго време. От общ поглед, реда на бактериалните колонии по уловеното количество прах на единица листна площ е *C. pedunculatum> B. papyrifera> L. chinense> F . altissima> J. mimosifolia*. Може да се види, че *Jacaranda mimosifolia* има определена способността за прахо-улавяне, докато има много по-силна способност да инхибира микроорганизмите отколкото другите контролни растения. Затова конфигурацията на съвременно растение трябва да се комбинира с конкретно местообитание, следвайки обективен закон. Въпреки това, специфичната секрецията на *Pythoncidere*, произвеждани от *Jacaranda mimosifolia*, както и вида на микроорганизмите трябва да се проучат допълнително.