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Medicinal uses of a leafy cactus, *Pereskia bleo*, in Singapore: A survey on the users' knowledge and their perceptions

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Abstract
Pereskia bleo is a leafy cactus traditionally used for various purposes. We aim to study the information about the usage, preparation methods, effects and possible unwanted effects of *Pereskia bleo* from the users of fresh medicinal plants in Singapore. The participants were recruited through advertisement and interviewed. Data was evaluated using thematic analysis and statistical methods. From 25 participants, 36% used this plant for treatment of medical conditions such as breast, lung and prostate cancers and constipation, 32% for health promotion like detoxification and improving blood flow and immunity, and 32% for both. Reported side effects were mild and reversible pruritus, diarrhea, cold sensation and weakness in the feet, and increased prothrombin time caused by potential herb-drug interaction. Studies are needed to further explore the potential therapeutic effects and possible herb-drug interactions. Moreover, healthcare professionals should actively enquire about the concurrent usage of fresh medicinal plants including *Pereskia bleo* by patients to monitor for possible interactions.

Keywords: *Pereskia bleo*, medicinal uses, knowledge, perception

1. Introduction
Medicinal plants have been used since time immemorial for the treatment of ailments. Indigenous healers often claim to have learnt by observing that sick animals change their food preferences to nibble at bitter herbs they would normally reject [1]. Such knowledge was traditionally acquired by the medicine men of indigenous tribes and has gradually become ethnic habits and dietary preferences, and practiced as traditional medicine (TM) [2]. TM that has been adopted by other populations (outside its indigenous culture) is often termed complementary and alternative medicine (CAM). Herbal medicine is the most commonly used form of TM in developing and developed countries [3]. In many developed countries, TM is not usually practiced in the dominant healthcare system. Singapore is a developed city state with allopathic medicine as the dominant healthcare system. Despite the advanced health care system in Singapore, there are still pockets of the population who use fresh medicinal plants for health maintenance and/or medical purposes.
Pereskia bleo (Kunth) DC (*P. bleo*) is a medicinal plant that belongs to the Cactaceae family. The native distributions of this plant are in Panama and Colombia. It grows well in Singapore and other tropical countries like Malaysia [4]. It is also called "Qi Xing Zhen" in Chinese and "Pokok Jarum Tujuh Bilah" in Malay. Its Chinese name literally means "seven star needle"[5]. *P. bleo* has been eaten raw as vegetables by some people in Malaysia and China or taken as a decoction brewed from the fresh leaves for dietary purposes, detoxification and revitalizing the body [6]. The plant is also available commercially as a tea product in Malaysia. The leaves of *P. bleo* have been traditionally used to treat cancer, hemorrhoid, hypertension, diabetes, infections, gastric pain, headache, ulcer and inflammatory conditions like rheumatism and asthma [4]. Indigenous Colombians have used *P. bleo* to neutralize the effects of snake bites, to relax spastic muscles and for muscle aches [7]. In Central America, Kuna Indians used the crushed leaves to clarify drinking water [8]. We have previously published the collated results of a survey involving 200 users of fresh medicinal plants. *P. bleo* was the third most commonly used plant among these participants [9]. The objective of the present study is to further investigate the usage of *P. bleo* among the users in Singapore.

2. Methodology
The study was conducted between the period of October 2010 and May 2013 in Singapore. The survey protocol was approved by National University of Singapore Institutional Review Board.

2.1 Participant recruitment
Participants were recruited via the local newspapers, namely "The Straits Times" and "Lian He Zao Bao", as well as by word of mouth (snowball sampling). In addition, recruitment advertisements were mounted in some community gardens and notice boards.

2.2 Inclusion and exclusion criteria
Subjects aged 18 or above, who were using or had used *P. bleo* in the past 5 years for health promotion and/or therapeutic purposes and who gave an informed consent, were interviewed. They should be able to speak either English or Mandarin. Participants who were not able to provide a fresh sample of the plant or a photograph of it were excluded.

2.3 Questionnaire
After getting an informed consent, a face-to-face interview was carried out using a questionnaire to collate information on people's knowledge and usage of *P. bleo*. The questionnaire consisted of 3 main sections: demographic details, plant-use information and perceptions [9].

2.4 Plant identification
The plant species was identified using the information provided in Singapore National Park Board, International Plant Nomenclature Index and Tropicos (Missouri Botanical Garden) databases. In addition, a sample of the fresh plant or a self-taken photograph of the plant used was obtained from every participant for identification purposes. Voucher specimens of the plant were kept in the herbarium of the Department of Pharmacy, National University of Singapore (NUS).

2.5 Data analysis
The data was analyzed by the Microsoft Office Excel 2014 program. Relevant demographic information was analyzed by Chi-square using SPSS 20 software (SPSS Inc, Chicago, IL, USA). Medical conditions were categorized based on WHO International Classification of Disease Version 2020 (ICD-11) and Traditional Chinese Medicine (TCM) concepts. Thematic analysis was also used for the descriptive part of the data. In addition, literature search was performed to compare the information obtained in the survey with published literature. The level of satisfaction was measured using a 5-point Likert scale, with scores of 1 for highly unsatisfied, 2 for unsatisfied, 3 for neutral, 4 for satisfied and 5 for highly satisfied.

3. Results and discussion
A total of 25 users of *P. bleo* were interviewed. Their demographic information, knowledge and experiences on the usage of this plant and perception of use were collated.

3.1 Demographic characteristics
Demographic characteristics of the participants are presented in Table 1. As can be seen, the number of female participants (17, 68%) was twice that of male (8, 32%). Furthermore, most of the participants were Singaporean (23, 92%) and of Chinese ethnicity (24, 96%). The median age was 59 years old (range: 37 to 79 years old). The mean monthly household income of participants in this survey was S$ 3,416 (median: S$3,500). It was considerably lower than the household-income trend of Singapore in 2012, the time of the study (Mean: S$7214; Median: S$5000) [10]. Approximately one-third of the participants were retirees, hence many of them did not have much income, if any.

In this study, three out of 25 users (12%) had a history of health-related employment, namely in nursing, pharmacy and TCM. All of them indicated that their jobs have made a positive impact on their attitude towards herbal medicine and they were willing to recommend *P. bleo* to others. This is also implied in a study in Malaysia which investigated the understanding, perceptions and self-use of CAM among pharmacy students. More than half (289, 57.8%) of the participants were currently using CAM while a bigger proportion (388, 77.6%) had used it previously [11].

Table 1: Demographic information of *P. bleo* users (n=25).

Characteristics		No.	%
Gender	Male	8	32
	Female	17	68
Ethnicity	Chinese	24	96
	Eurasian	1	4
Age	18 – 39	1	4
	40 – 64	16	64
	≥ 65	8	32
Nationality	Singaporean	23	92
	Indonesian	1	4
	Malaysian	1	4
Highest level of education	No formal education	2	8
	Secondary	7	28
	Pre-university	6	24
	University and beyond	8	32
Current employment status	Unemployed	2	8
	Homemaker	3	12
	Retiree	7	28
	Self-employed	3	12
	Teacher	5	20
	Others	5	20
History of having a health-related job	Yes	3	12
	No	22	88
Family size (including self)	1	4	16
	2 – 4	9	36
	≥ 5	12	48
Approximate monthly household income (S$) *approximately equivalent to 4,000 USD	0 – < 5,000*	16	64
	≥ 5,000	7	28
	Unsure/ declined to answer	2	8

3.2 Information on the use of *P. bleo*

3.2.1 Sources of the plant

Participants cited own residential places (10, 40%), community gardens (9, 36%) and friends'/neighbor's gardens (6, 24%) as the top main sources of obtaining *P. bleo* for their use. None of the users had purchased this plant. Worth to notice that this fresh plant is not commercially available in most wet markets or supermarkets, but it is available at stalls specializing in selling fresh medicinal plants. In addition, the consumers may get the plant from their personal gardens or community gardens in which there would be no cost incurred. In land scarce Singapore, community gardens are useful and important places for growing medicinal plants and exchanging information about their usage.

3.2.2 Indications of use

P. bleo was used for health maintenance (13, 52%), for treatment of medical conditions (7, 28%) or for both purposes (5, 20%) as reported by the participants. Each category was further classified as follows:

3.2.2.1 Health maintenance

Using *P. bleo* for the purpose of maintaining general health and preventing diseases, the plant parts used and methods of preparation are presented in Table 2. It can be seen that some used *P. bleo* for general health promotion (9, 36%), detoxification (7, 28%), "smoothing blood flow" (2, 8%) and prevention of certain pathological conditions like cancer (7, 28%) and constipation (7, 28%).

Table 2: Using *P. bleo* for the purpose of maintaining general health and preventing diseases, the plant parts used and methods of preparation as reported by the participants

Purpose of usage	No. of users	Used part	Method of preparation
General health promotion	9	Leaf Flower	(1) 2 to 10 fresh leaves are eaten raw daily or weekly, alone or with other vegetables but without dressing. (2) 1 to 2 fresh flowers are eaten raw if available. They are not regularly eaten as they are scarce.
Cancer prevention	7	Leaf Flower	(1) 1 to 3 leaves are eaten raw daily or at least weekly. (2) 1 to 2 fresh flowers are eaten raw if available. They are not regularly used as they are scarce.
Detoxification	7	Leaf	(1) 5 to 7 leaves are boiled in water and drunk occasionally. (2) 2 to 3 fresh leaves are taken raw daily.
Constipation prevention	7	Leaf	(1) 1 to 10 fresh leaves are taken raw daily. (2) 15 to 20 leaves are cooked with fried garlic and water and eaten daily or on alternate days.
Gastritis prevention	2	Leaf	1 to 3 leaves are eaten raw daily or weekly.
Smoothing blood flow/ break up blood clots (TCM concepts)	2	Leaf Flower	(1) 7 leaves are boiled in water and drunk occasionally. (2) 1 leaf is eaten raw daily. 1 fresh flower is eaten raw if available. The flowers are not regularly eaten as they are scarce.
Improving the immunity	1	Leaf Flower	1 leaf or flower is taken raw daily.

3.2.2.2 Medical conditions

Twenty participants used *P. bleo* for the treatment of 15 medical conditions. Some of them consumed it to treat more than one medical condition. Table 3 presents the details of the medicinal uses of *P. bleo* as reported by the participants, the plant parts used and methods of preparation. The diseases were classified according to ICD-11. Malignant neoplasms (7, 28%), followed by benign tumors (4, 16%), constipation and gastritis (4, 16%) were the most common medical conditions for which it was used. Traditionally, *P. bleo* has been used to treat cancer [4]. Some studies reported the antiproliferative properties and mechanism of actions of *P. bleo* extracts against selected human cancer cell lines, i.e. nasopharyngeal epidermoid carcinoma, colon carcinoma, cervical and breast carcinoma [4, 6, 12-14]. Breast and prostate cancers were the conditions for which *P. bleo* was used by our participants. In a study, nine users of *P. bleo* from three selected villages in the State of Kelantan, Malaysia, reported that "the use of leaves, tips and flower of *P. bleo* was alone effective against cancer, hypertension, boils, diabetes mellitus and also as a health supplement" [15].

Table 3: Details of the medicinal uses of *P. bleo* as reported by the participants (based on ICD-11), plant parts used and methods of preparation

ICD-11 category	No. of users	Used part	Method of preparation
Neoplasm Malignant breast, lung, prostate, uterus, blood: thrombocytosis, lymphoma	7	Leaf	2 to 3 fresh leaves are chewed twice a week or daily. The juice of 2 to 3 fresh leaves in combination with some other herbs is drunk 2 to 3 times a week. 10 to 15 leaves are boiled in water and drunk 1 cup a day.
Benign breast, thyroid, salivary gland	4	Leaf Fruit	2 to 10 fresh leaves are eaten raw daily. The fruit should be grilled on the fire to soften, and then it is cut into half. The cut surface is positioned on top of the tumor twice a day for 2 hours. It is done daily for thyroid mass or weekly for parotid mass.
Digestive system diseases Constipation & gastritis	4	Leaf	3 to 4 fresh leaves are taken 3 to 4 times a week or daily.
Respiratory disorders Cold & flu symptoms	1	Flower	1 flower is boiled in a cup of water and taken daily.
Endocrine and metabolic disorders Diabetes mellitus	1	Leaf	5 to 6 fresh leaves are taken raw daily.
Infectious diseases Herpes Simplex-I	1	Leaf	5 to 7 leaves are boiled in water and drunk daily.
Musculoskeletal diseases Osteoarthritis	1	Leaf	3 fresh leaves are taken raw weekly.
Urinary system Renal failure	1	Leaf	6 to 12 fresh leaves are taken raw daily.

Table 4 presents the usage of *P. bleo* and its reported pharmacological activities. Some of the reported usage is consistent with the traditional usage of *P. bleo* [4]. On the other hand, traditional knowledge may be lost due to rapid urbanization and development in Singapore, which further emphasizes the importance of proper documentation of them. Although some scientific studies have been conducted thus far to investigate the biological activities of this plant, there are as yet many other unexplored areas (e.g., in the treatment of ulcer and hypertension) which warrant further investigation. The database created in this study serves as a useful resource for further scientific studies.

Table 4: The usage of *P. bleo* and its reported pharmacological activities**.**

	Usage reported by survey participants	References of traditional usage	References of reported pharmacological activity
Analgesic or antinociceptive	Yes	[16, 17]	[17-19]
Anti-ulcer	No	[20, 21]	NA
Anti-hemorrhoid	Yes	[20]	NA
Anti-hyperglycemia	No	[20, 22]	[23]
Anti-hypertension	No	[4, 22]	NA
Anti-inflammatory	Yes	[4, 21, 22]	NA
Anti-microbial	Yes	NA	[24-27]
Cancer prevention	Yes	[4, 12, 27]	NA
Anti-cancer	Yes	[4]	[4, 6, 13, 22]
Detoxification	Yes	[17]	[7, 28, 29]

NA means “not applicable”.

3.2.3 Plant parts used

The leaves were the most commonly used part of this plant and mainly consumed fresh without any special preparation (19, 76%). Only a few participants drank the decoction of the leaves boiled in water (6, 24%). The flowers were eaten in the same way as the leaves. The only reason for fewer people using the flowers was the scarcity, as mentioned by the users.

3.2.4 Timing for plant intake

P. bleo users held different beliefs regarding the suitable timing for taking the herb. Sixteen participants (64%) believed that the timing of taking the herb is important and that the leaves should be taken after food (6, 24%), with food (6, 24%) or before food (4, 16%). The rest of the users were not concerned about the timing for using/taking the plant. To the best of our knowledge, there is no prior published literature available on the method of preparation and the timing of taking it.

3.3 Reported outcomes of usage

The participants were asked about the effects experienced from using *P. bleo*, namely cure, symptomatic relief, sense of well-being, no effect or worsening of the symptoms/diseases. Table 5 shows the reported outcomes of using *P. bleo*.

Table 5: Reported outcomes of using *P. bleo*

Reported outcomes	No. of users
Sense of well-being only	11
Symptomatic relief only	8
Cure	4
Symptomatic relief of conditions and sense of well-being	2
No effect experienced	0
Worsening of symptoms	0

Most of the participants achieved a sense of well-being (13 users) or had symptomatic relief of their conditions (10 users) after using this plant. For these users, consuming the leaves of *P. bleo* helped to promote bowel movement (6 users) and relieve constipation (3 users). A study has found that the leaves of *P. bleo* are rich in mucilage which exhibited a much higher water holding capacity as compared to Arabic gum [30]. The mucilage content could be responsible for facilitating bowel movement.

In this study, four participants reported that their conditions (namely, lymphoma, benign breast mass, thyroid cyst and cold sore – Herpes Simplex Virus-1 (HSV-1) infection) were cured after taking the plant. Several studies have previously demonstrated its anti-proliferative effects [4, 31]. However, the plant did not show any promising effects in an anti-viral study against HSV-1 [32].

3.4 Reported side effects

Five participants reported mild side effects as follows:

a) Dermatologic manifestations

A participant experienced localized itchiness (pruritus) after applying the cut fruit on the skin for more than 2 hours. Another user reported generalized itchiness without any rash after eating the raw leaves. Fortunately, the symptoms were relieved upon cleaning the skin and stopping the consumption of the leaves, respectively.

b) Gastrointestinal manifestation

A participant experienced diarrhea after taking more than 3 leaves per day or if the leaves were taken on an empty stomach. Diarrhea was, however, not triggered by taking less than 3 leaves after meal.

c) General manifestation

A participant experienced cold sensation and weakness in the legs after eating the raw leaves. This might be a sign of decreased blood pressure, which is consistent with the report by Khor *et al.* (2013) [15]. In their study, one of the participants experienced low blood pressure upon eating the “tips of the plant or recently grown small leaves and very thin stalks”.

d) Effects on blood coagulation

A participant experienced increased prothrombin time (PT) and increased international normalized ratio (INR), while taking the leaves daily as a vegetable, concurrently with his anticoagulant medication, warfarin. However, the potential herb-drug interaction needs to be further confirmed.

Since users from the above two cases (c) and (d) were also on concomitant medications for hypertension and deep vein thrombosis respectively, more studies are needed to confirm any potential herb-drug interaction for this plant. No serious adverse effect or toxicity was experienced or reported by any of the participants.

3.5 Communication with healthcare professionals regarding the use of *P. bleo*

Table 6 shows the percentage of the users who consulted a healthcare professional on the use of *P. bleo*.

Table 6: Percentages of the users consulting a healthcare professional on the use of *P. bleo* by gender, age and educational level

Characteristics		Consulted a health care professional about the use of *P. bleo*		
		No	**Yes**	**Total**
Gender	Male	6 (24%)	2 (8%)	8 (32%)
	Female	13 (52%)	4 (16%)	17 (68%)
Age	< 65 years old	13 (52%)	2 (8%)	15 (60%)
	≥ 65 years old	6 (24%)	4 (16%)	10 (40%)
Educational level	Below pre-university	9 (36%)	2 (8%)	11 (44%)
	Above pre-university	10 (40%)	4 (16%)	14 (56%)

$p > 0.05$ for gender (OR= 1.08 [95% CI, 0.154 – 7.642]), age groups (OR= 4.33 [95% CI, 0.614 – 30.570]) and educational level (OR= 1.80 [95% CI, 0.264 – 12.296]).

Chi square analysis did not show any significant correlation between gender (OR = 1.08 [95% CI, 0.154 –7.642]), age groups (OR = 4.33 [95% CI, 0.614 – 30.570]) or educational level (OR = 1.80 [95% CI, 0.264 – 12.296]) with "consulting a healthcare professional about using this plant" ($p > 0.05$).

In addition, 15 of the 25 *P. bleo* users reported taking conventional medicine concurrently. However, only 4 of them informed healthcare professionals about the use of this plant. These findings are consistent with other studies that show most people are reluctant to inform their physicians about the usage of CAM [33, 34]. In our study, reasons for patients not informing their healthcare professionals about the use of *P. bleo* include "they are not knowledgeable about herbal medicine" (8 users), "they do not believe in herbal medicine and would show objection for using them" (4 users), "healthcare provider did not ask" (1 user), "there is no need to inform the doctors as it is a natural treatment" (2 users), "I have not visited a healthcare professional since the start of the use of this plant" (3 users). Such reasons have been similarly reported by other studies like the work done by Teo *et al*., 2016[34]. In their study, although most of the participants did not inform their healthcare professional about using CAM, they would like to know more about CAM from their doctors. In the current study, the most common reason for not consulting or informing a healthcare professional was due to the perception that healthcare professionals had inadequate information about CAM. A study among pharmacy students in Malaysia showed that most of the students (74.8%) believed that lack of scientific evidence is one of the most important barriers obstructing them to use CAM [11]. Moreover, in another study on nursing students in Australia, they had positive attitude towards using CAM but limited knowledge was the main obstacle [35]. Hence, the lack of communication between patients and healthcare providers regarding the use of CAM need to be addressed.

3.6 Reported contra-indications or cautions by the participants

Most of the participants (18, 72%) did not report any contra-indication for using this plant. However, a few of them mentioned that taking this plant while having upper respiratory symptoms can lead to throat irritation. In addition, some participants mentioned that pregnant/lactating ladies and children should avoid consuming this plant. To the best of our knowledge, there is no report from existing literature on the possible side/adverse effects of consumption of *P. bleo* in pregnant women or children.

3.7 Motivations for use

Participants were asked to provide their reasons for using *P. bleo*. Figure 1 shows the reasons cited by the participants for using this plant. They were asked to provide more than one reason, if applicable. A majority of them indicated reasons such as "recommendation by others" (24, 96%) and "others' good experience with this plant" (16, 64%).

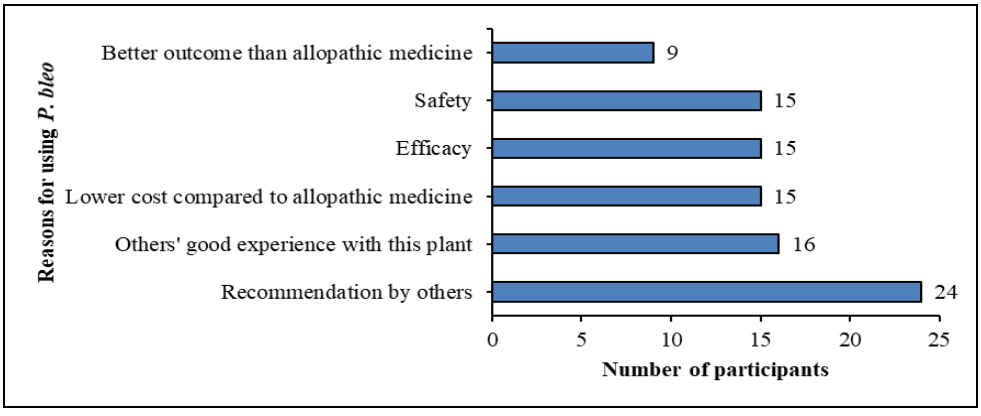

Fig 1: Reasons cited by the participants for using *P. bleo*. The participants were asked to provide more than one reason if applicable.

In addition, more than half of the participants (15, 60%) mentioned efficacy and safety as reasons for using *P. bleo*.

In this study, a total of 21 users (84%) ranked friends and family, 12 users (48%) ranked the herbalists and 8 users (32%) ranked the internet as the main sources of obtaining information about this plant.

In addition, the users (23, 92%) were keen to recommend this plant to others because of the following reasons: safety and efficacy (15, 60%), no side effects (12, 48%) and lower cost (11, 44%) compared to conventional drugs. Despite a general perception about the good safety profile of *P. bleo*, published studies showed controversial results for the toxicity of the leaf extracts *in vitro* and *in vivo*. The mutagenic effects of the water and methanol leaf extracts on *Salmonella typhimurium* were studied, showing that the water extract of *P. bleo* may form mutagenic compound(s) upon metabolization by the liver enzymes [12]. On the other hand, another study showed that the methanol extract of the leaf of this plant did not exert any toxicity on ICR mice (LD_{50} > 2500 mg/kg) [5].

The results from this study suggest that further studies on the efficacy and safety of *P. bleo* should be carried out. Misconceptions about the safety of herbal medicine may lead to undesirable consequences. Hence, there is a need to improve public awareness about the safe usage of medicinal plants.

3.8 Satisfaction level

The level of satisfaction with the usage of *P. bleo* was measured by using a 5-point Likert scale. The mean score was 4.44 ± 0.82 (range: 3 – 5), indicating a level between "highly satisfied" and "satisfied". Sixteen (64%) of the users were highly satisfied with the use of *P. bleo*. No participant reported any dissatisfaction.

4. Conclusion

Information about the usage of *P. bleo* by 25 participants was collated and systematically documented. This is the first detailed survey on the usage of *P. bleo* in Singapore and the second study worldwide. Information collated in this study will be beneficial to the public and will serve as a useful resource to guide future research.

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6. Conflict of Interest

The authors have declared that there is no conflict of interest.

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