บทความวิจัย

การตรวจวัดคุณภาพอากาศเบื้องต้นด้วยไลเคนและการวัดสมรรถภาพปอดในชุมชนพุกร่าง อำเภอพระพุทธบาท จังหวัดสระบุรี

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บทคัดย่อ

การศึกษานี้มีการตรวจคุณภาพอากาศเบื้องต้นในชุมชนพุกร่าง อำเภอพระพุทธบาท จังหวัดสระบุรี ด้วยความถี่และชนิดของไลเคน พบชนิดไลเคนในกลุ่มทนทานมลภาวะระดับกลางและสูง ได้แก่ ไลเคน *Anthracothecium* sp. (ร้อยละ 66.4) ตามด้วย *Graphis subassimilis* (ร้อยละ 19.8) *Cryptothecia effusa* (ร้อยละ 12.0) และ *Pyxine cocoes* (ร้อยละ 1.8) ตามลำดับ ซึ่งแสดงคุณภาพอากาศในชุมชนอยู่ในระดับต่ำ นอกจากนั้นเมื่อตรวจสมรรถภาพปอดของอาสาสมัคร 47 คน ด้วยสไปโรมิเตอร์ พบความชุกของสมรรถภาพปอดผิดปกติรวม ร้อยละ 63.8 ประกอบด้วย การตีบแคบของทางเดินหายใจขนาดเล็ก (ร้อยละ 40.4) การจำกัดการขยายตัวของปอด (ร้อยละ 10.6) มีหลอดลมอุดกั้น (ร้อยละ 6.4) และเป็นทั้งการจำกัดการขยายตัวของปอดและหลอดลมอุดกั้น (ร้อยละ 6.4) นอกจากนั้นผลการศึกษาแสดงความสัมพันธ์เชิงลบระหว่างระยะเวลาที่อาศัยในชุมชนและค่า $FEF_{25\%-75\%}$ อย่างมีนัยสำคัญ ($r = -0.353$, $p = 0.015$) ซึ่งชี้ให้เห็นว่าอาสาสมัครมีโอกาสมากขึ้นที่จะมีการตีบแคบของทางเดินหายใจขนาดเล็ก หากอาศัยในชุมชนเป็นเวลานาน ดังนั้นการมีคุณภาพอากาศระดับต่ำในชุมชนอาจเป็นหนึ่งในปัจจัยสำคัญที่ส่งผลให้พบความผิดปกติของปอดในระยะแรกก่อนที่ผู้ป่วยจะมีอาการ จึงควรมีการศึกษาต่อไปโดยขยายพื้นที่สำรวจเพื่อหาความสัมพันธ์ของชนิดไลเคนกับการเกิดโรคระบบทางเดินหายใจ

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Monitoring preliminary air quality with lichens and lung function tests in Phukrang community, Amphoe Phra Phutthabat, Saraburi province

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ABSTRACT

In this study, air pollution in Phukrang community, Amphoe Phra Phutthabat, Saraburi province was preliminary monitored by frequencies and species of the lichens. The result found high and modulate pollution tolerant lichens, *Anthracothecium* sp. (66.4%), following *Graphis subassimilis* (19.8%), *Cryptothecia effuse* (12.0%) and *Pyxine cocoes* (1.8%), respectively, which implied low level of air pollution in the community. In addition to lung functions of 47 subjects were evaluated by a spirometer, it showed that there was a total prevalence of lung function abnormalities (63.8%) involving small airway obstruction pattern (40.4%), following restriction pattern (10.6%), obstruction (6.4%) and combined types (6.4%), respectively. Furthermore, a negative correlation between years of living in the community and values of $FEF_{25\%-75\%}$ was significantly detected ($r = -0.353$, $p = 0.015$). It is implied that subjects will get a higher chance to be small airway obstruction, if they lived in the community many years. Therefore, the low air quality in the community may be one of major determinants to influence on the finding of lung function abnormalities of people. Thus, increasing survey areas should be further studied to determine relationship between lichen species and respiratory diseases.

Keywords: lung function, lichens, air quality, community

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Introduction

Lichens are the symbiotic organisms of algae and fungi [3]. There are several reports involving lichens used as bioindicators for monitoring air pollution in many countries e.g. Slovenia forests [15], Northern provinces of Thailand; Nan, Phayao, Lampang, Lamphun, Chiang Rai, Chiang Mai and Mae Hong Son [19], and Northeast provinces of Thailand; Nakhon Rachasima, Chaiyaphum, Khon Kaen, Sakhon Nakhon, Loei, Nong Khai, Yasothon and Ubon Rachathani [8]. In addition to many lichens such as families *Physciaceae* and *Parmeliaceae* have been demonstrated in monitoring of air quality [19]. Moreover, lichens have been reported for benefits as bioindicators of human health (e.g. lung cancer) [4].

Nowadays, air pollution is a major environmental challenge in many developing countries [2]. Thailand is one of developing countries that consists of many industry areas (e.g. cement industry) increasing in urban led to air pollution. The air pollution is a result of releasing smoke, carbon monoxide, sulfur oxides, nitrogen oxides and dusts from the industries into the climate effecting on human health [1] e.g. asthma and lung cancer [9]. Furthermore, lung function tests are widely used to measure how well the lungs function and to evaluate a primary of lung diseases [17, 20]. Saraburi province has been reported involving poor quality of air pollution because of the cement production in an industry area [13]. Therefore, our major goal was to determine types and frequencies of lichens in Phukrang community, Amphoe Phra Phutthabat, Saraburi province, prevalence values of lung function abnormalities and correlation between years of living in the community and presence of lung function abnormalities. The obtained information may be useful for program management to reduce pollination in the atmosphere and to promote their health of people in the community, and used as basic data to further study.

Materials and Methods

Lichen sampling

In the study, Phukrang community, Amphoe Phra Phutthabat in Saraburi province was investigated as polluted areas situated near to the cement industry. Lichen sampling was surveyed between January 2015 and March 2015. Fourteen trees (e.g. Mango trees) were random selected based on the suitability of the accessible of the trees e.g. in the temple, gardens and parks (Figure 1). For each tree (circumference > 60 cm), frequencies and species of lichens were investigated by purposive sampling and recorded using a grid frame (10×10 cm^2) and a modifier grass. The grid frame was located systematically on the north, east, south and west side of each tree trunk at level of 1 m from the ground state, and lichens communities were counted [10]. After that, lichens were collected using a sharp knife and kept in polyethylene tube then species of lichens were classified under a stereomicroscope by using keys of Brodo et al. (2007) and Sriprang and Mongkolsuk (2010) [5, 24].

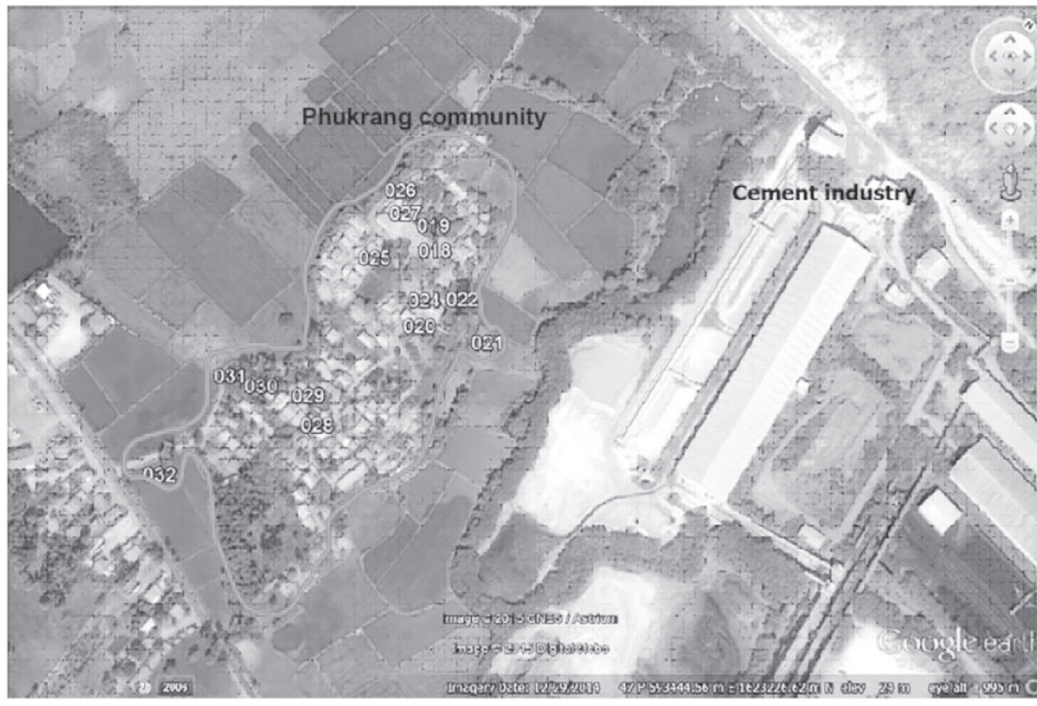

Figure 1 Sampling area in Phukrang community recorded by GPS (global positioning system) using Garmin GPS MAP 62s in system UTM (x-utm and y-utm), and shown in Google Earth version 7.1.2.2041

Lung function tests

This study was a cross sectional study and obtained research ethic of Faculty of Health Science, Srinakharinwirot University (HSHP2014-009). Total fifty-nine subjects who had provided consent and presently living in the community were evaluated by a recording form involving disease and smoking history, age, gender and years of living in the community. From the total subjects, 47 subjects were selected for the lung function test by a spirometer (Enraf-Nonius, Model SPIRO 601) on the basis of following criteria.

Inclusion criteria: Subjects were male or female adults with the age ≥ 20 years, lived in Phukrang community, Saraburi province since ≥ 5 years and had voluntariness to participate in this study.

Exclusion criteria: Subjects had history of any respiratory illness, cardiovascular illness, musculoskeletal abnormalities concerning upper trunk or rib cage, neuromuscular disease, and pregnant

The lung function tests of 47 selected subjects were examined by the spirometer for triplicate. The values of FVC (Forced Vital Capacity), FEV1 (Forced expiratory volume in 1 second), FEV1/FVC, $FEF_{25\%-75\%}$ (average forced expiratory flow rate over middle 50% of vital

capacity) were recorded and presented as a percentages of predicted normal values according to the method of Ip et al. (2000) [14]. Abnormal lung function tests were categorized on the following criteria shown in Table 1

Table 1 Categorization of lung function abnormalities

	FVC (% predicted values)	FEV_1 (% predicted values)	FEV_1/FVC %	FEF 25%-75% (% predicted values)
Restriction pattern	< 80			
Obstruction pattern		< 80	< 80	
Combined pattern	< 80	< 80		< 65
Small airway obstruction pattern				< 65

Data analysis

Descriptive statistics (e.g. percentage) were used to describe frequencies of lichens and prevalence values of lung function abnormalities. Pearson's correlation analysis was used to measure association between years of living in the community and the lung abnormalities of human [21].

Results

In this study, the lichen species were surveyed in Phukrang community. Four species of lichens were found. *Anthracothecium* sp. (66.4%) was found the most in the area, following *G. subassimilis* (19.8%), *C. effusa* (12.0%) and *P. cocoes* (1.8%), respectively (Table 2 and Figure 2).

Table 2 Species and groups of lichens used as bioindicator for monitoring air quality in Phukrang community

Air quality	Groups	Lichens	Number of lichens	%
poor	high tolerant	*Anthracothecium* sp.	144	66.4
		Pyxine cocoes	4	1.8
moderate	moderate tolerant	*Graphis subassimilis*	43	19.8
		Cryptothecia effusa	26	12.0
	Total		**217**	**100**

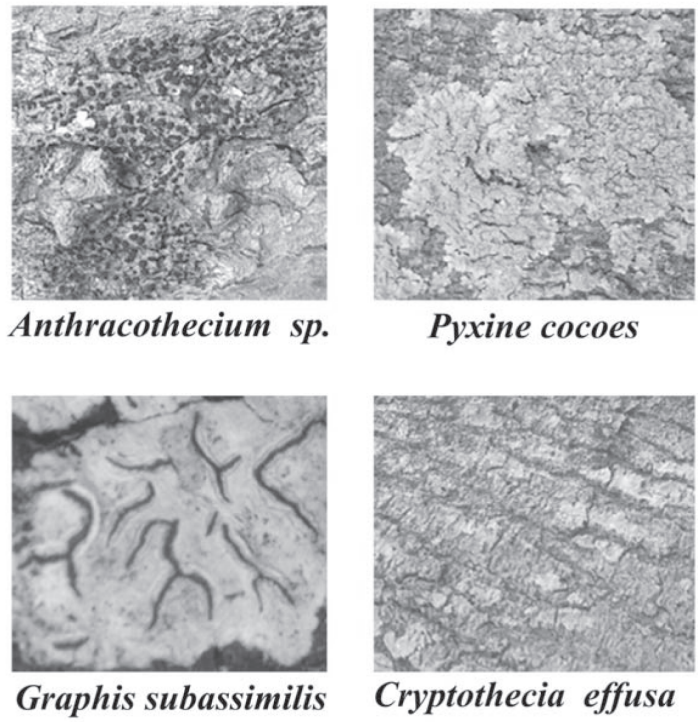

Figure 2 Examples of lichen species found in Phukrang community

The lung function test of 47 subjects in the community were measured by the spirometer. Distribution of the subjects according to age and years of living in the community was shown in Table 3. Table 4 and Figure 3 showed prevalence of lung function abnormalities that were classified following the types of respiratory abnormalities. The total prevalence of lung function abnormalities showed 63.8% consisting of small airway obstruction pattern (40.4%), following restriction pattern (10.6%), then obstruction (6.4%) and combined types (6.4%), respectively. Moreover, the result showed a negative correlation between years of living in the community and % predicted values of FEF 25%-75%, significantly ($r = -0.353$, $p = 0.015$).

Table 3 Distribution of age and duration of living in the community of subjects

	Number of subjects	%
Age group (years)		
20-25	3	6.4
26-30	4	8.5
31-35	6	12.8
36-40	2	4.3
41-45	5	10.6
46-50	3	6.4
51-55	6	12.8
56-60	10	21.3
61-65	5	10.6
66-70	1	2.1
71-75	2	4.3
Total	**47**	**100**
years of living in the community (years)		
5-10	6	12.8
11-15	-	-
16-20	5	10.6
21-25	3	6.4
26-30	5	10.6
31-35	6	12.8
36-40	-	-
41-45	3	6.4
50-55	1	2.1
56-60	5	10.6
61-65	6	12.8
66-70	5	10.6
71-75	2	4.2
Total	**47**	**100**

Table 4 Prevalence values of lung function abnormalities

Lung function abnormalities	Number of subjects affected	%
Restriction pattern	5	10.6
Obstruction pattern	3	6.4
Combined pattern	3	6.4
Small airway obstruction pattern	19	40.4
Total	**30**	**63.8**

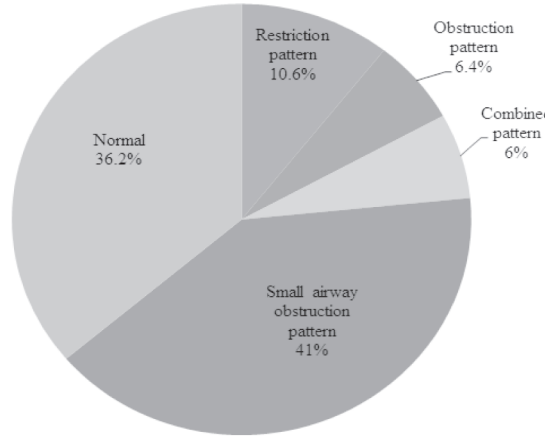

Figure 3 Classification of lung function abnormalities in Phukrang community.

Conclusion and Discussion

The measurement of respiratory function by a spirometer provides common parameters e.g. FVC, FEV1, FEV1/FVC and $FEF_{25\%-75\%}$. The FVC value has been used to predict respiratory muscle strength, e. g., being indicator of survival and disease progression in ALS patients [5]. For the FEV1 value, it is used to screen obstruction of the respiratory system resulting from air pollution in small and medium cities [7]. Moreover, the predicted values of $FEF_{25\%-75\%}$ and FEV1/FVC has been frequently reported in measurement of airway obstruction, e.g., evaluation of asthma and reversible airflow obstruction [18, 22].

For our result, it indicated the existence of lung function abnormalities in Phukrang community. The prevalence of small airway obstruction pattern had the highest value, following those of restriction pattern, then obstruction pattern and combined types, respectively. Similar findings has been reported in petrol filling workers [23] that total prevalence of lung function abnormalities was 42% involving prevalence of small airway obstruction (19%), prevalence of restrictive (14%), combined type (8%) and obstructive (1%), respectively. In addition, the result showed a negative correlation between years of living in the community and % predicted values of $FEF_{25\%-75\%}$, significantly. It is implied that the subjects will have a higher chance to be small airway obstruction, if they lived in the community many years. However, there are various determinants effecting on respiratory system of human. The air pollution may be one of contributing factors for respiratory abnormalities in the subjects. Thus, the types and frequencies of lichens were used to monitor air pollution in Phukrang community. The result showed that the number of the high tolerant lichens (*Anthracothecium* sp. and *P. cocoes*) and the tolerant lichens (*G. subassimilis* and *C. effusa*) was high. It implied low level of air quality in the community. It was supported by several reports in recent years that pointed the usefulness of lichens in monitoring air pollution based on ecological index (Q). The index was used to demonstrate the tolerance or sensitivity level to air pollution (low Q indicated high tolerance and high Q indicated low sensitivity). The Q indexes of *G. subassimilis, P. cocoes* and *C. effusa* were 8, 14 and 14 which were grouped in high, moderate and moderate tolerance, respectively [6]. Moreover, the tolerant lichens, *P. cocoes,* have been shown that they are grown well and distributed more than 50% in polluted areas e.g. Lampang, Lamphun, and Chiang Mai while sensitive lichens such as *Dirinaria applanata* were found most in the less polluted regions [19]. Furthermore, lichens diversity and abundance are trend to decrease in urban and industrial areas [11, 12].

Nowadays, it is known that Phukrang community was located in Saraburi province not far from the cement production area, resulting in the exposure of cement dust [13]. The exposure of cement dust may lead to diminish of lung function in people who chance to expose the cement dust [16]. The severity of the respiratory function abnormality has been increased to depend on rising of exposure years [17]. Therefore, the basic data obtained should be used to further studies by increasing other target regions to determine correlation between lichen species and respiratory diseases, and it may be useful for program management of health surveillance of people who risk to exposing the cement dust.

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