Normal Smell Identification Score and N-Butanol Threshold in Thai Adults

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Objective: *To identify commonly recognized odorants and to find a normal threshold for n-butanol in Thai adults.*
Material and Method: *Eighty-one normal adult volunteers were enrolled between April and September 2010. They were asked to sniff from each glass bottle as long as they preferred. The threshold test was performed in an ascending method. Each volunteer was asked to identify the n-butanol dilution bottle from two bottles of distilled water. Fifteen odorants available as commercial products were used for the identification test. Volunteers had to sniff each bottle and chose the answer from four choices.*
Results: *There were 33 male (40.7%) and 48 female (59.3%) volunteers. The mean age (± standard deviation) was 38.8±11.4 years, ranged from 22 to 60 years. The most common threshold bottle was number nine (40.7%). The most commonly recognized odorant was fish sauce (100%). The most intolerable odorant was ammonia (77.8%). The mean correct identification score (± standard deviation) was 13.6±1.4 odorants, ranged from six to 15 odorants.*
Conclusion: *The present study showed commonly recognized odorants that could be used for an identification test and the normal n-butanol threshold in Thai adults.*

Keywords: *Smell test, Smell identification test, Olfactory test, Thai*

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Functions of the nose are smell, sensation, immunology, air conditioning by filtration, mucociliary clearance, warm and humidification, and airflow dynamics[1]. The smell function of the nose is essential for life protection and pleasure. The psychophysical tests developed to assess this function are identification, discrimination, and threshold tests. The odorants must be familiar to local people, so many countries have developed their own test items, for example the Odor Stick Identification Test for Japanese (OSIT-J) in Japan[2]; the University of Pennsylvania Smell Identification Test (UPSIT), the Connecticut Chemosensory Clinical Research Center (CCCRC)[3], the Cross-Cultural Smell Identification Test (CC-SIT)[4] in the US, and Sniffin' Sticks' in Germany[3]. In Thailand, there is normative data for the phenyl ethyl alcohol threshold[5] but no identification test is available. The objectives of the present study were to identify commonly recognized odorants and to find normal threshold for n-butanol in Thai adults.

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Material and Method

Normal volunteers aged between 18 to 60 years were enrolled between April and September 2010. The exclusion criteria were sinonasal diseases, neurological disease, and people with smell disturbance. General data were collected such as age, sex, and education. For the smell identification test, volunteers were asked to sniff from each glass bottle with the eyes closed. Each bottle was separately presented by the experimenter to each nostrils, as long as the volunteers preferred to complete the task. For the threshold test, volunteers were sniff through both nostrils with their eyes opened. The tests were performed in room temperature (28-35 degree Celsius) with at least a 30 seconds delay each step to avoid olfactory adaptation/desensitization[3].

Odor thresholds

N-butanol (product of RCL Labscan Limited, Thailand. Batch No. 09 09 0029) was used as an odorant due to the simplicity of dilution and preparation

in the CCCRC test[3]. The highest concentration was 4% in water and the serial dilution of 1:3 was done to 11 dilutions in glass bottles (Appendix 1). The threshold test was performed in ascending method with triple forced choice. Each volunteer was asked to identify the odorant bottle from two bottles of distilled water with eyes opened. The threshold level was the lowest concentration at which the volunteer succeeded identified in three successive trials.

Odor identification

Fifteen odorants available as commercial products were used. They were banana, coconut, Thai perfume, oil, vinegar, fish sauce, coffee bean, tea, lemon, jasmine, rose, orange, lemongrass, patchouli water, and ammonia. Volunteers had to sniff each bottle and chose the answer from four choices the experimenter read. They were also asked for familiarity and tolerance to the odorants (Appendix 2).

The present study protocol was approved between June 2010 and August 2011 by the Research Ethics Committee, Faculty of Medicine, Chiang Mai University. Parameters were analyzed with SPSS version 11. Mann-Whitney U test was used to analyze smell threshold, identification score, and age between sexes. A p-value was set at 0.05 for statistical significance different. Spearman's correlation was used to evaluate correlation between the smell threshold and identification score.

This study is approved by the Research Ethics Committee, Faculty of Medicine, Chiang Mai University.

Results

Eighty-one volunteers were included in the present study. There were 33 males (40.7%) and 48 females (59.3%). The mean age was 38.8±11.4 years (22-60). Education ranged from no education to doctorate. The most common threshold bottle was number nine (0.06663 mmol/L) (Table 1).

The most common recognized odorant was fish sauce (100%); followed by banana, coffee bean, and patchouli water (98.8%). The most intolerable odorant was ammonia, followed by fish sauce, vinegar, lemongrass, and patchouli water (Table 2).

Mean correct identification score (± standard deviation) was 13.6±1.4 odorants (ranged from 6-15 odorants) (Fig. 1). Median correct identification score was 14. There was no correlation found between threshold and identification score (Spearman's correlation test).

Table 1. Smell threshold level of 81 volunteers

Bottle number	Number of volunteer(s)	Percent
6	1	1.23
7	7	8.64
8	13	16.05
9	33	40.74
10	12	14.82
11	15	18.52
Total	81	100.00

Table 2. Smell identification on selected odorants (n = 81)

Odorant	Number of volunteer (%)		
	Correct identification	Familiarity with the scent	Intolerance with the scent
1. Fish sauce	81 (100)	80 (98.8)	31 (38.3)
2. Banana	80 (98.8)	79 (97.5)	4 (4.9)
3. Coffee bean	80 (98.8)	80 (98.8)	4 (4.9)
4. Patchouli water	80 (98.8)	73 (90.1)	11 (13.6)
5. Coconut	79 (97.5)	74 (91.4)	6 (7.4)
6. Lemongrass	79 (97.5)	78 (96.3)	14 (17.3)
7. Orange	79 (97.5)	71 (87.7)	1 (1.2)
8. Ammonia	78 (96.3)	69 (85.2)	63 (77.8)
9. Vinegar	78 (96.3)	77 (95.1)	22 (27.2)
10. Oil	76 (93.8)	60 (74.1)	4 (4.9)
11. Tea leaf	74 (91.4)	63 (77.8)	0
12. Thai perfume	73 (90.1)	72 (88.9)	4 (4.9)
13. Jasmine	71 (87.7)	66 (81.5)	1 (1.2)
14. Rose	53 (65.4)	61 (75.3)	0
15. Lemon	36 (44.4)	57 (70.4)	2 (2.5)

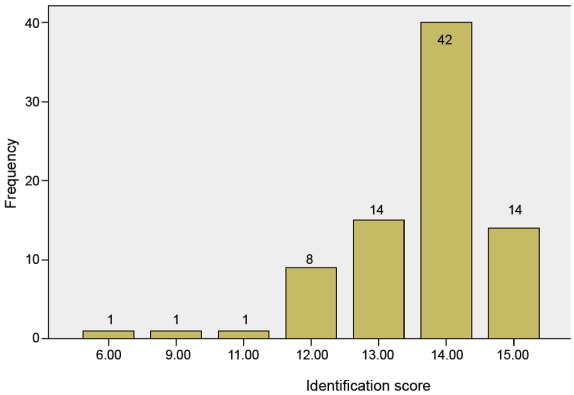

Fig. 1 Bar chart shows distribution of the identification score.

Table 3. Compare age and smell tests between sexes

Variables	Female (n = 48)	Male (n = 33)	p-value*
Mean age-year ± standard deviation (range)	39.08±11.05 (22-59)	38.36±12.06 (22-60)	0.795
Median threshold bottle (range)	9 (6-11)	9 (7-11)	0.189
Correct identification score			
Median	14	14	0.191
Mean ± standard deviation (range)	13.56±1.59 (6-15)	13.57±0.93 (12-15)	

*Mann-Whitney U test

There was no difference between female and male when compared age, correct identification score, and threshold bottle (Table 3).

Discussion

Sense of smell is important for life protection and quality. To develop an identification test, the odorants had to be identified by more than 75% of normal volunteers[3].

From the selected odorants in Table 2, number 1 to 13 could be used in the identification test. Rose and lemon, on the other hand, were not easy to recognize. This is different from the previous studies that 80-100% of normal healthy subjects could recognize rose[6,7]. This was explained by Saito et al, that participants were able to identify rose better when the odorant was in the same odor cluster e.g. perfume or flower (70% vs. 30%)[8]. In this study, the odorants were presented as isolated items. The intolerable odorant could be from the strong scent itself; e.g. fish sauce, or the stimulation of the cranial nerve V; e.g. patchouli water, lemon grass, vinegar and ammonia.

For the n-butanol threshold test, the dilution ratio 1:3 was not difficult to prepare when compared to phenyl ethyl alcohol though it stimulated both the I and V cranial nerves[3,5]. The n-butanol was better at test-retest reliability (use last three turning points), when compared with phenyl ethyl alcohol (use last four turning points)[3]. We used glass sniff bottles not squeeze bottles as in the study of Hummel et al[3], the most common threshold bottle was dilution number nine which was close to 8.2 dilution steps.

There was no correlation between the total identification score and n-butanol threshold test. There was no sex difference in the threshold and identification scores though in previous studies showed that females had a more sensitive smell[9].

Further studies should be done in elderly and in patients with smell dysfunction to see if the test could truly demonstrate the patients' problem.

Conclusion

The present study showed commonly recognized odorants that could be used for an identification test and normal n-butanol threshold in the Thai adult.

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Potential conflicts of interest

None.

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Appendix 1.

Bottle number	N-butanol concentration (mmol/L)
1*	437.12898
2	145.70966
3	48.56989
4	16.18996
5	5.39665
6	1.79888
7	0.59963
8	0.19988
9	0.06663
10	0.02221
11	0.00740

* Bottle number 1 = 4% w/v
Manufacture: RCI Labscan Limited, Thailand (Batch No. 09 09 0029)
Distributor: O.V. Chemical and Supply, Thailand

Appendix 2.

Odorant number	Correct 1 Wrong 0	Familiarity			Acceptance		
1. banana orange rose tea		yes,	not sure,	no	yes,	no comment,	no
2. jasmine coconut banana rose		yes,	not sure,	no	yes,	no comment,	no
3. tea coffee Thai perfume rose		yes,	not sure,	no	yes,	no comment,	no
4. orange jasmine coffee oil		yes,	not sure,	no	yes,	no comment,	no
5. lemon vinegar lemongrass Thai perfume		yes,	not sure,	no	yes,	no comment,	no
6. rose fish sauce orange ammonia		yes,	not sure,	no	yes,	no comment,	no
7. vinegar coffee banana oil		yes,	not sure,	no	yes,	no comment,	no
8. tea Thai perfume lemon rose		yes,	not sure,	no	yes,	no comment,	no
9. vinegar patchouli water lemon orange		yes,	not sure,	no	yes,	no comment,	no
10. jasmine ammonia lemongrass coffee		yes,	not sure,	no	yes,	no comment,	no
11. patchouli water tea oil rose		yes,	not sure,	no	yes,	no comment,	no
12. coconut jasmine Thai perfume orange		yes,	not sure,	no	yes,	no comment,	no
13. lemongrass fish sauce coffee vinegar		yes,	not sure,	no	yes,	no comment,	no
14. tea patchouli water lemon banbana		yes,	not sure,	no	yes,	no comment,	no
15. ammonia vinegar tea lemongrass		yes,	not sure,	no	yes,	no comment,	no

การศึกษาค่าปกติของการจำแนกกลิ่นและระดับการรับกลิ่น n-butanol ในผู้ใหญ่ไทย

สายสวาท ไชยเศรษฐ, กรรณิการ์ รุ่งโรจน์วัฒนศิริ, ณัฐิยา หาญประเสริฐพงษ์, สุปราณี ฟูอนันต์

วัตถุประสงค์: ศึกษาหากลิ่นที่เป็นที่รู้จักและค่าปกติของระดับการรับกลิ่น n-butanol ในผู้ใหญ่ไทย

วัสดุและวิธีการ: ศึกษาในคนปกติ อาสาสมัครผู้ใหญ่ 81 ราย จากเดือนเมษายน ถึง กันยายน พ.ศ. 2553 ให้สูดดมกลิ่นจากขวดแก้วได้นานเท่าที่ต้องการ การหาระดับการรับกลิ่นทำโดยวิธีเพิ่มความเข้มข้นขึ้น โดยให้แยกขวดที่มีสารละลาย n-butanol จากขวดน้ำเปล่าอีก 2 ขวด การจำแนกกลิ่นให้อาสาสมัครดมกลิ่น 15 ชนิด ซึ่งเป็นผลิตภัณฑ์ที่มีจำหน่าย โดยดมทีละขวดและเลือกคำตอบจากตัวเลือก 4 ข้อ

ผลการศึกษา: มีอาสาสมัครชาย 33 ราย (ร้อยละ 40.7) หญิง 48 ราย (ร้อยละ 59.3) อายุเฉลี่ย (± ส่วนเบี่ยงเบนมาตรฐาน) 38.8±11.4 ปี (ตั้งแต่ 22-60 ปี) ระดับการรับกลิ่นที่พบมากที่สุดคือขวดเบอร์ 9 (ร้อยละ 40.7) กลิ่นที่จำแนกได้มากที่สุดคือน้ำปลา (ร้อยละ 100) กลิ่นที่ทนไม่ได้มากที่สุดคือแอมโมเนีย (ร้อยละ 77.8) ค่าเฉลี่ยการจำแนกกลิ่น (± ส่วนเบี่ยงเบนมาตรฐาน) คือ 13.6±1.4 กลิ่น (ตั้งแต่ 6-15 กลิ่น)

สรุป: การศึกษานี้แสดงกลิ่นที่เป็นที่รู้จักที่สามารถนำมาทดสอบการจำแนกกลิ่นและค่าปกติของระดับการรับกลิ่น n-butanol ในผู้ใหญ่ไทย