

Session I -2

환경성 담배연기 (ETS)의
노출지표 개발

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Introduction

1. ETS란

환경성 담배연기로서 주로 공기 중 담배연기

2. 담배연기의 종류

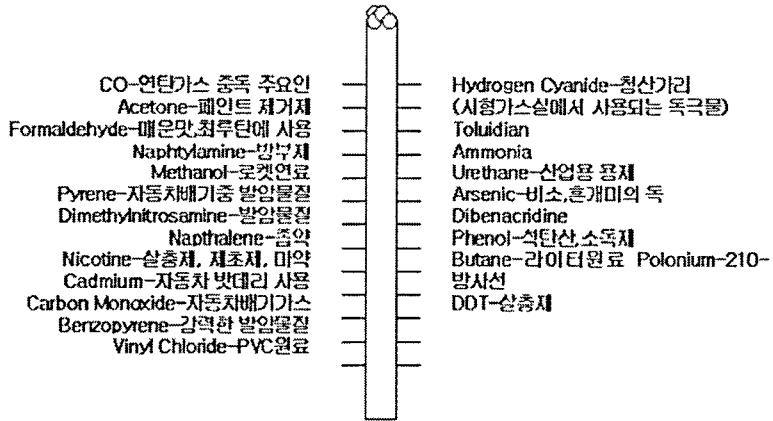
- Mainstream smoke : 흡연자가 직접 흡입한 담배연기로 흡연자의 폐 속에서 어느 정도 여과되어 내놓어진 연기
- Sidestream smoke : 흡연자가 들고 있는 담배자체가 타면서 발생한 생담배 연기

3. 간접흡연 (Passive Smoking)

간접흡연이란 비흡연자가 간접적으로 남이 피우는 담배 연기를 마시게 되는 상태 본인의 의사와 관계없이 남의 흡연행동에 의해서 담배연기를 마시기 때문에 수동적 흡연, 비자발적 흡연, 환경적 흡연이라고 부르기도 함

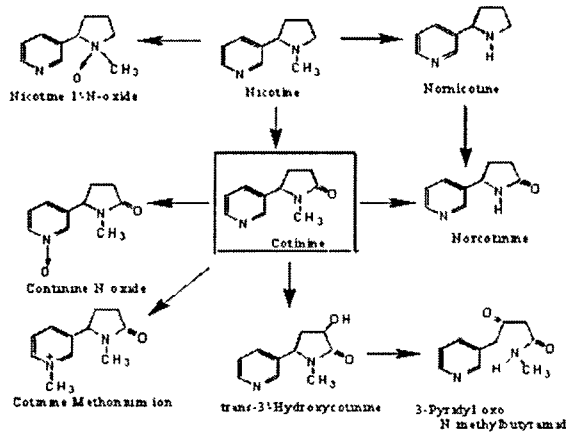
Introduction

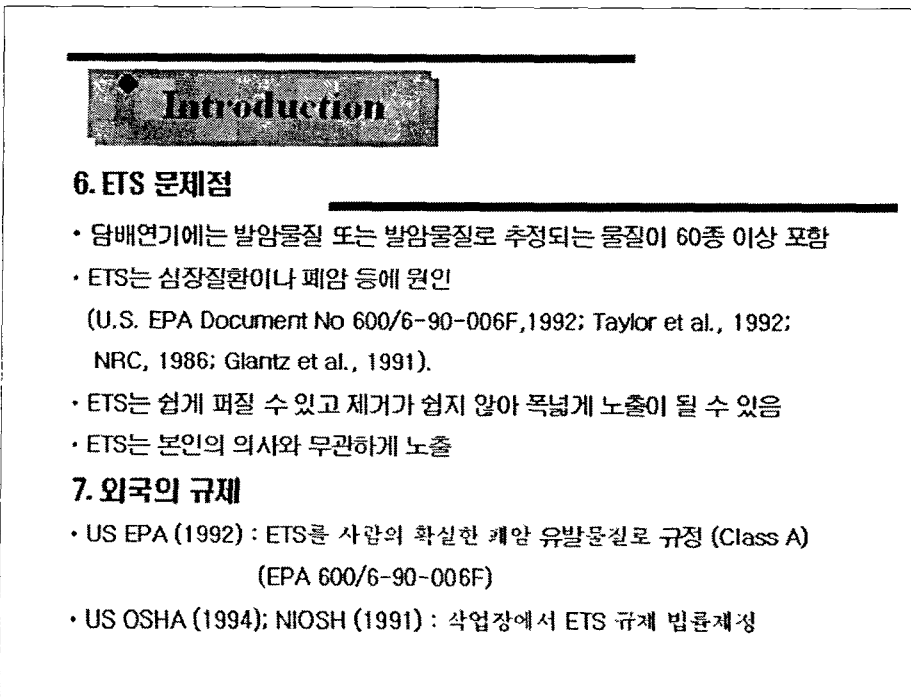
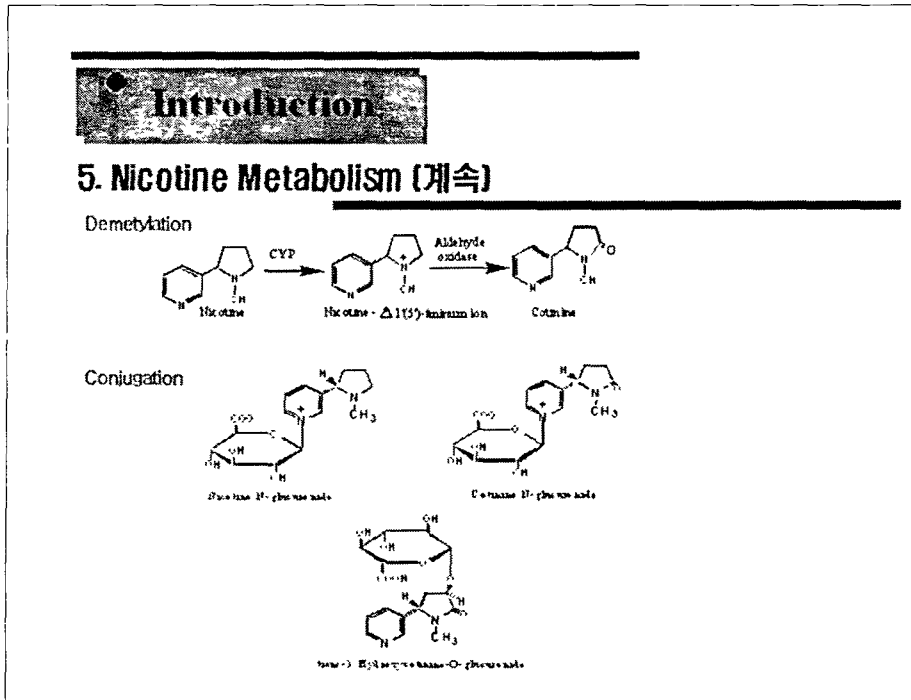
4. 담배연기 중 유해물질



Introduction

5. Nicotine Metabolism







8. 분석법

| Author(s) | Extraction solvent | Column | Internal standard | Detector | Limit of detection | Detection principle |
|-------------------------|----------------------------------|---------------------|---------------------------------------------------|---------------|---------------------|---------------------|
| Whitaker et al (1982) | diethyl ether or dichloromethane | Carbowax 20M | no cotinine-methyl cotinine-methyl-d ₂ | mass detector | no cotinine 50ng/L | GC-MS |
| Deamus et al (1985) | di-chloromethane | Carbowax 20M | 3-methyl cotinine-d ₂ | mass detector | no cotinine 1ng/L | GC-MS |
| Matharayan et al (1988) | methyl acetate | CISION DM7 | 2-methyl norcotinine | mass detector | no cotinine 1ng/L | HPLC |
| Warshaw et al (1988) | di-chloromethane | Carbowax 20M | no cotinine-d ₂ | mass detector | no cotinine 5ng/L | GC-MS |
| Fayazbakh et al (1990) | di-chloromethane | HP-1000 | 5-methyl cotinine | mass detector | no cotinine 0.1ng/L | GC-MS |
| Matharayan et al (1991) | di-chloromethane | Supelcosil LC-8 DB | no cotinine-d ₂ | mass detector | no cotinine 1ng/L | HPLC |
| JOSHI et al (1992) | toluene and 1-butanol | HP-5 reversed-phase | no cotinine-d ₂ | mass detector | no cotinine 10ng/L | GC-MS |
| Pacheco et al (1993) | di-chloromethane | Supelchem LC8 DB | no cotinine | mass detector | no cotinine 5ng/L | HPLC |
| Caicedo et al (1994) | di-chloromethane | Supelcosil LC8 DB | no cotinine | mass detector | no cotinine 50ng/L | HPLC |
| Isidoro et al (1995) | 1-butanol | HP-5 | no cotinine-d ₂ | mass detector | no cotinine 10ng/L | GC-MS |



8. 분석법 (계속)

| Author(s) | Extraction solvent | Column | Internal standard | Detector | Limit of detection | Detection principle |
|-------------------------|---------------------------------------|-------------------------|---------------------------------------------------|---------------|----------------------|---------------------|
| Yu et al (1994) | methylene chloride | MSK Hypasil C18 | no cotinine-methyl cotinine-methyl-d ₂ | mass detector | no cotinine 10ng/L | HPLC |
| Harson et al (1995) | diethyl ether | HP-1 | no cotinine-d ₂ | mass detector | no cotinine 20ng/L | GC-MS |
| Worrest et al (1995) | methylene chloride | PLASILAN column | no cotinine-d ₂ | mass detector | no cotinine 0.5ng/L | HPLC |
| James et al (1999) | Etrolut extraction methylene chloride | HP-1 | no cotinine-d ₂ | mass detector | no cotinine 0.1ng/L | GC-MS |
| Ordono et al (1999) | Etrolut-20 chloroform | L-bondapak C18 | 2-Phenylmethyl | mass detector | no cotinine 0.5ng/L | HPLC |
| Montroy et al (1999) | solid-phase | Omni Pac PC-506 | no cotinine-d ₂ | mass detector | no cotinine 0.5ng/L | HPLC |
| Wang et al (1999) | di-chloromethane | HP-5 | no cotinine-d ₂ | mass detector | no cotinine 20ng/L | GC-MS |
| Tseng et al (1999) | di-chloromethane | L-bondapak C18 | no cotinine | mass detector | no cotinine (10ng/L) | HPLC |
| Debes et al (2000) | di-chloromethane | Acquity C ₁₈ | 2-Phenylmethyl | mass detector | no cotinine 5ng/L | HPLC |
| Matharayan et al (2000) | di-chloromethane | C ₁₈ UG120 | acetylcholine | mass detector | no cotinine 10ng/L | HPLC |

Research Contents

1. 분석법 개발

- 타액, 혈액 및 뇨 중 nicotine 및 cotinine 분석법 개발
- 타액, 혈액 및 뇨 중 nicotine 및 cotinine 분석법 정도관리

2. ETS 노출지표 개발

- 타액, 혈액 및 뇨 중 nicotine 상관성 분석
- 타액, 혈액 및 뇨 중 cotinine 상관성 분석.
- ETS는 지표 시료 및 물질 개발

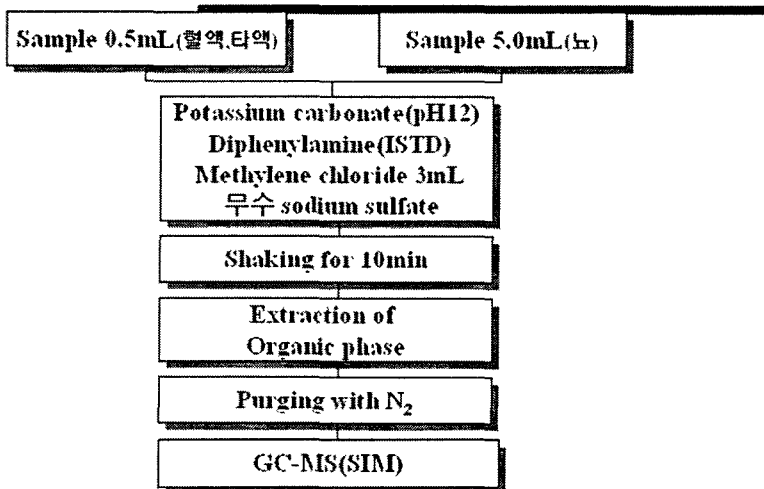
3. ETS 실태조사

- 학생조사
- 일반인 조사

4. 금연교육에 활용

Experimental Method

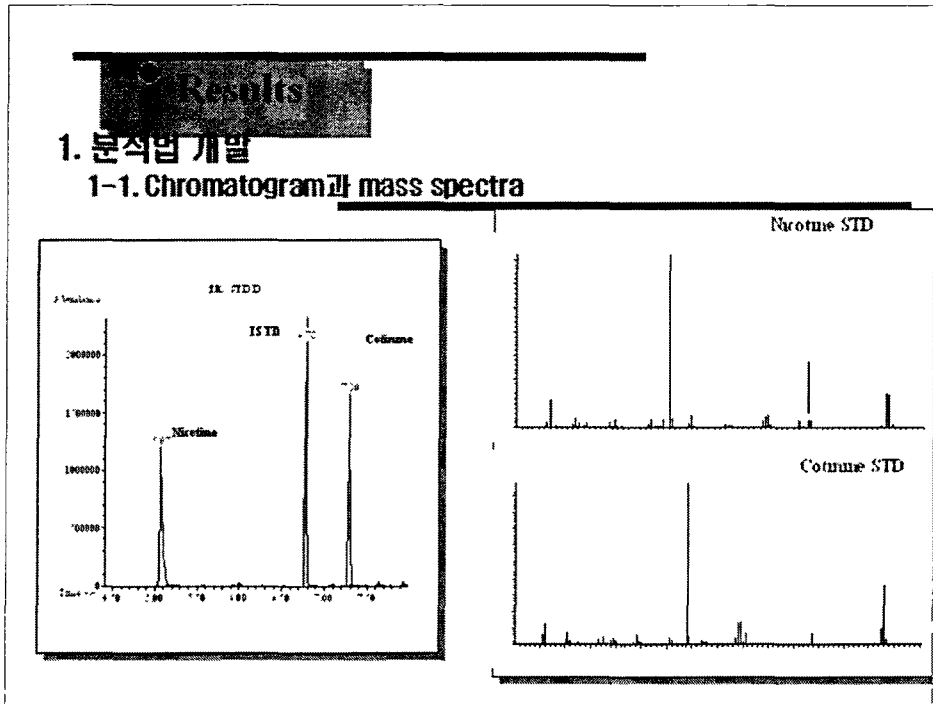
1. Sample Extraction



Experimental Method

2. Operating conditions of Nicotine and Cotinine by GC-MS

| Parameter | Conditions | | |
|----------------|-------------------------------------------------------------------------------|-----------------|--------------------|
| Column | HP-5MS(Cross-linked 5% phenylmethylsilicon 30m × 0.2mm I.D. × 0.33µm F.T.) | | |
| Carrier gas | He at 0.9mL/min | | |
| Injector Temp. | 280°C | | |
| Oven Temp | Initial | rate | final |
| Program | 80°C(0min) | 20°C/min | 300 °c(5min) |
| Detector Temp. | 280°C | | |
| Selected Ion | Group | Start time(min) | Selected ions, m/z |
| Group | 1 | 4.00 | 84, 133, 161 |
| | 2 | 6.00 | 168, 169 |
| | 3 | 6.80 | 98, 176 |



Results

1-2. Recovery

(1) Recoveries of Nicotine and Cotinine from Saliva

| Spiked Conc. (ng/mL) | Results (ng/mL), X ± SD (RSD) | |
|-------------------------|------------------------------------------------------|-----------------------------------------------------|
| | Nicotine | Cotinine |
| 100 | 90.8, 103.5, 100.4, 101.4, 94.8 98.2 ± 4.7 (4.8%) | 97.2, 104.6, 96.7, 102.7, 97.9 99.8 ± 3.2 (3.2%) |
| 500 | 85.5, 96.4, 86.6, 87.5, 89.6 89.1 ± 3.9 (4.4%) | 99.5, 96.3, 97.4, 97.6, 94.5 97.1 ± 1.6 (1.7%) |

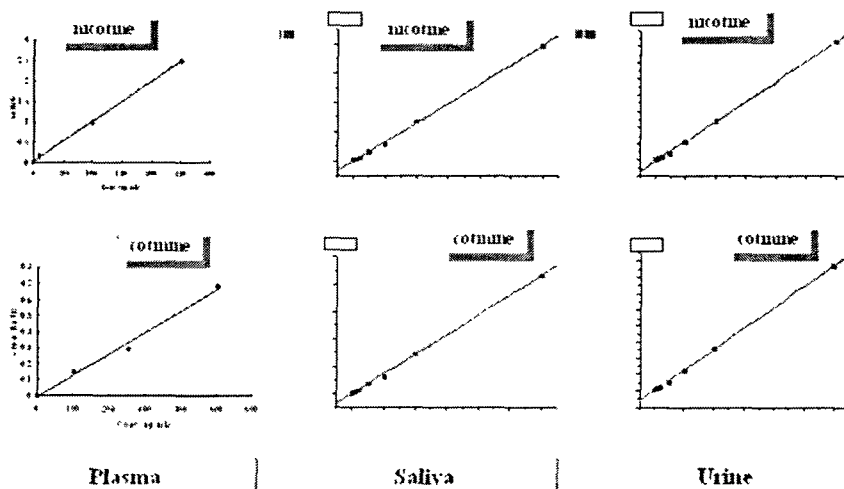
(2) Recoveries of Nicotine and Cotinine from Urine

| Spiked Conc. (ng/mL) | Results (ng/mL), X ± SD (RSD) | |
|-------------------------|---------------------------------------------|---------------------------------------------|
| | Nicotine | Cotinine |
| 100 | 98.7, 88.7, 88.8, 96.0 92.1 ± 4.7 (5.1%) | 97.4, 99.0, 97.9, 98.3 98.2 ± 0.6 (0.6%) |
| 500 | 99.2, 95.8, 97.6, 98.1 97.7 ± 1.2 (1.3%) | 93.9, 99.1, 97.4, 94.7 96.3 ± 2.1 (2.2%) |

X=mean value; SD=standard deviation, RSD=relative standard deviation

Results

1-3. Calibration Curve



Results

1-4. Precision and Accuracy

(1) Precision and Accuracy of Nicotine and Cotinine in Saliva

| Spiked Conc. (ng/mL) | Nicotine | | Cotinine | |
|----------------------|-------------------------|----------------|-------------------------|----------------|
| | Founded Conc. (ng/mL) | Mean±SD(RSD%) | Founded Conc. (ng/mL) | Mean±SD(RSD%) |
| 100 | 92, 91, 92, 92, 81 | 90 ± 4(4.8%) | 105, 105, 105, 103, 105 | 105 ± 1(0.8%) |
| 250 | 240, 253, 235, 235, 254 | 243 ± 8(3.5%) | 261, 273, 266, 242, 257 | 260 ± 10(4.0%) |
| 500 | 461, 411, 436, 445, 480 | 447 ± 23(5.2%) | 458, 433, 444, 505, 430 | 454 ± 27(6.0%) |

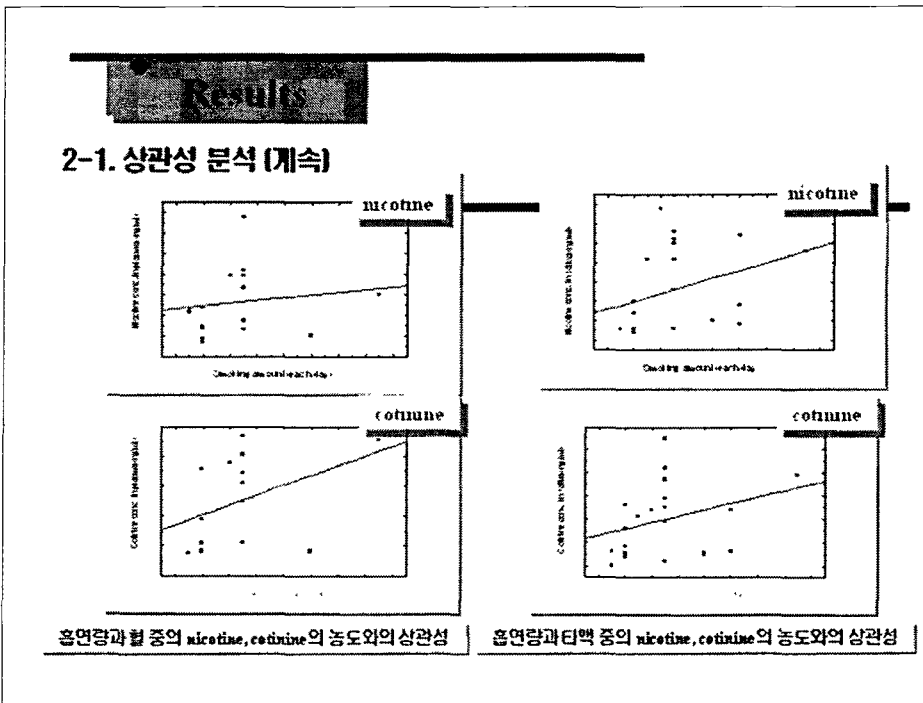
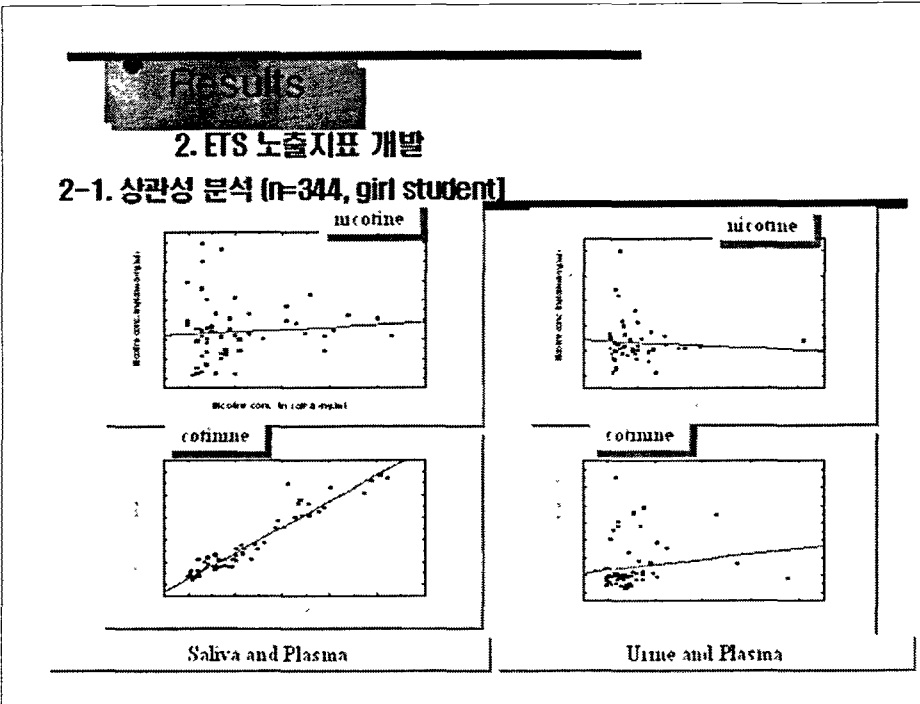
(2) Precision and Accuracy of Nicotine and Cotinine in Urine

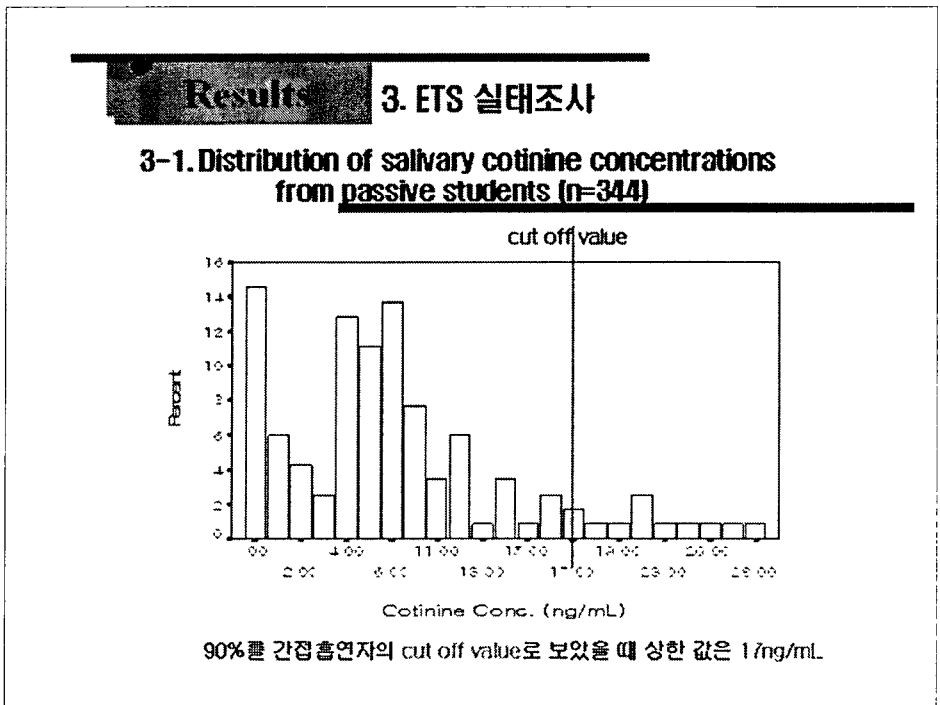
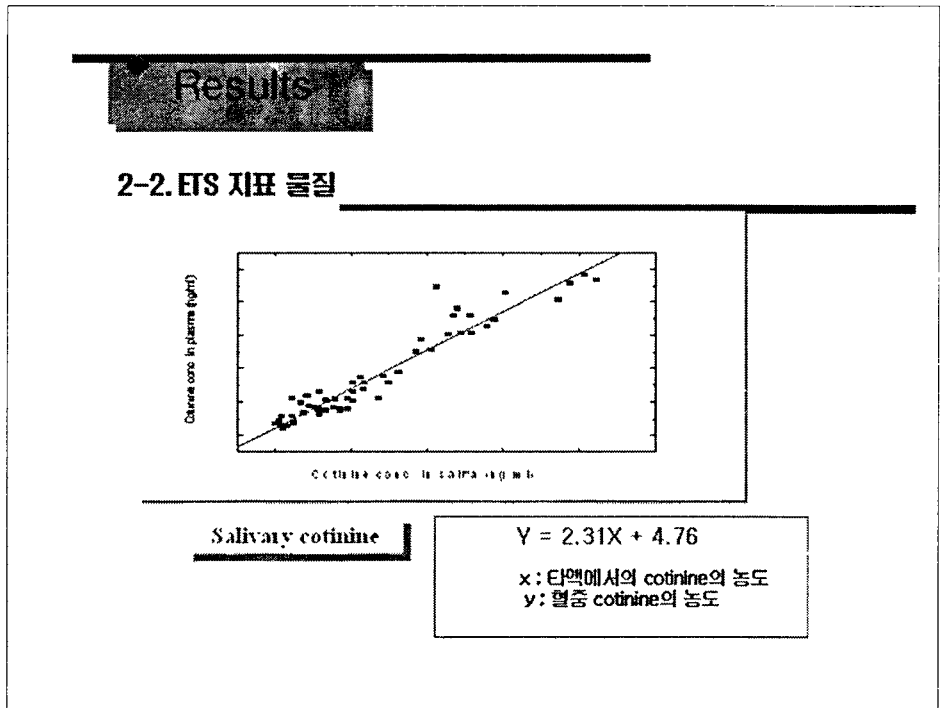
| Spiked Conc. (ng/mL) | Nicotine | | Cotinine | |
|----------------------|-------------------------|----------------|-------------------------|----------------|
| | Founded Conc. (ng/mL) | Mean±SD(RSD%) | Founded Conc. (ng/mL) | Mean±SD(RSD%) |
| 100 | 102, 89, 95, 89 | 90 ± 4(4.8%) | 99, 99, 93, 92 | 96 ± 3(3.4%) |
| 250 | 201, 204, 201, 217 | 243 ± 8(3.5%) | 217, 207, 220, 209 | 213 ± 5(2.5%) |
| 500 | 517, 465, 502, 500, 509 | 499 ± 18(3.6%) | 491, 489, 518, 524, 474 | 499 ± 19(3.8%) |

Results

1-5. Method detection limits(MDL)

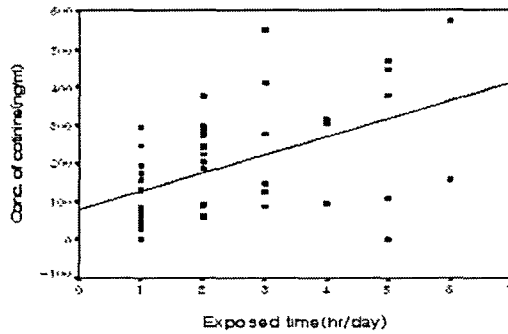
| Samples | MDL(ng/mL) |
|---------|------------|
| Plasma | 1.0 |
| Saliva | 1.0 |
| Urine | 0.1 |





Results

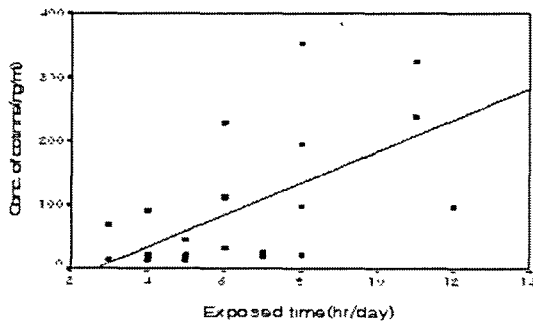
3-2. Correlation of exposure time-saliva cotinine concentration from passive smoker in housekeeping



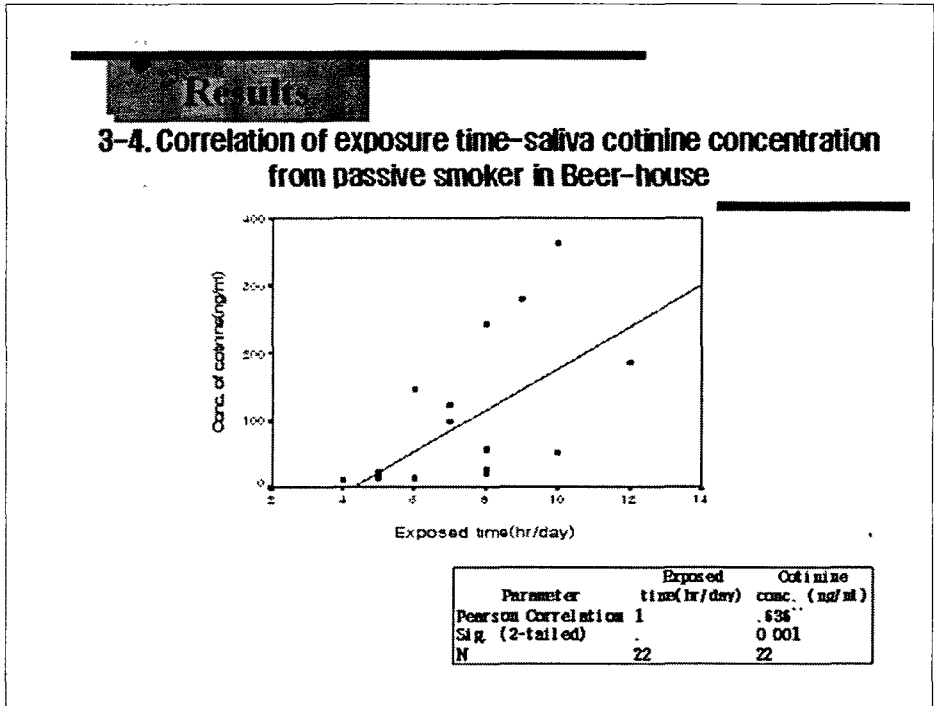
| Parameter | Exposed time (hr/day) | Cotinine (ng/ml) |
|-----------------------|-----------------------|------------------|
| Pearson Correlation 1 | | .476** |
| Sig. (2-tailed) | | .0 |
| N | 56 | 56 |

Results

3-3. Correlation of exposure time-saliva cotinine concentration from passive smoker in PC-entertainment hall



| Parameter | Exposed time (hr/day) | Cotinine conc. (ng/ml) |
|-----------------------|-----------------------|------------------------|
| Pearson Correlation 1 | | .610** |
| Sig. (2-tailed) | | .001 |
| N | 25 | 25 |



Results

4. 금연교육에 활용

4-1. Self-diagnostic ability for health of smoker and non-smoker

| 흡연상태 | 건강상태 | 자가건강진단결과* | | | |
|----------------|------|-----------|-----------|----------|----------|
| | | 1 | 2 | 3 | 4 |
| 흡연자 + 5년이상 흡연자 | 정상 | 16명 (36%) | 16명 (16%) | 7명 (16%) | 5명 (12%) |
| | 비정상 | 8명 (57%) | 5명 (36%) | 1명 (7%) | 0명 (0%) |
| 비흡연자 | 정상 | 22명 (52%) | 16명 (38%) | 2명 (5%) | 2명 (5%) |
| | 비정상 | 0 (0%) | 3명 (75%) | 0명 (0%) | 1명 (25%) |

Results

4. 금연교육에 활용

4-2. 금연교육에 활용

설문지와 코티닌 분석에 따른 흡연 여부 비교

| 구분 | 흡연자(명) | | | 비흡연자(명) | | | 총계(41명) | | |
|-----|--------|------|-----|---------|------|------|---------|------|------|
| | 남자 | 여자 | 소계 | 남자 | 여자 | 소계 | 남자 | 여자 | |
| 설문지 | 명 | 8 | 0 | 8 | 21 | 12 | 33 | 29 | 12 |
| | % | 19.5 | 0 | 19.5 | 51.3 | 29.2 | 80.5 | 70.7 | 29.2 |
| 코티닌 | 명 | 13 | 2 | 15 | 16 | 10 | 26 | | |
| | % | 31.7 | 4.8 | 36.6 | 39 | 24.4 | 63.4 | | |

교육 및 면담 후 흡연여부 확인

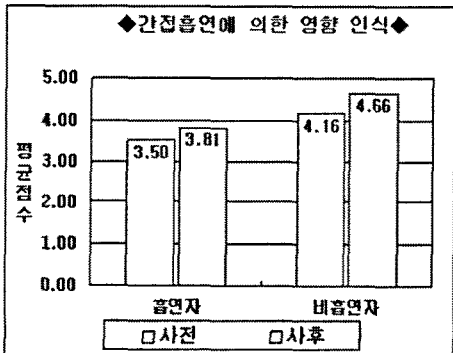
| 구분 | 흡연자(명) | | | 강변 간점흡연자(명) | | | 간점흡연자(명) | | |
|----|----------|----|-------------|-------------|----|-------------|----------|----|-------------|
| | 남자 | 여자 | 코티닌 (ng/ml) | 남자 | 여자 | 코티닌 (ng/ml) | 남자 | 여자 | 코티닌 (ng/ml) |
| 소계 | 11 | 1 | 55-1317 | 2 | 1 | 13-16 | 16 | 10 | 0-10 |
| 총계 | 12(29.3) | | | 3(7.3) | | | 26(63.4) | | |

Results

4. 금연교육에 활용

4-2. 금연교육에 활용 (계속)

문항별로 5단계식 리커트 척도



금연교육 전후 코티닌 분석결과

| 구분 | 학생수(41명) | |
|---------------|-------------------------|--------|
| | 평균 (ng/ml) | 표준편차 |
| 사전검사 | 138.61 | 347.19 |
| 사후검사 | 21.98 | 42.27 |
| paired t-test | t=2.129, df=40, p=0.039 | |

Conclusion

1. ETS의 노출지표로 타액 중 Cotinine이 적합하다.
2. 이 분석법은 ETS로 인한 피해를 모니터링하고, 예측하고, 예방하는데 유용하게 사용될 수 있다.
3. 전체 340명의 여고생을 대상으로 하여 간접흡연자의 빈도수 중 90%선의 농도를 간접흡연자의 cut off value로 정할 때 직접 흡연자와 간접 흡연자의 기준값은 17ng/mL이다.
4. 설문조사방법과 타액 중 코티닌 분석법이 병행하여 기초조사가 수행되어야 한다.
5. 국내에도 ETS가 규제되어야 한다.