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APPENDICES

Appendix A Calibration Curves for Gas Chromatography (Temperature of 45 °C, Retention Time of 60 Minute)

Table A1 Calibration curve for hydrogen (H_2)

Volume of Hydrogen (ml)	Peak Area
0.02	16,313
0.04	58,770
0.08	180,674
0.1	226,743
0.2	427,198
0.4	778,509

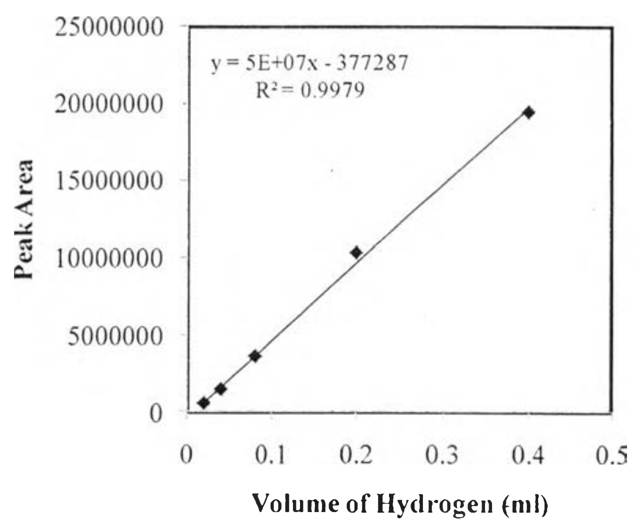

Figure A1 The relationship between volume of hydrogen (H_2) and peak area.

Equation

$$\text{Amount of hydrogen} = \frac{\text{Peak area} + 377287}{5 \times 10^7}$$

Table A2 Calibration curve for nitrogen

Volume of Nitrogen (ml)	Peak Area
0.02	34,210
0.04	128,767
0.08	305,287
0.1	393,916
0.2	809,433
0.4	1,602,475

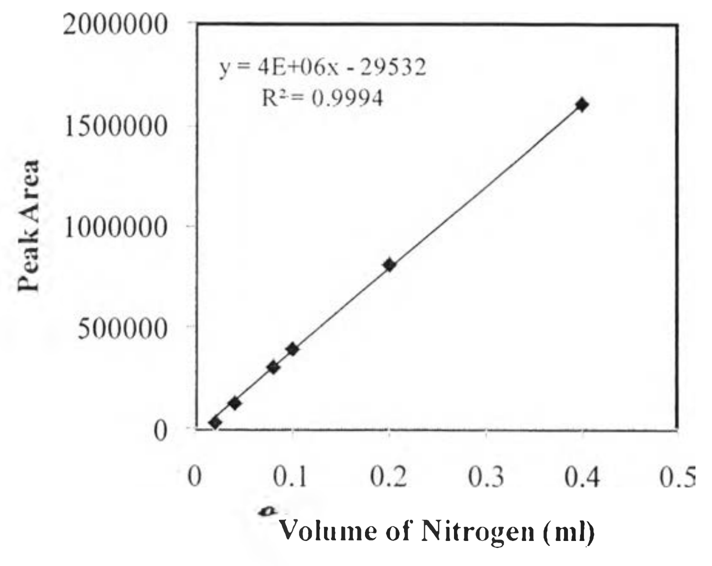

Figure A2 The relationship between volume of nitrogen (N_2) and peak area.

Equation

$$\text{Amount of nitrogen} = \frac{\text{Peak area} + 29532}{4 \times 10^6}$$

Table A3 Calibration curve for oxygen

Volume of Oxygen (ml)	. Peak Area
0.02	12,286
0.04	43,995
0.08	104,342
0.1	135,546
0.2	280,220
0.4	562,001

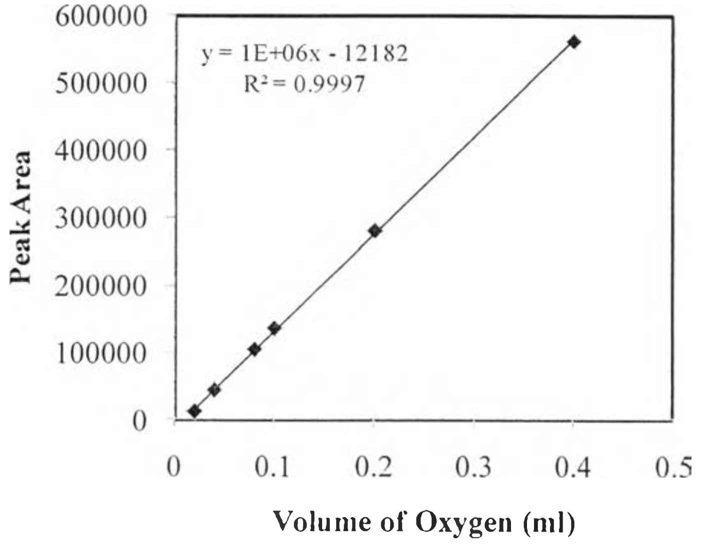

Figure A3 The relationship between volume of oxygen (O_2) and peak area.

Equation

$$\text{Amount of oxygen} = \frac{\text{Peak area} + 12182}{1 \times 10^6}$$

Table A4 Calibration curve for methane (CH_4)

Volume of Methane (ml)	Peak Area
0.02	92,517
0.04	381,106
0.1	1,293,552
0.2	2,674,654

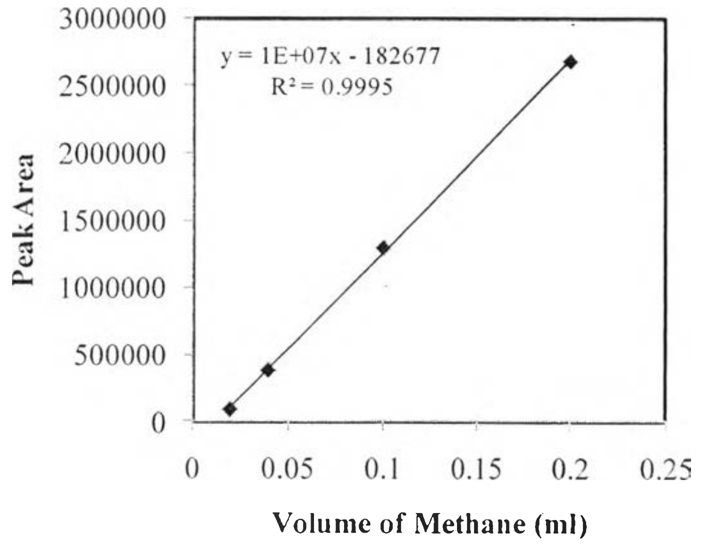

Figure A4 The relationship between volume of methane (CH_4) and peak area.

Equation

$$\text{Amount of methane} = \frac{\text{Peak area} + 182677}{1 \times 10^7}$$

Table A5 Calibration curve for carbon dioxide (CO_2)

Volume of Carbon Dioxide (ml)	Peak Area
0.02	26,118
0.04	97,539
0.08	220,122
0.2	596,414
0.4	1,315,885

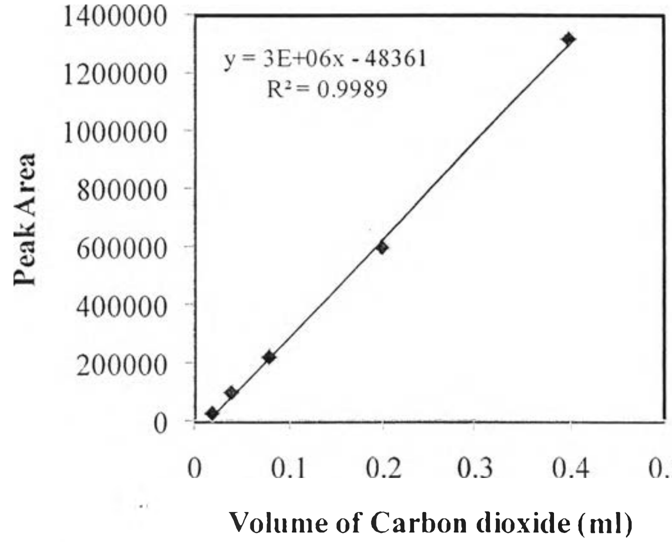

Figure A5 The relationship between volume of carbon dioxide (CO_2) and peak area.

Equation

$$\text{Amount of carbon dioxide} = \frac{\text{Peak area} + 48361}{3 \times 10^6}$$

Appendix B Calibration Curves for High Performance Liquid Chromatography (Temperature of 45 °C, Retention Time of 60 Min, Mobile Phase of 4 Mm H_2SO_4)

Table B1 Calibration curve for ethanol (C_2H_5OH)

Concentration of Ethanol (ppm)	Peak Area
1000	189,866
2000	377,275
3000	569,223
4000	765,786
5000	958,108

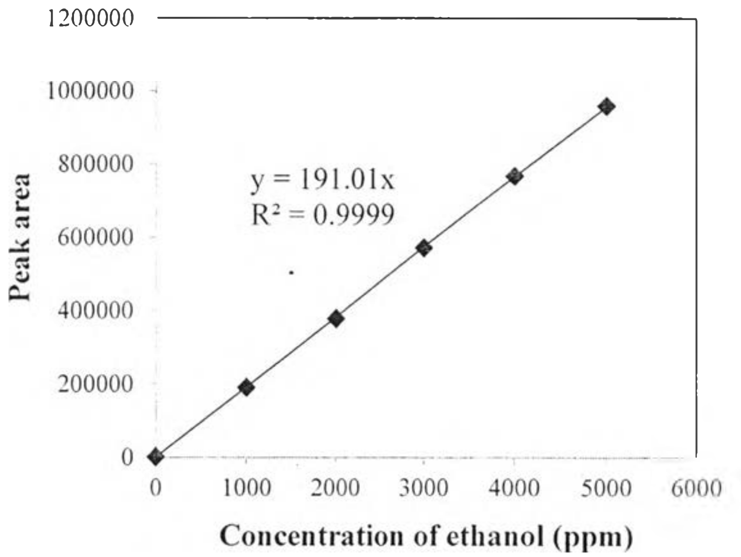

Figure B1 The relationship between concentration of ethanol (C_2H_5OH) and peak area.

Equation

$$\text{Concentration of ethanol} = \frac{\text{Peak area}}{191.01}$$

Table B2 Calibration curve for lactic acid ($C_3H_6O_3$)

Concentration of Lactic acid (ppm)	Peak Area
1000	241,057
2000	513,754
3000	735,330
4000	1,047,749
5000	1,350,707

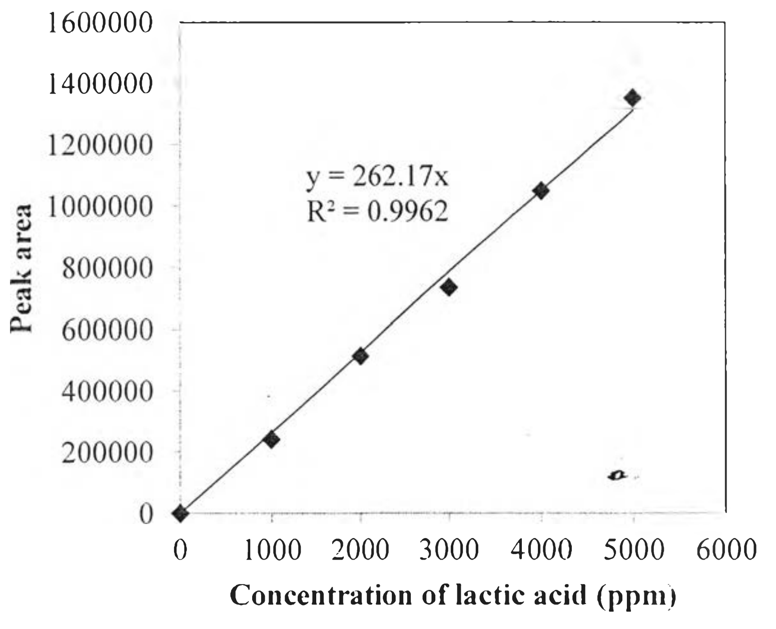

Figure B2 The relationship between concentrations of lactic acid ($C_3H_6O_3$) and peak area.

Equation

$$\text{Concentration of lactic acid} = \frac{\text{Peak area}}{262.17}$$

Table B3 Calibration curve for valeric acid ($C_5H_{10}O_2$)

Concentration of Valeric Acid (ppm)	Peak Area
1000	346,808
2000	707,645
3000	108,2011
4000	1,470,955
5000	1,844,040

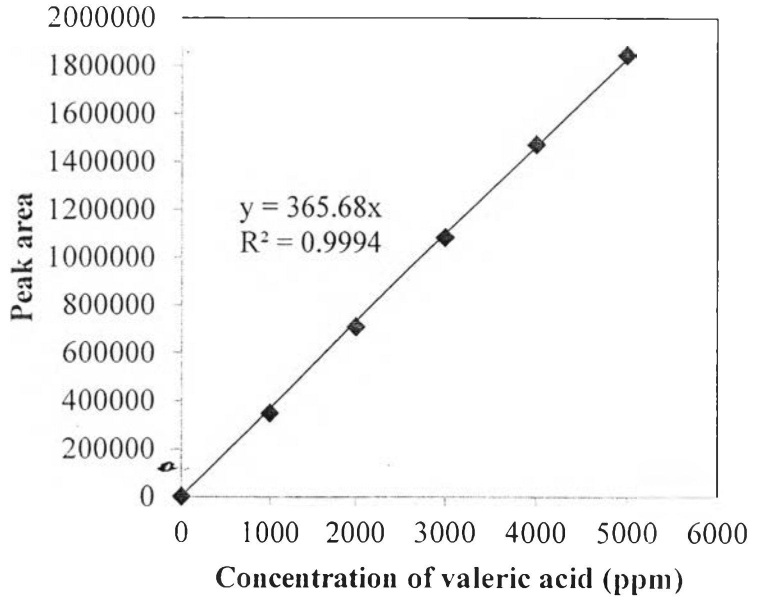

Figure B3 The relationship between concentrations of valeric acid ($C_5H_{10}O_2$) and peak area.

Equation

$$\text{Concentration of valeric acid} = \frac{\text{Peak area}}{365.68}$$

Table B4 Calibration curve for propionic acid ($C_3H_6O_2$)

Concentration of Propionic Acid (ppm)	Peak Area
1000	274,670
2000	553,990
3000	836,683
4000	1,091,859
5000	1,435,669

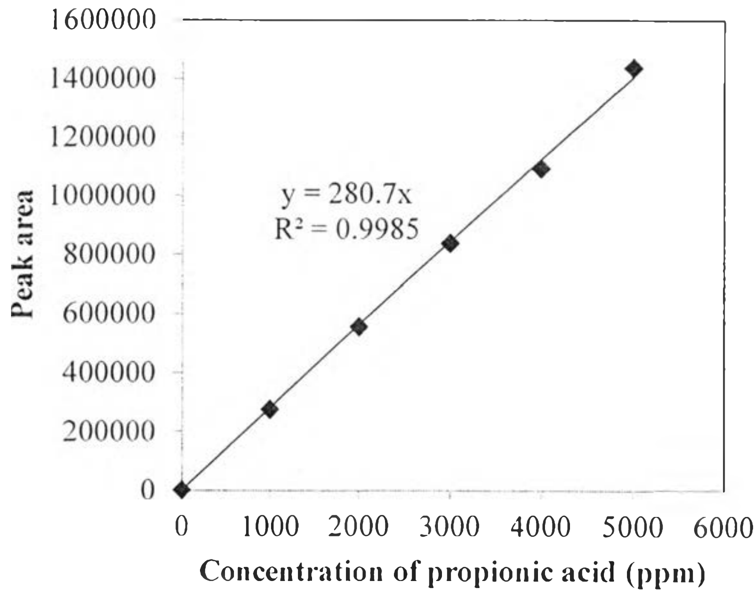

Figure B4 The relationship between concentrations of propionic acid ($C_3H_6O_2$) and peak area.

Equation

$$\text{Concentration of propionic acid} = \frac{\text{Peak area}}{280.7}$$

Table B5 Calibration curve for acetic acid (CH_3COOH)

Concentration of Acetic Acid (ppm)	Peak Area
1000	226,593
2000	458,639
3000	693,445
4000	951,778
5000	1,179,161

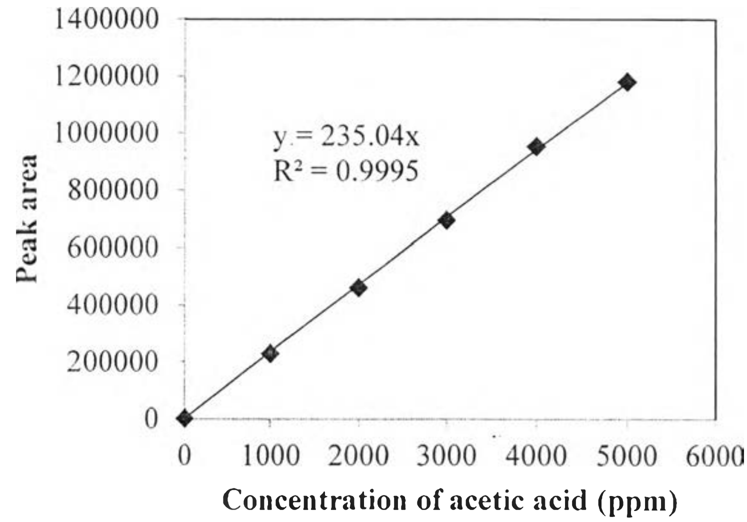

Figure B5 The relationship between concentration of acetic acid (CH_3COOH) and peak area.

Equation

$$\text{Concentration of acetic acid} = \frac{\text{Peak area}}{235.04}$$

Table B6 Calibration curve for butyric acid ($C_3H_6O_3$)

Concentration of Butyric Acid (ppm)	Peak Area
1000	310,185
2000	636,623
3000	974,830
4000	1,315,752
5000	1,672,791

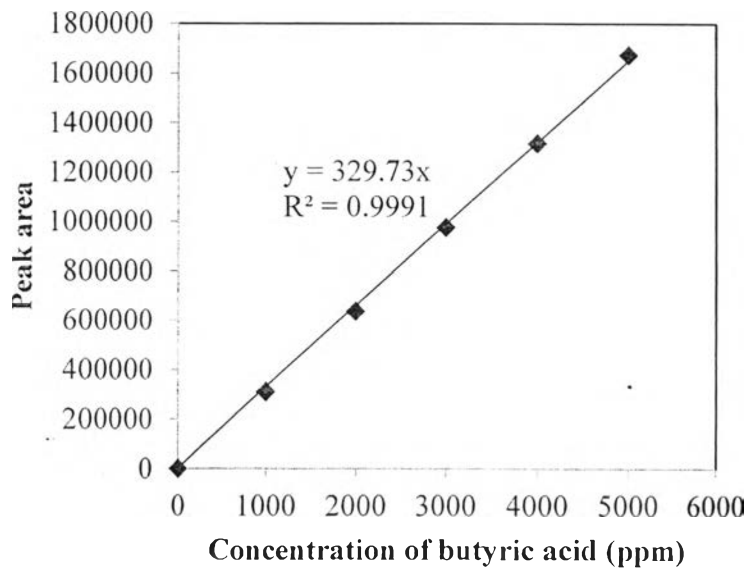

Figure B6 The relationship between concentrations of butyric acid ($C_3H_6O_3$) and peak area.

Equation

$$\text{Concentration of butyricacid} = \frac{\text{Peak area}}{329.73}$$

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