

มหาวิทยาลัยเชียงใหม่
Chiang Mai University

APPENDICES

APPENDIX A

Calibration Curve and Percent Content

Table A1 Absorbance of Aspirin in Acetate buffer pH4.5 at 265 nm

| Concentration (mg/ml) | Absorbance |
|-----------------------|------------|
| 0 | 0 |
| 0.03518 | 0.128 |
| 0.05025 | 0.178 |
| 0.1005 | 0.341 |
| 0.15075 | 0.525 |
| 0.201 | 0.689 |
| 0.25125 | 0.930 |

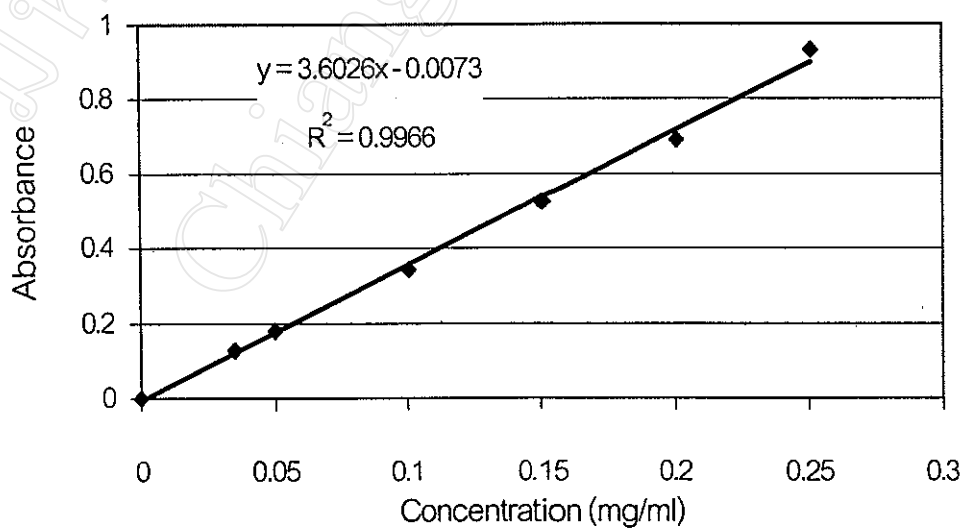


Figure A1 The Calibration Curve of Aspirin in Acetate buffer pH 4.5 at 265 nm

Table A2 The Percent Aspirin Content of Each Formulation

| Sample | Formulation | | | | | | | | | | | |
|---------|----------------|-------|--|-------------------|-------|----------|----------------|-------|----------|----------------|-------|----------|
| | Aspirin powder | | | Commercial Tablet | | | X1 | | | X2 | | |
| | Weight (mg) | Abs. | | Weight (mg) | Abs. | dilution | Weight (mg) | Abs. | dilution | Weight (mg) | Abs. | dilution |
| 1 | 30.6 | 0.199 | | 570.6 | 0.438 | 5 | 443.0 | 0.445 | 5 | 433.5 | 0.414 | 5 |
| 2 | 30.2 | 0.198 | | 577.6 | 0.458 | 5 | 446.1 | 0.454 | 5 | 436.2 | 0.416 | 5 |
| 3 | 29.2 | 0.194 | | 576.4 | 0.451 | 5 | 438.1 | 0.443 | 5 | 429.1 | 0.415 | 5 |
| % | 94.53 | | | 96.94 | | | 100.58 | | | 95.48 | | |
| Content | | | | | | | | | | | | |

APPENDIX B

Formulations Data

Table B1 The Powder Properties of Each Formulation

| Formulation | Powder Property | | | | | |
|-------------|-----------------|-------|-------|-------------------|-------|-------|
| | AOR | | | % Compressibility | | |
| | 1 | 2 | 3 | 1 | 2 | 3 |
| F1 | 35.18 | 32.66 | 38.66 | 17.72 | 16.88 | 15.58 |
| F2 | 37.23 | 36.87 | 38.66 | 8.51 | 13.68 | 10.42 |
| F3 | 43.23 | 44.42 | 46.12 | 16.05 | 15.29 | 16.47 |
| F4 | 39.6 | 38.66 | 39.14 | 20.65 | 18.68 | 19.57 |
| F5 | 32.88 | 32.06 | 36.59 | 20 | 18.48 | 18.68 |
| F6 | 39.93 | 43.13 | 37.87 | 26.14 | 24.14 | 21.84 |
| F7 | 41.47 | 39.42 | 37.18 | 26.88 | 23.08 | 24.44 |
| F8 | 33.8 | 36.43 | 36.03 | 21.59 | 20.69 | 22.99 |
| F9 | 38.24 | 35.54 | 38.18 | 20.21 | 17.39 | 19.35 |
| F10 | 40.8 | 39.87 | 39.81 | 25.27 | 21.84 | 23.6 |

Table B2 The Tablet Hardness of Formulations F1 -F20

| Formulation | Hardness (N) | | | Formulation | Hardness (N) | | |
|-------------|--------------|------|------|-------------|--------------|------|------|
| | 1 | 2 | 3 | | 1 | 2 | 3 |
| F1 | 65.8 | 65.8 | 62.8 | F11 | 69.5 | 78.5 | 73.5 |
| F2 | 50.9 | 48.7 | 52.3 | F12 | 60.8 | 61.8 | 61.2 |
| F3 | 18.3 | 23.6 | 20.9 | F13 | 15.6 | 18.3 | 14.3 |
| F4 | 36.6 | 37.2 | 38.2 | F14 | 54.2 | 59.2 | 58.8 |
| F5 | 18.9 | 16 | 15 | F15 | 38.2 | 32.9 | 35.6 |
| F6 | 24.3 | 28.3 | 33.6 | F16 | 44.9 | 46.9 | 48.2 |
| F7 | 21.9 | 22.6 | 20.6 | F17 | 36.6 | 37.6 | 39.9 |
| F8 | 47.9 | 45.2 | 50.9 | F18 | 57.8 | 56.5 | 59.2 |
| F9 | 35.2 | 36.6 | 37.2 | F19 | 44.2 | 40.2 | 46.9 |
| F10 | 36.9 | 38.6 | 40.2 | F20 | 42.6 | 37.6 | 44.2 |

Table B3 The Transformation of Disintegration Time Data

| Formulation | DI | Log DI | Formulation | DI | Log DI |
|-------------|------|--------|-------------|------|--------|
| F1 | 11 | 1.0414 | F11 | 22 | 1.3424 |
| F2 | 3600 | 3.5563 | F12 | 3600 | 3.5563 |
| F3 | 22 | 1.3424 | F13 | 27 | 1.4314 |
| F4 | 11 | 1.0414 | F14 | 15 | 1.1761 |
| F5 | 23 | 1.3617 | F15 | 20 | 1.3010 |
| F6 | 15 | 1.1761 | F16 | 19 | 1.2788 |
| F7 | 20 | 1.3010 | F17 | 19 | 1.2788 |
| F8 | 11 | 1.0414 | F18 | 12 | 1.0792 |
| F9 | 13 | 1.1139 | F19 | 13 | 1.1139 |
| F10 | 19 | 1.2788 | F20 | 13 | 1.1139 |

Table B4 The Percent Drug Release at 45 Minutes of Formulations F1-F20

| Formulation | % Drug Release at 45 Minutes | | | | | |
|-------------|------------------------------|-------|-------|-------|-------|-------|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| F1 | 88.47 | 89.97 | 88.09 | 88.00 | 87.51 | 87.82 |
| F2 | 11.29 | 9.20 | 10.92 | 9.37 | 10.54 | 9.37 |
| F3 | 67.65 | 62.79 | 75.20 | 37.33 | 46.78 | 59.81 |
| F4 | 81.29 | 67.06 | 88.29 | 74.36 | 82.34 | 79.14 |
| F5 | 71.02 | 51.24 | 65.64 | 51.68 | 73.25 | 44.91 |
| F6 | 65.73 | 65.01 | 87.51 | 88.62 | 86.83 | 66.40 |
| F7 | 73.60 | 66.78 | 63.50 | 70.61 | 85.42 | 54.58 |
| F8 | 87.95 | 88.93 | 89.13 | 88.99 | 88.46 | 89.08 |
| F9 | 72.39 | 81.40 | 86.72 | 79.17 | 89.37 | 90.02 |
| F10 | 78.04 | 84.23 | 81.76 | 74.93 | 81.80 | 85.86 |
| F11 | 90.19 | 89.48 | 89.20 | 88.78 | 87.72 | 86.67 |
| F12 | 10.80 | 10.96 | 10.51 | 10.79 | 11.52 | 10.82 |
| F13 | 50.63 | 60.81 | 39.10 | 37.69 | 71.48 | 69.94 |
| F14 | 60.10 | 70.75 | 86.37 | 66.40 | 83.98 | 89.57 |
| F15 | 40.21 | 63.31 | 55.39 | 72.51 | 80.35 | 70.90 |
| F16 | 88.13 | 89.24 | 87.79 | 86.85 | 87.79 | 90.08 |
| F17 | 75.91 | 75.64 | 80.85 | 51.26 | 69.04 | 47.21 |
| F18 | 86.26 | 88.36 | 84.92 | 86.26 | 87.65 | 86.65 |
| F19 | 77.06 | 45.97 | 77.19 | 71.27 | 67.25 | 57.96 |
| F20 | 85.51 | 87.59 | 82.17 | 78.25 | 78.23 | 82.97 |

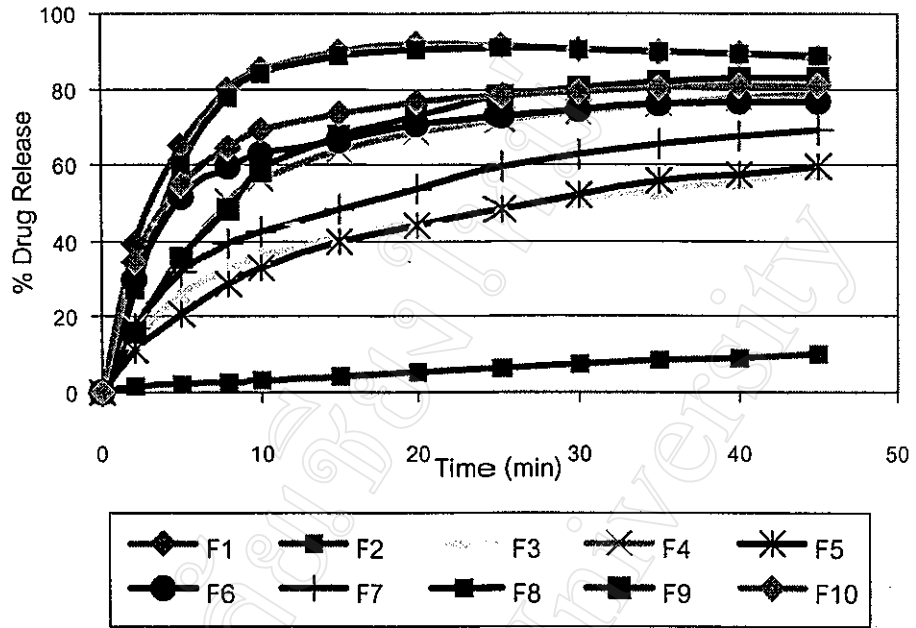


Figure B1 The Percent Drug Release of Formulations F1-F10

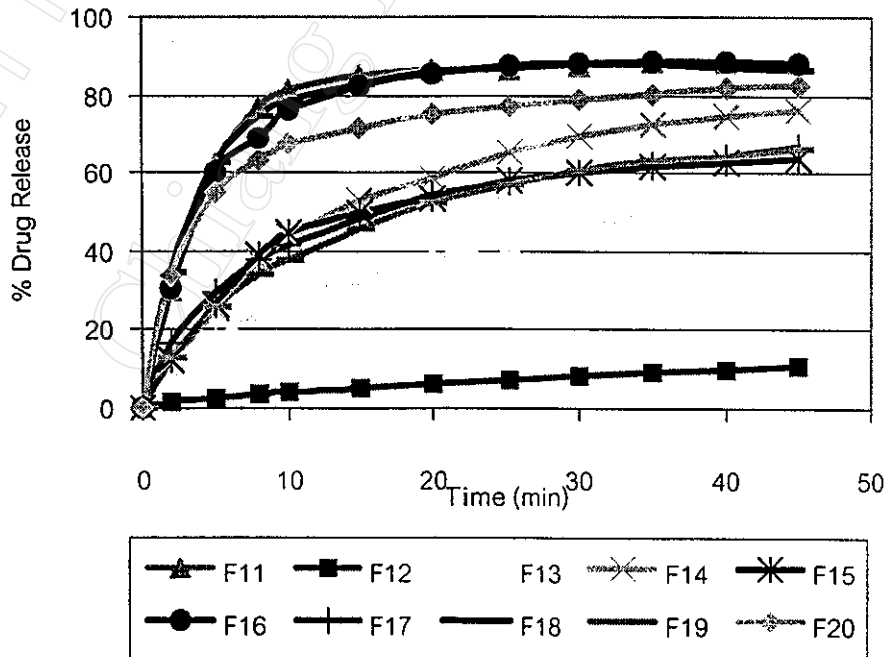


Figure B2 The Percent Drug Release of Formulations F11-F20

Table B5 The Td of Each Tablet of Formulations F1-F20

| Formulation | Td | | | | | |
|-------------|---------|---------|---------|---------|---------|---------|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| F1 | 5.42 | 6.22 | 4.36 | 6.39 | 4.07 | 2.30 |
| F2 | 1035.87 | 1808.24 | 1286.69 | 1566.60 | 1342.86 | 1783.37 |
| F3 | 33.12 | 46.23 | 24.24 | 159.52 | 76.29 | 49.38 |
| F4 | 15.17 | 34.37 | 14.43 | 18.94 | 13.16 | 14.12 |
| F5 | 31.38 | 59.73 | 33.79 | 66.93 | 23.97 | 115.83 |
| F6 | 30.71 | 6.22 | 2.68 | 6.51 | 6.52 | 24.25 |
| F7 | 22.32 | 34.14 | 42.84 | 29.32 | 14.98 | 62.77 |
| F8 | 8.78 | 4.19 | 4.49 | 7.91 | 5.09 | 6.75 |
| F9 | 22.91 | 15.67 | 14.42 | 22.43 | 13.40 | 8.62 |
| F10 | 11.68 | 4.80 | 5.54 | 25.01 | 7.56 | 9.38 |
| F11 | 5.01 | 5.25 | 4.66 | 13.66 | 6.13 | 5.76 |
| F12 | 1535.88 | 1329.34 | 1339.61 | 2013.04 | 1306.03 | 1369.12 |
| F13 | 66.23 | 48.55 | 120.66 | 199.52 | 29.38 | 35.87 |
| F14 | 43.02 | 28.23 | 22.06 | 39.82 | 15.47 | 11.13 |
| F15 | 85.96 | 31.75 | 52.80 | 26.88 | 12.43 | 26.12 |
| F16 | 12.94 | 237.75* | 4.72 | 11.08 | 4.85 | 6.42 |
| F17 | 17.58 | 31.67 | 17.66 | 79.71 | 27.22 | 82.52 |
| F18 | 7.62 | 3.87 | 6.83 | 11.45 | 4.56 | 4.31 |
| F19 | 23.01 | 82.84 | 22.86 | 27.80 | 25.63 | 48.57 |
| F20 | 6.98 | 6.43 | 3.20 | 21.59 | 17.64 | 9.81 |

* excluded data

Table B6 The b Parameter of Each Tablet of Formulations F1-F20

| Formulation | b | | | | | |
|-------------|------|-------|------|------|------|------|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| F1 | 0.81 | 0.77 | 0.75 | 0.69 | 0.71 | 0.52 |
| F2 | 0.70 | 0.65 | 0.67 | 0.67 | 0.66 | 0.64 |
| F3 | 0.49 | 0.52 | 0.59 | 0.58 | 0.65 | 0.50 |
| F4 | 0.60 | 0.78 | 0.68 | 0.66 | 0.60 | 0.74 |
| F5 | 0.72 | 0.80 | 0.70 | 0.71 | 0.55 | 0.57 |
| F6 | 0.46 | 0.77 | 0.43 | 0.42 | 0.55 | 0.62 |
| F7 | 0.56 | 0.56 | 0.69 | 0.47 | 0.65 | 0.56 |
| F8 | 1.10 | 0.66 | 0.66 | 0.92 | 0.71 | 0.93 |
| F9 | 0.67 | 0.64 | 0.87 | 0.76 | 1.09 | 0.66 |
| F10 | 0.35 | 0.53 | 0.38 | 0.53 | 0.46 | 0.61 |
| F11 | 0.81 | 0.85 | 0.67 | 0.59 | 0.87 | 0.71 |
| F12 | 0.62 | 0.65 | 0.66 | 0.58 | 0.63 | 0.64 |
| F13 | 0.70 | 0.74 | 0.62 | 0.52 | 0.77 | 0.76 |
| F14 | 0.79 | 0.72 | 0.93 | 0.86 | 0.79 | 0.82 |
| F15 | 0.74 | 0.59 | 0.69 | 0.67 | 0.58 | 0.67 |
| F16 | 0.69 | 0.10* | 0.54 | 0.72 | 0.66 | 0.68 |
| F17 | 0.68 | 0.56 | 0.60 | 0.62 | 0.47 | 0.56 |
| F18 | 0.59 | 0.63 | 0.63 | 0.61 | 0.71 | 0.53 |
| F19 | 0.78 | 0.71 | 0.73 | 0.70 | 0.43 | 0.73 |
| F20 | 0.45 | 0.40 | 0.28 | 0.53 | 0.48 | 0.61 |

*excluded data

APPENDIX C

The Scale Up and Commercial Aspirin Tablet Data

Table C1 The Powder Properties of Scale Up Formulations

| Formulation | Powder Property | | | | | |
|-------------|-----------------|-------|-------|-------------------|-------|-------|
| | AOR | | | % Compressibility | | |
| | 1 | 2 | 3 | 1 | 2 | 3 |
| X1 | 41.49 | 40.08 | 41.69 | 23.46 | 21.95 | 20.73 |
| X2 | 37.44 | 38.49 | 40.14 | 21.95 | 24.1 | 23.17 |

Table C2 The Tablet Hardness and Thickness of Three Formulations

| Sample | Property | | | | | |
|--------|--------------|-------|------|----------------|------|------|
| | Hardness (N) | | | Thickness (mm) | | |
| | X1 | X2 | Com | X1 | X2 | Com |
| 1 | 87.8 | 87.1 | 65.8 | 3.94 | 3.76 | 4.62 |
| 2 | 90.8 | 78.1 | 69.8 | 3.94 | 3.86 | 4.75 |
| 3 | 87.4 | 87.4 | 59.2 | 4.01 | 3.86 | 4.67 |
| 4 | 85.4 | 80.4 | 56.2 | 3.99 | 3.89 | 4.67 |
| 5 | 96.4 | 84.8 | 55.2 | 3.99 | 3.71 | 4.83 |
| 6 | 96.4 | 77.8 | 66.8 | 3.96 | 3.86 | 4.72 |
| 7 | 96.7 | 83.4 | 60.2 | 3.99 | 3.94 | 4.78 |
| 8 | 89.4 | 101.4 | 62.5 | 3.99 | 4.01 | 4.62 |
| 9 | 83.4 | 97.7 | 61.2 | 3.98 | 3.94 | 4.65 |
| 10 | 104.4 | 95.1 | 59.2 | 3.86 | 3.78 | 4.65 |

Table C3 The Tablet Weight (mg) of Three Formulations

| Sample | Formulation | | |
|--------|-------------|-------|------------|
| | X1 | X2 | Commercial |
| 1 | 442.3 | 434.8 | 561.8 |
| 2 | 442.8 | 441.8 | 570.1 |
| 3 | 429.4 | 439.4 | 578.6 |
| 4 | 442.4 | 440.3 | 577.3 |
| 5 | 448.3 | 425.7 | 572.6 |
| 6 | 440.3 | 447.7 | 584.0 |
| 7 | 444.3 | 422.0 | 574.3 |
| 8 | 446.3 | 440.5 | 576.8 |
| 9 | 445.8 | 425.0 | 569.0 |
| 10 | 441.8 | 436.3 | 572.5 |
| 11 | 426.5 | 433.7 | 563.4 |
| 12 | 433.8 | 444.1 | 580.6 |
| 13 | 448.5 | 436.4 | 560.4 |
| 14 | 445.6 | 446.1 | 568.6 |
| 15 | 438.6 | 444.6 | 577.6 |
| 16 | 438.5 | 436.2 | 563.3 |
| 17 | 437.9 | 435.8 | 576.2 |
| 18 | 442 | 436.6 | 573.6 |
| 19 | 437.2 | 443.6 | 570.0 |
| 20 | 445.4 | 422.0 | 569.1 |

Table C4 Percent Drug Release of Each Tablet of Formulation X1

| Time (min) | 1 | 2 | 3 | 4 | 5 | 6 |
|------------|-------|-------|-------|-------|-------|-------|
| 2 | 21.10 | 20.82 | 24.00 | 22.05 | 25.92 | 22.14 |
| 5 | 50.08 | 43.74 | 46.55 | 46.36 | 53.33 | 43.96 |
| 8 | 64.50 | 55.50 | 57.08 | 58.63 | 64.91 | 55.49 |
| 10 | 70.03 | 59.61 | 62.91 | 62.53 | 70.57 | 60.13 |
| 15 | 73.63 | 66.14 | 71.27 | 69.96 | 78.61 | 65.90 |
| 20 | 80.67 | 70.81 | 78.39 | 76.45 | 83.57 | 73.81 |
| 25 | 85.00 | 74.18 | 80.98 | 79.63 | 87.17 | 75.92 |
| 30 | 86.61 | 75.55 | 84.89 | 80.10 | 89.20 | 80.70 |
| 35 | 86.63 | 79.33 | 85.16 | 84.78 | 89.22 | 80.97 |
| 40 | 86.85 | 80.26 | 85.62 | 86.39 | 89.67 | 81.88 |
| 45 | 87.75 | 83.59 | 87.23 | 86.85 | 90.12 | 82.79 |

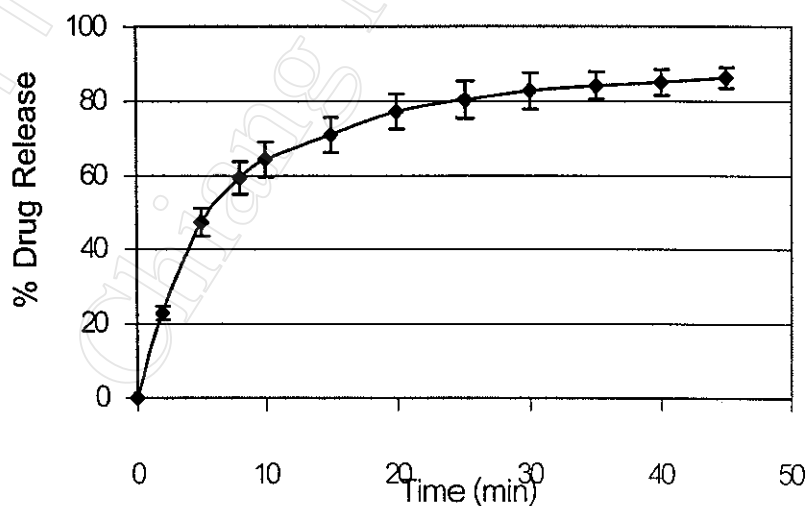


Figure C1 The Release Profile of Formulation X1

Table C5 Percent Drug Release of Each Tablet of Formulation X2

| Time (min) | 1 | 2 | 3 | 4 | 5 | 6 |
|------------|-------|-------|-------|-------|-------|-------|
| 2 | 21.04 | 13.88 | 23.70 | 16.24 | 17.46 | 15.00 |
| 5 | 32.97 | 26.57 | 36.98 | 26.81 | 32.36 | 27.92 |
| 8 | 43.60 | 32.57 | 47.62 | 33.74 | 43.75 | 36.77 |
| 10 | 49.34 | 35.78 | 49.58 | 36.86 | 52.46 | 43.79 |
| 15 | 54.00 | 41.47 | 55.59 | 42.08 | 61.25 | 51.35 |
| 20 | 58.28 | 47.96 | 59.38 | 50.60 | 63.35 | 56.66 |
| 25 | 61.58 | 52.96 | 62.88 | 56.18 | 64.33 | 58.60 |
| 30 | 65.57 | 56.30 | 71.01 | 59.81 | 66.72 | 63.80 |
| 35 | 67.47 | 58.92 | 73.41 | 62.71 | 68.17 | 66.68 |
| 40 | 70.28 | 61.76 | 75.05 | 67.51 | 69.86 | 70.48 |
| 45 | 71.01 | 63.20 | 77.61 | 70.19 | 73.69 | 72.16 |

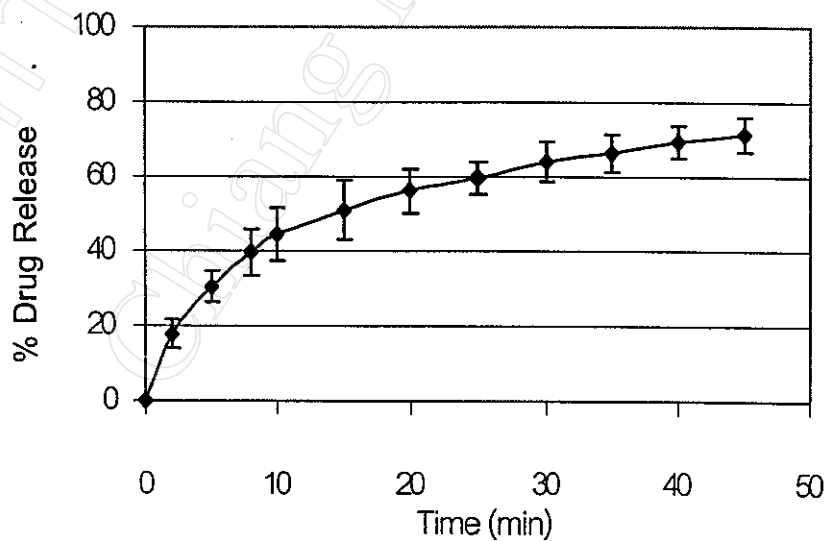


Figure C2 The Release Profile of Formulation X2

Table C6 Percent Drug Release of Each Tablet of Commercial Tablet

| Time (min) | 1 | 2 | 3 | 4 | 5 | 6 |
|------------|-------|-------|-------|--------|-------|-------|
| 2 | 2.41 | 2.79 | 2.50 | 3.61 | 3.84 | 2.59 |
| 5 | 11.75 | 7.19 | 9.79 | 12.61 | 14.16 | 6.27 |
| 8 | 23.33 | 12.93 | 17.67 | 22.43 | 19.84 | 9.83 |
| 10 | 29.33 | 16.77 | 21.23 | 32.60 | 22.66 | 12.57 |
| 15 | 37.48 | 25.64 | 30.42 | 58.70 | 26.55 | 20.85 |
| 20 | 50.07 | 33.44 | 43.02 | 76.34 | 31.83 | 28.30 |
| 25 | 58.68 | 38.94 | 64.37 | 86.73 | 33.99 | 33.43 |
| 30 | 64.65 | 51.94 | 67.52 | 94.38 | 65.21 | 41.71 |
| 35 | 67.54 | 61.18 | 75.23 | 96.90 | 82.44 | 45.17 |
| 40 | 72.36 | 73.12 | 83.20 | 99.37 | 90.52 | 51.53 |
| 45 | 73.27 | 86.22 | 90.28 | 100.95 | 97.19 | 57.46 |

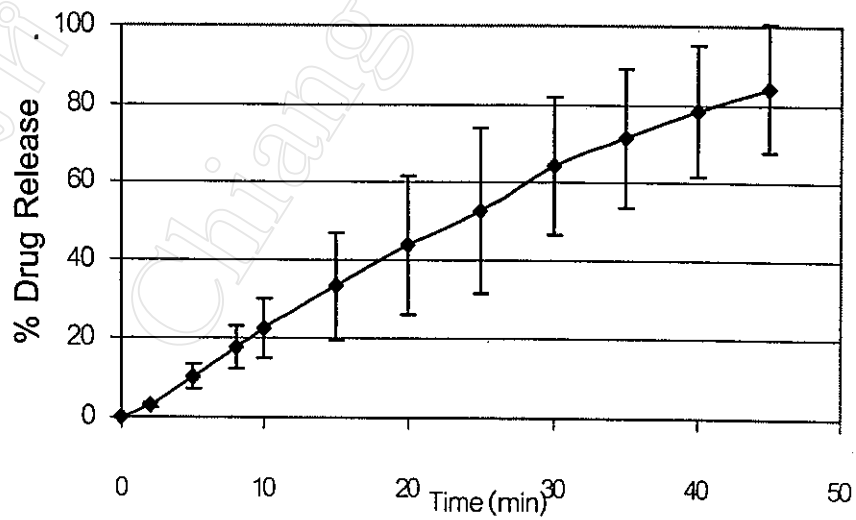


Figure C3 The Release Profile of Aspirin Commercial Tablet

Table C7 The Td of Each Tablet of Three Formulations

| Sample | Td | | |
|--------|-------|-------|------------|
| | X1 | X2 | Commercial |
| 1 | 10.55 | 26.51 | 29.27 |
| 2 | 15.03 | 41.56 | 35.73 |
| 3 | 11.71 | 21.60 | 26.94 |
| 4 | 12.36 | 34.87 | 16.28 |
| 5 | 8.92 | 23.58 | 27.49 |
| 6 | 14.05 | 27.90 | 53.94 |

Table C8 The b Parameter of Each Tablet of Three Formulations

| Sample | b | | |
|--------|------|------|------------|
| | X1 | X2 | Commercial |
| 1 | 0.65 | 0.53 | 1.23 |
| 2 | 0.60 | 0.59 | 1.30 |
| 3 | 0.63 | 0.53 | 1.41 |
| 4 | 0.63 | 0.61 | 1.66 |
| 5 | 0.63 | 0.59 | 1.29 |
| 6 | 0.60 | 0.65 | 1.14 |

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" Development of aspirin Tablet Using Statistical Mixture
Design " Poster No. 14 in " Application of Natural
Materials in Pharmacy and cosmetics " 14-15 March,
2002, faculty of Pharmacy, Chiang Mai University,