

Lampiran 2. Gambar alat yang digunakan dalam proses ekstraksi, formulasi dan uji sifat fisik



Rotary Evaporator



Alat uji sifat alir



Timbangan analitik



Alat uji pengetapan



Friability tester



Hardness tester



Alat cetak tablet single punch



Moisture Balance

Lampiran 3. Hasil evaluasi sifat fisik granul efervesen ekstrak daun tin

a. Hasil uji waktu dan kecepatan alir granul efervesen

| Keterangan | Formula | | | | | | | | | |
|-----------------------|-------------|--------------|-------------|--------------|-------------|--------------|-------------|--------------|-------------|--------------|
| | 1 | | 2 | | 3 | | 4 | | 5 | |
| | Wkt. Alir | Kec. alir | Wkt. alir | Kec. alir | Wkt. Alir | Kec. alir | Wkt. alir | Kec. alir | Wkt. alir | Kec. alir |
| Rep. I | 2,42 | 41,32 | 2,43 | 41,15 | 2,52 | 39,68 | 2,49 | 40,16 | 2,42 | 41,32 |
| Rep. II | 2,34 | 42,74 | 2,37 | 42,19 | 2,45 | 40,82 | 2,51 | 39,84 | 2,38 | 42,02 |
| Rep. III | 2,37 | 42,19 | 2,49 | 40,16 | 2,41 | 41,49 | 2,41 | 41,49 | 2,35 | 42,55 |
| Rata-rata | 2,38 | 42,08 | 2,43 | 41,17 | 2,46 | 40,66 | 2,47 | 40,50 | 2,38 | 41,96 |
| SD | 0,04 | 0,71 | 0,06 | 1,02 | 0,06 | 0,92 | 0,05 | 0,88 | 0,04 | 0,62 |
| CV (%) | 1,70 | 1,69 | 2,47 | 2,47 | 2,26 | 2,25 | 2,14 | 2,16 | 1,47 | 1,47 |
| Rata-rata ± SD | 2,38 ± 0,04 | 42,08 ± 0,71 | 2,43 ± 0,06 | 41,17 ± 1,02 | 2,46 ± 0,06 | 40,66 ± 0,92 | 2,47 ± 0,05 | 40,50 ± 0,88 | 2,38 ± 0,04 | 41,96 ± 0,62 |

Keterangan: Wkt. Alir = waktu alir (detik), Kec. Alir = Kecepatan alir (g/detik)

b. Hasil uji sudut diam granul granul efervesen ekstrak daun tin

| Keterangan | | Formula | | | | |
|-----------------------|----------|---------------|---------------|---------------|---------------|---------------|
| | | 1 | 2 | 3 | 4 | 5 |
| Replikasi I | h | 32,38 | 33,03 | 32,81 | 29,03 | 28,54 |
| | r | 50 | 50 | 50 | 50 | 50 |
| | α | 32,927 | 33,4487 | 33,273 | 30,139 | 29,718 |
| Replikasi II | h | 32,54 | 33,15 | 32,95 | 28,92 | 28,33 |
| | r | 50 | 50 | 50 | 50 | 50 |
| | α | 33,056 | 33,544 | 33,385 | 30,045 | 29,536 |
| Replikasi III | h | 32,72 | 33,41 | 32,72 | 28,87 | 28,29 |
| | r | 50 | 50 | 50 | 50 | 50 |
| | α | 33,2 | 33,751 | 33,2 | 30,002 | 29,501 |
| Rata-rata α | | 33,06 | 33,58 | 33,29 | 30,06 | 29,59 |
| SD | | 0,137 | 0,155 | 0,093 | 0,070 | 0,117 |
| CV (%) | | 0,413 | 0,460 | 0,280 | 0,233 | 0,394 |
| Rata-rata ± SD | | 33,06 ± 0,137 | 33,58 ± 0,155 | 33,29 ± 0,093 | 30,06 ± 0,070 | 29,59 ± 0,117 |

Keterangan: h = tinggi granul (mm), r = jari-jari granul (mm), α = sudut diam ($^{\circ}$)

c. Hasil uji kompresibilitas granul efervesen ekstrak daun tin

| Keterangan | Jumlah tap | Formula | | | | |
|---------------|---|------------------|------------------|------------------|------------------|------------------|
| | | 1 | 2 | 3 | 4 | 5 |
| Replikasi I | 300 | 84 | 83 | 83 | 84 | 83 |
| | 600 | 82 | 82 | 80 | 82 | 82 |
| | 900 | 81 | 82 | 78 | 82 | 81 |
| | 1200 | 81 | 80 | 78 | 81 | 80 |
| | m granul | 65,58 | 63,94 | 64,25 | 66,14 | 66,72 |
| | ρ granul (bulk) | 0,66 | 0,64 | 0,64 | 0,66 | 0,67 |
| | ρ granul (tap) | 0,81 | 0,80 | 0,82 | 0,82 | 0,83 |
| | <i>Carr's Index</i> (CI) | 19 | 20 | 22 | 19 | 20 |
| | Rasio Hausner (RH) | 1,23 | 1,25 | 1,28 | 1,23 | 1,25 |
| Replikasi II | 300 | 83 | 83 | 82 | 83 | 84 |
| | 600 | 81 | 82 | 81 | 82 | 82 |
| | 900 | 80 | 81 | 79 | 80 | 81 |
| | 1200 | 80 | 81 | 78 | 80 | 81 |
| | m granul | 64,30 | 63,23 | 62,43 | 66,03 | 66,45 |
| | ρ granul (bulk) | 0,64 | 0,63 | 0,62 | 0,66 | 0,66 |
| | ρ granul (tap) | 0,80 | 0,78 | 0,80 | 0,83 | 0,82 |
| | <i>Carr's Index</i> (CI) | 20 | 19 | 22 | 20 | 19 |
| | Rasio Hausner (RH) | 1,25 | 1,23 | 1,28 | 1,25 | 1,23 |
| Replikasi III | 300 | 83 | 83 | 83 | 84 | 83 |
| | 600 | 82 | 82 | 81 | 83 | 82 |
| | 900 | 80 | 82 | 80 | 81 | 80 |
| | 1200 | 80 | 81 | 80 | 81 | 80 |
| | m granul | 64,61 | 63,54 | 64,72 | 65,44 | 65,92 |
| | ρ granul (bulk) | 0,65 | 0,64 | 0,65 | 0,65 | 0,66 |
| | ρ granul (tap) | 0,81 | 0,78 | 0,81 | 0,81 | 0,82 |
| | <i>Carr's Index</i> (CI) | 20 | 19 | 20 | 19 | 20 |
| | Rasio Hausner (RH) | 1,25 | 1,23 | 1,25 | 1,23 | 1,25 |
| | Rata-rata <i>Carr's Index</i> | 19,67 | 19,33 | 21,33 | 19,33 | 19,67 |
| | SD <i>Carr's Index</i> | 0,58 | 0,58 | 1,15 | 0,58 | 0,58 |
| | % CV <i>Carr's Index</i> | 2,94 | 2,99 | 5,41 | 2,99 | 2,94 |
| | Rata-rata \pm SD (CI) | 19,67 \pm 0,58 | 19,33 \pm 0,58 | 21,33 \pm 1,15 | 19,33 \pm 0,58 | 19,67 \pm 0,58 |
| | Rata-rata Rasio Hausner | 1,24 | 1,24 | 1,27 | 1,24 | 1,24 |
| | SD Rasio Hausner | 0,01 | 0,01 | 0,02 | 0,01 | 0,01 |
| | % CV Rasio Hausner | 0,72 | 0,72 | 1,46 | 0,72 | 0,72 |
| | Rata-rata \pm SD (RH) | 1,24 \pm 0,01 | 1,24 \pm 0,01 | 1,27 \pm 0,02 | 1,24 \pm 0,01 | 1,24 \pm 0,01 |

Keterangan: tap = tapping (ml), m = massa granul (g), ρ = massa jenis granul (g/ml)

d. Hasil uji kelembaban (*moisture content*) granul efervesen ekstrak daun tin

| Rep | Keterangan | Formula | | | | |
|----------------------------|-----------------|---------------|---------------|---------------|---------------|---------------|
| | | 1 | 2 | 3 | 4 | 5 |
| I | Massa awal (g) | 0,510 | 0,505 | 0,504 | 0,503 | 0,519 |
| | Massa akhir (g) | 0,502 | 0,496 | 0,493 | 0,491 | 0,505 |
| | Kadar air (%) | 1,57 | 1,78 | 2,18 | 2,39 | 2,70 |
| | % sisa | 98,43 | 98,22 | 97,82 | 97,61 | 97,30 |
| II | Massa awal (g) | 0,502 | 0,503 | 0,507 | 0,504 | 0,504 |
| | Massa akhir (g) | 0,494 | 0,494 | 0,496 | 0,491 | 0,490 |
| | Kadar air (%) | 1,59 | 1,79 | 2,17 | 2,58 | 2,78 |
| | % sisa | 98,41 | 98,21 | 97,83 | 97,42 | 97,22 |
| III | Massa awal (g) | 0,509 | 0,512 | 0,514 | 0,510 | 0,508 |
| | Massa akhir (g) | 0,501 | 0,503 | 0,503 | 0,497 | 0,495 |
| | Kadar air (%) | 1,57 | 1,76 | 2,14 | 2,55 | 2,56 |
| | % sisa | 98,43 | 98,24 | 97,86 | 97,45 | 97,44 |
| Rata-rata kadar air | | 1,578 | 1,776 | 2,164 | 2,505 | 2,678 |
| SD | | 0,014 | 0,016 | 0,022 | 0,104 | 0,111 |
| CV (%) | | 0,864 | 0,929 | 1,006 | 4,159 | 4,131 |
| Rata-rata ± SD | | 1,578 ± 0,014 | 1,776 ± 0,016 | 2,164 ± 0,022 | 2,505 ± 0,104 | 2,678 ± 0,111 |

Lampiran 4. Hasil evaluasi sifat fisik tablet efervesen ekstrak daun tin

a. Hasil uji waktu hancur tablet ekstrak daun tin (satuan menit)

| Replikasi | Formula | | | | |
|-----------------------|---------------|---------------|---------------|---------------|---------------|
| | 1 | 2 | 3 | 4 | 5 |
| I | 3,667 | 3,667 | 3,417 | 3,250 | 3,217 |
| II | 3,833 | 3,750 | 3,533 | 3,283 | 3,300 |
| III | 3,500 | 3,633 | 3,600 | 3,350 | 3,333 |
| Rata-rata | 3,667 | 3,683 | 3,517 | 3,294 | 3,283 |
| SD | 0,167 | 0,060 | 0,093 | 0,051 | 0,060 |
| % CV | 4,545 | 1,631 | 2,639 | 1,546 | 1,830 |
| Rata-rata ± SD | 3,667 ± 0,167 | 3,683 ± 0,060 | 3,517 ± 0,093 | 3,294 ± 0,051 | 3,283 ± 0,060 |

b. Hasil uji bobot tablet efervesen ekstrak daun tin (satuan g)

| No | FORMULA | | | | |
|-----------------------|--------------|--------------|--------------|--------------|--------------|
| | 1 | 2 | 3 | 4 | 5 |
| 1 | 3,935 | 3,908 | 4,119 | 3,972 | 4,059 |
| 2 | 3,973 | 4,026 | 3,928 | 4,069 | 3,927 |
| 3 | 3,878 | 3,895 | 3,890 | 3,907 | 3,947 |
| 4 | 3,920 | 3,950 | 3,927 | 4,073 | 3,966 |
| 5 | 3,864 | 3,839 | 3,955 | 3,973 | 3,946 |
| 6 | 4,051 | 3,921 | 3,995 | 3,994 | 3,934 |
| 7 | 3,862 | 4,042 | 3,963 | 3,995 | 3,952 |
| 8 | 3,892 | 3,914 | 4,058 | 4,035 | 3,922 |
| 9 | 3,919 | 3,964 | 3,898 | 3,994 | 3,978 |
| 10 | 3,907 | 3,873 | 3,927 | 3,941 | 3,988 |
| 11 | 3,927 | 4,034 | 3,899 | 3,952 | 3,924 |
| 12 | 3,850 | 3,924 | 3,901 | 4,018 | 3,933 |
| 13 | 3,995 | 3,927 | 3,989 | 3,889 | 3,950 |
| 14 | 3,807 | 4,026 | 3,980 | 3,988 | 3,975 |
| 15 | 4,016 | 4,011 | 3,922 | 3,953 | 3,921 |
| 16 | 3,938 | 4,029 | 3,923 | 3,917 | 3,968 |
| 17 | 3,934 | 4,025 | 3,890 | 3,968 | 3,943 |
| 18 | 3,970 | 3,975 | 3,928 | 3,924 | 3,968 |
| 19 | 3,979 | 3,878 | 4,093 | 3,983 | 3,943 |
| 20 | 3,927 | 3,869 | 4,207 | 4,014 | 3,994 |
| Rata-rata | 3,927 | 3,952 | 3,970 | 3,978 | 3,957 |
| SD | 0,06 | 0,07 | 0,09 | 0,05 | 0,03 |
| Bobot minimal | 3,807 | 3,839 | 3,890 | 3,889 | 3,921 |
| Bobot maksimal | 4,051 | 4,042 | 4,207 | 4,073 | 4,059 |
| % CV | 1,518 | 1,658 | 2,179 | 1,248 | 0,822 |
| Rata-rata ± SD | 3,927 ± 0,06 | 3,952 ± 0,07 | 3,970 ± 0,09 | 3,978 ± 0,05 | 3,957 ± 0,03 |

c. Hasil uji keseragaman ukuran tablet ekstrak daun tin

| No | FORMULA | | | | |
|-----------------------|-------------|-------------|-------------|-------------|-------------|
| | 1 | 2 | 3 | 4 | 5 |
| 1 | 7,46 | 7,42 | 7,42 | 7,46 | 7,40 |
| 2 | 7,47 | 7,39 | 7,40 | 7,45 | 7,44 |
| 3 | 7,41 | 7,41 | 7,39 | 7,42 | 7,47 |
| 4 | 7,39 | 7,46 | 7,41 | 7,41 | 7,46 |
| 5 | 7,40 | 7,45 | 7,43 | 7,44 | 7,45 |
| 6 | 7,38 | 7,40 | 7,44 | 7,43 | 7,45 |
| 7 | 7,42 | 7,43 | 7,44 | 7,44 | 7,44 |
| 8 | 7,44 | 7,45 | 7,45 | 7,45 | 7,43 |
| 9 | 7,45 | 7,44 | 7,46 | 7,40 | 7,43 |
| 10 | 7,46 | 7,41 | 7,42 | 7,39 | 7,44 |
| 11 | 7,46 | 7,43 | 7,42 | 7,40 | 7,45 |
| 12 | 7,45 | 7,42 | 7,43 | 7,41 | 7,45 |
| 13 | 7,42 | 7,44 | 7,43 | 7,42 | 7,46 |
| 14 | 7,43 | 7,47 | 7,46 | 7,44 | 7,44 |
| 15 | 7,44 | 7,46 | 7,39 | 7,46 | 7,43 |
| 16 | 7,44 | 7,39 | 7,40 | 7,45 | 7,46 |
| 17 | 7,43 | 7,43 | 7,42 | 7,43 | 7,45 |
| 18 | 7,41 | 7,44 | 7,48 | 7,44 | 7,45 |
| 19 | 7,47 | 7,46 | 7,46 | 7,43 | 7,42 |
| 20 | 7,45 | 7,42 | 7,45 | 7,42 | 7,43 |
| Rata-rata | 7,434 | 7,431 | 7,430 | 7,430 | 7,443 |
| SD | 0,026 | 0,024 | 0,025 | 0,020 | 0,016 |
| Tebal minimal | 7,38 | 7,39 | 7,39 | 7,39 | 7,40 |
| Tebal maksimal | 7,47 | 7,47 | 7,48 | 7,46 | 7,47 |
| % CV | 0,353 | 0,318 | 0,338 | 0,274 | 0,217 |
| Rata-rata ± SD | 7,434±0,026 | 7,431±0,024 | 7,430±0,025 | 7,430±0,020 | 7,443±0,016 |

Keterangan: ukuran dalam satuan mm, ukuran diameter semua tablet sama, yaitu 25,10 mm

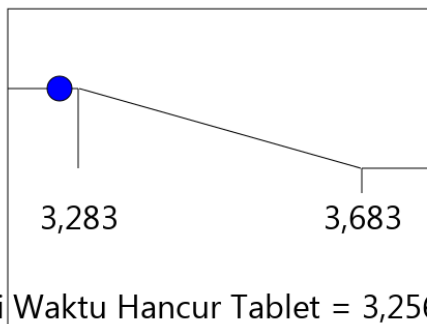
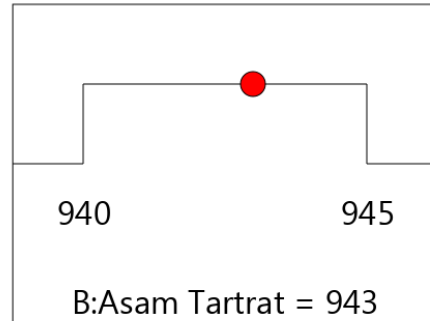
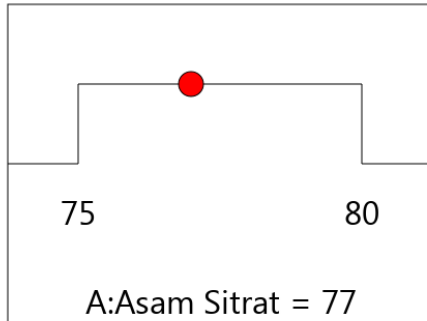
d. Hasil uji kekerasan tablet ekstrak daun tin

| Nomor | Formula | | | | |
|---------------------------|-------------|-------------|-------------|-------------|-------------|
| | 1 | 2 | 3 | 4 | 5 |
| 1 | 6,17 | 6,57 | 6,91 | 7,41 | 7,92 |
| 2 | 5,69 | 6,32 | 6,93 | 7,37 | 8,20 |
| 3 | 5,72 | 6,42 | 7,36 | 7,21 | 8,12 |
| 4 | 5,47 | 6,74 | 7,66 | 7,04 | 8,33 |
| 5 | 5,34 | 6,14 | 7,46 | 7,51 | 7,98 |
| 6 | 5,28 | 6,39 | 7,22 | 7,36 | 7,95 |
| 7 | 5,57 | 6,44 | 6,95 | 7,15 | 8,56 |
| 8 | 5,42 | 6,27 | 7,13 | 6,98 | 8,22 |
| 9 | 5,63 | 6,48 | 7,29 | 6,93 | 8,41 |
| 10 | 5,56 | 6,51 | 7,61 | 7,12 | 8,17 |
| Rata-rata | 5,585 | 6,428 | 7,252 | 7,208 | 8,186 |
| SD | 0,251 | 0,166 | 0,275 | 0,197 | 0,207 |
| Kekerasan minimal | 5,28 | 6,14 | 6,91 | 6,93 | 7,92 |
| Kekerasan maksimal | 6,17 | 6,74 | 7,66 | 7,51 | 8,56 |
| % CV | 4,498 | 2,583 | 3,787 | 2,736 | 2,529 |
| Rata-rata ± SD | 5,585±0,251 | 6,428±0,166 | 7,252±0,275 | 7,208±0,197 | 8,186±0,207 |

Keterangan: satuan kekerasan dalam kg/cm³

e. Hasil uji kerapuhan tablet ekstrak daun tin

| Rep | Keterangan | Formula | | | | |
|-----------------------|------------------|-------------|-------------|-------------|-------------|--------|
| | | 1 | 2 | 3 | 4 | 5 |
| I | Bobot awal (g) | 78,309 | 78,722 | 79,412 | 78,794 | 79,629 |
| | rpm | 25 | 25 | 25 | 25 | 25 |
| | waktu (menit) | 4 | 4 | 4 | 4 | 4 |
| | bobot akhir (g) | 74,235 | 74,873 | 75,341 | 75,032 | 75,921 |
| | % kerapuhan | 5,202 | 4,889 | 5,126 | 4,774 | 4,657 |
| | Bobot awal (g) | 79,417 | 78,625 | 79,113 | 78,921 | 78,711 |
| II | rpm | 25 | 25 | 25 | 25 | 25 |
| | waktu (menit) | 4 | 4 | 4 | 4 | 4 |
| | bobot akhir (g) | 75,749 | 74,613 | 75,102 | 75,423 | 75,429 |
| | % kerapuhan | 4,619 | 5,103 | 5,070 | 4,432 | 4,170 |
| | Bobot awal (g) | 78,436 | 78,848 | 78,326 | 78,727 | 79,332 |
| | rpm | 25 | 25 | 25 | 25 | 25 |
| III | waktu (menit) | 4 | 4 | 4 | 4 | 4 |
| | bobot akhir (g) | 74,316 | 74,529 | 74,257 | 75,210 | 75,827 |
| | % kerapuhan | 5,253 | 5,478 | 5,195 | 4,467 | 4,418 |
| | Rata-rata | 5,025 | 5,157 | 5,130 | 4,558 | 4,415 |
| | SD | 0,352 | 0,298 | 0,063 | 0,188 | 0,243 |
| | % CV | 7,015 | 5,775 | 1,220 | 4,130 | 5,515 |
| Rata-rata ± SD | 5,025±0,352 | 5,157±0,298 | 5,130±0,063 | 4,558±0,188 | 4,415±0,243 | |

Lampiran 5. Solusi Formula Optimal

Desirability = 1,000
Solution 1 out of 12