

## 7. LAMPIRAN

### Lampiran 1. Efisiensi isolat protein

#### 7.1. Perhitungan efisiensi isolat protein

Efisiensi isolat protein dihitung berdasarkan perbandingan berat isolat protein dengan ekstrak protein awal sebelum dilakukan presipitasi. angka yang digunakan merupakan hasil berat isolat protein dai 3 batch percobaan dengan 3 kali ulangan.

##### 7.1.1. Buffer aqua bidest

###### 7.1.1.1. Efisiensi isolat protein metode presipitasi dengan TCA/Aseton

- Jumlah ekstrak protein = 100  $\mu$ l = 0,1 gram ( asumsi 1 gram = 1 ml)
- Berat isolat protein (gram) = 0,013 + 0,013 + 0,011 + 0,015 + 0,015 + 0,020 + 0,009 + 0,009 + 0,008 = 0,113
- Rarta – rata berat isolat protein =  
$$\frac{0,113}{9} = 0,01256 \text{ gram}$$
- Efisiensi isolat protein =  
$$\frac{0,01256}{0,1} \times 100\% = 12,56\%$$

###### 7.1.1.2. Efisiensi isolat protein metode presipitasi dengan Aseton

- Jumlah ekstrak protein = 200  $\mu$ l = 0,2 gram ( asumsi 1 gram = 1 ml)
- Berat isolat protein (gram) = 0,037 + 0,025 + 0,027 + 0,036 + 0,034 + 0,035 + 0,032 + 0,030 + 0,032 = 0,288
- Rarta – rata berat isolat protein =  
$$\frac{0,288}{9} = 0,032 \text{ gram}$$
- Efisiensi isolat protein =  
$$\frac{0,032}{0,2} \times 100\% = 16\%$$

###### 7.1.1.3. Efisiensi isolat protein metode presipitasi dengan Salting Out

- Jumlah ekstrak protein = 1,5 ml = 1,5 gram ( asumsi 1 gram = 1 ml)
- Berat isolat protein (gram) = 0,722 + 0,754 + 0,762 + 0,822 + 0,878 + 0,837 + 0,660 + 0,681 + 0,666 = 6,705
- Rarta – rata berat isolat protein =  
$$\frac{6,705}{9} = 0,745 \text{ gram}$$
- Efisiensi isolat protein =  
$$\frac{0,745}{1,5} \times 100\% = 49,67\%$$

## 7.1.2. Buffer tris-HCl

### 7.1.2.1. Efisiensi isolat protein metode presipitasi dengan TCA/Aseton

- Jumlah ekstrak protein = 100  $\mu$ l = 0,1 gram ( asumsi 1 gram = 1 ml)
- Berat isolat protein = 0,012 + 0,009 + 0,012 + 0,010 + 0,010 + 0,012 + 0,011 + 0,011 + 0,011 = 0,09801
- Rarta – rata berat isolat protein = 
$$\frac{0,09801}{9} = 0,01089 \text{ gram}$$
- Efisiensi isolat protein = 
$$\frac{0,01089}{0,1} \times 100\% = 10,89\%$$

### 7.1.2.2. Efisiensi isolat protein metode presipitasi dengan Aseton

- Jumlah ekstrak protein = 200  $\mu$ l = 0,2 gram ( asumsi 1 gram = 1 ml)
- Berat isolat protein (gram) = 0,036 + 0,023 + 0,035 + 0,031 + 0,031 + 0,034 + 0,031 + 0,031 + 0,032 = 0,28404
- Rarta – rata berat isolat protein = 
$$\frac{0,28404}{9} = 0,03156 \text{ gram}$$
- Efisiensi isolat protein = 
$$\frac{0,03156}{0,2} \times 100\% = 15,78\%$$

### 7.1.2.3. Efisiensi isolat protein metode presipitasi dengan Salting Out

- Jumlah ekstrak protein = 1,5 ml = 1,5 gram ( asumsi 1 gram = 1 ml)
- Berat isolat protein (gram) = 0,640 + 0,643 + 0,654 + 0,627 + 0,605 + 0,621 + 0,623 + 0,635 + 0,600 = 5,572
- Rarta – rata berat isolat protein = 
$$\frac{5,572}{9} = 0,6192 \text{ gram}$$
- Efisiensi isolat protein = 
$$\frac{0,6912}{1,5} \times 100\% = 41,27\%$$

## Lampiran 2. Konsentrasi isolat protein

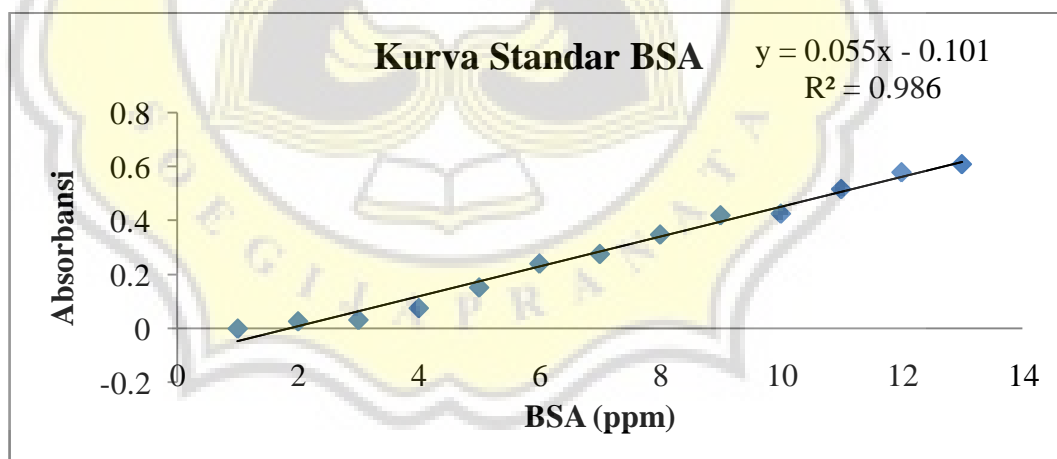
### 7.2. Perhitungan konsentrasi protein

Persamaan regresi linear  $y = 0,055x - 0,101$

Dilakukan pengenceran 1x, sehingga hasil konsentrasi dikalikan dengan 10.

Tabel 8. Hasil absorbansi BSA

BSA (ppm)	Absorbansi
0	0
5	0,0268
10	0,0321
20	0,0758
40	0,1521
60	0,2403
80	0,2759
100	0,3479
120	0,4192
140	0,4252
160	0,5163
180	0,5784
200	0,6084



Gambar 10. Kurva standar BSA

#### 7.2.1. Buffer Aqua bidest

##### 7.2.1.1. Konsentrasi protein Metode TCA/Aseton (mg/ml)

- Absorbansi ulangan 1 = 0,24
  - $y = 0,055x - 0,101$
  - $0,24 = 0,055x - 0,101$

- $x = 6,2$   
Konsentrasi  $\times$  pengenceran =  $6,2 \times 10 = 62$
- Absorbansi ulangan 2 = 0,236
  - $y = 0,055x - 0,101$
  - $0,236 = 0,055x - 0,101$
  - $x = 6,1273$   
Konsentrasi  $\times$  pengenceran =  $6,1273 \times 10 = 61,273$
- Absorbansi ulangan 3 = 0,2347
  - $y = 0,055x - 0,101$
  - $0,2347 = 0,055x - 0,101$
  - $x = 6,10364$   
Konsentrasi  $\times$  pengenceran =  $6,10364 \times 10 = 61,0364$
- Rata – rata =  

$$\frac{62 + 61,273 + 61,0364}{3} = 61,436$$
- Rata – rata  $\pm$  StDev =  $61,436 \pm 0,5022$

#### 7.2.1.2. Konsentrasi protein Metode Aseton (mg/ml)

- Absorbansi ulangan 1 = 0,199
  - $y = 0,055x - 0,101$
  - $0,199 = 0,055x - 0,101$
  - $x = 5,455$   
Konsentrasi  $\times$  pengenceran =  $5,455 \times 10 = 54,55$
- Absorbansi ulangan 2 = 0,1964
  - $y = 0,055x - 0,101$
  - $0,1964 = 0,055x - 0,101$
  - $x = 5,4073$   
Konsentrasi  $\times$  pengenceran =  $5,4073 \times 10 = 54,073$
- Absorbansi ulangan 3 = 0,1965
  - $y = 0,055x - 0,101$
  - $0,1965 = 0,055x - 0,101$
  - $x = 5,4091$   
Konsentrasi  $\times$  pengenceran =  $5,4091 \times 10 = 54,091$
- Rata – rata =  

$$\frac{54,55 + 54,073 + 54,091}{3} = 54,2364$$
- Rata – rata  $\pm$  StDev =  $54,2364 \pm 0,2678$

#### 7.2.1.3. Konsentrasi protein Metode Salting out (mg/ml)

- Absorbansi ulangan 1 = 0,3848
  - $y = 0,055x - 0,101$
  - $0,3848 = 0,055x - 0,101$
  - $x = 8,8327$   
Konsentrasi  $\times$  pengenceran =  $8,8327 \times 10 = 88,327$
- Absorbansi ulangan 2 = 0,4072
  - $y = 0,055x - 0,101$

- $0,4072 = 0,055x - 0,101$
- $x = 9,24$
- Konsentrasi  $\times$  pengenceran =  $9,24 \times 10 = 92,4$
- Absorbansi ulangan 3 = 0,4137
  - $y = 0,055x - 0,101$
  - $0,4137 = 0,055x - 0,101$
  - $x = 9,358$
 Konsentrasi  $\times$  pengenceran =  $9,358 \times 10 = 93,58$
- Rata – rata =
 
$$\frac{88,327 + 92,4 + 93,58}{3} = 91,436$$
 Rata – rata  $\pm$  StDev =  $91,436 \pm 2,757$

## 7.2.2. Buffer tris-HCl

### 7.2.2.1. Konsentrasi protein Metode TCA/Aseton (mg/ml)

- Absorbansi ulangan 1 = 0,2154
  - $y = 0,055x - 0,101$
  - $0,2154 = 0,055x - 0,101$
  - $x = 5,7527$
 Konsentrasi  $\times$  pengenceran =  $5,7527 \times 10 = 57,527$
- Absorbansi ulangan 2 = 0,2122
  - $y = 0,055x - 0,101$
  - $0,2122 = 0,055x - 0,101$
  - $x = 5,6945$
 Konsentrasi  $\times$  pengenceran =  $5,6945 \times 10 = 56,945$
- Absorbansi ulangan 3 = 0,2143
  - $y = 0,055x - 0,101$
  - $0,2143 = 0,055x - 0,101$
  - $x = 5,7327$
 Konsentrasi  $\times$  pengenceran =  $5,7327 \times 10 = 57,327$
- Rata – rata =
 
$$\frac{57,527 + 56,945 + 57,327}{3} = 57,2667$$
- Rata – rata  $\pm$  StDev =  $57,2667 \pm 0,2956$

### 7.2.2.2. Konsentrasi protein Metode Aseton (mg/ml)

- Absorbansi ulangan 1 = 0,1551
  - $y = 0,055x - 0,101$
  - $0,1551 = 0,055x - 0,101$
  - $x = 4,6564$
 Konsentrasi  $\times$  pengenceran =  $4,6564 \times 10 = 46,564$
- Absorbansi ulangan 2 = 0,1582
  - $y = 0,055x - 0,101$
  - $0,1582 = 0,055x - 0,101$
  - $x = 4,7127$

- Kosentrasi  $\times$  pengenceran =  $4,7127 \times 10 = 47,127$
- Absorbansi ulangan 3 = 0,1586
  - $y = 0,055x - 0,101$
  - $0,1586 = 0,055x - 0,101$
  - $x = 4,72$
 Kosentrasi  $\times$  pengenceran =  $4,72 \times 10 = 47,2$
- Rata – rata =
 
$$\frac{46,564 + 47,127 + 47,2}{3} = 46,964$$
- Rata – rata  $\pm$  StDev =  $46,964 \pm 0,3483$

### 7.2.2.3. Konsentrasi protein Metode Salting out (mg/ml)

- Absorbansi ulangan 1 = 0,692
  - $y = 0,055x - 0,101$
  - $0,692 = 0,055x - 0,101$
  - $x = 14,4182$
 Kosentrasi  $\times$  pengenceran =  $14,4182 \times 10 = 144,182$
- Absorbansi ulangan 2 = 0,6813
  - $y = 0,055x - 0,101$
  - $0,6813 = 0,055x - 0,101$
  - $x = 14,2236$
 Kosentrasi  $\times$  pengenceran =  $14,2236 \times 10 = 142,236$
- Absorbansi ulangan 3 = 0,6849
  - $y = 0,055x - 0,101$
  - $0,6849 = 0,055x - 0,101$
  - $x = 14,2891$
 Kosentrasi  $\times$  pengenceran =  $14,2891 \times 10 = 142,891$
- Rata – rata =
 
$$\frac{144,182 + 142,236 + 142,891}{3} = 143,103$$
- Rata – rata  $\pm$  StDev =  $143,103 \pm 0,9899$

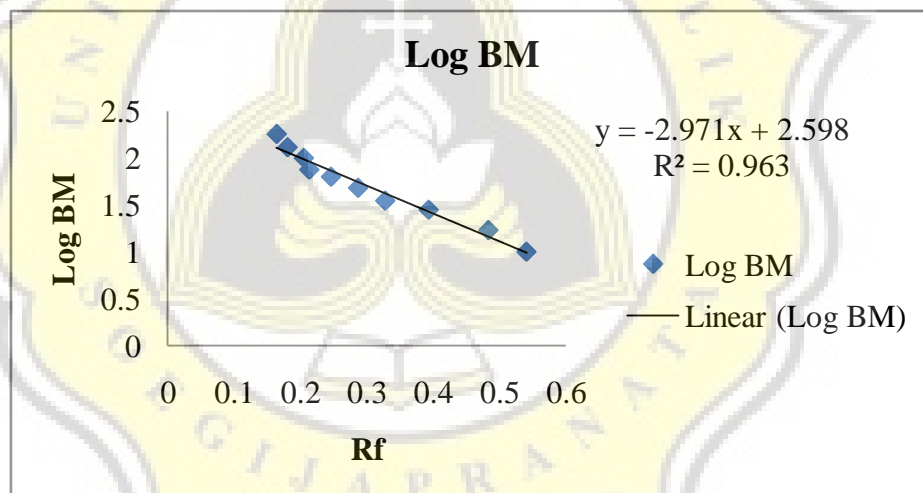
### Lampiran 3. Perhitungan Berat Molekul

#### 7.3. Perhitungan hasil pengukuran berat molekul

##### 7.3.1. Berat Molekul protein gel dengan buffer aqua bidest

Tabel 9. Hasil perhitungan Rf *protein ladder* gel dengan sampel yang menggunakan buffer *aquabidest*

BM (kDa)	Panjang pita (cm)	Log (BM)	Rf
180	2	2,2553	0,1639
130	2,2	2,1139	0,1803
100	2,5	2	0,2049
75	2,6	1,8751	0,2131
63	3	1,7993	0,2459
48	3,5	1,6812	0,2869
35	4	1,5441	0,3279
28	4,8	1,4471	0,3934
17	5,9	1,2304	0,4836
10	6,6	1	0,5410



Gambar 11. Kurva persamaan linear gel dengan buffer *aqua bidest*

Persamaan linear regresi  $y = -2,971x + 2,598$

- $Rf = \frac{\text{jarak pergerakan pita dari tempat awal}}{\text{jarak panjang gel dari tempat awal}}$
- Panjang gel = 12,2
  - Panjang pita = 2,3
    - $x = Rf = \frac{2,3}{12,2} = 0,1885246$
    - $y = -2,971x + 2,598 = 2,037893$
    - $BM = \text{antilog } y = 109,117 \text{ kDa}$
  - Panjang pita = 2,5
    - $x = Rf = \frac{2,5}{12,2} = 0,204918$
    - $y = -2,971x + 2,598 = 1,989189$

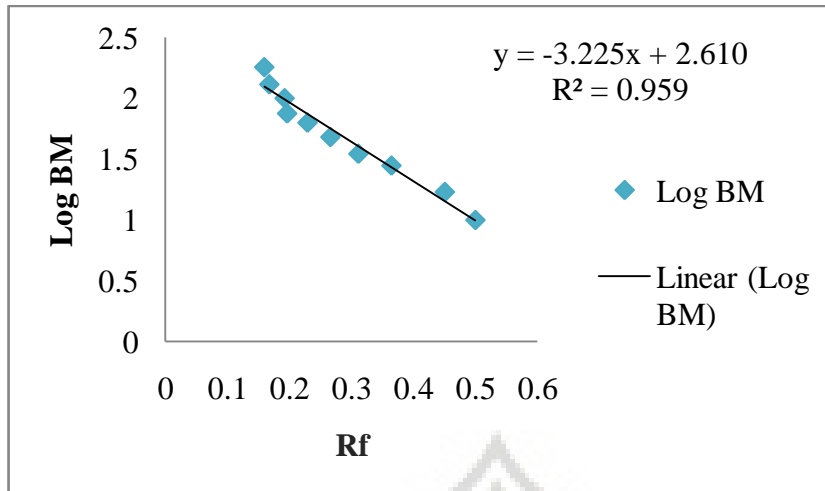
- $BM = \text{antilog } y = 97,5413 \text{ kDa}$
- Panjang pita = 3,4
  - $x = Rf = \frac{3,4}{12,2} = 0,2786885$
  - $y = -2,971x + 2,598 = 1,770016$
  - $BM = \text{antilog } y = 58,8866 \text{ kDa}$
- Panjang pita = 3,6
  - $x = Rf = \frac{3,6}{12,2} = 0,295082$
  - $y = -2,971x + 2,598 = 1,721311$
  - $BM = \text{antilog } y = 52,6395 \text{ kDa}$
- Panjang pita = 3,8
  - $x = Rf = \frac{3,8}{12,2} = 0,3114754$
  - $y = -2,971x + 2,598 = 1,672607$
  - $BM = \text{antilog } y = 47,0551 \text{ kDa}$
- Panjang pita = 4,2
  - $x = Rf = \frac{4,2}{12,2} = 0,3442623$
  - $y = -2,971x + 2,598 = 1,575197$
  - $BM = \text{antilog } y = 37,6008 \text{ kDa}$
- Panjang pita = 6
  - $x = Rf = \frac{6}{12,2} = 0,4918033$
  - $y = -2,971x + 2,598 = 1,136852$
  - $BM = \text{antilog } y = 13,7042 \text{ kDa}$
- Panjang pita = 7,2
  - $x = Rf = \frac{7,2}{12,2} = 0,5901639$
  - $y = -2,971x + 2,598 = 0,844623$
  - $BM = \text{antilog } y = 6,99235 \text{ kDa}$

### 7.3.2. Berat Molekul protein gel dengan buffer tris-HCl

Tabel 10. Hasil Perhitungan  $Rf$  *protein ladder* gel dengan sampel yang menggunakan buffer tris-HCl pH 7

BM (kDa)	Panjang pita (cm)	Log (BM)	Rf
180	2	2,2553	0,1639
130	2,1	2,1139	0,1721
100	2,3	2	0,1885
75	2,45	1,8751	0,2008
63	2,85	1,7993	0,2336
48	3,3	1,6812	0,2705
35	3,8	1,5441	0,3115
28	4,5	1,4472	0,3689
17	5,5	1,2305	0,4508
10	6,2	1	0,5082





Gambar 12. Kurva persamaan linear gel dengan buffer tris-HCl pH 7

Persamaan linear regresi  $y = -3,225x + 2,610$

- $Rf = \frac{\text{jarak pergerakan pita dari tempat awal}}{\text{jarak panjang gel dari tempat awal}}$
- Panjang gel = 12,2
  - Panjang pita = 2,3
    - $x = Rf = \frac{2,3}{12,2} = 0,1885246$
    - $y = -3,225x + 2,610 = 2,0020082$
    - BM = antilog  $y = 100,463$  kDa
  - Panjang pita = 3,1
    - $x = Rf = \frac{3,1}{12,2} = 0,2540984$
    - $y = -3,225x + 2,610 = 1,7905328$
    - BM = antilog  $y = 61,7352$  kDa
  - Panjang pita = 3,25
    - $x = Rf = \frac{3,25}{12,2} = 0,2663934$
    - $y = -3,225x + 2,610 = 1,7508811$
    - BM = antilog  $y = 56,3483$  kDa
  - Panjang pita = 3,5
    - $x = Rf = \frac{3,5}{12,2} = 0,2868852$
    - $y = -3,225x + 2,610 = 1,6847951$
    - BM = antilog  $y = 48,3944$  kDa
  - Panjang pita = 3,9
    - $x = Rf = \frac{3,9}{12,2} = 0,3196721$
    - $y = -3,225x + 2,610 = 1,5790574$
    - BM = antilog  $y = 37,9365$  kDa
  - Panjang pita = 5,6
    - $x = Rf = \frac{5,6}{12,2} = 0,4590164$
    - $y = -3,225x + 2,610 = 1,1296721$
    - BM = antilog  $y = 13,4794$  kDa

**Lampiran 4. Sekuens Asam Amino penyusun protein hasil analisa SDS PAGE dan Bioinformatika**

10 20 30 40 50 60  
 MRIPVATYRI QFNPDFDFED AQKILPYLQE LGISDIYASP IFKARSGSTH GYDVVDPNQI  
 70 80 90 100 110 120  
 NPELGSPETF DELIEEIQER DMGWVQDIVP NHMAYDSENK LLMDVLEHGP DSEYFDYFEI  
 130 140 150 160 170 180  
 DWDQAYENIK GRVLAPLLGD FYGNCLENGQ LKLSYNESGL SVNYYNLKFPP LRIESYATLI  
 190 200 210 220 230 240  
 SYKINTLSQT LGNRHPDVIK LLGVLYILKN IPSETSSQQR RDQAEFVKKL LWEIYQENPE  
 250 260 270 280 290 300  
 IQKFIDENID FFNGDTGKSE SFNLLDNLLS DQFFRLSFWK VGAEELNRYR FFTVNELICV  
 310 320 330 340 350 360  
 RVEDYKVFQR THDLIGELVK SGKFTGLRID HIDGLYNPVQ YLRWLREKGTG EIYIVVEKIL  
 370 380 390 400 410 420  
 ELEEKLPANW PIQGTSGYEF LNYVNLGFCQ SKNEERFNQI YAEMTGLTRT YNDLLVAKKR  
 430 440 450 460 470 480  
 LIADKNLAGD ADNLAQLLKR VCGDYRYGRD FTLAGLKTAI MEFLVRFPPV RTYINQEGVG  
 490 500 510 520 530 540  
 EDDRAYVQQA IREAKVKLPE LLNELNLMK FLFLDYDEFL SEENQQLWLR FVMKLLQFSG  
 550 560 570 580 590 600  
 PLTAKGIEDT LFYVYRFLA LNEVGGSPSH FGISVEKFHE FNQERLNSWP HAMNATATHD  
 610 620 630 640 650 660  
 TKRGEDVRSR LNVISELPDQ WEERVKVWVSQ LNRVHKTQID SKIIPDRNDE YFLYQTLVGS  
 670 680 690 700 710 720  
 FPFLEEEYPE YVQRIKDYVV KAVREAKVHT AWRPDTDYE NGFVNFVEKI LDFSEDNKFW  
 730 740 750 760 770 780  
 QEFRPFQEKV AFYGHFNLSL QTLKLLISPG LPDIYQGTTEL WDFSLVDPDN RRPVDFDGRLL  
 790 800 810 820 830 840  
 SYVQEIKRRS RTGMQNLIDD LMATWEDGRL KLFLIARVLQ ARQEYLDIFQ QGDYQPVAVT  
 850 860 870 880 890 900  
 GKYCDRIMAV ARSYGKHTAI AIIPRFLTDI IEPPQFPLGD IWGDTAIIVP EGNLSNMYEA  
 910 920 930  
 IVNHDIASP NILVSQILQY FPGVLLINES VPISDK

Gambar 13. Sekuens asam amino penyusun *Malto-oligosyltrehalose synthase*

(Sumber: web.expasy.org)

10 MSSPNRKLKP 20 TILVWDEPD 30 NLDLLYRTFH 40 REFKVLKAE 50 GPAALKILEE 60 VGEVAVIISD  
 70 QRMPYMSGTE 80 FLSLTATQYP 90 DSIRIILTGY 100 TDVEDLVEAI 110 NSGKVFKYVT 120 KPNKSDELKA  
 130 IVQQGLETHN 140 VLKSRTEELR 150 LAQQQESLLY 160 EVTSTIRACP 170 NSQEMLQRIV 180 ETVGKMFVVS  
 190 YCLLRSFGVG 200 SDLIGLGAGV 210 SPTKQDITAT 220 QGKENFAYLA 230 EGQNHQNSTT 240 DNISVINMND  
 250 LELRSLVNET 260 TEVMILSEGL 270 GNDISDHGDP 280 EWQQRDVYQ 290 RADIRSSLIV 300 PLYYRQELLA  
 310 VLALHHTGSP 320 RNMHEHEVQL 330 AAGVADQAAL 340 ALSQVRAYEQ 350 VRELARREAL 360 VNTITNAIRS  
 370 SLDPQKIFAA 380 ITEQLGEALE 390 VDGICALSLMS 400 PGDEYMQCVG 410 LYNAAIKETV 420 VETRPAALSE  
 430 PDTSTTTLNP 440 LLGVETNQSI 450 ESDQSDDLPO 460 SAAPISGNPV 470 LQELIRTRAP 480 VAIADIEQRP  
 490 DSHMMLPLRS 500 PSKALLVVPL 510 LLDGDIIGSI 520 SLRQNHQVRH 530 HQPSEIDMWL 540 LVAAQAALAV  
 550 QQARLYQKTR 560 QQAERLLEAD 570 RLKTEFFQNV 580 SHEFRTPLTL 590 HIGPLETVVN 600 QQQDLSLDQA  
 610 KIA LRNSRR 620 LRLVNQLLDL 630 QRFDAGRINQP 640 SFRPCDLVEF 650 CQQTVESFKS 660 YCDRKQINLV  
 670 TNLQSCPQLY 680 LDLERFDKVL 690 YNLLSNAMKF 700 TPTDGTITVS 710 LQPEGNYCRL 720 MVKDTGIGIK  
 730 QEQLPHLFER 740 FRQAEGSANR 750 SFEGSGLGLA 760 LVKELVELHH 770 GRITVESEYG 780 QGTTFTVNLQ  
 790 MGNLHLPPSP 800 LLDVPAEFDA 810 RRAAVELADV 820 EVDLPDVQID 830 DINLPEVLVA 840 DGSASLTDHG  
 850 QLGSNTVLVV 860 DDNPDLRRYV 870 SHMLQAGFN 880 AVLAKNGADG 890 FNKAQTYHPD 900 VIVTDLVHPQ  
 910 VSGLELIRMI 920 RSSPELRGTP 930 IILLTAKADE 940 DTRIEGVERG 950 ADAYVSKPFN 960 DRELIAEVRN  
 970 LQALKAEERR 980 VAHLNKYLTE 990 SVLRRFLPES 1000 MVKKAAGDL 1010 TLDLRPEPRL 1020 ITILFSDIVG  
 1030 FTRMSNALQS 1040 QGVAELLNEY 1050 LGEMTRAVFE 1060 NQGTVDKFBG 1070 DAIMALYGAP 1080 EEMSPSEQVR  
 1090 RAIATARQML 1100 VALEKLNQGN 1110 QERGLVGRNE 1120 VPPVRFRCGI 1130 HQGMVAVGLF 1140 GSQERSDFTA  
 1150 IGPSVNIAAR 1160 LQEATAPNSI 1170 MVSAMWAQYV 1180 PDEEIIKREF 1190 LELKGIDEPV 1200 MTCVINPNML

NQ

Gambar 14. Sekuens asam amino penyusun *Adenylate cyclase*  
(Sumber: web.expasy.org)

10 20 30 40 50 60  
 MAKIVAFDEE SRRAIERGVN ALVDAVRVTL GPRGRNVLIE KKFGVPDIIS DGITVAKAIE  
 70 80 90 100 110 120  
 LGDPLENTGA RLIQEVAAKT NDVAGDGTIT AAVLAQAMIQ EGLKNVAAGA NPVALRRGID  
 130 140 150 160 170 180  
 KTIQYLVKEI ESLAKPVEGS AIEQVATVSA GNDKEVGEMI ALAMDKVTKD GVITVEESKS  
 190 200 210 220 230 240  
 LTTELEVVEG MQIDRGYISP YFITDNEMI VELDNTRVLI TDKKISAIQD IVSVLEKVAR  
 250 260 270 280 290 300  
 SGQPLLIIE DIDGEALATL VVNKARGVLN VAGIKAPGFG ERRKAMLQDI AILTGGQLIS  
 310 320 330 340 350 360  
 EEIGLNLETA TIEMLGATK VTINKDSTTI VSGSGHKGEI QQRVEQLRKQ LAETDSEYDK  
 370 380 390 400 410 420  
 EKLQERIAKL AGGVAVIKVG AATETELKSR KLRIEDALNA TKAAVEEGIV PGGGTTLIHL  
 430 440 450 460 470 480  
 VKKVEQLAST FTIEEEKLGA KIVARALEAP LRQIANAGV EGSVIVEQVR NSDSNIGYNA  
 490 500 510 520 530 540  
 LTGKFEDLIV AGILDPAKVV RSSLQAGSI AGMVIITTEVL VVEKPEPKPA MPDMDGMGGM  
 550  
 GGMGGMGGMG GMGGMGMM

Gambar 15. Sekuens asam amino penyusun 60 kDa *chaperonin*  
 (Sumber: web.expasy.org)

10 20 30 40 50 60  
 MTTRVILVRH GQSTYNAQKR IQGRLDDSVL TDQGRVDATC VAQALQGLRF DAIYHSPLQR  
 70 80 90 100 110 120  
 AQQTAQLIRA RVGAAPPLQP TDLLMEIDLW LWAGLPRQEV RDRFPQDYQC WQOSPHEFFM  
 130 140 150 160 170 180  
 VLESGHKHFP VLALFEQAQQ FWRHILSHHP NQITLVVAHN GINRSLIATA LGVQPQFYQS  
 190 200 210 220 230 240  
 IQQSNCGISI INIGDVTPGE LPKPAAVQLE SMNLTSHVGD KLPSLRPEHR GPRLLLVRHG  
 250 260 270 280 290 300  
 ETEWNRKQGF QGQIDIPLND NGRLQARQAA DFLQDIKIDF AITSPMARPR ETAEIIIEHH  
 310 320 330 340 350 360  
 RDIELQFEDN FREISHGLWE GKFESEIEQD YPGLLNQWKT APETVQMPEG ENLNQVGERV  
 370 380 390 400 410 420  
 AKGWENILNK YDSQSVTGLV VAHDAVNKAL LCQLLGLSPE HFWNFKQNG SVTVIDYPHG  
 430 440  
 AKGEPVLQTM NITTHLSGSI LDKTAAGAL

Gambar 16. Sekuens asam amino penyusun *Phosphoglycerate mutase*  
 (Sumber: web.expasy.org)

10 20 30 40 50 60  
 MSSNNPTPNL EQLMLEARQL MKDLGLPDKM QGDTPIFVLL VMLDMKPAKS WSEANNQKWG  
 70 80 90 100 110 120  
 ITPLMNKMRE LGFKNLAPNT RENIRDDCVG QLVDAELATE NPKPRPKNS PKYCYQINQE  
 130 140 150 160 170 180  
 VLYLVKKIGS ADYPIALNNF LSNYQTIKHK YQAKRQSQRL NVKIAHNFSV SIAPGGQGVL  
 190 200 210 220 230 240  
 IKSVLQDFCK YFNIDKVLVI DNTVDTARGY SPFIDENLIN YLGIDIDKFK NSYDKPDIVL  
 250 260 270 280 290 300  
 YKSDNKYLII IEAVKTGGAI NVERRDRLLS LFENVVKLS FVNAFESFKE LKRLTKEITR  
 310 320  
 ETHAWIMEFP DHMIHFNGDQ YLFH

Gambar 17. Sekuens asam amino penyusun *Type-2 restriction enzyme*  
 (Sumber: web.expasy.org)

10 20 30 40 50 60  
 MIIDDFSSTP DPLNPSRRAY FASLELTOIS GEDRGQAINR MADGLKQRKN DILEANTLDL  
 70 80 90 100 110 120  
 EASREMGVSE VIGDWLKLTP VRLEKAIKVL ERLSTISDPI GRVVSAPYQI KOYKGGYQYI  
 130 140 150 160 170 180  
 PLGVIALIYE APPELGAIAA GFALKTANSL ILQGSSEANS SNQIIAETLQ SALEDARMP  
 190 200 210 220 230 240  
 GCLEFVPADP DHPIPDVTE DRYINLIIPY GRPQLIQEVI NKATVPILKT AMGNCYLYWS  
 250 260 270 280 290 300  
 ATASMDLVRW MITDSHKSEP DPVNAIEKVL IDPHQKNSSL VRLNLSLQEE GFQLRGDRDF  
 310 320 330 340 350 360  
 IQNFPELTEA EPSEWYHPYL SKTIAFRFVE NLENAIGM'N QCSSNHANCI ATESYSESRI  
 370 380 390 400 410 420  
 FAQNSNSALT FMNTSPQFSR HQNRGDALFL GVSNQKGYRR GLISLESMT LKHIVQGNR

Gambar 18. Sekuens asam amino penyusun *Gamma-glutamyl phosphate reductase*

(Sumber: web.expasy.org)

10            20            30            40            50            60  
 MAFELPSLPF DQDALESSKM SANTLSYHHG KHHAAYVKNL NAAIEGTDMA DMSLEEEIIKA  
 70            80            90            100           110           120  
 TYNDPSKSGI FNNAAQVWNH SFFWKCLKPN GGGQPTGALA DKIQADFGSF DAFIQEFKNA  
 130           140           150           160           170  
 AATQFGSGWA WLVLNGLTK VTKTANAVNP WVEGKTSLLT SMWEDAYYI

Gambar 19. Sekuens asam amino penyusun *Superoxide dismutase*  
(Sumber: web.expasy.org)

10            20            30            40            50            60  
 MKTPITEAIS AADAQGRFVS NTELQFVNGR LDRAQASMEA ARALTNKSND LINGAANAVY  
 70            80  
 QKFPYTTQM QPNYAYDQRG KDKCARD

Gambar 20. Sekuens asam amino penyusun *Phycocyanin  $\alpha$  subunit*  
(Sumber: web.expasy.org)

10            20            30            40            50            60  
 SQADTRGEML STAQIDALSQ MVAESNKRLD AVNRITSNAS TIVSNAARSL FAEQPQLIAP  
 70            80            90            100           110           120  
 GGNAYTSRRM AACLRDMEII LRYVTVAVFA GDASVLEDRC LNGLRETYLA LGTPGSSVAV  
 130           140           150           160  
 GVGKMKEAAL AIVNDPAGIT PGDCSALASE IASYFDRACA AVS

Gambar 21. Sekuens asam amino penyusun *Phycocyanin  $\beta$  subunit*  
(Sumber: web.expasy.org)