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Molar Absorptivity and $A^{1\%}_{1\,cm}$ Values for Proteins at Selected Wavelengths of the Visible and Ultraviolet Regions. XXIV

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ABSTRACT

The molar absorptivity and $A^{1\%}_{1cm}$ values for 154 proteins are reported. The conditions under which these values were obtained and citations to the sources of the data are also provided.

Index Entries: Proteins, molar absorptivity of; $A^{1\%}_{1cm}$ values, of proteins; molar absorptivity, of proteins; ultraviolet absorption, of proteins.

INTRODUCTION

The molar absorptivity and $A^{1\%}_{1cm}$ values for 154 proteins are given in Table 1. The sources of these proteins, the conditions under which the numerical data were obtained, the molecular weights for many proteins, and citations to the primary references are also given. The footnotes to Table 1 contain additional information. The method used to compile these data has been described (*1*).

This paper is part of a continuing compilation of absorption characteristics of proteins in the ultraviolet and visible regions (*2*).

REFERENCES

1. Kirschenbaum, D. M. (1980), *J. Chem. Info. Comput. Sci.* **20,** 152.
2. Kirschenbaum, D. M. (1982), *Appl. Biochem. Biotechnol.* **7,** 475.

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TABLE 1
Molar Absorption Coefficients, ϵ_M and $A^{1\%}_{1cm}$ Values for Proteins

Protein	$\epsilon_M^a \times 10^{-4}$	$A^{1\%\,b}_{1cm}$	nm[c]	Ref.	Comments[d]
Complement					
C4					
Human plasma		8.2	280	*1*	Interf.
C6					
Human plasma		10.77	280	*2*	Biuret
Clq					
Beef plasma		7.3	280	*3*	Dry wt; 300 m*M* NaCl
Guinea pig blood		6.8	280	*4*	300 m*M* NaCl
Human serum		6.82	280	*5*	0.5*M* HOAc
Mouse blood	33.1	7.53	280	*6*	300 m*M* NaCl dry wt; mw = 439,500 [*6*]
Clr̄					
Cohn Fr. I		11.5	280	*7*	
Clr					
Human serum		11.3	nc[e]	*8*	
Cls					
Human serum		11.7	nc[e]	*8*	
Clt					
Human serum		14.0	nc[e]	*8*	
Concanavalin A					
Jack bean [*Canavalia ensiformis*]		12.9	280	*9*	PBS, pH 7.4; dry wt
		13.7	280	*10*	pH 5, 0.02–0.05*M* NaOAc, 0.2*M* NaCl, 1 m*M* $CaCl_2$, 0.5 m*M* $MnCl_2$
Conglutinin					
Beef serum		9.2	280	*11*	PBS–EDTA, pH 7.2; LS
Convacilin					
Pea seeds [*Pisum sativum*]		7.3	280	*12*	
Coproporphyrinogen oxidase					
Beef liver	11.9	16.6	282	*13*	Dry wt; mw = 71,600
Corticosteroid-binding globulin					
Human serum	3.38	6.5	279	*14*	50 m*M* Ph buffer, pH 7.4; dry wt; mw = 52,000 [*14*]
Creatinase [EC 3.5.2.-]					
Pseudomonas putida		9.8	280	*15*	Dry wt

(*continued*)

TABLE 1 (*continued*)

Protein	$\epsilon_M^a \times 10^{-4}$	$A_{1cm}^{1\%\,b}$	nm[c]	Ref.	Comments[d]
Creatinine deiminase [EC 3.5.4.21]					
Corynebacterium lilium	28.3	14.5	280	*16*	mw = 195,000 [*16*]
Creatine Kinase					
Human muscle		8.85	280	*17*	0.05*M* Ph, pH 7.0
Human muscle, dystrophic		8.30	280	*17*	0.05*M* Ph, pH 7.0
Crotalocytin					
Timber rattlesnake	14.7	26.7	280	*18*	mw = 55,000 [*17*]
α-Crystallin					
Beef eyes		8.16	nc[e]	*19*	
Mice eyes		9.3	280	*20*	
Mice eyes with cataract		9.3	280	*20*	
β-Crystallin					
Mice eyes		17.2	280	*20*	
Mice eyes with cataract		17.1	280	*20*	
γ-Crystallin					
Mice eyes		16.6	280	*20*	
Mice eyes with cataract		16.8	280	*20*	
Cyanase					
Escherichia coli	0.60	4.1	280	*21*	mw = 14,661 [*21*]; AA
β-Cyanoalanine synthase					
Blue lupine seedlings		0.5	411	*22*	Data from Fig. 1 [*22*]; 0.1*M* Tris buffer
Cyclic adenosine monophosphate phosphodiesterase					
Dog kidney	5.7	9.4	280	*23*	0.1*N* NaOH; mw = 60,600 [*23*]
	13.3	22	280	*23*	40 m*M* Tris-HCl, pH 8.0; mw = 60,600 [*23*]
Cyclic nucleotide phosphodiesterase, calmodulin dependent					
Beef brain	5.6	9.6	278	*24*	mw = 58,000 [*24*]

(*continued*)

TABLE 1 (*continued*)

Protein	$\epsilon_M^a \times 10^{-4}$	$A_{1cm}^{1\%\,b}$	nm[c]	Ref.	Comments[d]
β-Cystathionase					
Escherichia coli	5.8	12.5	280	*25*	mw = 46,561 [25] AA
Cytochrome b type					
Ascaris lumbricoides var suum					
Muscle microsomes	12.0		415	*26*	Oxidized, Soret α.
	2.5		560	*26*	Reduced, Soret α.
	2.0		525	*26*	Reduced, Soret β.
	13.7		424	*26*	Reduced, Soret γ.
Cytochrome b5					
Tetrahymena pyriformes	14.03[f]		414	*27*	Oxidized
	2.78[f]		560	*27*	Reduced
	1.48[f]		528	*27*	Reduced
	22.15[f]		425	*27*	Reduced
Cytochrome b9					
Rat liver	37.95	30.36	413	*28*	Oxidized; mw = 125,000 [*28*]
	38.39	30.71	280	*28*	Oxidized, mw = 125,000 [*28*]
	55.8	44.64	423	*28*	Reduced, mw = 125,000 [*28*]
	5.71	4.57	527	*28*	Reduced, mw = 125,000 [*28*]
	11.16	8.93	556	*28*	Reduced, mw = 125,000 [*28*]
Cytochrome c					
Beef					
Adrenal cortex	2.5[g]		550	*29*	α-Band
Heart	1.92		552.4	*30*	Reduced–oxidized form
Horse heart	0.9720		190	*31*	
Rat					
Heart	2.22	17.90	549.5	*32*	mw = 12,400 [*32*]
	1.24	10.00	520	*32*	mw = 12,400 [*32*]
	10.44	84.19	412	*32*	mw = 12,400 [*32*]
	8.22	66.29	409	*32*	mw = 12,400 [*32*]
	1.70	13.71	280	*32*	mw = 12,400 [*32*]
Liver	2.16	17.42	549.5	*32*	mw = 12,400 [*32*]
	1.24	10.00	520	*32*	mw = 12,400 [*32*]
	10.11	81.53	412	*32*	mw = 12,400 [*32*]

(*continued*)

TABLE 1 (*continued*)

Protein	$\epsilon_M^a \times 10^{-4}$	$A_{1cm}^{1\% b}$	nm[c]	Ref.	Comments[d]
	7.95	64.11	409	*32*	mw = 12,400 [32]
	1.68	13.55	280	*32*	mw = 12,400 [32]
Kidney	2.12	17.10	549.5	*32*	mw = 12,400 [32]
	1.18	9.54	520	*32*	mw = 12,400 [32]
	9.60	77.42	412	*32*	mw = 12,400 [32]
	7.59	61.21	409	*32*	mw = 12,400 [32]
	1.70	13.71	280	*32*	mw = 12,400 [32]
Testes	3.36	27.10	549.5	*32*	mw = 12,400 [32]
	1.80	14.52	520	*32*	mw = 12,400 [32]
	15.66	126.29	412	*32*	mw = 12,400 [32]
	12.16	98.06	409	*32*	mw = 12,400 [32]
	3.20	25.81	280	*32*	mw = 12,400 [32]
Pseudomonas AM1					
C_H	3.1	28.2	550.5	*33*	mw = 11,000 [33]
	16.2	147.3	416.5	*33*	mw = 11,000 [33]
C_L	2.6	12.4	549	*33*	mw = 20,900 [33]
	16.3	78.0	416	*33*	mw = 20,900 [33]
Methylophilus methylotrophus					
C_H	2.71	31.88	551.25	*34*	mw = 8500 [*34*]
	12.8	150.59	416.25	*34*	mw = 8500 [*34*]
C_{LM}	2.52	15.0	550.75	*34*	mw = 16,800 [*34*]
	11.6	69.0	416.5	*34*	mw = 16,800 [*34*]
C_L	2.69		549.75	*34*	mw = 17,000–21,000 [*34*]
	13.9		416	*34*	mw = 17,000–21,000 [*34*]
iso-1-Cytochrome C-like, Yeast [*Saccharomyces cerevisiae*, ATCC 24853]					
ferrous form	13.6		416	*35*	
Cytochrome C1					
Beef heart	6.0		276	*36*	50 m*M* KPh, pH 7.4, 1% cholate; data from Fig. 6 [*36*]
Reduced	17.2		417	*36*	50 m*M* KPh, pH 7.4, 1% cholate; data from Fig. 6 [*36*]
Oxidized	11.2		410	*36*	50 m*M* KPh, pH 7.4, 1% cholate; data from Fig. 6 [*36*]

(*continued*)

TABLE 1 (*continued*)

Protein	$\epsilon_M^a \times 10^{-4}$	$A_{1cm}^{1\%\ b}$	nm[c]	Ref.	Comments[d]
Cytochrome C3					
Desulfovibrio desulfuricans, Norway strain					
Oxidized	8.76	33.69	531	*37*	AA; mw = 26,000 [*37*]
	111.51	428.88	410	*37*	AA; mw = 26,000 [*37*]
	21.02	80.85	349.5	*37*	AA; mw = 26,000 [*37*]
Reduced	24.52	94.46	553.5	*37*	AA; mw = 26,000 [*37*]
	12.84	49.38	524	*37*	AA; mw = 26,000 [*37*]
	144.79	556.88	421	*37*	AA; mw = 26,000 [*37*]
Cytochrome C550					
Bacterium PS3					
Reduced	2.75		550	*38*	
	17.4		416	*38*	
Oxidized	11.31		408	*38*	
	0.088		690	*38*	
Cytochrome C551					
Alcaligenes sp. N.C.I.B., 11015					
Oxidized	30.76	106.81	410.5	*39*	pH 7.0; mw = 28,800 [*39*]
Reduced	37.67	130.80	415.5	*39*	pH 7.0; mw = 28,800 [*39*]
	4.38	15.21	522	*39*	pH 7.0; mw = 28,800 [*39*]
	5.76	20.0	551	*39*	pH 7.0; mw = 28,800 [*39*]
Methylomonas J					
I, reduced	2.53		551	*40*	100 m*M* Ph, pH 6.0
		54.48	409	*40*	Data from Fig. 3 [*40*]
Oxidized		68.97	417	*40*	Data from Fig. 3 [*40*]
II, reduced	2.24		551	*40*	100 m*M* Ph, pH 6.0
		49.67	409	*40*	Data from Fig. 3 [*40*]
Oxidized		63.40	416	*40*	Data from Fig. 3 [*40*]
Cytochrome C552					
Purple sulfur bacteria [*Thiocapsa roseopersicina*]					
Oxidized	17		409	*41*	
Reduced	2.85		552	*41*	
	1.72		523	*41*	
	19.6		417	*41*	

(*continued*)

TABLE 1 (*continued*)

Protein	$\epsilon^{a}_{M} \times 10^{-4}$	$A^{1\%}_{1cm}$ [b]	nm[c]	Ref.	Comments[d]
Pseudomonas perfectomarinus					
Oxidized	20.39		408.5	*42*	0.1*M* NaPh, pH 7.0
	5.09		282	*42*	0.1*M* NaPh, pH 7.0
Reduced					
Ascorbate	15.774		408.5	*42*	0.1*M* NaPh, pH 7.0
	20.758		418	*42*	0.1*M* NaPh, pH 7.0
	2.01		523	*42*	0.1*M* NaPh, pH 7.0
	3.302		551.7	*42*	0.1*M* NaPh, pH 7.0
Dithionite	31.220		418	*42*	0.1*M* NaPh, pH 7.0
	2.442		523	*42*	0.1*M* NaPh, pH 7.0
	5.128		551.7	*42*	0.1*M* NaPh, pH 7.0
Cytochrome C553					
Desulfovibrio vulgaris, Miyazaki					
Oxidized	1.06		—[h]	*43*	
	10.9		410	*43*	
	2.78		360	*43*	
	1.93		—[i]	*43*	
Reduced	2.39		553	*43*	
	1.62		524	*43*	
	14.2		417	*43*	
	3.21		317	*43*	
Cytochrome C553[550]					
Desulfovibrio desulfuricans					
Norway					
Oxidized[j]	0.199		690	*44*	
	3.85		280	*44*	50 m*M* Tris-HCl, pH 7.6; data from Fig. 1 [44]
Reduced	4.73		553	*44*	
Ascorbate	28		413	*44*	50 m*M* Tris-HCl, pH 7.6; data from Fig. 1 [44]
Dithionite	37		415	*44*	50 m*M* Tris-HCl, pH 7.6; data from Fig. 1 [44]
Desulfovibrio vulgaris					
Hildenborough	2.6		553	*44*	

(*continued*)

TABLE 1 (*continued*)

Protein	$\epsilon_M^a \times 10^{-4}$	$A_{1cm}^{1\%\ b}$	nm[c]	Ref.	Comments[d]
Cytochrome C555, 549					
Thermus thermophilus					
HB8					
Oxidized[k]	2.89		360	*45*	
	11.04		409	*45*	
	1.07		528	*45*	
Reduced[k]	17.07		417	*45*	
	1.54		522	*45*	
	1.73		548.6	*45*	
	2.20		554.8	*45*	
Cytochrome C556					
Alcaligenes sp.					
N.C.I.B., 11015					
Oxidized	14.16	77.80	412	*39*	mw = 18,200 [*39*]; pH 7.0
Reduced	15.70	86.26	417.5	*39*	mw = 18,200 [*39*]; pH 7.0
	1.77	9.73	523	*39*	mw = 18,200 [*39*]; pH 7.0
	2.21	12.14	556	*39*	mw = 18,200 [*39*]; pH 7.0
Cytochrome cd					
Thiobacillus denitrificans					
Oxidized	31.2		406.5	*46*	0.1*M* Tris, pH 7.6
	21.2		280	*46*	0.1*M* Tris, pH 7.6
Cytochrome cd1					
Paracoccus denitrificans					
ATCC 13543					
Oxidized	14.2		407	*47*	
	2.36		530	*47*	
	1.42		641	*47*	
	1.08		702	*47*	
Reduced	15.9		417	*47*	
	2.70		522	*47*	
	2.78		548	*47*	
	2.70		553	*47*	
	1.82		630	*47*	
	1.94		655	*47*	
Cytochrome f [553-4]					
Cachonina niei	2.94	26.72	553-4	*48*	mw = 11,000 [*48*]

(*continued*)

TABLE 1 (*continued*)

Protein	$\epsilon^{a}_{M} \times 10^{-4}$	$A^{1\%\ b}_{1cm}$	nm[c]	Ref.	Comments[d]
Cytochrome f					
Japanese radish	2.5		277	*49*	50 μ*M* KPh, pH 7.8; data from Fig. 2 [*49*]
Oxidized[i]	12.13		410.5	*49*	
Reduced[i]	19.49		420.5	*49*	
	1.34		524	*49*	
	2.76		553.5	*49*	
Cytochrome f-556.5					
Blue green alga [*Spirulina platensis*]	3.02		556.5	*50*	
Cytochrome P448					
Brewer's yeast [*Saccharomyces cerevisiae* NCYC 240]					
Oxidized	12.0		417	*51*	0.005*M* KPh buffer, pH 7.0, cont. 20% glycerol and 0.2% Emulgen 911
	1.4		565	*51*	0.005*M* KPh buffer, pH 7.0, cont. 20% glycerol and 0.2% Emulgen 911
	1.2		578	*51*	0.005*M* KPh buffer, pH 7.0, cont. 20% glycerol and 0.2% Emulgen 911
Reduced	7.8		412	*51*	0.005*M* KPh buffer, pH 7.0, cont. 20% glycerol and 0.2% Emulgen 911
	1.2		565	*51*	0.005*M* KPh buffer, pH 7.0, cont. 20% glycerol and 0.2% Emulgen 911
	1.1		578	*51*	0.005*M* KPh buffer, pH 7.0, cont. 20% glycerol and 0.2% Emulgen 911
CO-Reduced	4.5		446	*51*	0.005*M* KPh buffer, pH 7.0, cont. 20% glycerol and 0.2% Emulgen 911

(*continued*)

TABLE 1 (*continued*)

Protein	$\epsilon_M^a \times 10^{-4}$	$A_{1cm}^{1\%\ b}$	nm[c]	Ref.	Comments[d]
	1.2		560	*51*	0.005*M* KPh buffer, pH 7.0, cont. 20% glycerol and 0.2% Emulgen 911
Rabbit liver microsomes					
Ligand:					
Pyridine	10.3		421	*52*	0.1*M* KPh, pH 7.2, cont. 20% glycerol
1-Methyl-imidazole	9.7		424	*52*	0.1*M* KPh, pH 7.2, cont. 20% glycerol
2-Methyl-pyridine	10.3		421	*52*	0.1*M* KPh, pH 7.2, cont. 20% glycerol
1-Propanol[m]	11.0		417	*52*	0.1*M* KPh, pH 7.2, cont. 20% glycerol
Cytochrome $P448_1$					
Rabbit liver microsomes[n]					
Oxidized	9.59		393	*53*	
	1.39		512	*53*	
	0.72		646	*53*	
Reduced	8.05		411	*53*	
	1.46		545	*53*	
Reduced-CO	12.8		448	*53*	
	1.37		550	*53*	
Cytochrome P450					
Rabbit liver microsomes[o]					
Oxidized	8.47		393	*54*	
	1.09		518	*54*	
	0.39		647	*54*	
Reduced	7.21		413	*54*	
	1.45		547	*54*	
Reduced-CO	11		452	*54*	
	1.24		554	*54*	
Beef adrenal cortex microsomes					
Oxidized	12.2		418	*55*	Data from Fig. 6 [55]
Reduced	8.7		412	*55*	Data from Fig. 6 [55]
Reduced-CO	12.4		450	*55*	Data from Fig. 6 [55]

(*continued*)

TABLE 1 (*continued*)

Protein	$\epsilon^{a}_{M} \times 10^{-4}$	$A^{1\%\,b}_{1cm}$	nm[c]	Ref.	Comments[d]
Beef adrenal cortex mitochondria					
	27.5	11.2	278	*56*	0.1*M* Ph, pH 7.0. Data from Fig. 3 [*56*]
Oxidized	10.7	4.35	393	*56*	0.1*M* Ph, pH 7.0. Data from Fig. 3 [*56*]
	0.52	0.21	648	*56*	0.1*M* Ph, pH 7.0. Data from Fig. 1 [*56*]
Oxidized + 20α-hydroxy-cholesterol	12.1	4.94	416	*56*	0.1*M* Ph, pH 7.0. Data from Fig. 1 [*56*]
	1.34	0.55	570	*56*	0.1*M* Ph, pH 7.0. Data from Fig. 1 [*56*]
Reduced	9.63	3.93	413	*56*	0.1*M* Ph, pH 7.0. Data from Fig. 1 [*56*]
	1.65	0.67	552	*56*	0.1*M* Ph, pH 7.0. Data from Fig. 1 [*56*]
Reduced-CO	6.19	2.53	424	*56*	0.1*M* Ph, pH 7.0. Data from Fig. 1 [*56*]
	12.04	4.92	448.5	*56*	0.1*M* Ph, pH 7.0. Data from Fig. 1 [*56*]
	1.55	0.63	552	*56*	0.1*M* Ph, pH 7.0. Data from Fig. 1 [*56*]
Cytochrome $P450_1$[p]					
Rabbit liver microsomes					
Ligand					
Pyridine	10.3		422	*52*	0.1*M* KPh, pH 7.2, cont. 20% glycerol
1-Methyl-imidazole	10.0		425	*52*	0.1*M* KPh, pH 7.2, cont. 20% glycerol
KCN	9.3		440	*52*	0.1*M* KPh, pH 7.2, cont. 20% glycerol
2-Methyl-pyridine	10.5		421	*52*	0.1*M* KPh, pH 7.2, cont. 20% glycerol
Rabbit liver microsomes[n]					
Oxidized	10.7		418	53	
	1.13		534	53	
	1.12		570	53	

(*continued*)

TABLE 1 (*continued*)

Protein	$\epsilon_M^a \times 10^{-4}$	$A_{1cm}^{1\%}$ [b]	nm[c]	Ref.	Comments[d]
Reduced	8.19		414	*53*	
	1.50		545	*53*	
Reduced-CO	10.9		451	*53*	
	1.39		554	*53*	
Cytochrome $P450_2$					
Rabbit liver microsomes[n]					
Oxidized	10.9		417	*53*	
	1.22		535	*53*	
	1.25		570	*53*	
Reduced	8.63		412	*53*	
	1.59		546	*53*	
Reduced-CO	11.3		450	*53*	
	1.56		554	*53*	
Cytochrome P450 I					
Rabbit liver and lung					
Fe III	5.34		277	*57*	
	10.6		418	*57*	
Fe II	8.11		415	*57*	
Cytochrome P450 PB[q]					
Fe III	5.58		277	*57*	
	10.6		418	*57*	
Fe II	8.05		415	*57*	
Cytochrome $P450_{s21}$					
Beef adrenocortical microsomes					
Oxidized[r]	10.7		418	*58*	
	1.37		537	*58*	
	1.18		570	*58*	
Reduced[r]	8.37		413	*58*	
	1.64		550	*58*	
Reduced-CO[r]	11.2		450	*58*	
	1.53		552	*58*	
Cytochrome oxidase					
Pseudomonas[s]					
Oxidized	4.1		640	*59*	
	28.2		410	*59*	
Reduced	3.7		650	*59*	
	5.2		548	*59*	
	35.5		417	*59*	

(*continued*)

TABLE 1 (*continued*)

Protein	ϵ_M[a] × 10^{-4}	$A^{1\%}_{1cm}$[b]	nm[c]	Ref.	Comments[d]
Pseudomonas aeruginosa					
Oxidized		14.5	410	*60*	0.05*M* Tris, pH 7.5, cont. 0.05% Brij 58. Data from Fig. 2 [*60*]
Reduced		12.5	419	*60*	0.05*M* Tris, pH 7.5, cont. 0.05% Brij 58.
		1.6	552	*60*	0.05*M* Tris, pH 7.5, cont. 0.05% Brij 58.
Reduced-CO		15.6	415	*60*	0.05*M* Tris, pH 7.5, cont. 0.05% Brij 58. Data from Fig. 2 [*60*]
Nitrobacter agilis					
Oxidized[t]	13.1		276	*61*	
	9.01		422	*61*	
	1.01		598	*61*	
	0.15		840	*61*	
Reduced[t]	9.48		442	*61*	
	2.07		606	*61*	
Reduced-CO[t]	7.77		436	*61*	
Beef heart[u]	7.0		418	*62*	
	6.68		428	*62*	
Subunit I	11.5		280	*64*	
Subunit III	8.0		280	*64*	
Cytochrome c peroxidase [E.C. 1.11.1.5]					
Pseudomonas aeruginosa	0.34		640	*66*	pH 6.0
	0.097		705	*66*	pH 6.0
Cytochrome b5 reductase, NADH-					
Rabbit erythrocyte	1.04[v]		460	*67*	
Cytochrome P450 reductase [NADPH]					
Rabbit liver					
Microsomes	2.14		456	*68*	FC
	1.95		382	*68*	FC
	15.9		277	*68*	FC

(*continued*)

TABLE 1 (*continued*)

Protein	$\epsilon_M^a \times 10^{-4}$	$A_{1cm}^{1\%\ b}$	nm[c]	Ref.	Comments[d]
Yeast [*Lodderomyces elongisporus* EH 15D]		29	272	*69*	0.4*M* KPh, pH 7.7, cont. 0.1 m*M* EDTA. Data from Fig. 2 [*69*]
		4.4	380	*69*	0.4*M* KPh, pH 7.7, cont. 0.1 m*M* EDTA. Data from Fig. 2 [*69*]
		3.3	453	*69*	0.4*M* KPh, pH 7.7, cont. 0.1 m*M* EDTA. Data from Fig. 2 [*69*]
Decamin, BHK-21 cells		6.0	277	*70*	
Deoxyribo-nuclease 1					
Beef pancreas		12.3	280	*71*	
Deoxyribonuclease A1					
Achatina fulica	3.57	12.1	280	*72*	mw = 29,509 [*72*]
Deoxyribonuclease A2					
Achatina fulica	3.57	12.1	280	*72*	mw = 29,509 [*72*]
Deoxyribonucleic acid polymerase					
Bacteriophage T7		18.0	280	*73*	
Deoxyribonucleo-protein					
Rat thymus					
Copper-protein complex		18.8	310	*74*	
Desmin					
BHK-21 cells/ Hamster smooth muscle, stomach		6.0	277	*70*	
Dextranase					
Chaetomium gracile					
CD I	14.6	19.0	280	*75*	mw = 77,000 [*75*]
CD II	13.4	18.9	280	*75*	mw = 71,000 [*75*]
Diamine oxidase					
Shrub [*Euphorbia characias*]					
Latex	17.7	12.3	280	*76*	mw = 144,000 [*76*]

(*continued*)

TABLE 1 (*continued*)

Protein	$\epsilon_M^a \times 10^{-4}$	$A_{1cm}^{1\%\ b}$	nm[c]	Ref.	Comments[d]
meso-α,ε-Diamino-pimelate dehydrogenase					
Bacillus sphaericus		7.07	280	*77*	
DT-Diaphorase [EC 1.6.99.2]					
Rat liver	7.9	28.4	270	*78*	mw = 28,000[w] [*78*]
	0.85	3.0	380	*78*	
	1.13[w]	4.0	450	*78*	
Dioldehydrase					
Klebsiella pneumonia [*Aerobacter aerogenes*]					
ATCC 8724	11.96	527	278	*79*	mw = 230,000 [*79*]
Diamine oxidase					
Pig kidney		17[x]	280	*80*	
Dihydrolipoamide dehydrogenase[y]					
E. coli K 12		12.7	273	*81*	0.1*M* KPh, pH 7.6. Data from Fig. 3 [*81*]
Dipeptidyl carboxypeptidase [EC 3.4.15.1]					
Rabbit testicles	29	29	280	*82*	mw = 100,000 [*82*]
Diphtheria toxin					
Commercial		10.5	276	*83*	
Toxin A[z]		8.5	276	*83*	
Fragment A		11.8	278	*84*	
Direct lytic factor					
Hemachatus hamachetus		2.91	280	*85*	
Dynein I					
Sea urchin [*strongylo-centrotus intermedius*]					
Sperm		9.5	281	*86*	10 m*M* KPh, pH 7.6, cont. 1 m*M* DTT.N
Elastase					
Pig	1.03		190	*87*	

(*continued*)

TABLE 1 (*continued*)

Protein	$\epsilon_M^a \times 10^{-4}$	$A_{1cm}^{1\%\,b}$	nm[c]	Ref.	Comments[d]
Elastin, digested					
Human lung		13.3	280	*88*	
Beef ligamentum nuchea		6.0	280	*88*	
Electrolectin					
Electrophorus electricus	3.74	11.5	278	*89*	Data from Fig. 10 [*89*]. mw = 32,500 [*89*]
Electron transferring flavoprotein					
Pig kidney	1.33		436	*90*	
	7.82		272	*90*	
Electron transport flavoprotein					
Pig liver mitochondria	1.16		460	*91*	
	1.35		436	*91*	
	1.22		375	*91*	
	7.83		270	*91*	
Endoglucanase [EC 3.2.1.4]					
Clostridium thermocellum	5.38	6.11	280	*92*	mw = 88,000 [*92*]
Endonuclease					
Serratia marcescens	4.73	14.6	280	*93*	mw = 32,300 [*93*]; 0.1*M* NaPh cont. 6*M* GHCl, pH 7.4
Endopeptidase, proline specific					
Flavobacterium meningo-septicum	10.85	14.0	280	*94*	mw = 77,500 [*94*]; dry wt
Enterotoxin					
Clostridium perfringens		43.4	235	*95*	OTS[aa]
		13.3	280	*95*	OTS[aa]
Enzyme, lytic					
Penicillium lilacinum	7.4	20.0	280	*96*	mw = 37,000 [*96*]; AA

(*continued*)

TABLE 1 (*continued*)

Protein	$\epsilon_M^a \times 10^{-4}$	$A^{1\%}_{1cm}$ [b]	nm[c]	Ref.	Comments[d]
Epoxide hydrase					
Rabbit liver	8.7	18.9[bb]	280	*97*	mw = 45,848 [*97*]
Epoxide hydrolase [EC 3.3.2.3]					
Rat liver		32	280	*98*	
Erythrocruorin					
Lugworm [*Abarenicola affinis affinis* (Ashworth)]					
Blood					
Oxy form		5.44	540	*99*	
		47.60	414	*99*	
		22.49	280	*99*	
Deoxy form		4.75	558	*99*	
		49.64	430	*99*	
CO form		5.30	536	*99*	
		77.55	420	*99*	
Caenestheria inopinata	61.31	20.3	280	*100*	0.1*M* Ph buffer, pH 6.8. mw = 302,000 [*100*]
	51.04	16.9	280	*100*	6*M* GHCl, pH 6.8. mw = 302,000 [*100*]
Water flea [*Daphnia magna*]		19.6[cc]	280	*101*	0.1*M* Ph buffer, pH 6.8
Eisenia fetida					
Oxy form	855	22.4	280	*102*	mw = 3.82×10^6
	478	12.5	343	*102*	mw = 3.82×10^6
	2000	52.4	416	*102*	mw = 3.82×10^6
	2370	6.2	540	*102*	mw = 3.82×10^6
	2480	6.5	575	*102*	mw = 3.82×10^6
Deoxy form	1970	51.5	430	*102*	mw = 3.82×10^6
	195	5.1	—[dd]	*102*	mw = 3.82×10^6
Cyanferriform	183	4.8	540	*102*	mw = 3.82×10^6
Erythropoietin					
Human urine		10	278	*103*	Dry wt
D-Erythrulose reductase					
Chicken liver		4.0	290	*104*	0.05*M* NaPh, pH 7.0. Dry wt
Esterase					
Pig liver		12.4	280	*105*	5 m*M* Ph, pH 8.0
Maleylated derivative		13.1	280	*105*	5 m*M* Ph, pH 8.0 Data from Fig. 11 [*105*]

(*continued*)

TABLE 1 (*continued*)

Protein	$\epsilon_M^a \times 10^{-4}$	$A_{1cm}^{1\%}$ [b]	nm[c]	Ref.	Comments[d]
Estradiol-17β dehydrogenase					
Chicken liver		12.1	280	*106*	0.1*M* NaPh, pH 7.2, cont. 1 m*M* EDTA and 7 m*M* ME
Eu-actinin					
Chicken breast muscle		8.47	280	*107*	Biuret
Exonuclease II					
Crotalus adamanteus					
Venom	14.8	10.4	280	*108*	mw = 142,000 [*108*]
Exotoxin					
Pseudomonas aeruginosa	7.92	12	280	*109*	mw = 66,000 [*109*]; 0.05*M* Tris-HCl, pH 8.1. KN
Staphylococcus aureus	0.9	5	280	*110*	mw = 18,000 [*110*]. Data from Fig. 7 [*110*]. LS
Factor, α [Yeast mating hormone]					
Synthetic	1.21		280	*111*	Water
Factor, activating, 21-hydroxylation system					
Beef adrenal cortex					
Cytosol		6.0	280	*112*	0.05*M* KPh, pH 7.2
Factor, anti-hemorrhagic					
Snake [*Vipera palaestinae*]					
Serum		14	280	*113*	
Factor, desmutagenic					
Cabbage [*Brassica oleracea*]					
Leaves		7.33	404	*114*	
Factor H					
Human plasma	22.1	14.2	280	*115*	mw = 155,000; LS; Interf. [*115*]

(*continued*)

TABLE 1 (*continued*)

Protein	$\epsilon_M^a \times 10^{-4}$	$A^{1\%}_{1cm}{}^b$	nm[c]	Ref.	Comments[d]
Factor, hemorrhagic					
Snake [*Vipera palaestinae*]					
Venom		14	280	*116*	
Factor, inactivating for nitrate reductase					
Alcaligenes faecalis str. S6	0.57	4.8	277	*117*	0.02*M* Ph buffer, pH 6.3. mw = 12,000
	0.118	0.98	450	*117*	0.02*M* Ph buffer, pH 6.3. mw = 12,000
	0.29	2.4	593	*117*	0.02*M* Ph buffer, pH 6.3. mw = 12,000
	0.135	1.1	750	*117*	0.02*M* Ph buffer, pH 6.3. mw = 12,000
Factor, intrinsic: IF-B12 complex					
Human gastric juice					
Complex S		9.5	278	*118*	
Complex I		9.1	278	*118*	
IF		9.2	278	*119*	
Factor rho; transcription termination factor					
Bacillus subtilis		8.4	280	*120*	
Factor 1; ATP-dependent proteolysis factor					
Rabbit reticulocytes	0.1590	1.87	278	*121*	20 m*M* Tris-HCl, pH 7.6. Data from Fig. 4 [*121*]. mw = 8500 [*121*]
	0.2304	2.71	296	*121*	0.1*N* NaOH. Data from Fig. 4 [*121*]; mw = 8500 [*121*]
Factor 4					
Platelet		1.88	280	*122*	
Factor V					
Human		8.9	280	*123*	0.15*M* NaCl, 20 m*M* Tris-HCl, pH 7.4, 5 m*M* $CaCl_2$. LS; Interf.

(*continued*)

TABLE 1 (*continued*)

Protein	$\epsilon_M^a \times 10^{-4}$	$A_{1cm}^{1\%\,b}$	nm[c]	Ref.	Comments[d]
Factor Va					
Beef		15.1[ee]	280	*124*	
Light chain		18.7	280	*124*	N
		17.4	280	*124*	AA
		17.1	280	*124*	Biuret-Folin
		22	280	*124*	Lowry and dye binding
		15.8	280	*124*	Lowry and dye binding
Heavy chain		12.7	280	*124*	KN and AA
		11.3	280	*124*	Biuret-Folin
		15	280	*124*	Lowry and dye binding
		9.6	280	*124*	Lowry and dye binding
Factor VIII/Von Willebrand Factor					
Human blood		12.3	280	*125*	
Factor IXa					
Beef blood		14.3	280	*126*	
Factor Xaβ					
Beef blood		10.0	280	*126*	
Factor XIa					
Beef blood		12.6	280	*126*	
Factor XIIa					
Beef blood		14.2	280	*126*	
Fatty acid synthetase					
Yeast	230[ff]		279	*127*	0.05*M* KPh, pH 6.5, cont. 2 m*M* DTT. Data from Fig. 2 [*127*]
Brewer's yeast					
Holoenzyme	1.86		460	*128*	0.05*M* NaPh, pH 6.94, cont. 1 m*M* EDTA and 1*M* DTT
		13.7	280	*128*	0.05*M* NaPh, pH 6.94, cont. 1 m*M* EDTA and 1*M* DTT
Apoenzyme	227		279	*128*	0.02*M* KPh, pH 6.5, cont. 2 m*M* DTT. Data from Fig. 6 [*128*]

(*continued*)

TABLE 1 (*continued*)

Protein	$\epsilon_M^a \times 10^{-4}$	$A_{1cm}^{1\%}$ [b]	nm[c]	Ref.	Comments[d]
Rat liver	46.7	9.73	280	*129*	mw = 480,000 [*129*], AA
Ferralterin					
Spinach leaves		8.7	280	*130*	30 m*M* Tris-HCl buffer, pH 7.9, cont. 14 m*M* ME. Data from Fig. 2 [*130*]
Nostoc muscorum str.	7119	11.6	275	*130*	30 m*M* Tris-HCl buffer, pH 7.9, cont. 14 m*M* ME. Data from Fig. 2 [*130*]
Ferredoxin					
Clostridium pasteurianum	3.5		462	*131*	80% hexamethylphosphoramide cont. 50 m*M* Tris-HCl, pH 8.0, 9.6 μ*M* *o*-xylyl-α,α′-dithiol and 60 m*M* thiophenol
Clostridium perfringens	1.55	25.8	390	*132*	mw = 6000 [*132*]
Clostridium thermocellum	3.9	60.9	390	*133*	mw = 6400 [*133*]
Cucurbita pepo	0.98	8.9	422	*134*	mw[gg] = 11,000 [*134*]
	1.92	17.5	277	*134*	mw[gg] = 11,000 [*134*]
Desulfovibrio africanus	3.787		283	*135*	AA
	2.128		380	*135*	AA
Desulfovibrio desulfuricans					
Norway	2.059		305	*136*	
	1.750		390	*136*	
Desulfococcus mobilis	0.35		393	*137*	ε/Fe atom
Lettuce [*Lactuca sativa*]	0.974		422	*138*	
	2.162		274	*138*	
Mycobacterium smegmatis Takeo	2.6		406	*139*	
	4.3		280	*139*	
Rhizobium japonicum bacteroids	3.08		380	*140*	

(*continued*)

TABLE 1 (*continued*)

Protein	$\epsilon_M^a \times 10^{-4}$	$A_{1cm}^{1\% \, b}$	nm[c]	Ref.	Comments[d]
Rhodymenia					
palmata	0.58		423	*141*	Fe det.
Ruminococcus					
albus	2.83		390	*142*	AA
	3.7		280	*142*	AA
Spinach	1.2		485	*131*	Data from Fig. 1 [*131*]
Sulfolobus					
acidocaldarus	0.43		402	*137*	ϵ/Fe atom
Thermoplasma					
acidophilum	0.42		402	*137*	ϵ/Fe atom
Thermus					
thermophilus	4.88		280	*143*	
	3.07		400	*143*	
Wheat					
Aegilops					
squarrosa DD[hh]	1.1		425	*144*	
Aegilops ovata					
$C^uC^uM^o$-M^o[hh]	1.23		425	*144*	
Triticum aegilopoides					
AA[hh]	1.16		425	*144*	
Triticum aestivum					
AABBDD[hh]	1.08		425	*144*	
Triticum durum					
AABB[hh]	1.06		425	*144*	
Ferredoxin II					
Desulfovibrio					
africanus	3.015		283.5	*135*	AA
	2.895		290.5	*135*	AA
	1.865		385	*135*	AA
Desulfovibrio					
desulfuricans					
Norway	4.719		305	*136*	AA
	3.158		390	*136*	AA
Clostridium					
thermoaceticum	3.04		390	*145*	
	4.14		280	*145*	
Ferredoxin III					
Desulfovibrio					
africanus	5.85		408	*146*	100 m*M* Tris-HCl buffer, pH 7.6
	8.2		280	*146*	100 m*M* Tris-HCl buffer, pH 7.6

(*continued*)

TABLE 1 (*continued*)

Protein	$\epsilon^a_M \times 10^{-4}$	$A^{1\%}_{1cm}{}^b$	nm[c]	Ref.	Comments[d]
Ferredoxin–nitrite reductase [EC 1.7.7.1] Spinach [*Spinacia oleracea*]	7.87	9.15	388	*147*	mw = 86,000 [*147*]
	2.45	2.85	573	*147*	mw = 86,000 [*147*]
	12.90	15.0	278	*147*	mw = 86,000 [*147*]
Ferredoxin–sulfite reductase Spinach [*Spinacia oleracea* L. cv Michinoku No. 2]	51.6	19.1	279	*148*	0.2*M* NaCl in 50 m*M* Tris-H_2SO_4, pH 8.0, 10% v/v glycerol, 1 m*M* EDTA. Data from Fig. 9 [*148*]. mw = 270,000 [*148*]
Ferredoxin$_{tol}$ reductase, NADH- *Pseudomonas putida*	1.04	2.26	448	*149*	mw = 46,000 [*149*]
	5.5	11.96	274	*149*	mw = 46,000 [*149*] Data from Fig. 7 [*149*]
Ferredoxin–NADP$^+$ reductase [EC 1.6.7.1] *Spirulina platensis* No. 1	8.64		273	*150*	50 m*M* Tris-HCl, pH 7.5, in 0.35*M* NaCl. Data from Fig. 4 [*150*]
	1.08		459	*150*	50 m*M* Tris-HCl, pH 7.5, in 0.35*M* NaCl. Data from Fig. 4 [*150*]
No. 2	9.32		273	*150*	50 m*M* Tris-HCl, pH 7.5, in 0.35*M* NaCl. Data from Fig. 4 [*150*]
	1.12		459	*150*	50 m*M* Tris-HCl, pH 7.5, in 0.35*M* NaCl. Data from Fig. 4 [*150*]

(*continued*)

TABLE 1 (*continued*)

Protein	$\epsilon_M^a \times 10^{-4}$	$A_{1cm}^{1\%}$ [b]	nm[c]	Ref.	Comments[d]
Ferredoxin–$NADP^+$ reductase					
Bumilleriopsis filiformis Vischer					
Complex with $NADP^+$ and Ferredoxin	1.07		459	*151*	
Ferredoxin–thioredoxin reductase					
Spinach leaves		10.4	277	*152*	30 m*M* Tris-HCl, pH 7.9, 0.1% ME. Data from Fig. 3 [*152*]
Ferribactin					
Pseudomonas fluorescens		12.4	435-40	*153*	pH 7.5
		10.1	470	*153*	pH 2.0
		11.8	275	*153*	Water
Ferrochelatase					
Rhodopseudomonas spheroides	9[ii]	7.8	278	*154*	mw = 115,000 [*154*]
	75.9	66	278	*154*	mw = 115,000 [*154*] Data from Fig. 4 [*154*]. 10 m*M* Tris-Ac, pH 8.1, 0.5% deoxycholate

[a] ϵ_M is the molar absorptivity with units of $M^{-1}cm^{-1}$ and is either the value reported in the reference cited or calculated from the $A_{1cm}^{1\%}$ value and the molecular weight.

[b] $A_{1cm}^{1\%}$ is the absorption for a 1% solution in a 1 cm cuvet and is either the value reported in the reference cited or calculated from the ϵ_M and the molecular weight. The relationship between ϵ_M, $A_{1cm}^{1\%}$, and molecular weight, mw, is $10\epsilon_M = (A_{1cm}^{1\%})$ (mw).

[c] Refers to the wavelength cited and may not be the peak of the absorption band.

[d] *Abbreviations used*: Ac, acetate; DTT, dithiothreitol; EDTA, ethylenendiaminetetraacetic acid; GHCl, guanidine hydrochloride; HOAc, acetic acid; KPh, potassium phosphate; ME, β-mercaptoethanol; NaOAc, sodium acetate; NaPh, sodium phosphate; PBS, phosphate buffered saline; Ph, phosphate; Tris, tris[hydroxymethyl]aminomethane.
Methods of protein determination: Dry wt, dry weight; Folin, Lowry, Biuret are all colorimetric assays; Interf., interferometry; LS, corrected for light scattering; mw, molecular weight; AA, amino acid analysis; FC, based on flavin content; N, nitrogen determination.

[e] nc, Not cited.

[f] All values based on protoheme content.

[g] Based on iron content.

[h] 525–526 nm.

[i] 277–280 nm.

[j] At 411 nm $\epsilon_M = 26 \times 10^4$, Tris-HC1, pH 7.6; data from Fig. 1 [*44*].

(*continued*)

TABLE 1 (*continued*)

[k]Values based on extinction of 29.1 $mM^{-1}cm^{-1}$ for the α peak of pyridine ferrohemochrome.
[l]Values based on heme determination as pyridine hemochrome.
[m]Other alkanols give similar results.
[n]Rabbits pretreated with phenobarbital and 3-methyl cholanthrene.
[o]Ethanol treated rabbits.
[p]Ferric form.
[q]Phenobarbital induced.
[r]All values based on protoheme content.
[s]mw = 122,000 based on iron determination.
[t]All values per heme. Solvent is 20 m*M* Tris-HCl buffer, pH 8, containing Emasol 1130.
[u]All values refer to concentration of heme a. In ref. *63* there are data relating to the effect of phosphine on the spectrum. In ref. *65* there are a large number of absorbance coefficients for the following forms: Form III, oxidized cyanide complex; Form IV, reduced carbon monoxide complex; Form V, partially reduced cyanide complex, Form VI, partially oxidized carbon monoxide complex.
[v]OD 273:OD 462 = 5.6–5.8.
[w]Based on extinction coefficient of FAD at 450 of 11,300 $M^{-1}cm^{-1}$.
[x]In (*81*) this value is given as 1.7. This is an error [personal communication from Prof. M.D. Kluetz].
[y]This is a component of pyruvate dehydrogenase complex.
[z]This is one chain of diphtheria toxin.
[aa]OTS = organic total solids.
[bb]In (*97*) this is given as 1.89. The correct value is 18.9 [personal communication from Dr. Halpert].
[cc]Reported as L $g^{-1}cm^{-1}$.
[dd]550–565 nm.
[ee]Calculated from subunit contribution.
[ff]This is taken from the spectrum of the flavin-free enzyme. In the legend to the figure the following appears: " . . . 217 n*M* in 2.0 mL." It is difficult to interpret this and I have assumed that the concentration is 217 n*M*.
[gg]mw = 11,400 based on iron determination; 11,045 based on amino acid analysis. The value of 11,000 was used to calculate the ϵ_M values.
[hh]Genome designation.
[ii]This is the value cited (*154*).

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