TABLE 5.2. Some Properties of Carboxylases

Enzyme	Source	CO_2 or HCO_3^- as substrate	$K_{½}$ in terms of free CO_2 at specified pH/mmol m^{-3}	M_r	Specific reaction rate under optimal conditions/mol C fixed (mol enzyme)$^{-1}$ s^{-1}	Increment of C fixed (μmol C (g enzyme)$^{-1}$ s^{-1}) per 1 mmol m^{-3} increment of CO_2 at rate-limiting $[CO_2]$	References
Ribulose bis-phosphate carboxylase/ oxygenase[a]	*Anabaena variabilis*	CO_2	280 (pH 8)	550,000	41	0.13	Badger [1980]
	Synechococcus sp.	CO_2	240 (pH 8.3)	550,000	27	0.10	Andrews and Abel [1981] Andrews et al. [1981]
(E.C.4.1.1.39)	*Beta vulgaris*	CO_2	11 (pH 8.2)	550,000	6.6 (20)[b]	0.60 (1.82)[b]	Bird et al. [1982] cf. Hall et al. [1981]
	Chlorophycean microphytes	CO_2	60 (pH 8.2)	550,000	15	0.23	Lord and Brown [1975] Jordan and Ogren [1981, 1983]
Phosphoenolpyruvate carboxylase (E.C.4.1.1.31)	*Zea mays*	HCO_3^-	2 (pH 8.0)	400,000	167 (233)[c]	104 (146)[c]	O'Leary [1982]
	Acetobacter aceti	HCO_3^-	178 (pH 7.5)	380,000	101	0.74	Schwitzguebel and Ettlinger [1979]
Phosphoenolpyruvate carboxykinase (PP_i; E.C. 4.1.1.38)	*Propionobacter shermanii; Entamoeba histolytica*	CO_2	961 (pH 6.8)	430,00	172[d]	0.21[d]	Wood et al. [1977]
Phosphoenolpyruvate carboxykinase (GTP enzyme from animals	*Sus* liver[e] mitochondria	CO_2	950 (pH 7.5)	73,000	11[d]	0.08[d]	Chang and Lane [1966], Chang et al. [1966]
	Panicum[e] *maximum* leaves	CO_2	1700 (pH 7.2)	?	?	0.03[d]	Ray and Black [1976]
E.C.4.1.1.32; ATP enzyme from plants E.C.4.1.1.49)	*Phaeodactylum tricornutum*	(HCO_3^-?)	590 (pH 7.6)	62,000	0.04[g]	0.006[g]	Holdsworth and Bruck [1978]
Pyruvate carboxylase (E.C.6.4.1.1)	*Gallus* liver	HCO_3^-	76 (pH 7.4)	655,000	382	3.83	Scruton and Utter [1965]
	Ratus liver	HCO_3^-	49 (pH 8.0)	500,000	208	4.25	McClure et al. [1971]
Propionyl CoA carboxylase (E.C.6.4.1.3)	*Suus* heart	HCO_3^-	49 (pH 8.0)	700,000	252	3.67	Kaziro et al. [1961]
Malic enzyme ($NADP^+$) (E.C.1.1.140)	*Rattus* skeletal muscle	CO_2	268 (pH 7.2)	264,000	88[d]	0.62[d]	Swierczynski [1980]
	Solanum tuberosum	CO_2	129 (pH 7.0) 230 (pH 7.6)	?	?	2.45[d] 1.38[d]	Davies and Patil [1974]
Acetyl CoA carboxylase (E.C.6.4.1.2)	*Ricinus communis* endosperm	HCO_3^-	67 (pH 8.0)	528,000	18	0.25	Finlayson and Dennis [1983]
Malic enzyme (NAD^+) (E.C.1.1.1.38)	*Crassula argentea* leaves	CO_2	13480 (pH 6.5)	968,000	4.2	0.000155[d]	Wedding and Black [1983]

[a]All RUBISCO data refer to the properties of the carboxylase activity in the absence of oxygen inhibition. Comments on the procedures necessary to obtain correct values of $K_{½}$ and CO_2-saturated specific reaction rates for RUBISCO may be found in Bird et al. [1982].
[b]Values in parentheses are extrapolated specific reaction rates based on maximal activity of all catalytic sites [Hall et al., 1981].
[c]Values in parentheses are highest values quoted by O'Leary [1982]; other specific reaction rate values are mean maximum values.
[d]Reversible enzyme; rates quoted refer to initial rates, when concentration of product, and hence the rate of the reverse reaction, are negligible.
[e]Enzyme from animal tissue using GDP as cosubstrate for carboxylation.
[f]Enzyme from plant tissue using ADP as cosubstrate for carboxylation.
[g]Authors admit to substantial loss of activity of enzyme during purification.