

● TOYOBO ENZYMES ●
(Diagnostic Reagent Grade)

ASCORBATE OXIDASE

from Cucurbita sp.

L-Ascorbate : Oxygen oxidoreductase (EC 1. 10. 3. 3)



PREPARATION and SPECIFICATION

Appearance	: Light blue amorphous powder, lyophilized	
Activity	: Grade III 200U/mg -solid or more	
Contaminants	: Catalase $\leq 1.0 \times 10^{-1}\%$ Phosphatase $\leq 2.0 \times 10^{-2}\%$	
Stabilizers	: Bovine serum albumin (BSA), borate	(Fig.1)

PROPERTIES

Stability	: Store at -20°C	
Molecular weight	: 140,000	
Isoelectric point	: 5.5 ± 0.2	
Michaelis constant	: $2.7 \times 10^{-4}\text{M}$ (Ascorbate)	
Inhibitors	: cyanide, Na_2S , diethyldithiocarbamate (Na)	
Optimum pH	: pH 5.5–6.5	(Fig.2)
Optimum temperature	: approx. 45°C	(Fig.3)
pH Stability	: 6.0–10.0 (25°C , 20hr)	(Fig.4)
Thermal stability	: below 45°C (pH 7.0, 30min)	(Fig.5)
Substrate specificity	: The enzyme oxidizes ascorbic acid and several ascorbic acid derivatives.	
Effect of various chemicals	: (Table 1)	

APPLICATIONS

This enzyme is useful for enzymatic determination of ascorbic acid and for eliminating the interference of ascorbic acid in clinical analysis.

ASSAY

Principle:



The disappearance of ascorbic acid is measured at 245nm by spectrophotometry.

Unit definition:

One unit causes the decrease of one micromole of ascorbic acid per minute under the conditions described below.

Method:

Reagents

- A. Ascorbic acid solution : 1.0mM [Dilute the stock solution (10mM) to 10-fold volume with 0.2M KH_2PO_4 solution containing 1.0mM EDTA.] (Prepare freshly)
 Stock solution: 176mg L-ascorbic acid (MW=176.13)/100ml of 1.0mM HCl solution containing 1.0mM EDTA (Stable for one month if stored at 0–5°C)
- B. Na_2HPO_4 solution : 10mM
- C. HCl solution : 0.2N
- D. Enzyme diluent : 10mM Na_2HPO_4 solution containing 0.05% BSA (Prepare freshly)

Procedure

- Prepare the following reaction mixture in a test tube and equilibrate at 30°C for about 5 minutes.

Concentration in assay mixture		
KH_2PO_4	82	mM
Na_2HPO_4	5.5	mM
Ascorbic acid	0.45	mM
EDTA	0.45	mM
BSA	45.4	$\mu\text{g/ml}$

0.5ml Substrate solution (A)

0.5ml Na_2HPO_4 solution (B)

(pH of the reaction mixture should be 5.6.)

- Add 0.1ml of the enzyme solution* and mix.
- After exactly 5 minutes at 30°C, add 3.0ml of HCl solution (C) to stop the reaction and measure the optical density at 245nm against water (OD test).
 At the same time, prepare the blank by first mixing the reaction mixture with 3.0ml of HCl solution (C) after 5min-incubation at 30°C, followed by addition of the enzyme solution (OD blank).

- * Dissolve the enzyme preparation in ice-cold distilled water (more than 60U/ml) and dilute to 0.15–0.25U/ml with ice-cold enzyme diluent (D), immediately before assay.

Calculation

Activity can be calculated by using the following formula :

$$\text{Volume activity (U/ml)} = \frac{\Delta \text{OD (OD blank} - \text{OD test)} \times V_t \times \text{df}}{10.0 \times 1.0 \times t \times V_s} = \Delta \text{OD} \times 0.820 \times \text{df}$$

$$\text{Weight activity (U/mg)} = (\text{U/ml}) \times 1/\text{C}$$

V_t : Total volume (4.1ml)

V_s : Sample volume (0.1ml)

10.0 : Millimolar extinction coefficient of ascorbic acid under the assay condition at pH 1.0 ($\text{cm}^2/\text{micromole}$)

1.0 : Light path length (cm)

t : Reaction time (5 minutes)

df : Dilution factor

C : Enzyme concentration in dissolution (c mg/ml)

REFERENCES

- T.Nakamura, N.Makino and Y.Ogura; *J.Biochem.*, **64**,189 (1968).
- V.Ts.Aikazyan and R.M.Nalbandyan; *FEBS LETTERS*, **104**,127 (1979).
- G.A.White and F.G.Smith; *Nature*, **190**,187 (1961).

Table 1. Effect of Various Chemicals on Ascorbate oxidase

[The enzyme dissolved in 10mM K-phosphate buffer, pH 7.0 contg. 0.2% BSA (55 U/ml) was incubated with each chemical at 25°C for 1hr.]

Chemical	Concn.(mM)	Residual activity	Chemical	Concn.(mM)	Residual activity
None	—	100%	MIA	2.0	100%
Metal salt	2.0		NEM	2.0	98
MgCl ₂		96	IAA	2.0	97
CaCl ₂		98	Hydroxylamine	2.0	99
Ba(OAc) ₂		98	EDTA	5.0	100
FeCl ₃		100	o-Phenanthroline	2.0	84
CoCl ₂		55	α, α' -Dipyridyl	1.0	98
MnCl ₂		100	Borate	50	99
ZnCl ₂		100	NaF	2.0	98
CdCl ₂		86	NaN ₃	2.0	95
NiCl ₂		99	Triton X-100	0.10%	100
CuSO ₄		80	Brij 35	0.10%	100
Pb(OAc) ₂		100	Tween 20	0.10%	100
AgNO ₃		15	Span 20	0.10%	100
HgCl ₂		5.2	Na-cholate	0.10%	97
2-Mercaptoethanol	2.0	94	SDS	0.05%	100
PCMB	1.0	86	DAC	0.05%	99

Ac, CH₃CO; PCMB, p-Chloromercuribenzoate; MIA, Monoiodoacetate; EDTA, Ethylenediaminetetraacetate; IAA, Iodoacetamide; NEM, N-Ethylmaleimide; SDS, Sodium dodecyl sulfate; DAC, Dimethyl-benzyl-alkyl-ammonium-chloride.

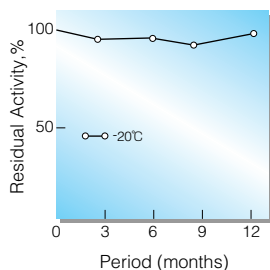


Fig.1. Stability (Powder form)
(kept under dry conditions)

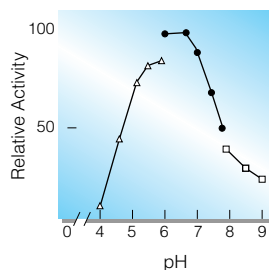


Fig.2. pH-Activity
[30°C in 0.1 M buffer solution: pH4.0-6.0, acetate; pH6.0-8.0, phosphate pH8.0-9.0, borate]

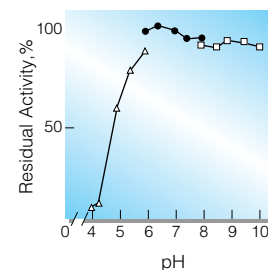


Fig.4. pH-Stability
[25°C, 20hr-treatment with 0.1M buffer solution; pH4.0-6.0, acetate; pH6.0-8.0, phosphate; pH8.0-10.0, borate]

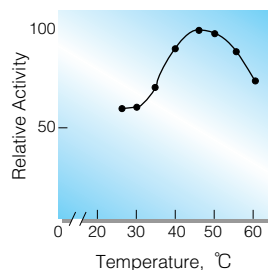


Fig.3. Temperature activity
(in 0.33M phosphate buffer, pH5.6)

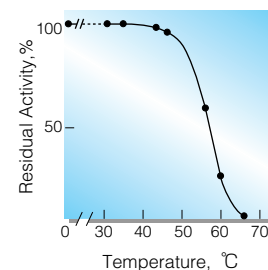
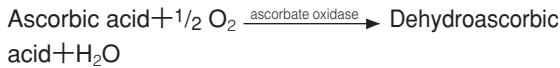


Fig.5. Thermal stability
[30min-treatment with 10mM phosphate buffer, pH 7.0(contg.0.2% BSA) enzyme concn.: 15U/ml]

活性測定法 (Japanese)

1.原理



Ascorbic acidの消失量を245nmの吸光度の変化で測定する。

2.定義

下記条件下で1分間に1マイクロモルのアスコルビン酸を酸化する酵素量を1単位(U)とする。

3.試薬

- A. 1.0mMアスコルビン酸溶液 [保存溶液(10mMのL-アスコルビン酸溶液)を1.0mM EDTAを含む0.2M KH_2PO_4 溶液で10倍希釈する](用時調製)
保存溶液は176mgのL-アスコルビン酸(試薬特級, MW=176.13)を精秤し1.0mM EDTAを含む1.0mM HCl溶液100mlに溶解して調製する(0~5°C保存で1ヶ月は使用可能)。

- B. 10mM Na_2HPO_4 溶液

- C. 0.2N HCl溶液

酵素溶液：酵素標品を予め氷冷した蒸留水で溶解(60U/ml以上)し、分析直前に0.05%BSAを含む10mM Na_2HPO_4 溶液(氷冷)で0.15~0.25U/mlに希釈する。

4.手順

- ①試験管に下記反応混液を調製し、30°Cで約5分間予備加温する。

0.5ml 基質溶液 (A)

0.5ml Na_2HPO_4 溶液 (B)

(反応混液のpHは5.6)

- ②酵素溶液0.1mlを加え、反応を開始する。
③30°Cで正確に5分間反応させた後、HCl溶液(C)3.0mlを加えて反応を停止させる。この液につき245nmにおける吸光度を測定する(ODtest)。
④盲検は反応混液①を30°Cで5分間放置後、HCl溶液(C)3.0mlを加えて混和し、次いで酵素溶液0.1mlを加えて調製する。以下同様に吸光度を測定する(ODblank)。

5.計算式

$$U/ml = \frac{\Delta OD (OD \text{ blank} - OD \text{ test}) \times 4.1 (ml) \times \text{希釈倍率}}{10.0 \times 1.0 \times 5 (\text{分}) \times 0.1 (ml)}$$

$$= \Delta OD \times 0.82 \times \text{希釈倍率}$$

$$U/mg = U/ml \times 1 / C$$

10.0 : アスコルビン酸の上記測定条件下(pH1.0)でのミリモル分子吸光係数($\text{cm}^2/\text{micromole}$)

1.0 : 光路長(cm)

C : 溶解時の酵素濃度(c mg/ml)