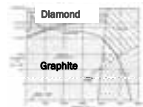
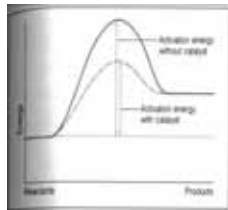


효소란 무엇인가?

장 현 철

국립암센터 기초실험화학연구부

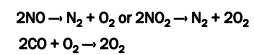
촉매 (CATALYST)



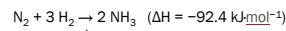
High Pressure Research: An International Journal
Volume 16, Issue 1, 1998
Conversion of graphite to diamond assisted by non-metallic catalysts under high pressure and high temperature: A review

촉매 (CATALYST)

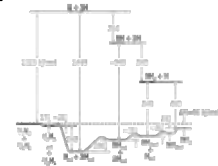
Catalytic converter



Haber-Bosch process



iron promoted with K_2O , CaO , SiO_2 , and Al_2O_3



효소 (ENZYME) : 생체 촉매

Most enzymes are Proteins

Cofactors

Loosly bound : Coenzymes
Tightly bound : Prosthetic groups

Organic : biotin, flavin, heme, NAD, FAD etc
Inorganic : metal ions, iron-sulfur clusters, etc



DNA polymerase
Modified From enzymall.com

Catalytic RNA molecules

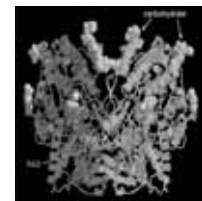
효소 (ENZYME) : 생체 촉매

Most enzymes are Proteins

Cofactors

Loosly bound : Coenzymes
Tightly bound : Prosthetic groups

Organic : biotin, flavin, heme, NAD, FAD etc
Inorganic : metal ions, iron-sulfur clusters, etc



Glucose oxidase
From 10.2210/rcsb_pdb/mom_2006_5

Catalytic RNA molecules



효소 (ENZYME) : 생체 촉매

Most enzymes are Proteins

Cofactors

Loosly bound : Coenzymes
Tightly bound : Prosthetic groups

Organic : biotin, flavin, heme, NAD, FAD etc
Inorganic : metal ions, iron-sulfur clusters, etc



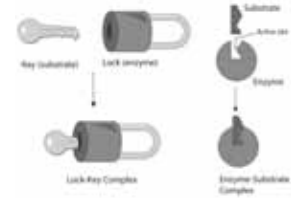
Hairpin ribozyme
From Wikipedia

Catalytic RNA molecules

효소의 특징

Specificity :

Highly selective for substrates



High Fidelity

DNA polymerase : Error rates → less than 1 error in 100 million reactions

효소의 어원



Anselme Payen

First enzyme discovered :
diastase (1833, French
chemist)
breakdown of starch into maltose



Louise Pasteur

Fermentation of sugar to
alcohol by yeast
→ Fermentation is catalyzed
by a vital force called
"ferments"



Wilhelm Kühne

1877,
German physiologist;
First used the term
"enzyme"
Enzyme is comes
from Greek *ενζυμων*,
"in leaven"



Eduard Buchner

1897, First paper on the
ability of yeast extracts that
lacked any living yeast cells
to ferment sugar
Nobel Prize Winner in
Chemistry , 1907

효소, 발효, 부패 ?

Fermentation (발효) :

a metabolic process converting sugar to acids, gases and/or alcohol
식품이 미생물의 작용으로 인하여 우리에게 유익한 형태로 변화

Putrefaction (부패)

식품이 미생물의 작용으로 인하여 우리에게 무익 또는 유해하게 변화



효소의 종류

Class 1. Oxidoreductases

Class 2. Transferases.

Class 3. Hydrolases.

Class 4. Lyases.

Class 5. Isomerases.

Class 6. Ligases.

ExplorEnz - The Enzyme Database

	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	All classes
	Oxidoreductases	Transferases	Hydrolases	Lyases	Isomerases	Ligases	Enzymes
Current	1881	1547	1032	911	274	101	5206
Translated	201	88	278	88	9	4	627
Checked	76	58	103	21	6	4	208
Total	1778	1679	1135	940	289	179	6159

2013.11. 1. 기준

사람 몸속의 효소

Metabolic enzymes : assist in a wide range of basic bodily processes, from breathing to thinking, maintaining the immune system, etc

Digestive enzymes : break down nutrients chemically into smaller molecules that are more easily absorbed by the body.

Food enzymes : enzymes supplied to us through the foods we eat.
ie) proteases, lipases, amylases.

질병과 효소

Tight control of enzyme activity is essential for homeostasis

Phenylketonuria

A mutation of a single amino acid in the enzyme phenylalanine hydroxylase

Untreated PKU can lead to mental retardation, seizures, and other serious medical problems

Xeroderma pigmentosum

nucleotide excision repair (NER) enzymes are mutated XP A~D, DDB2, ERCC4, RAD2...etc

Patients with XP are at a high risk for developing skin cancers, such as basal cell carcinoma,



From Wikipedia

나이와 효소

[Exp Gerontol](#), 1972 Feb;7(1):53-67.

Enzyme activities, gene function and ageing in mammals. (Review).

[Finch CE](#)

Abstract

about 75 per cent of enzyme activities measured changed to a minor degree, if at all, during ageing.

Ageing does not appear to involve the loss of genomic competence.

VS

Recent developments in the age-related alteration of enzymes: a review.

[Rutishauser M](#)

Abstract

three enzymes have been purified to homogeneity from young and old nematodes (enolase, phosphoglycerate kinase, triosephosphate isomerase) and one from the liver of young and old rats (superoxide dismutase).

In all cases except for triosephosphate isomerase, the enzymes from old animals show a reduced catalytic ability compared to those from young animals.

Though final conclusions cannot be made, the evidence favors the latter idea to explain the presence of altered enzymes in old animals.



나이와 효소

[Dig Dis Sci](#), 1986 Sep;31(9):970-7.

Influence of aging upon pancreatic digestive enzymes.

[Greenberg RE](#), [Holt PR](#)

Abstract

The effects of aging upon pancreatic digestive enzymes were studied in 27- and 3-month-old Fischer 344 rats.

Thus, **aging may induce modest changes in pancreatic digestive enzymes** and in jejunal enteropeptidase **which are unlikely to be physiologically important**. However, the pancreas of aging rats does not adapt to changes in dietary intake as well as young rats.

[Mech Ageing Dev](#), 1992 Sep;65(2-3):187-98.

Age-related changes in antioxidant enzyme activities are region and organ, as well as sex, selective in the rat.

[Carrillo MC](#), [Kanai S](#), [Sato Y](#), [Kitani K](#)

superoxide dismutase (SOD), catalase (CAT) and glutathione peroxidase (GSH-Px)

In the liver of male rats, activities of CAT as well as Mn-SOD were lower, while activities of Cu Zn-SOD were higher

Activities of total SOD as well as GSH Px were comparable

In contrast to male rats, in female rat livers,

activities of CAT were significantly higher in old (28-months-old) rats, while activities of Mn-SOD were slightly (but significantly) higher in old rat livers.

Results suggest that the **significance of the changes of these antioxidant enzyme activities during aging needs to be carefully interpreted**, taking into consideration the fact **that changes are markedly variable depending on sex as well as the organs and brain regions examined**.

나이와 효소

[Neurobiol Aging](#), 2006 Feb;27(2):351-60.

Age-related changes in adenosine metabolic enzymes in sleep/wake regulatory areas of the brain.

[Mackiewicz M](#), [Naragona EV](#), [Zimmermann JP](#), [Ramesh MA](#), [Carter J](#), [Galante EJ](#), [Pack AL](#)

Source

Center for Sleep and Respiratory Neurobiology, University of Pennsylvania School of Medicine, 991 Maloney Building, 3600 Spruce Street, Philadelphia, PA 19104-4283, USA, mirekmm@mail.med.upenn.edu

Abstract

The impact of age on the enzymatic activities of adenosine metabolic enzymes, i.e., adenosine deaminase, adenosine kinase, cytosolic- and ecto-5'-nucleotidase have been assessed in the brain sleep/wake regulatory areas of young, intermediate and old rats (2, 12 and 24 months, respectively). There were significant spatial differences in the distribution of enzymes of adenosine metabolism in the brain. **Age did not impact on the enzymatic activity of adenosine deaminase. Adenosine kinase activity increased significantly** in the cerebral cortex of old animals. However, there were no differences in the activity of adenosine kinase between young and intermediate aged rats. **The largest age-related changes were in the activity of cytosolic- and ecto-5'-nucleotidase and there was a significant age-related increase in the activity of these enzymes in the sleep/wake regulatory areas.** In addition, the activity of cytosolic- and ecto-5'-nucleotidase increased in the cerebral cortex of old and intermediate age rats when compared to young animals. An increase in the enzymatic activities in the cerebral cortex of adenosine kinase and 5'-nucleotidases was accompanied by an increase in the level of their mRNA. An increase in the activity of 5'-nucleotidases with age likely leads to an increase in adenosine levels in the brain.