Amino acids, peptides and proteins

amino acids — basic building units

peptides — significant biological effects

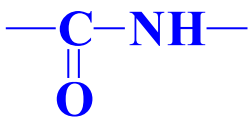
proteins — basic constituent of all living cells ⇒ foods

⇓

basic nutrient

amino acids — functional groups: NH_2 COOH

compounds of amino acids bounded by peptide bond



***N*-substituted amino acid amides**

peptides — 2-100 amino acids

proteins — > 100 amino acids (typically hundreds to thousands)

Amino acids

> 700 amino acids in plant and animal tissues

as free amino acids in food 1%

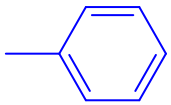
as building units of peptides, proteins and other compounds 99%

structure

always at least 1 group NH_2 free, substituted

1 group COOH

additional functional groups

1. hydroxyl -OH
2. sulfhydryl (thiol) -SH
3. sulfide -S-R
4. guanidyl 
5. phenyl 

classification

- **according to distance of amino group from carboxylic group**

		n
2-amino acids	α-amino acids	0
3-amino acids	β-amino acids	1
4-amino acids	γ-amino acids	2
5-amino acids	δ-amino acids	3
6-amino acids	ε-amino acids	4

- **according to their occurrence**

➢ found in all organisms (invariable)

20 basic (coded, proteinogenic) amino acids

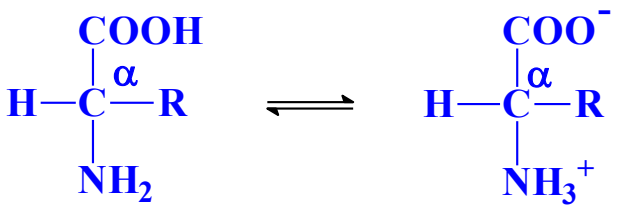
➢ found in only some organisms (variable)

2 proteinogenic amino acids - selenocystein, pyrrolysin

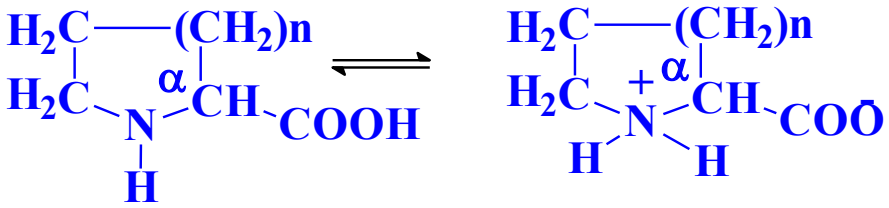
about 700 other amino acids(free, bounded)

basic amino acids

19 α-amino acids with primary amino group **-NH_2**



1 α-amino acid with secondary amino group **-NH-** **(proline)**



n=0, pyrrolidin

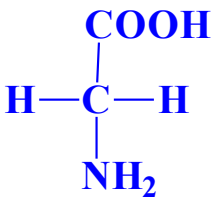
19 amino acids = chiral compounds, L-isomers

Trivial names	Systematic names	Three letter symbols	One letter symbols
glycine	aminoacetic	Gly	G
L-alanine	L-2-aminopropionic	Ala	A
L-valine	L-2-amino-3-methylbutyric	Val	V
L-leucine	L-2-amino-4-methylvaleric	Leu	L
L-isoleucine	L-2-amino-3-methylvaleric	Ile	I
L-serine	L-2-amino-3-hydroxypropionic	Ser	S
L-threonine	L-2-amino-3-hydroxybutyric	Thr	T
L-cysteine	L-2-amino-3-merkaptopropionic	Cys	C
L-methionine	L-2-amino-4-methylthiobutyric	Met	M
L-aspartic acid [a)]	L-aminosuccinic	Asp	D
L-glutamic acid [b)]	L-2-aminoglutaric	Glu	E
L-asparagine [a)]	L-2-amino-4-carbamoylbutyric	Asn	N
L-glutamine [b)]	L-2-amino-5-carbamoylvaleric	Gln	Q
L-lysine	L-2,6-diaminohexanoic	Lys	K
L-arginine	L-2-amino-5-guanidylvaleric	Arg	R
L-histidine	L-2-amino-3-(4-imidazolyl)propionic	His	H
L-phenylalanine	L-2-amino-3-phenylpropionic	Phe	F
L-tyrosine	L-2-amino-3-(4-hydroxyphenyl)propionic	Tyr	Y
L-tryptophan	L-2-amino-3-(3-indolyl)propionic	Trp	W
L-proline	L-pyrrolidin-2-carboxylic	Pro	P
[a)] aspartic acid and asparagine		Asx	B
[b)] glutamic acid and glutamine		Glx	Z

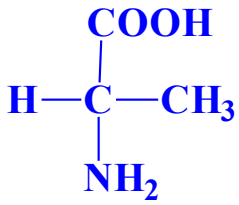
classification of basic amino acids

according the structure of side-chain and functional groups

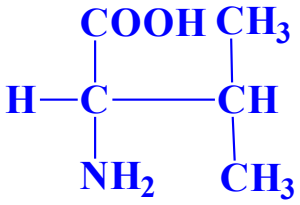
aliphatic amino acids with nonsubstituted chain



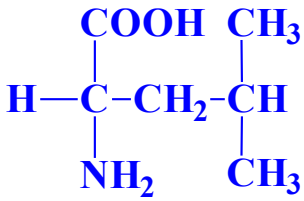
glycine



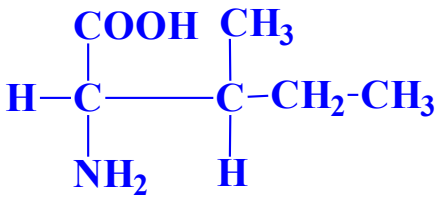
alanine



valine

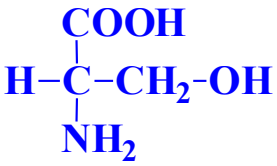


leucine

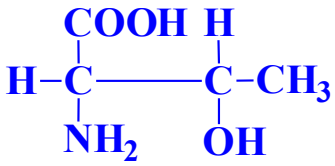


isoleucine

alifatic hydroxyamino acids

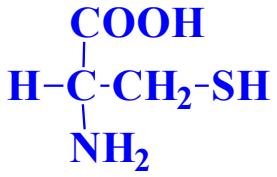


serine

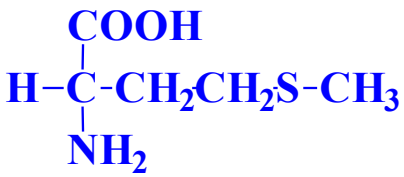


threonine

aliphatic sulphur amino acids

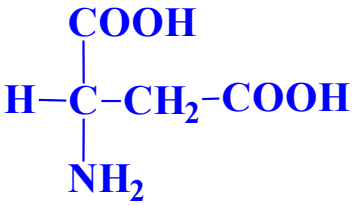


cysteine

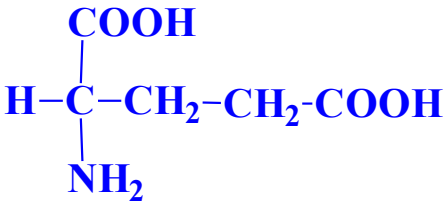


methionine

with carboxyl group in the side-chain (monoaminodicarboxylic acids, acidic)

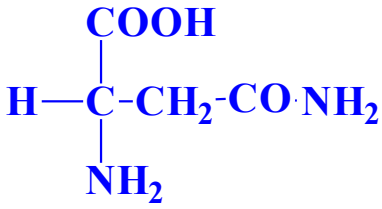


aspartic acid

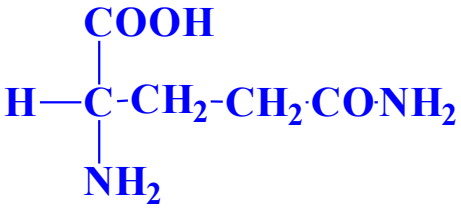


glutamic acid

their monoamides (with carboxamide group in the side-chain)



asparagine



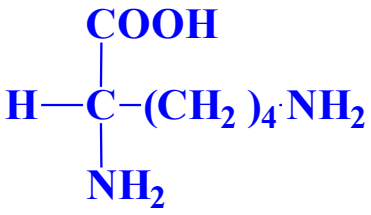
glutamine

with basic groups in the side-chain

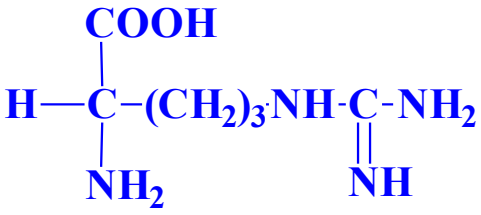
second amino group (lysine)

guanidylic group (arginine)

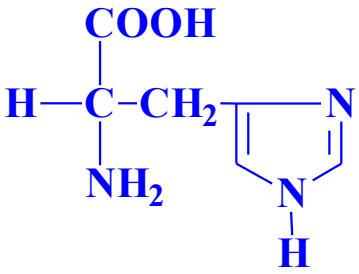
imidazole cycle (histidine)



lysine

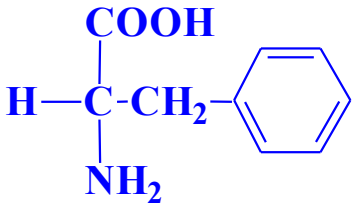


arginine

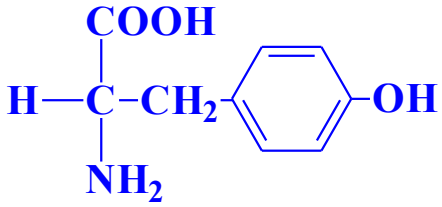


histidine

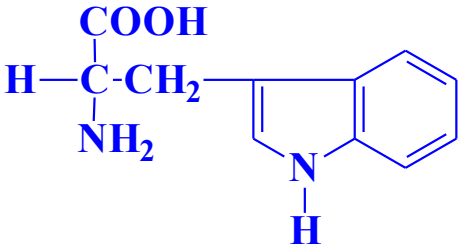
with aromatic (heterocyclic) side-chain



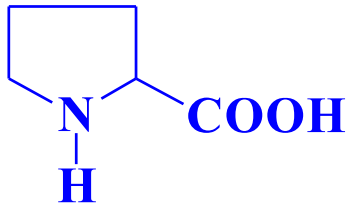
phenylalanine



tyrosine



tryptophan (derivative of indole)



proline (derivative of pyrrolidine)

classification in biochemistry

according to polarity of the side-chain and its ionic forms (in neutral medium) – related to protein interactions

- **nonpolar, hydrophobic: Val, Leu, Ile, Phe, Tyr, Met, Pro;**

  to some extent Gly, Ala, Trp (amphiphilic)

- **polar, hydrophilic: Ser, Thr, Cys, Asp, Glu, Asn, Gln, Lys, Arg, His**

by ionic forms of the side chain in organisms :

- **neutral (without electric charge): most amino acids**
- **acidic (negative electric charge): Asp, Glu**
- **basic (positive electric charge): Lys, Arg, His**

classification according to importance in human nutrition

- **essential**: **Val, Leu, Ile, Thr, Met, Lys, Phe, Trp** ⟹ **only from food**
- **semiessential**: **Arg, His** **by fast growing organisms (children)**
- **nonessential: others**

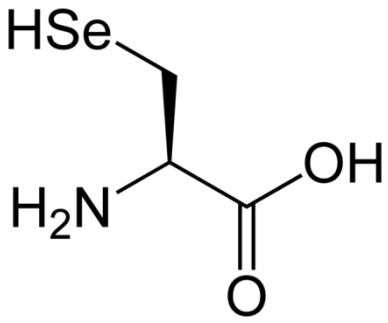
coded amino acids in human body synthesized:

- **from other amino acids**
- **from glucose**
- **from fatty acids etc.**

limiting = amino acid, which is in the diet / commodity present in relatively less amount (based on recommended daily intake)

⟹ **determines the nutritional value of food / commodity**
only essential amino acids !

21. proteinogenic amino acid - selenocysteine

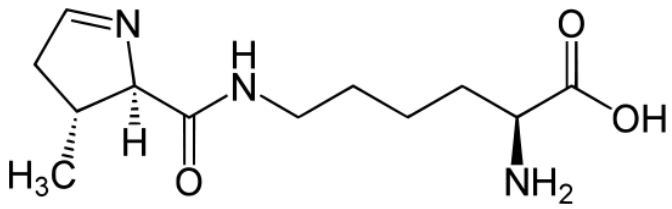


Selenocysteine (Se-Cys)

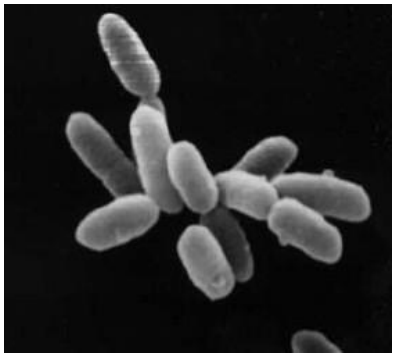
• higher reduction potential than Cys - in proteins with antioxidant activity

• in enzymes (glutathione peroxidase, formate dehydrogenases, glycine reductase, some hydrogenase)

22. proteinogenic amino acid - pyrrolysine



pyrrolysine



Layers of thermophilic archaea in Yellowstone National Park

Archaea - an ancient form of life - is estimated to be 3.5 billion years on Earth
- known primarily as an extremophile organisms growing also at high temperature, extreme pH or high salt content

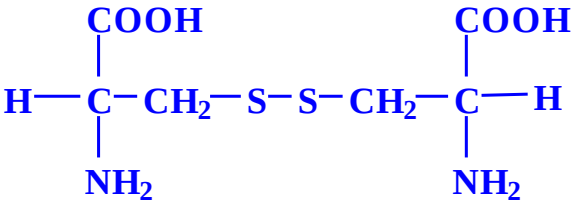
In the food industry enzymes amylase, galactosidase and pululanase isolated from archaea Pyrococcus genus are used to produce food (e.g. milk and whey with low amount of lactose) - even at temperatures above the boiling point still retains their catalytic function

Methanobrevibacter smithii - most common archeon in the human intestine
- represents about one tenth of all prokaryotic organisms in the gut

derivatives of proteinogenic amino acids

- 20 basic amino acids = ~ 90% amino acids in foods
- their derivatives - formed by posttranslational modifications

L-cystine (CySSCy)

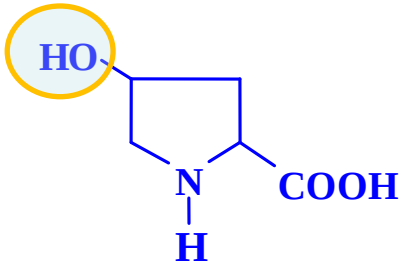


L-4-hydroxyproline

(L-4-hydroxypyrrolidin-2-carboxylic acid, Hyp)

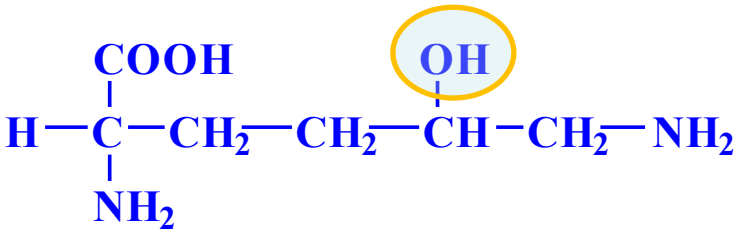
important structural component of connective tissue, collagen and gelatin protein (content about 12%)

amount in meat products correlates with the amount of lower-quality materials such as skin or cartilage



L-3-hydroxyproline

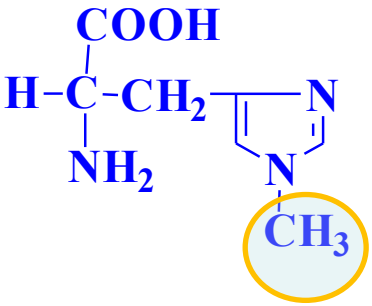
L-5-hydroxylysine



to a small extent accompany **L-4-hydroxyproline** in collagen

3-methylhistidine

minority in myofibrillar meat proteins (actin and myosin)
criterion for determining the quality of ingredients in meat products

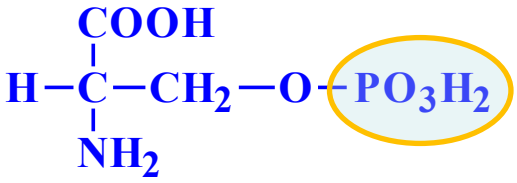


O-fosfoserin

fosfoproteins (phosvitin in eggs)

glycoproteins (κ-casein)

phospholipids (cereal germs)



Amino acid	Content in proteins (%) Beef muscle*	Beef collagen**	Wheat proteins***
Gly	5.0	31.10	2.8
Ala	4.0	11.0	2.0
Ser	5.4	3.8	4.0
Thr	5.3	2.0	2.3
Pro	6.0	11.8	11.5
Hypro	0.0	10.1	0.0
Val	5.8	2.1	2.6
Ileu	6.3	1.2	3.1
Leu	8.0	2.8	6.2
Phe	4.5	1.6	2.9
Tyr	3.1	0.3	1.1
Trp	1.2	0.0	1.0
Cys (+CySSCy)	1.1	0.0	2.3
Met	3.2	0.5	1.6
Asp(+ $AspNH_2$)	6.0	5.0	3.7
Glu(+$GluNH_2$)	15.4	7.6	34.6
Arg	7.2	4.9	2.9
His	1.9	0.6	2.0
Lys	7.6	2.6	1.9
Hylys	0.0	0.6	0.0

*actin, myosin **collagen ***glutenin, gliadin

The content of amino acids in cereals and pseudocereals (in g based on 16 g of nitrogen)

AA	wheat	rye	barley	oat	rice	corn	millet	buckwheat	amaranth
Ala	3.6	4.3	4.0	4.5	6.0	7.5	7.9	4.7	3.4
Arg	4.6	4.6	4.7	6.3	8.3	4.2	5.3	9.8	7.4
Asx	4.9	7.2	5.7	7.7	10.3	6.3	8.0	8.9	8.3
Cys	2.5	1.9	2.3	2.7	1.1	1.6	2.4	2.4	1.4
Glx	29.9	24.2	23.6	20.9	20.6	18.9	18.6	17.3	15.4
Gly	3.9	4.3	3.9	4.7	5.0	3.7	3.8	5.0	8.7
His	2.3	2.2	2.1	2.1	2.5	2.7	2.4	2.1	2.3
Ile	3.3	3.5	3.6	3.8	3.8	3.7	4.1	3.4	3.6
Leu	6.7	6.2	6.7	7.3	8.2	12.5	9.6	5.9	5.3
Lys	2.9	3.4	3.5	3.7	3.8	2.7	3.4	3.8	5.0
Met	1.5	1.5	1.7	1.7	2.3	1.9	2.5	1.5	1.8
Phe	4.5	4.4	5.1	5.0	5.2	4.9	4.8	3.8	3.6
Pro	9.9	9.4	10.9	5.2	4.7	8.9	6.1	4.3	3.6
Ser	4.6	4.3	4.0	4.7	5.4	5.0	4.9	5.0	7.1
Thr	2.9	3.3	3.3	3.3	3.9	3.6	3.9	3.6	3.5
Trp	0.9	1.9	0.9	1.1	0.8	0.7	2.0	1.4	1.5
Tyr	3.0	1.9	3.1	3.3	3.5	3.8	3.2	2.4	3.4
Val	4.4	4.8	5.0	5.1	5.5	4.8	5.5	6.7	4.3
Sum EAA [1)]	32.8	31.6	35.8	37.1	38.5	40.2	41.1	34.8	28.4
Sum AA [2)]	96.5	92.0	94.6	93.3	101.2	97.5	98.1	93.3	89.4
EAAI (%) [3)]	68	75	78	79	76	55	67	76	76
AAS (%) [4)]	44	46	54	57	57	41	53	51	54
Limiting AA	Lys	Trp Ile	Lys Leu	Ile Lys	Ile Lys	Lys	Lys	Lys, Ile	Lys, Ile

[1)] EAA = essential amino acids, [2)] AA = amino acids, [3)] EAAI = index of essential AA, [4)] AAS = score of AA

The content of amino acids in legumes, oil seeds and nuts (in g based on 16 g of nitrogen)

AA	Soy	Lens	Pea	Beans	Sunflower	Peanuts	Sesame	Walnut	Hazelnut
Ala	4.3	4.3	4.1	4.2	4.2	3.9	4.5	4.1	4.2
Arg	7.2	8.7	9.5	5.7	8.0	11.2	12.1	12.3	15.0
Asx	11.7	11.6	11.0	12.0	9.3	11.4	8.2	8.3	7.2
Cys	1.3	0.9	1.1	0.8	1.5	1.2	1.8	0.5	0.4
Glx	18.7	16.6	16.1	14.8	21.8	18.3	19.4	20.1	20.5
Gly	4.2	4.2	4.0	3.8	5.4	5.6	4.9	7.0	8.7
His	2.5	2.7	2.3	2.8	2.3	2.4	2.4	2.0	1.8
Ile	4.5	4.3	4.3	4.2	4.2	3.4	3.6	3.9	6.2
Leu	7.8	7.6	6.8	7.6	6.4	6.4	6.7	7.5	6.2
Lys	6.4	7.2	7.5	7.2	3.6	3.5	2.7	1.6	2.9
Met	1.3	0.8	0.9	1.1	1.9	1.2	2.8	1.3	0.8
Phe	4.9	5.2	4.6	5.2	4.4	5.0	4.4	4.1	3.6
Pro	5.5	4.3	3.9	3.6	4.5	4.4	3.7	4.7	5.6
Ser	5.1	5.3	4.3	5.6	4.3	4.8	4.7	6.1	9.6
Thr	3.9	4.0	4.1	4.0	3.7	2.6	3.6	2.7	2.7
Trp	1.3	1.5	1.4	1.4	1.4	1.0	1.0	1.0	1.1
Tyr	3.1	3.3	2.7	2.5	1.9	3.9	3.1	3.1	3.7
Val	4.8	5.0	4.7	4.6	5.2	4.2	4.6	4.4	6.4
Sum EAA [1)]	39.3	39.8	38.2	38.6	34.1	32.4	34.8	26.5	33.1
Sum AA [2)]	98.5	97.4	93.4	90.9	93.9	94.2	94.7	94.5	106.7
EAAI (%) [3)]	62	41	50	47	93	69	63	60	35
AAS (%) [4)]	47	31	37	34	56	43	43	24	22
Limiting AA	Met Val	Met Trp	Met Trp	Met Trp	Met Lys	Met Ile	Lys Ile	Met Lys	Met Lys

[1)] EAA = essential amino acids, [2)] AA = amino acids, [3)] EAAI = index of essential AA, [4)] AAS = score of AA

other amino acids (nonproteinogenic)

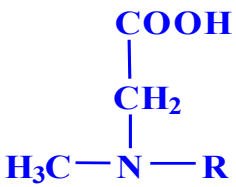
secondary metabolites

- products of various metabolic processes
- biosynthetic precursors of some nitrogenous compounds
- with specific functions (neural mediators and hormones)
- toxic compounds (plant protection from predators)
- storage and transport form of nitrogen

products of microorganisms

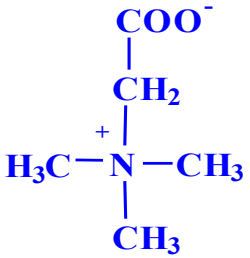
products of chemical transformation of proteins (isomerization, hydrolysis) or free amino acids (isomerization)

N-substituted α-amino acids



***N*-methylglycine (sarkosine, R = H)**

by degradation of creatine



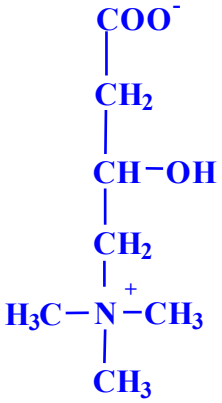
***N*,*N*-dimethylglycine**

part of pangamic acid

(vit B_{13}, yeast, cereals)

***N*,*N*,*N*-trimethylglycine (betaine)**

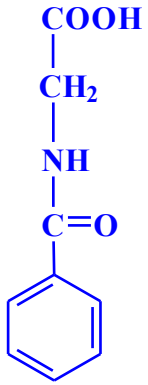
in sugar beet



L-carnitine (3-hydroxy-4-trimethylaminobutyrate, vitamin B_t)

foods of animal origin, food supplements

metabolismus lipidů

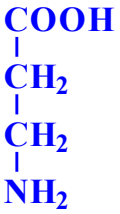


hippurová kyselina (*N*-benzoylglycin)

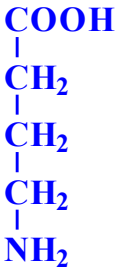
from Gly by detoxication of benzoic acid

(plants, milk)

β-aminoacids and γ-aminoacids



β-alanine (3-aminopropionic acid)
decarboxylation of Asp (by lyases)
part of pantothenic acid (vit. B_5)

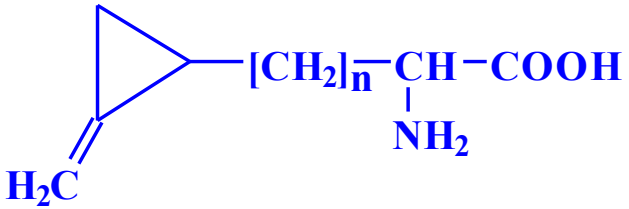


γ-aminobutyric (4-aminobutyric) acid (GABA)
decarboxylation of Glu
brain tissue, inhibitor of transmission of nerve impulses

alicyclic amino acids

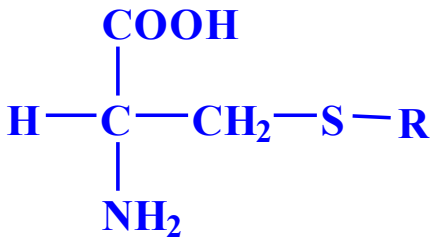
1-aminocyclopropan-1-carboxylic acid

fruits (apples, pears,…)
ethylene precursor (stimulates maturation)

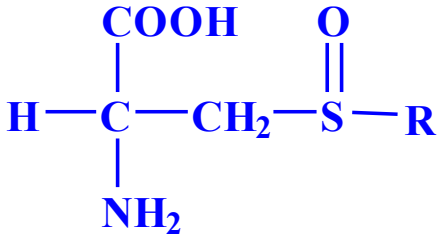


2-amino-3-(2-methylencyclopropyl)propionic acid (hypoglycine)
in unripe ackee fruit (Africa, Jamaica,…)
hypoglycaemic and other toxic effects

sulphurous amino acids



S-alk(en)yl L-cysteines



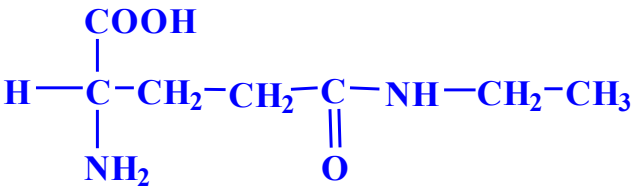
S-alk(en)yl-L-cysteine sulfoxides

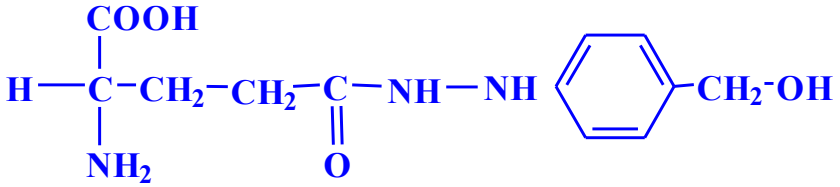
S-methylcysteine sulfoxide (methiin, R = CH_3)
cruciferous (cabbage), Lily (garlic, etc.), toxic for ruminants

S-allyl-cysteine sulfoxide (alliin, R = CH_2-CH=CH_2)
garlic aroma

S-(prop-1-en-1-yl)cysteine sulfoxide (isoalliin, R = CH=CH-CH_3)
onion

acidic amino acids





***N*-ethyl-L-glutamine (L-theanin, L-ethanin)**
tea leaves

agaritine (0.03 - 0.173% f.w.)

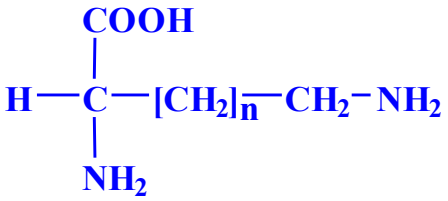
antiviral, hydrazine-derivative mycotoxin carcinogen that occurs in mushroom species of the genus Agaricus decompose readily upon cooking (up to 90% reduction)

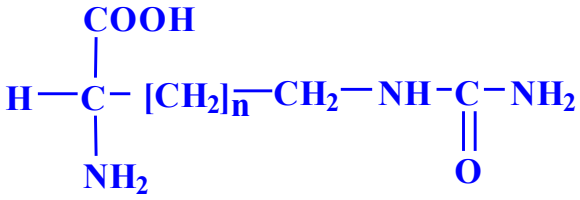
Agaricus bisporus

basic amino acids and related compounds

L-ornithine (L-2,5-diaminovaleric acid, n = 2)

arginine biosynthesis, ornithine (urea) cycle





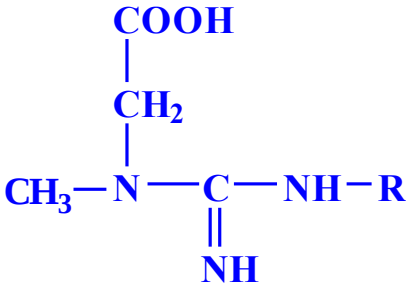
L-citrulline (n = 2, karbamoylderivát ornithinu)

intermediate of formation of urea, nitrogen reserve in plants, the transport form of nitrogen

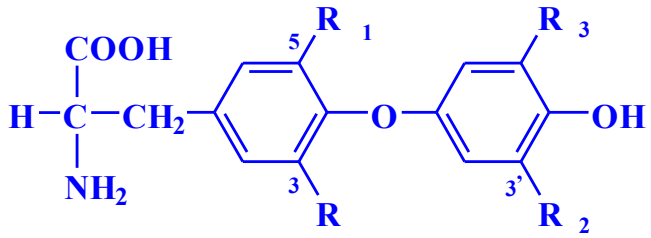
creatine-phosphate

muscle tissue (3-6 g/kg), an energy reserve for muscle activity and regeneration of ATP

creatine (R = H)



aromatic amino acids

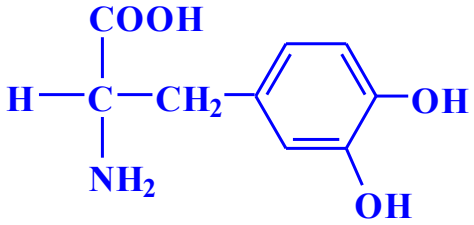


thyronine, R = R^1 = R^2 = R^3 = H

trijodthyronine, R = R^1 = R^2 = I, R^3 = H

tetrajodthyronine (thyroxine), R = R^1 = R^2 = R^3 = I

hormonal effects



L-3,4-dihydroxyphenylalanine (DOPA)

precursor of brown to black pigment melanin

enzymatic browning reaction

PHYSIOLOGY AND NUTRITION

varied diet ⇨ essential AA supplying is sufficient

possibility of enriching foods with essential (limiting) AA

- **Lys (low content in cereals and vegetable proteins in general)**
- **Met (lower content in meat and milk proteins)**
- **Thr (low content in wheat and rye proteins)**
- **Trp (lower content of milk caseins, proteins, corn and rice)**

human nutrition and livestock feed (performance)

0,05-0,2% as additives in feedingstuffs (mainly Lys, Met) – for farmed animals

PHYSICAL PROPERTIES

Acidobasic properties

in physiological values of pH

α-carboxylic groups, α-amino groups and α-imino groups dissociated

- **amfolytes (amphoteric electrolytes)**
- **form a so-called inner salt (dipolar, amphoteric ion, amfion, zwitterion)**

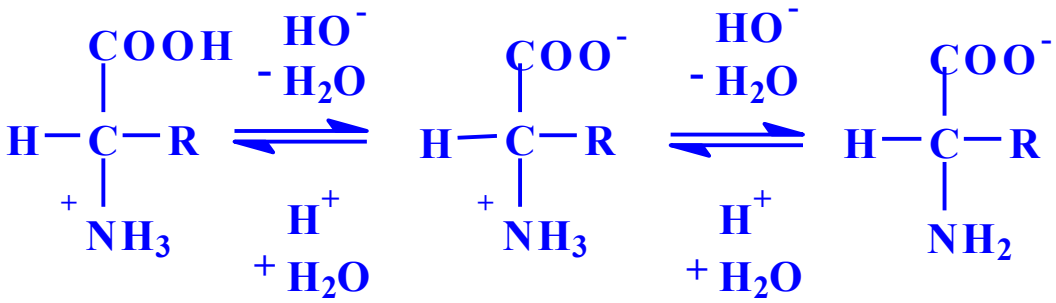
AA currently carries a positive and negative electrical charge

resulting electric charge of the molecule is zero

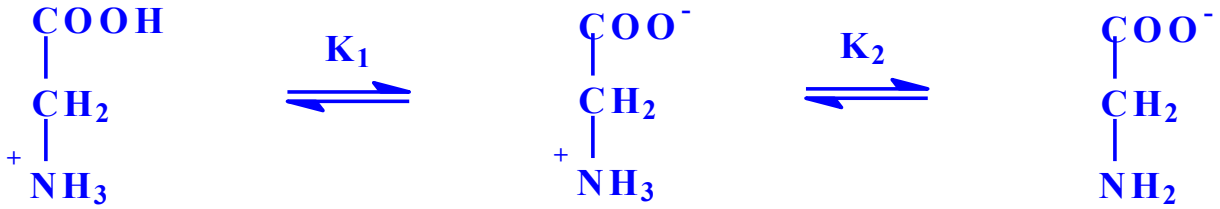
amfion - predominant form of almost all amino acids in the physiological environment of animal and plant tissues

depending on pH of medium - except amfions also cations (if acting as base) and anions (if acting as acid)

disociation of AA depending on the pH of the medium



disociation of glycine depending on the pH of the medium:



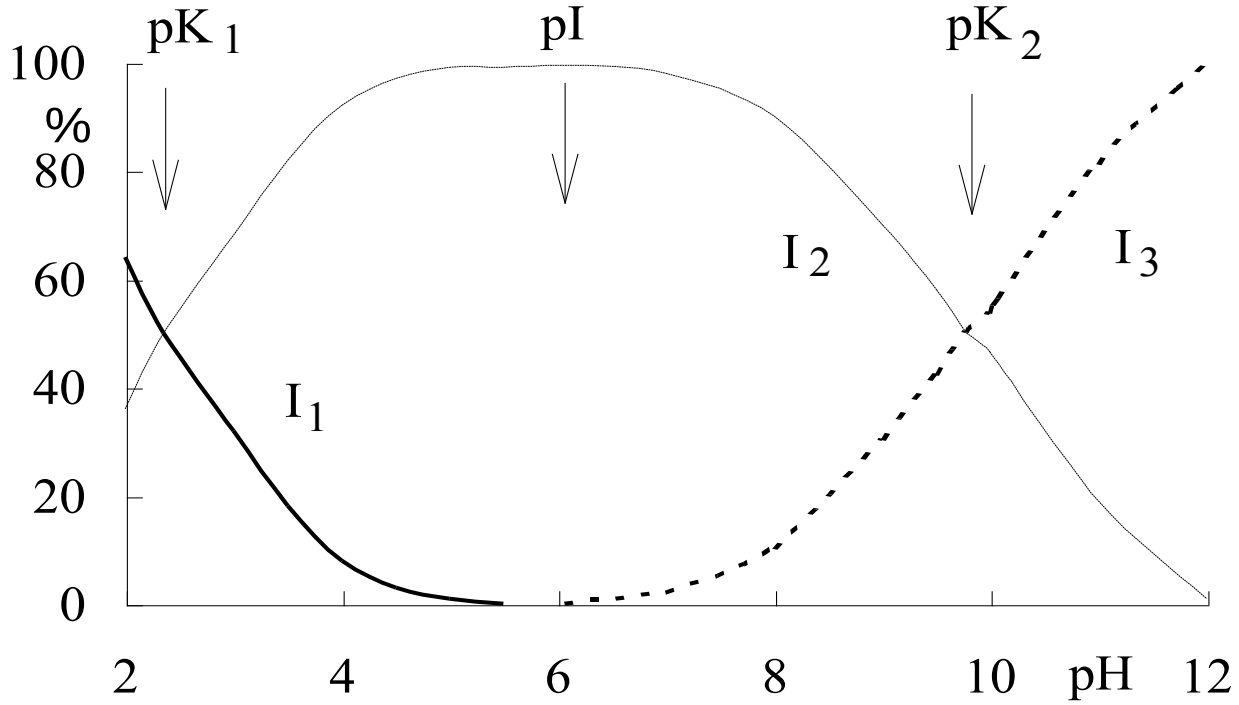
ion I_1 (cation)
free charge +1
pH < 2

ion I_2 (amfion)
free charge 0
pH ≈ 6

ion I_3 (anion)
free charge -1
pH > 10

- **maximum concentration of amfions in pH = pI (isoelectric point):**

$$pI = \frac{pK_1 + pK_2}{2} = 6{,}1$$

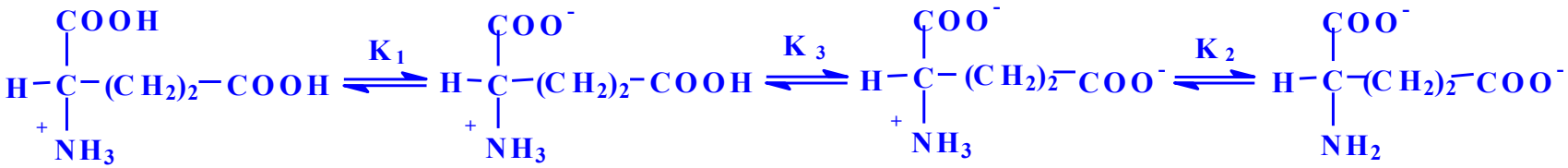


dependence of ionic forms of glycine at pH

——— = cation (I_1) — — — = amfion (I_2) ..... = anion (I_3)

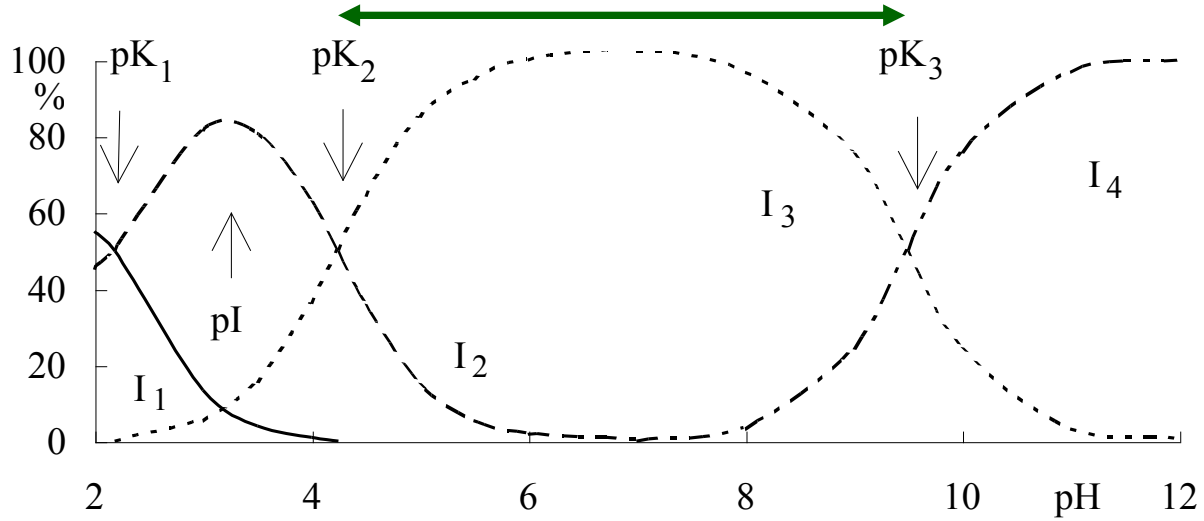
acidic amino acids

disociation of Glu depending on pH:



ion I_1 (cation)	ion I_2 (amfion)	ion I_3 (anion)	ion I_4 (anion)
free charge +1	free charge 0	free charge -1	free charge -2
pH < 2	pH ≈ 3	pH ≈ 7	pH > 10

desirable organoleptic properties



dependence of ionic forms of glutamic acid on pH

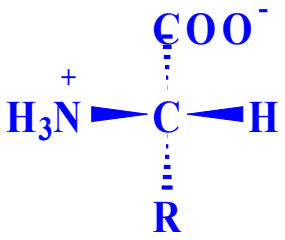
—— = cation (I_1) - - - - = amfion (I_2) ····· = anion (I_3) -·-·-·- = anion (I_4)

optical activity

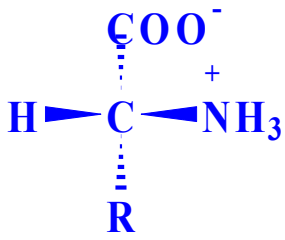
glycine = exception

other amino acids = chiral carbon atom C_α

2 optical isomers (enantiomers)



L-amino acid
(*S*)-amino acid



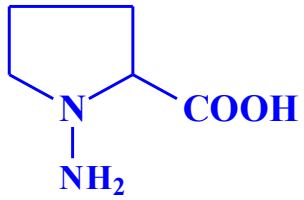
D-amino acid
(*R*)-amino acid

- **amino acids with L-configuration = (*S*)-stereoisomers**
  derived from L-glyceraldehyd
  exception: L-cysteine = (*R*)-stereoisomer
  (priority of R=CH_2SH is higher than –COOH)

- **amino acids with D-configuration = (*R*)-stereoisomers**
  derived from D-glyceraldehyd

amino acids with D-configuration

- sporadic in nature in biologically active peptides of plants and animals
- in peptidoglycans of cell walls of microorganisms
- free compounds (eg. linatin in flax seeds)

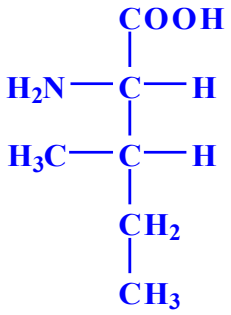


in fresh, unprocessed foods mostly of microbial origin

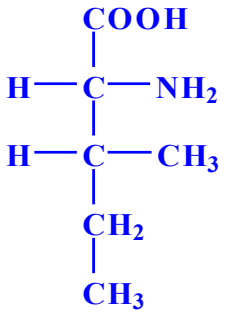
other origin

- non-enzymatic isomerization of L-amino acids
  in food processed at high temperatures
  in an alkaline pH (abiogenic D-amino acids)

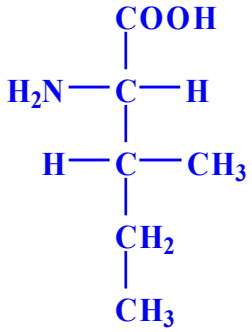
diastereoisomers



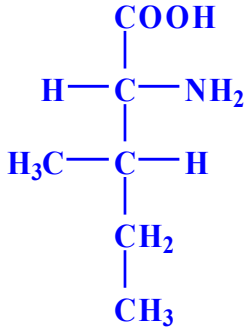
L-isoleucine
(2*S*, 3*S*)-isoleucine



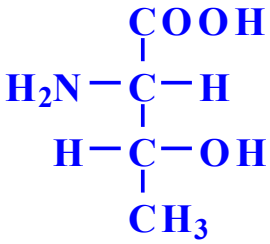
D-isoleucine
(2*R*, 3*R*)-isoleucine



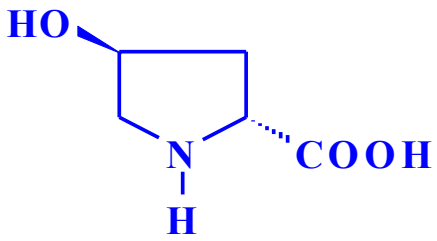
L-*allo*-isoleucine
(2*S*, 3*R*)-isoleucine



D-*allo*-isoleucine
(2*R*, 3*S*)-isoleucine



L-threonine
(2*S*, 3*R*)-threonine



L-4-hydroxyproline
(2*S*, 4*R*)-4- hydroxyproline

ORGANOLEPTIC PROPERTIES

sensory active substances, particularly taste

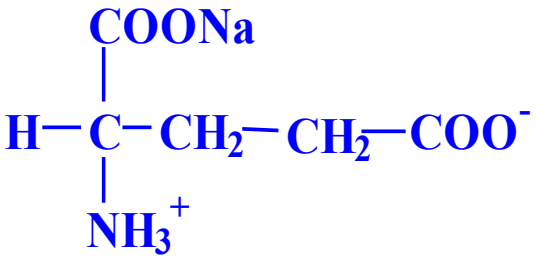
- **sweet (Gly, Ala, Thr, Pro)**
- **sour (Asp, Glu)**
- **bitter (with hydrophobic side chains: Leu, Ile, Phe, Tyr, Trp)**
- **indifferent (all others)**

umami (in Japanese = delicious) full, meaty, bringing a sense of satisfaction in the mouth

unique organoleptic properties = Glu,

resp. natrium-hydrogen glutamate

intensifier meaty taste (soups, sauces)



additive (E 621), in U.S.A. abbreviated as MSG (Mono Sodium Glutamate)

CHEMICAL PROPERTIES

reactions: **(isomerization)**

elimination

addition

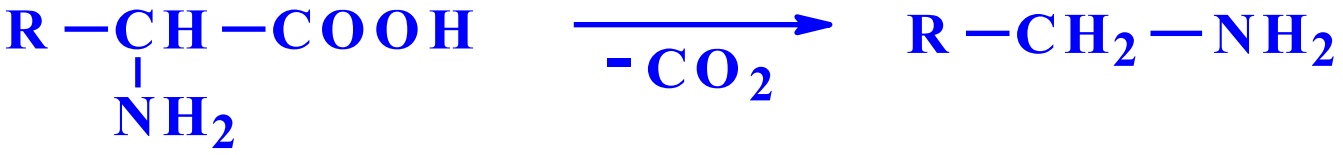
oxidation

formation of flavour compounds

(amines, aldehydes, alcohols, sulphurous compounds)

Elimination reactions

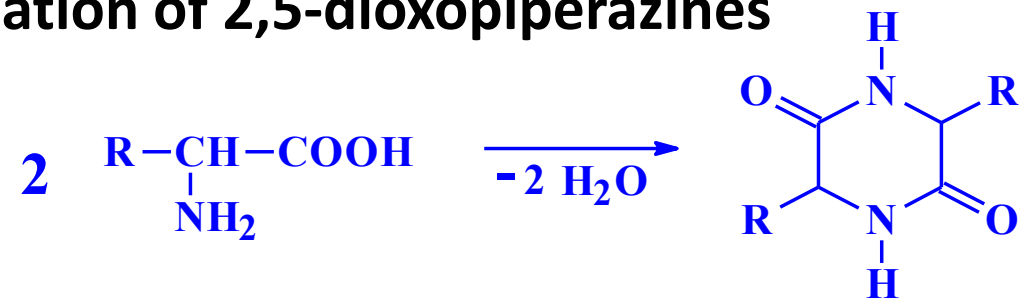
decarboxylation (elimination of CO_2)



amino acid **amine**

elimination of ammonia and water

formation of 2,5-dioxopiperazines



α-amino acid

2,5-dioxopiperazine

Gly etc.

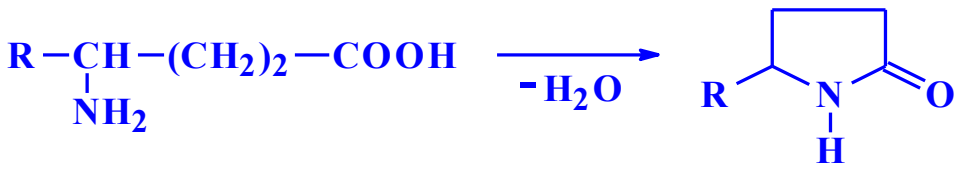
formation of alk-2-enic acids

β-amino acid

alk-2-enic acid

Asp

formation of γ-lactams



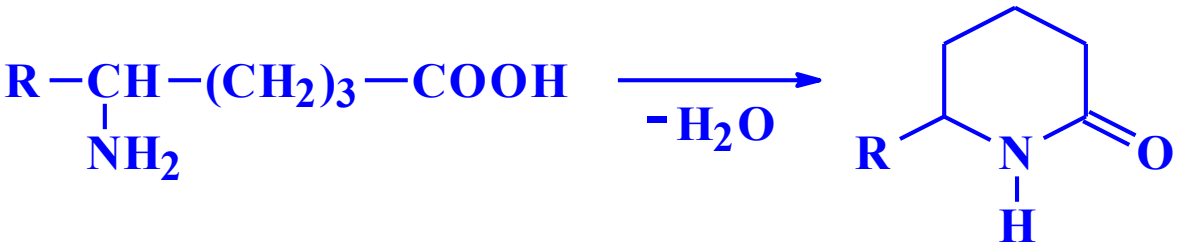
γ-amino acid

γ-lactam

Glu

A lactam (of the words lactone + amide) is a cyclic amide.

formation of δ-lactams

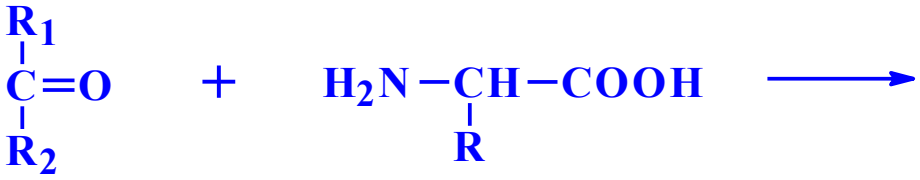


δ-amino acid

δ-lactam

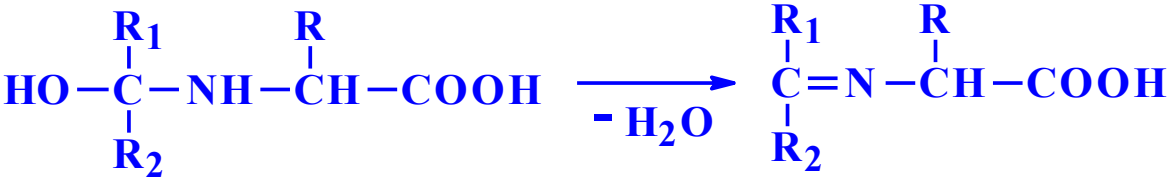
Addition reactions

reaction with aldehydes and ketones



carbonyl compound

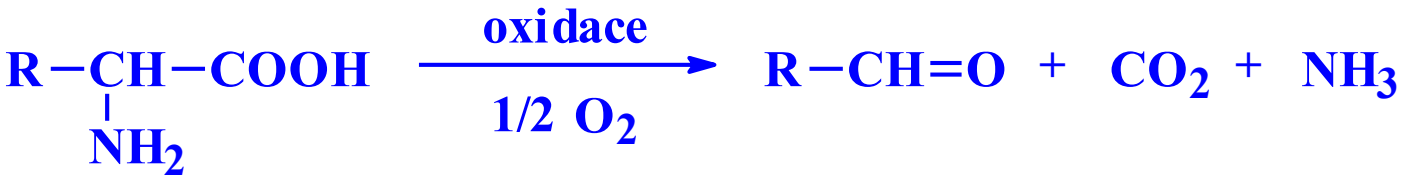
α-amino acid



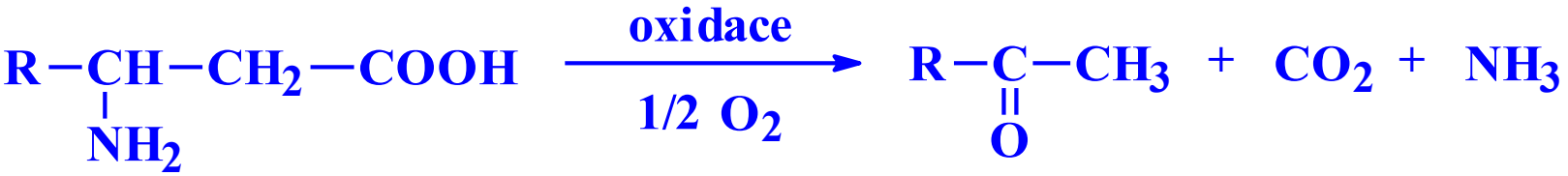
imin (Schiff´s base)

OXIDATION REACTIONS

Strecker´s degradation (oxidative decarboxylation)



α-amino acid aldehyde



β-amino acid methylketon

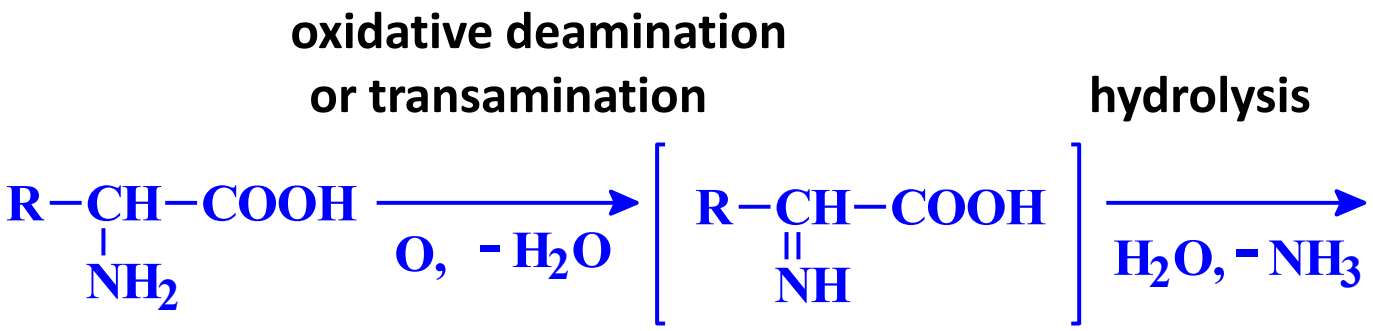
Strecker´s degradation aldehydes

Amino acid	Product of degradation
Gly	methanal (formaldehyd)
Ala	ethanal (acetaldehyd)
Thr	propanal
α- a γ-aminobutyric acid	propanal
Val	2-methylpropanal
Leu	3-methylbutanal
Ile	2-methylbutanal
Met	methional
Phe	2-phenylethanal (phenylacetaldehyd)
norvalin	Butanal
norleucin	Pentanal
Cys	2-merkaptoacetaldehyd
Orn	4-aminobutanal
Asp	oxalacetic acid (acetaldehyd)
Glu	2-oxoglutaric acid (propanal)

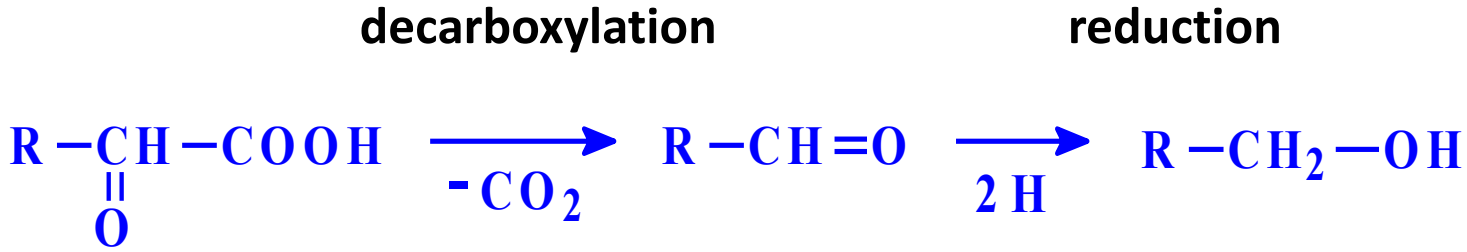
oxidative deamination and transamination

(enzymes, the mechanism like Strecker degradation)

2-ketoacids → aldehydes → alcohols



α-amino acid **α-imino acid**



2-oxo acid **aldehyde** **alcohol**

the word Fusel is German for "bad liquor”

- **aldehydes mainly in fruits and vegetables**
- **alcohols in alcoholic beverages(fusel alcohols)**

influence on flavour

alcohol	amino acid
propan-1-ol	Thr
butan-1-ol	Thr
2-methylbutan-1-ol (isobutanol)	Val
(*S*)-2-methylbutan-1-ol	Ile
3-methylbutan-1-ol	Leu
2-phenylethanol	Phe
tyrosol	Tyr
tryptofol	Trp

influence on flavour

Some beverages, such as rum, whisky (especially Bourbon) and traditional ales and ciders, are expected to have relatively high concentrations of non-hazardous alcohols as part of their flavor profile

However, in other beverages, such as vodka and lagers, the presence of other alcohols than ethanol is considered a fault.