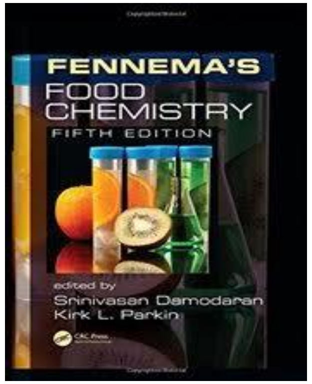
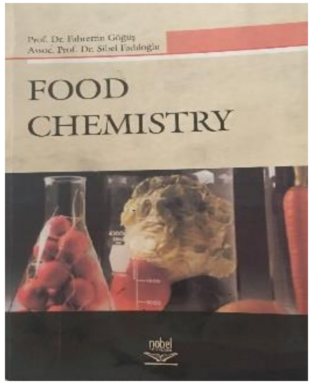
Food Chemistry I

These materials have been prepared by H. Elif Kormalı Ertürün for educational purposes only (as lecture notes) using the following resources. Responsibility for reproducing any part of these materials in any form or by any means or stored in a retrieval system for different purposes, rests with the third person performing the action.

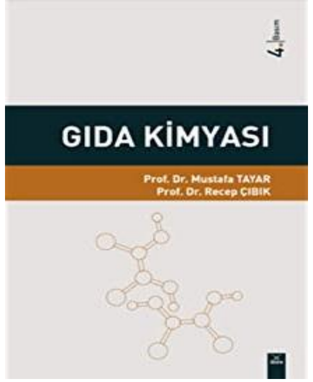
1.



2.



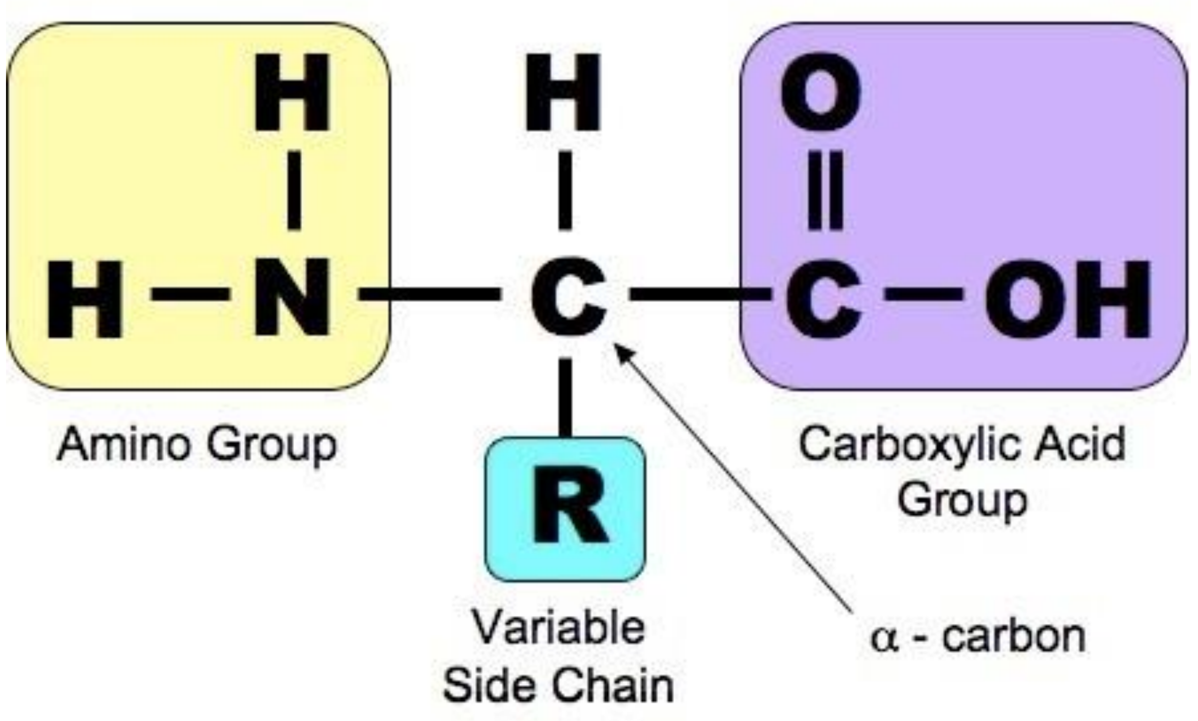
3.



1. Fennema O.R., Ed: Damodaran S. and Parkin K.L. 2017. *Fennema's Food Chemistry*, CRC Press Taylor & Francis Group Boca Raton, FL, USA.
2. Göğüş F. and Fadıloğlu S. 2006. *Food Chemistry*, Nobel Akademik Yayıncılık, Ankara.
3. Tayar M. ve Çıbık R. 2013. *Gıda Kimyası*, Dora Basın-Yayın Dağıtım Ltd. Şti., Bursa.

AMINO ACIDS

Structure and Classification:



Primary α-amino acids that occur in proteins.

PHYSICAL AND CHEMICAL PROPERTIES OF AMINO ACIDS

Acid-Base Properties

Amino acids are amphiphilic molecules that contain an acidic carboxyl group and one alkaline amine group.

Isoelectric Point

Chemical Reactions

Amino acids show the usual reactions of both carboxylic acids and amines and these reactions might occur during food processing.

(1) Acylation of amine group
(2) Alkylation of amine group
(3) Reaction with nitrous acid
(4) Reaction with ninhydrin
(5) Reactions of carboxylic groups
(6) Maillard Reaction

Acylation of amine group

Activated acid derivatives, such as acid halogenides and anhydrides, can react with the amine group of amino acids as acylating agents.

Alkylation of amine group

Amino acids can react with 1-fluoro-2, 4-dinitrobenzene (FDNB) to yield N-2,4- dinitrophenyl amino acids (DNP-amino acids), which are yellow compounds and crystallize readily. This reaction is very important in N-terminal acid labeling for protein sequencing in Sanger's method.

Reaction with nitrous acid

All α-amino acids, except proline, can react with nitrous acid to yield nitrogen and hydroxyl acid. The liberated nitrogen gas is contributed by equal molar amine group and nitrous group.

Reaction with ninhydrin

All α-amino acids, except proline, can react with ninhydrin in alkaline solutions to produce purple products. This reaction has been widely used in the identification and colorimetric quantification of amino acids.

Reactions of carboxylic groups

The carboxylic groups of amino acids can undergo various chemical reactions. Azide reaction is a typical reaction on the carboxylic group. Amino acid ester reacts with hydrazine to yield hydrazide and the product then reacts with nitrous acid to produce azide.The azide compound can react with another amino acid ester by condensation to produce a dipeptide

Maillard Reaction

Foods containing proteins and reducing carbohydrates or carbonyl compounds (such as aldehydes and ketones produced by lipid oxidation) are subject to Maillard reactions during processing and storage.

Sensory Properties

Bitterness

Amino acids contain multiple functional groups and can act with various taste receptors to exhibit different tastes.

The sensory properties of oligopeptides, especially dipeptides, are decided by the original tastes of the amino acid components. The rules are as follows:

(1) Neutral peptides consisting of type I and V amino acids and those containing only type II amino acids exhibit light tastes.

(2) The sodium salts of oligopeptides consisting of only type I amino acids or type I and type II amino acids taste fresh, such as Glu-Glu, Glu-Asp, Glu-Ser, and Glu-Thr.

(3) The combination of type III amino acids with type I amino acids remove the bitter taste, but remain the sour taste.

(4) Peptides composed of type III, IV, or V amino acids only or their combinations are bitter.

(5) Peptide formation, carboxyl group esterification, or diketopiperazine formation by coupling of type IV and V amino acids enhances the bitter taste.

(6) Peptides with type IV and V amino acids locating at the C terminal are 3~5 times bitterer than those with the amino acids locating at the N terminal or the middle of the peptides.

(7) Type II amino acids (especially Gly) locating at either terminals or cyclized increase the bitterness.

All peptides contain AH polar groups. However, because peptides differ markedly in molecular weight and nature of hydrophobic groups, they have different bitterness receptor binding capabilities.

The average hydrophobicity of a peptide can be calculated by using the following formula:

$$Q = \frac{\Delta G}{n} = \frac{\Sigma \Delta G}{n}$$

⊿G: is the free energy change of the side chains of amino acids
n: is the number of resides in the peptide

Peptides with Q greater than 6.85kJ/mol are bitter

Q less than 5.43kJ/mol are not bitter.

The bitterness intensity of peptides is also affected by their molecular weights and higher structures in addition to Q values.