



DAYANANDA SAGAR COLLEGE OF ENGINEERING
DEPARTMENT OF BIOTECHNOLOGY
BENGALURU -560 078

FOOD BIOTECHNOLOGY

(Subject Code: 10BT74)

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COs and POs/PSOs for the Topic

CO: CO1- Analyze nutritional aspects of carbohydrates, proteins & lipids.

CO-PO and CO-PSO

PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO	3	3	3	-	-	-	-	-	-	-	-	-	1	-	-



UNIT 1

FOOD SCIENCE

Aroma compounds

- **Interaction of taste, odor and textural feeling provides an overall sensation- Flavor**

Flavor compounds

1. **Compounds responsible for taste**
 2. **Compounds responsible for odor**
- **Compounds responsible for the odor: Aroma substances**



Aroma substances contd..

- **Aroma compounds –Flavorants**
- **Volatile compounds**
- **Ortho nasal detection**
- **Retro nasal detection**

Major Types of Aroma Compounds

Alcohols

- Benzyl alcohol (Almond)
- Ethyl maltol (Cooked fruit)
- Furaneol (Strawberry)
- Menthol (Peppermint)



Aroma Compounds contd..

Aldehydes

- Acetaldehyde (Pungent)
- Benzaldehyde (Marzipan, almond)
- Hexanal (Green, grassy)
- Cinnamaldehyde (Cinnamon)
- Citral (Lemongrass, lemon oil)
- Hexenal (Green tomatoes)
- Neral (Citrus, lemongrass)
- Vanillin (Vanilla)



Aroma Compounds contd..

Amines

- Cadaverine (Rotting flesh)
- Indole (Jasmine flowery)
- Putrescine (Rotting flesh)
- Pyridine (Very unpleasant)
- Trimethylamine (Fish)



Aroma Compounds contd..

Esters

- Ethyl acetate (Fruity)
- Ethyl butanoate (Fruity)
- Fructose (Fruity, apple-like)
- Octyl acetate (Orange)
- Isoamyl acetate (Banana)
- Pentyl pentanoate (Apple, pineapple)



Aroma Compounds contd..

Ketones

- Octenone (blood, metallic, mushroom-like)
- Acetyl pyrroline (fresh bread, jasmine rice)
- Acetyl tetrahydropyridine (fresh bread, pop corn)



Aroma Compounds contd..

Lactones

- Sweet coconut odor

Terpenes

- Limonene (Orange)
- Nerol (Sweet rose)





Aroma Compounds contd..

Threshold value of aroma foods

1. Isolation of the volatile compounds
2. Differentiation of the aroma substances from the remaining components of volatile fraction by dilution analysis
3. Concentration and identification
4. Quantification and calculation of aroma values (threshold values)
5. Simulation of the aroma on the basis of the analytical results.



FOOD FLAVORS

- **Flavor**: Chemical senses of taste and smell
- **Flavorant** : Substance gives flavor

Flavoring substances

1. Natural flavoring substances
2. Nature-identical flavoring substances
3. Artificial flavoring substances



Food flavors

Chemical	Odor
Diacetyl	Buttery
Isoamyl acetate	Banana
Benzaldehyde	Bitter almond
Cinnamic aldehyde	Cinnamon
Ethyl propionate	Fruity
Methyl anthranilate	Grape
Limonene	Orange
Allyl hexonate	Pineapple
Ethyl maltol	sugar
Ethyl vanillin	vanilla
Methyl salicylate	Wintergreen



Favour Enhancers

Savory flavorants (Umami)

- 1. Glutamic acid salts: MSG**
- 2. Glycine salts**
- 3. Guanylic acid salts**
- 4. Inosinic acid salts**
- 5. 5'-ribonucleotides salts**
- 6. Organic acids: Citric, Lactic, Malic, Tartaric acids**

BROWNING REACTIONS

- **Maillard browning**

reducing sugar + amine \longrightarrow brown pigments
+ flavors

- **Caramelization**

sugar

high temps
 \longrightarrow brown pigments
+ flavors

Non-
enzymatic
Involve
sugars

- **Enzymatic browning**

phenolics $\xrightarrow{\text{polyphenoloxidase}}$ brown pigments
+ flavors

Does **not**
involve
sugars

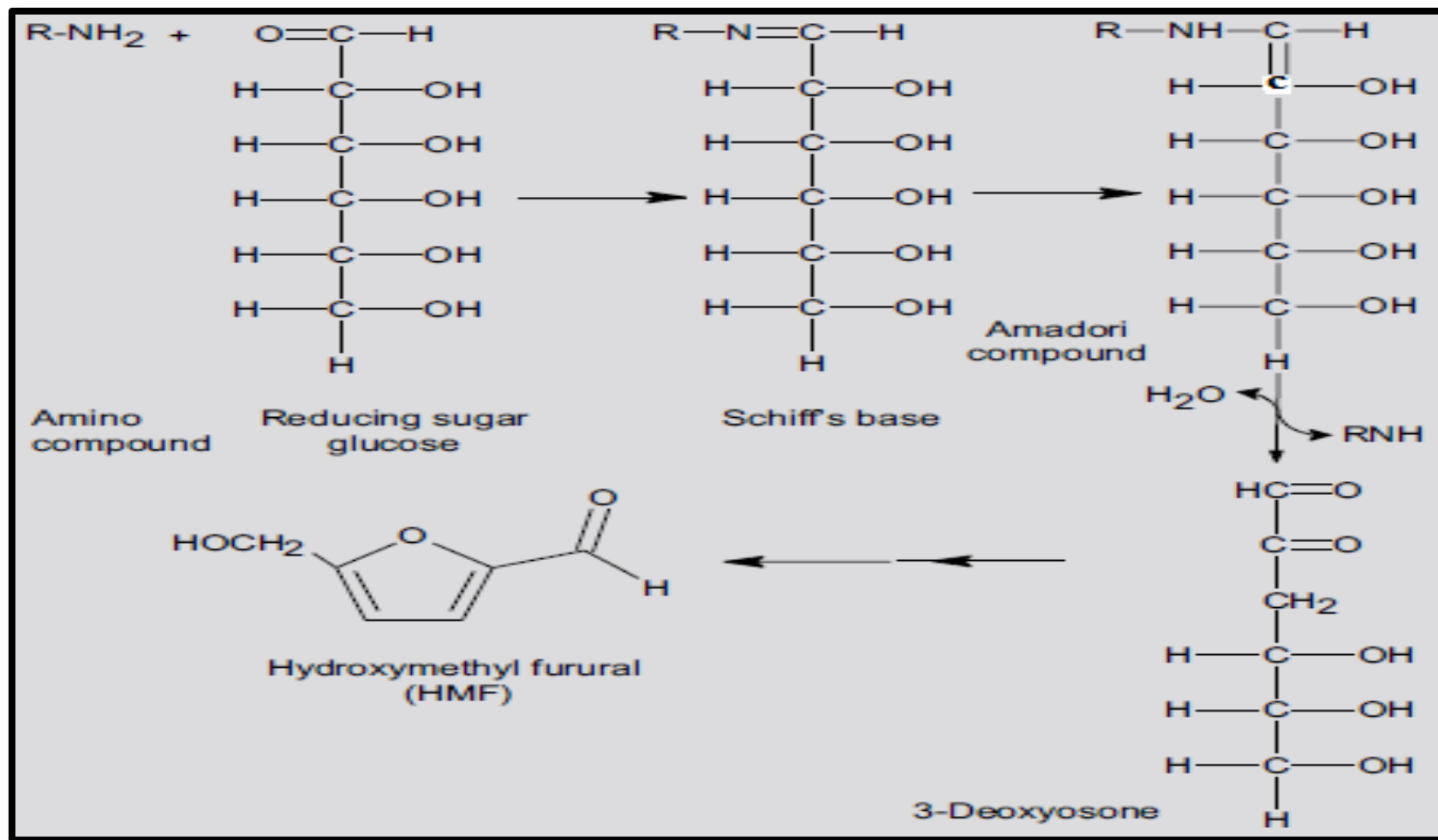
Non-enzymatic Browning

Maillard Browning Reaction

- **Louis-Camille Maillard**
- **Brown color of baked products**
- **Responsible for the flavour of bread, cookies, cakes, meat, beer, chocolate, popcorn, cooked rice**



Mechanism of Millard Reaction





Factors influencing Maillard reaction

1. Types of amino acid / sugar
2. Concentration of protein and sugar content in food
3. High temperature
4. High pH
5. Time interval
6. Water activity (a_w) - low water content
7. Presence of Oxygen



Detrimental effect of Maillard reaction

- **Discoloration of food products**
- **Loss of essential amino acids such as Lysine, tryptophan, histidine**
- **Impact on nutritional quality**



Control of Maillard reaction

- **Reduce the initial concentration of sugar and protein content in food**
- **Control of pH – maintain lower pH**
- **Addition of food additives such as SO₂ and sodium metabisulphate- these can inhibit Maillard reaction**



Caramelization

- Oxidation of sugar

Initial caramelization temperatures

Sugar	Temperature
Fructose	110° C
Galactose	160° C
Glucose	160° C
Maltose	180° C
Sucrose	160° C

End Products

- **Caramelans ($C_{24}H_{36}O_{18}$)**
- **Caramelens ($C_{36}H_{50}O_{25}$)**
- **Caramelins ($C_{125}H_{188}O_{80}$)**
- **Desirable colour and flavour in bakery's goods, coffee, beverages, beer and peanuts**



Mechanism of Caramelization

- 1. Equilibration of anomeric and ring forms**
- 2. Sucrose inversion to fructose and glucose**
- 3. Condensation reactions: lose of water**
- 4. Intramolecular bonding: Formation of di-fructose anhydride.**
- 5. Isomerization of aldoses to ketoses**
- 6. Dehydration reactions**
- 7. Fragmentation reactions (Flavor production)**
- 8. Unsaturated polymer formation (Colour formation)**



Enzymatic Browning

- **Polyphenoloxidase (PPO, Phenolase)**
- **Polyphenols**
 - ❑ **Anthocyanins (colours in fruits)**
 - ❑ **Flavonoids (catechins, tannins in tea and wine)**
 - ❑ **Non-flavonoids components (gallic acid in tea leaves)**



Enzymatic Browning contd..

PPO

- **Presence: plastids and chloroplasts of plants**
- **Role in the resistance of plants to microbial and viral infections**
- **Hydroxylation and oxidation**
- **Biochemical conversion of phenolics to produce quinones – Melanins**



SUMMARY AND CONCLUSION

- **Aroma Compounds are essential to the food as they provide characteristics flavors, odor and texture.**
- **Alcohols, Aldehydes, Amines, Esters, Ketones, Lactones, Terpenes are the main group of aroma compounds which provide various types of flavors to food.**



Summary and conclusion contd.

- **Threshold value studies and their detection are essential approaches for the study of aroma compounds in food**
- **Flavors are one of the important type sof aroma compounds which are mainly in the form of Natural compounds, nature identical compounds, Artificial compounds.**
- **Various types of flavor enhancers such as amino acids, organic acids and nucleotides have significant role in food science**



REFERENCES

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- 2. Essentials of Food Sciences Vickie A. Vaclavik, Elizabeth W. Christian, Springer.**
- 3. Food Science by N. Potter & Hotchkiss, ASPEN Publication.**
- 4. An introduction to Food Science by Rick Parker and Delmar, Thomson Learning.**

More..

Introduction to Food Biotechnology

Is a comprehensive book the contents of which have been designed keeping in mind the courses in food biotechnology for the students pursuing undergraduate and postgraduate courses in life sciences and chemical engineering. It can be used as a self-study book for chemical engineers and biological scientists who have limited background in food processing and technology. The book focuses on application of concepts in chemical engineering and biological sciences in the field of food science and technology. Initial chapters emphasize more on the concepts and applications of biological sciences in food industry and the latter section concentrates on the utility of chemical engineering in food technology. It will be a useful guide for biologists, and a quick reference for engineers on the latest topics in food science and technology, including food biochemistry, food microbiology, food processing, production and preservation technologies, food quality assurance and standards and role of biotechnology in food industry.

It will also serve as a useful reference for the professionals in food and related industries as well as the teachers handling food processing and technology related courses at the BE/BTech or MSc/M Tech levels.

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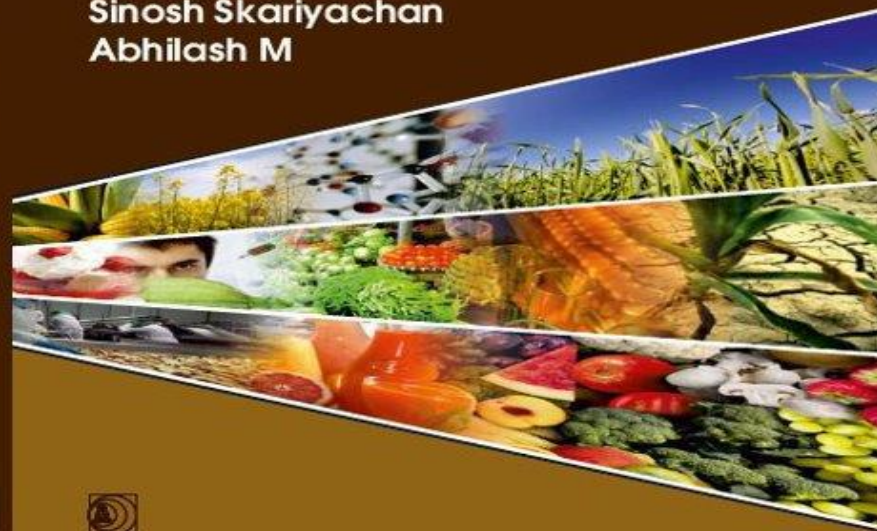


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Thank You..

For Further Clarification

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