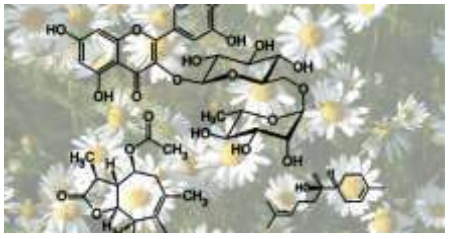
1

What is Pharmacognosy?

- Pharmacognosy is the oldest of all pharmacy sciences.
- Pharmacognosy is derived from two Greek words,
  - Pharmakon: mean “drug” &
  - Gnosis: means “knowledge”, thus, pharmacognosy is the knowledge of the drug.
- Sydler introduced the name in 1615, he wrote a small book entitled “*ANALECTA PHARMACOGNSTICA* “.
- Mrtius in 1825 defined Pharmacognosy as the study of drugs, either mineral, vegetable or animal.

2



- Pharmacognosy is a branch of **pharmacology**, study the **crude drugs** of **natural sources**, based on the *history*, *distribution*, *cultivation*, *collection*, *processing*, **study of physical, chemical, and structural characters**, which **contains one or more** chemical substance, existent under the **extract form**, which having **physiological** and **pharmacological** action for **amelioration** or **cure** a disease.

3

Crude Drug

- Is a natural drug of plant, animal, mineral or marine origin which has **suffered no possessing other than collection and drying**, that is, the quality or appearance of the drug has not been advanced in value or improved in condition by any physical or chemical treatment elsewhere, that which is essential for its proper **packing** and prevention from **deterioration**.

4

- **Extractive:**
  - The crude mixtures of chemical constituents that are "**extracted**" from plants or animals by various extraction processes are called extractives.
- **Metabolites:**
  - These are substances **synthesized or produced** as by-products by plants **during** their **metabolic activities**, classified in primary & secondary metabolites.
- **Monograph:**
  - The **descriptive material** pertaining to any drug, therapeutic agent included in the pharmacopoeia is known as the monograph.

5

Indigenous vs Naturalized

Indigenous

Plants growing in their **native countries** are said to be indigenous to those regions.

For example: *Silybum marianum* (Milk Thistle).

Naturalized

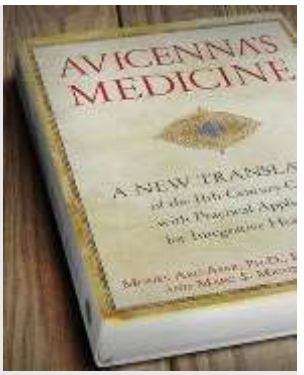
- Plants are said to be naturalized when they grow in a **foreign land** or in a locality other than their native homes.
- For example: **Carica papaya**

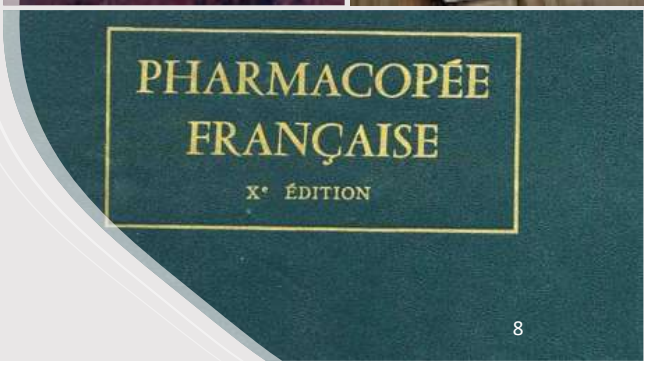
6

7

Official vs Unofficial vs Non-official drug

- **Official drug:** Any drug (crude or prepared) which is included in **pharmacopoeia** or in **national formulary** or in recognized books is called an 'official drug'.
- **Unofficial drug:** A drug which has been recognized earlier in the pharmacopoeia or in national formulary or in **recognized books** but not found in the current issue is designated as an 'unofficial drug'. Those substances were excluded from the recognized books due to their severe toxic effects on humans.
- **Non-official drug** Substance that has never been appeared in either of the official books may be called non-official (**Recipes**).





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Scope of Pharmacognosy

- Pharmacognosy deals primarily with information on the **sources** and **constituents** of natural drugs.
- Pharmacognosy is one of the five major divisions of the pharmaceutical curriculum which represents the **oldest** branch of the profession of pharmacy.
- The **ancients** gathered herbs, animals, plants, and minerals and **concocted them** into ill-flavored pungent mixtures.

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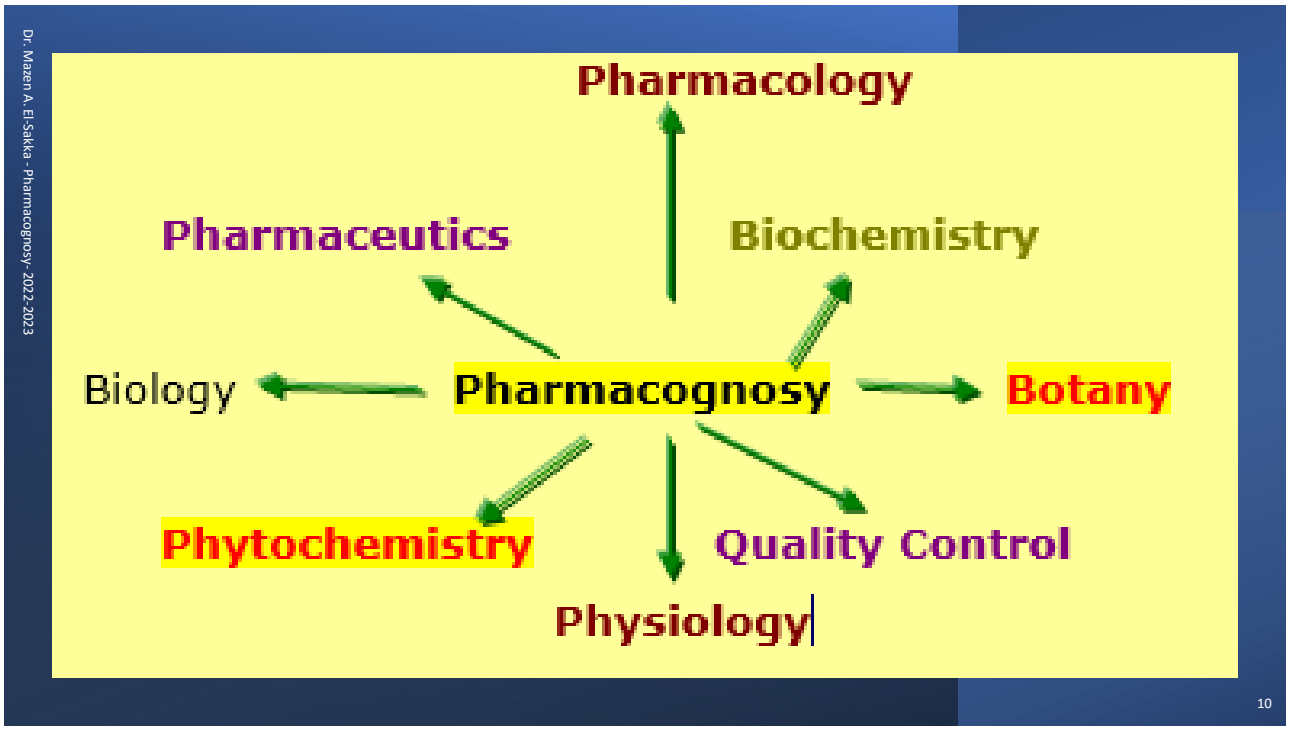

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Limitation of Pharmacognosy

- Drugs obtained from natural sources have a variety of limitations. The majors are:
  - **Toxicity**! (Aconite)
  - **Potency**! (Catharanthus), also, yield of active natural products may be very low and thus the production cost of those drugs will be very high; (Salix alba)
  - The source of a natural drug may be very limited with respect to **geography**, **season** and **climate** (Salvia officinalis)

11

12

Definition

- Traditional medicine refers to **health practices, approaches**, **knowledge** and **beliefs** incorporating plant, animal and mineral, spiritual therapies, manual techniques and exercises, applied singularly or in combination to treat, diagnose and prevent illnesses or maintain well-being.
- Traditional Medicine is the **systems of medicine** based on **cultural beliefs** and **practices** handed down from **generation to generation.**

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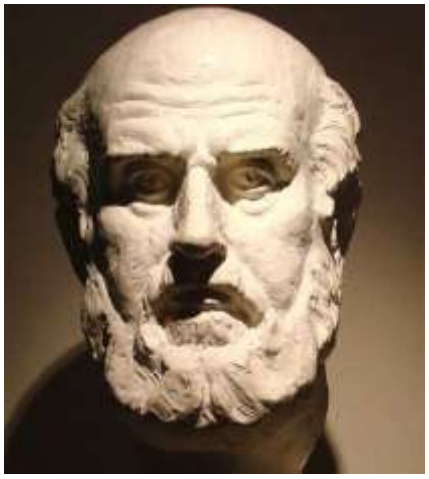

History

Hippocrates (Father of Medicine, 460

- He was the **first natural doctor** who utilized simple remedies such as vinegar, honey, herbs etc. in healing. He is also known to have collected and identified a number of medicinal plants.

Theophrastus (371

- **Gave scientific basis of use of plants as medicine.**

322 BC

200 AD

370 BC

287 BC

Aristotle (384

- He gave the **philosophy of medicine.** He listed more than 500 plants of medicinal importance.

Galen (131

- A Greek pharmacist-physician. He developed the **methods of preparing and compounding medicines** by mechanical means. He was the originator of the formulae for a cold cream.

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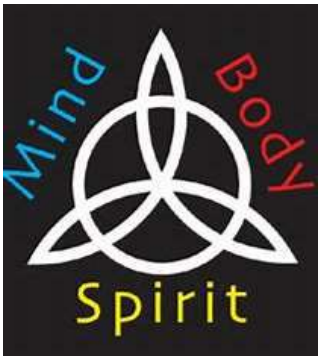

Ayurvedic Medicine- (Indian, 2500-600 BC)

- Ayurveda is the term for traditional medicine of ancient India.
- The word "Ayur" means 'Life' and "veda" means 'The study of'; that is "**Study of Life**".
- Ayurvedic medicine based on the **balance** between **mind-body-Spirit (behavior** and **environment)**.
- It focuses on unbalances in **"life energies"** as **etiologic** for disease states.

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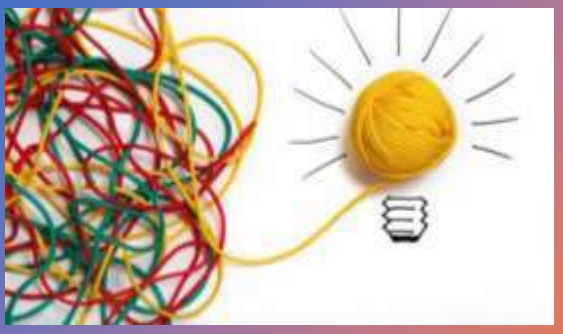


Ayurvedic Medicine- Functions/Precautions

- **Functions**:
  - Manages the sense, **creative thinking**, reasoning, quality of voice, memory, movement of food, elimination of waste, sexual functions, menstrual cycle, blood flow, heart rhythm, perspiration, sense of touch.
- **Precautions**:
  - **Reduce heavy/much**, cold, oily, sweet, sour, pungent, and salty food;
  - **Avoid** heavy meals;
  - **Avoid** mustard oil;
  - **Avoid** buttermilk;
  - **Avoid** over work;
  - **Avoid** smoking and alcohol;
  - **Avoid** excessive sleep
  - **Avoid** frozen &
  - **Avoid** desserts.

16

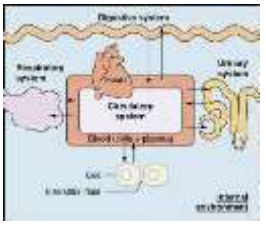

The 6 Tastes
Sweet
• Cold, Wet & Heavy
• P/V decreased
• K increased
Astringent
• Cold, Dry & Heavy
• P/K decreased
• V increased
Sour
• Hot, Wet & Light
• V decreased
• P/K increased
Bitter
• Cold, Dry & Light
• P/K decreased
• V increased
Salty
• Hot, Wet & Heavy
• V decreased
• P/K increased
Pungent
• Hot, Dry & Light
• K decreased
• V/P increased
K = Kapha
P = Pitta
V = Vata

17


Fire
Wood
Earth
YANG
YIN
Water
Metal

18

- This is originated from **Chinese, Japanese and Tibetians** etc.
- The orient herbalism was very old (142 – 220 BC) and called "**Kampo**".
- **Yin and Yang:**
  - anything moving, **hot**, bright and hyperactive is **yang**, and
  - anything quiescent, **cold**, dim and hypoactive is **yin**.
  - **Disease is an imbalance between Yin & Yang**
- **A pill for every ill**: The philosophical approach behind this idea is that an external force, or chemical, can cure disease.
- Normally the human body is able to **resist pathogens** and maintain a **healthy balance** between the **body** and the **environment (Normal Qi)**



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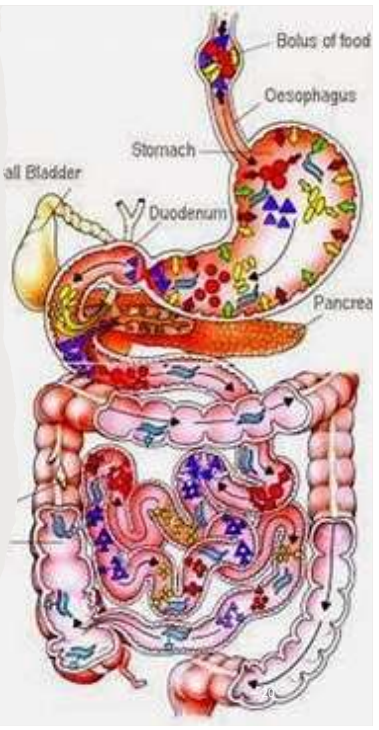
Qi Concept

- Qi is a complex concept; it relates to both substance and function. Clean qi (oxygen), waste qi (carbon dioxide) and qi (nutrients) .
- Generally known as the functional activity of various organs.
- **The function of an organ depends on the functional qi of that organ;**
  - for example, qi of xin-heart or qi of pi-spleen is the vital energy and functional activity of the xin-heart or pi-spleen.



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Chinese Medicine-The orient (2700 BC):

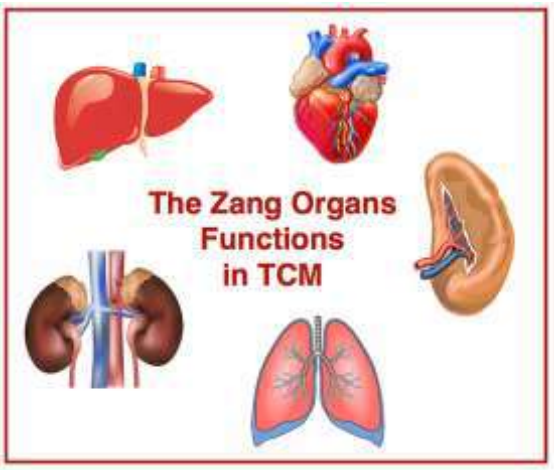
Zang organs

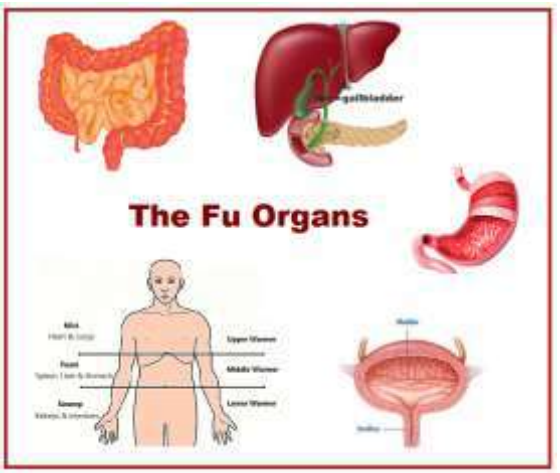
- xin-heart,
- gan-liver,
- pi-spleen,
- fei-lung,
- shen-kidney and
- Pericardium

Fu organs

- small intestine,
- large intestine,
- stomach,
- gall-bladder,
- urinary bladder and
- San-jiao ***(triple burner, by blockage of the flow of fluids leading to an accumulation of Heat and Dampness).***

21





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Islamic Medicine

- **Based on:**
  - Holly Quran (Body-Mind-Spirit)
  - Sunna Prophet Mohammad (Wet and dry), (Pill for every ill) & (Cupping)
  - Complement of other civilizations (Ayurvedic & Chinese)
- **Refer to** balance between **curative and palliative** (Healing & Calming) **(Prevention is better than Cure)**
- Islamic Medicine **added** the basic of preventive medicine (Prevention is better than cure).
- **Prevention Medicine based on:**
  - **Expectancy**
  - **Mortality & Morbidity**
  - **Diet**
  - **Sanitation**
- Islamic medicine consider prevention is a main step of healing process.
- Islamic medicine is characterized by:
  - A way of life to live
  - **A code of ethics**
  - A construction of lifestyle of every person (**individualization concept)**

24

24

- وإذا مرضت فهو يشفين (الشعراء 80)
- أَلَمْ نَجْعَل لَّهُ عَيْنَيْنِ *وَلِسَاناً وَشَفَتَيْنِ *وَهَدَيْنَاهُ النَّجْدَيْنِ (سورة البلد 8-10)
- كُلُوا مِنْ طَيِّبَاتِ مَا رَزَقْنَاكُمْ وَلَا تَطْغَوْا فِيهِ فَيَحِلَّ عَلَيْكُمْ غَضَبِي ۖ وَمَنْ يَحْلِلْ عَلَيْهِ غَضَبِي فَقَدْ هَوَىٰ (طه81)
- وَأَنْزَلْنَا الْحَدِيدَ فِيهِ بَأْسٌ شَدِيدٌ وَمَنَافِعُ لِلنَّاسِ (الحديد 25)
- وَاقْصِدْ فِي مَشْيِكَ وَاغْضُضْ مِنْ صَوْتِكَ ۚ(لقمان 19)
- وَمِنْ ثَمَرَاتِ النَّخِيلِ وَالْأَعْنَابِ تَتَّخِذُونَ مِنْهُ سَكَرًا وَرِزْقًا حَسَنًا إِنَّ فِي ذَٰلِكَ لَآيَةً لِقَوْمٍ يَعْقِلُونَ (النحل 67)
- وجعلنا من الماء كل شيئ حي (الأنبياء 30)
- وَيُسْقَوْنَ فِيهَا كَأْسًا كَانَ مِزَاجُهَا زَنْجَبِيلًا (الانسان، 17)
- يُوقَدُ مِنْ شَجَرَةٍ مُبَارَكَةٍ زَيْتُونَةٍ لَا شَرْقِيَّةٍ وَلَا غَرْبِيَّةٍ يَكَادُ زَيْتُهَا يُضِيءُ وَلَوْ لَمْ تَمْسَسْهُ نَارٌ نُورٌ عَلَىٰ نُورٍ يَهْدِي اللَّهُ لِنُورِهِ مَنْ يَشَاءُ (النور 35)
- وَعَلَى ٱلَّذِينَ هَادُواْ حَرَّمْنَا كُلَّ ذِي ظُفُرٍ ۖ وَمِنَ ٱلْبَقَرِ وَٱلْغَنَمِ حَرَّمْنَا عَلَيْهِمْ شُحُومَهُمَآ إِلَّا مَا حَمَلَتْ ظُهُورُهُمَآ أَوِ ٱلْحَوَايَآ أَوْ مَا ٱخْتَلَطَ بِعَظْمٍ ۚ ذَٰلِكَ جَزَيْنَٰهُم بِبَغْيِهِمْ ۖ وَإِنَّا لَصَٰدِقُونَ
- وَتِلْكَ الْأَمْثَالُ نَضْرِبُهَا لِلنَّاسِ ۖ وَمَا يَعْقِلُهَا إِلَّا الْعَالِمُونَ (العنكبوت 43)

- روى الإمام أحمد والحاكم وابن حبان عن ابن مسعود أن النبي صلى الله عليه وسلم قال: ما أنزل الله عز وجل داء إلا أنزل له دواء، علمه من علمه وجهله من جهله.
- وعن أسامة بن شريك رضي الله عنه قال : قَالَتْ الأَعْرَابُ : يَا رَسُولَ اللَّهِ ، أَلا نَتَدَاوَى ؟ قَالَ : (نَعَمْ ، يَا عِبَادَ اللَّهِ تَدَاوَوْا ، فَإِنَّ اللَّهَ لَمْ يَضَعْ دَاءً إِلا وَضَعَ لَهُ شِفَاءً ، إِلا دَاءً وَاحِدًا ، قَالُوا : يَا رَسُولَ اللَّهِ ، وَمَا هُوَ ؟ قَالَ : الْهَرَمُ)
- مَثَلُ المؤمنين في تَوَادِّهم وتراحُمهم وتعاطُفهم: مثلُ الجسد، إذا اشتكى منه عضو: تداعَى له سائرُ الجسد بالسَّهَرِ والحُمَّى (رواه البخاري)
- قَالَ رَسُولُ اللَّهِ ﷺ: مَا مَلأَ آدَمِيٌّ وِعَاءً شَرًّا مِنْ بَطْنٍ بِحَسْبِ ابْنِ آدَمَ أُكُلَاتٌ يُقِمْنَ صُلْبَهُ فَإِنْ كَانَ لَا مَحَالَةَ فَثُلُثٌ لِطَعَامِهِ وَثُلُثٌ لِشَرَابِهِ وَثُلُثٌ لِنَفَسِهِ . رواه الترمذي
- وقال عليه الصلاة والسلام اللَّهُمَّ إِنِّي أَعُوذُ بِكَ مِنَ الْبَرَصِ، وَالْجُنُونِ، وَالْجُذَامِ، وَمِنْ سَيِّئِ الأَسْقَامِ

Plants from Tib Al Nabawi

- **Henna *(Lawsonia inermis)*- Lythraceae**
- **Hindba'a *(Taraxacum officinali)*- Asteraceae**
- **Mushroom**
- **Honey**
- **Olive (Leaf & oil)**
- **Salt**
- **Vinegar**
- **Bloodletting**
- **Leprosy**
- **Siwak**
- **Diet**
- **Aromatherapy**
- **Homeopathy**
- **Autohemotherapy**

27

Lawsonia

Dandelion

28

Shiitake Mushrooms

Maitake Mushrooms

29

30

Old Bloodletting | Modern Blood letting | Siwak

31

Aromatherapy

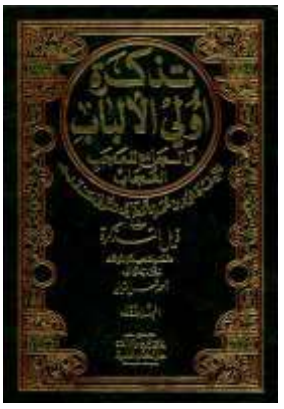
Homeopathy

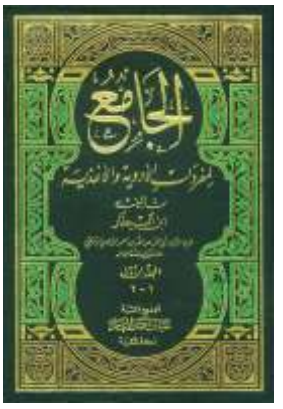
"It is good for everything "(*Binfa' li kul she)!!!*

32

Autohemotherapy

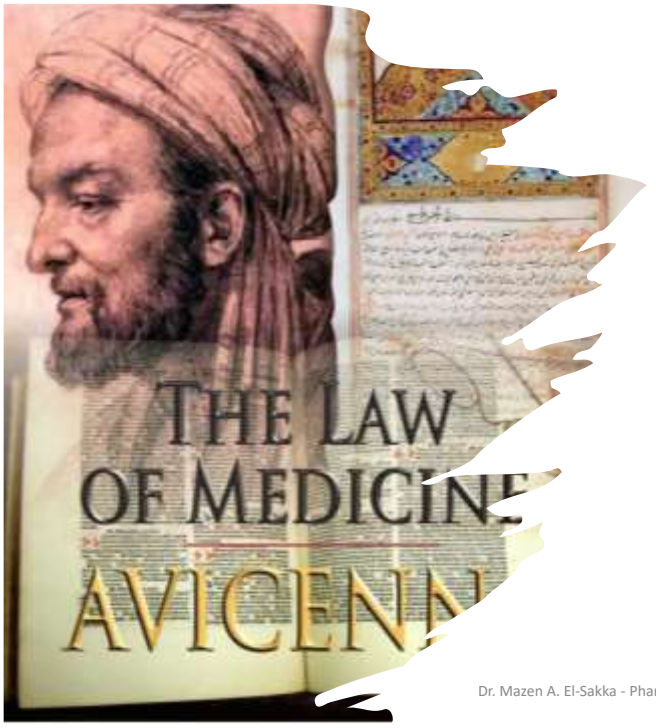
33





Muslim Scientists

34



Avicenna

- Abu-Ali al-Husayn ibn Abdullah ibn-Sina (Avicenna) was a Persian (Bukhara Region, Uzbekistan) polymath who is regarded as one of the most significant physicians, astronomers, thinkers and writers of the Islamic Golden Age.
- He has been described as the father of early modern medicine.
- ***The knowledge of anything, since all things have causes, is not acquired or complete unless it is known by its causes.***
- ***The Canon of Medicine,*** is an encyclopedia of medicine in five books. It presents an overview of the contemporary medical knowledge, which had been largely influenced by Galen.

35

Avicenna begins part one by **dividing theoretical medicine and medical practice, also dividing Medicine & Pharmacy**

He describes what he says are the "**four causes**" of illness, based on Aristotelian philosophy:

36

1. **Material Cause** Avicenna says that this cause is the **human** subject itself, the **members** or the **breath** or the **humours** indirectly.

2. **Efficient Cause** The efficient cause is broken up into two categories:

- The **first** is "**Extrinsic**",**(Environment)**
- The **second** is "**Intrinsic**", **(Lifestyle)**

3. **Formal Cause** **based upon the individual's temperament**.

4. **Final Cause** The final cause is given as "the **actions** or **functions**".

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Ethnopharmacology

38

Ethnopharmacology

- **Drugs Origin**
  a) From tradition plants
  b) From traditional Medicinal plants
  c) Common herbal medicine
- **Drug Discovery**
  a) Information sources
  b) Scientific investigation
  c) Chemical examination
  d) Value of Ethnopharmacology
- **Problems with Ethnopharmacology approaches**
  a) Reliability of information
  b) Biological variation
  c) Loss of species
  d) Loss of knowledge
  e) The Need for Dereplication

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Drugs origin

A) From tradition plants

- **Atropine**
- **Scopolamine**
- **Caffeine**
- **Digoxin**
- **Ephedrine**
- **Ergometrine**
- **Pilocarpine**
- **Reserpine**

40

Drug origin

B) From traditional Medicinal plants (Semi synthesis drugs)

- **Sodium cromoglicate:** from Khellin as urinary antiseptic.
- **Atracurium:** from Tubocurarine as Muscle relaxant
- **Etoposide:** from podophyllotoxin as anticancer
- **Bromocryptine:** from ergometrine to aid childbirth
- **Neostigmine:** from physostigmine to treat glaucoma & reduce memory loss and confusion.
- **Pethidine:** from morphine as strong analgesic after big surgery.

Drug discovery

- The discovery process is composed of five stages.
  1. **Reported** of a naturally-occurring material for some purpose which can be related to a medical use, (**clarification** and **translation).**
  2. **Identification** & **characterization** the material conform scientific approaches, (Extraction/Solvents/Detection).
  3. **Biological activity**,(Vivo/Vitro/ Screening).
  4. **Isolation and structure determination** with biological activity, (NMR/HPLC/Mass)
  5. **Clinical testing** of useful product.

D) The Value of the Ethnopharmacological Approach

Efficacy and safety

- A plant material has been used for generations in a particular culture.
- no serious adverse effects associated with the regular and correct use of the material.

Economic and sociopolitical considerations

- Economic: Drugs-wood-
- Social: Caffeine sources
- Political: narcotics
- Botanical Garden
- Possible validation of their traditional remedies .

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Problems with the Ethnopharmacological Approach

Reliability of information

Biological variation

Loss of species

Loss of knowledge

The Need for Dereplication (*process of testing samples of mixtures*).

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Biological and Geographical Sources of Drugs

45

Biological and Geographical Sources of Drugs

A- Biological Sources

- Pharmacopeia
- Taxonomy

B- Geographical Sources

- The suitability of the plant to a particular environment.
- The economic factors associated with the production of a drug in particular area.

46

Factors may Effect the Production of the Drug:

- Change in economic conditions.
- Change in the active constituents of the plant.
- Loss of the importance of the drug.
- Change in the govermental policies on the export of raw materials.

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Classification of Crude Drugs

Natural Substances

Crude Drugs

- **Alphabetical Classification:**
- ***Taxonomic Classification***
- ***Morphological Classification***
  - *Organized (Cellular, Primary) Drugs*
  - *Unorganized (Acellular, Secondary) Drugs*
- **Pharmacological or Therapeutically**
- **Chemical or Biogenetic**

48

Deterioration of Drugs

Moisture content.

Temperature.

Light.

Presence of oxygen.

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Processing of Vegetal Product

- Collection-Optimum moment
- Sorting
- Drying
- Conditioning

50

Collecting and Harvesting Processes

Advantage of Cultivation
1. For easy collection.
2. To assure a density.
3. To avoid the confusion with other species.
4. To simplified processing of medicinal plant (collection, sorter and conditioning).
5. Valorification of some area for used.
6. Obtaining of some new drugs from natural sources.

Factors Affecting cultivation
❶ Altitude, temperature and humidity.
❷ Rainfall or irrigation.
❸ Soil and soil fertility
❹ Fertilizers
❺ Pests and pest-control

Aims of Cultivation

1. Increasing the efficiency of active principle.
2. Obtaining some variety of plants which contain some special active principal.
3. To assure the constant efficiency.
4. Adaptation of some precious species (Ginkgo biloba).
5. To assure the resist of species facing the insect.
6. Possibility to used of chemical fertiliser.
7. To reduce or avoided toxic substances.
8. Maturation is uniform.

Extraction

Choosing the suitable solvent for extraction:
- Lipophile solvent
- Hydrophile solvent
- Water (Aqueous extract)

The process of extraction is used in making tinctures, fluid extracts, and solid extracts.

After extraction of the herb, the resulting solutions can be concentrated into fluid extracts or solid extracts.

We can add excipients if needed.

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The Pharmacological Action of Plant Drugs

Pharmacological Action	Drug (s)
Anti-inflammatory	**Develis claw, Taurmeric**
Antibacterial	**Rosemary, Garlic, Honey**
Antihistaminic	**Ephedra, lobelia**
Antispaspodic	**Hyocyamus, Datura, Papaverine**
Astringent	**Thea sineases, Hamamelides**
Opioid analgesic	**Morphine**
Opioid antitussive	**Codeine**
Cardiotonic	**Digitalis**
Tranqulizer	**Rauwolfia**
Emollient	**Althea**
Sedative	**Valapotriates**
Purgative	**Senna**

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The Pharmacological Action of Plant Drugs

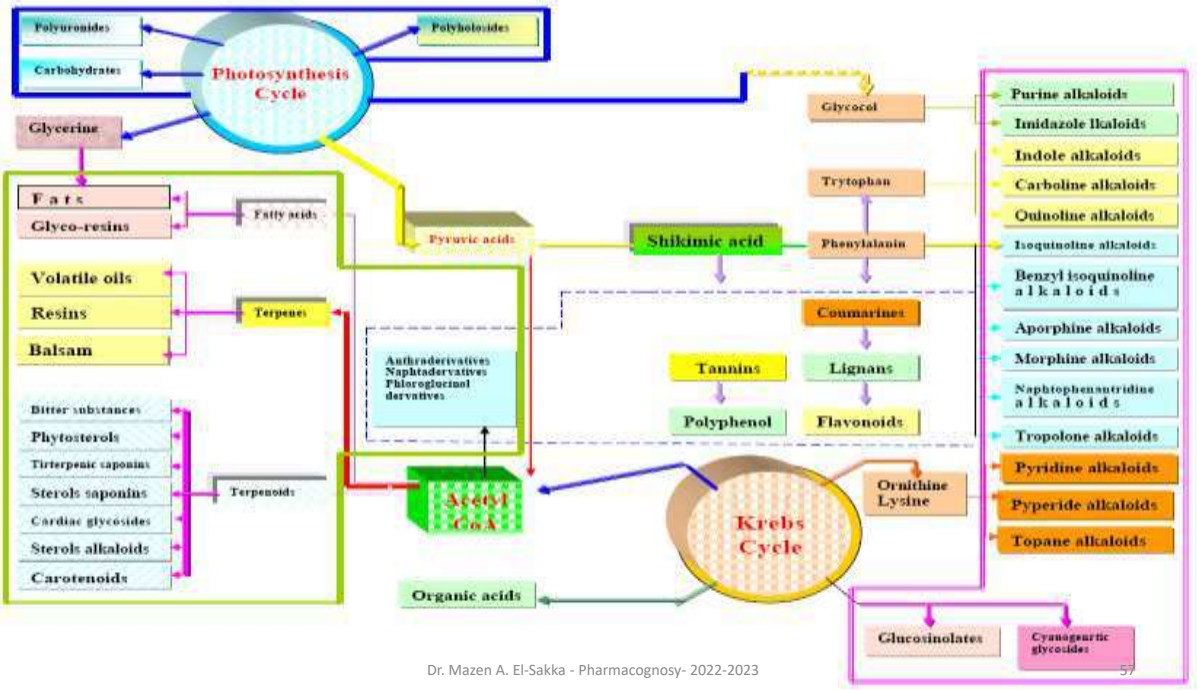
Pharmacological Action	Drug (s)
Anticholinergic	Atropine
Anti-inflammatory, proteolytic	Bromelain
CNS stimulant	Caffeine
Rubefacient	Camphor
Haemostatic	Catechin
Local anaesthetic	Cocaine HCl
Narcotic-Addiction	Cocaine
Choleretic	Curcumin
Amoebicide, emetic	Emetine
Antitumor agent, anti-gout	Colchicine
Antitumor agent	Etoposide

55

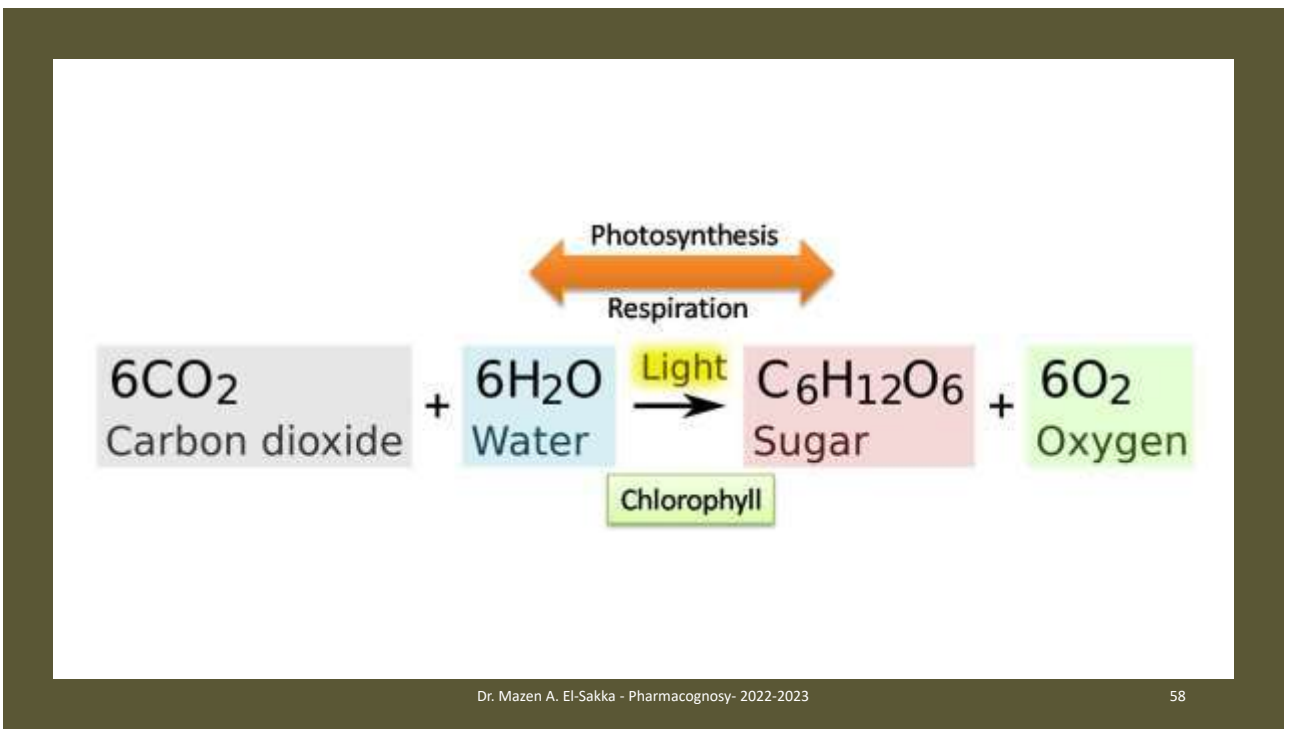
55

Biogenetical Relationship with Active Principles Biosynthesis

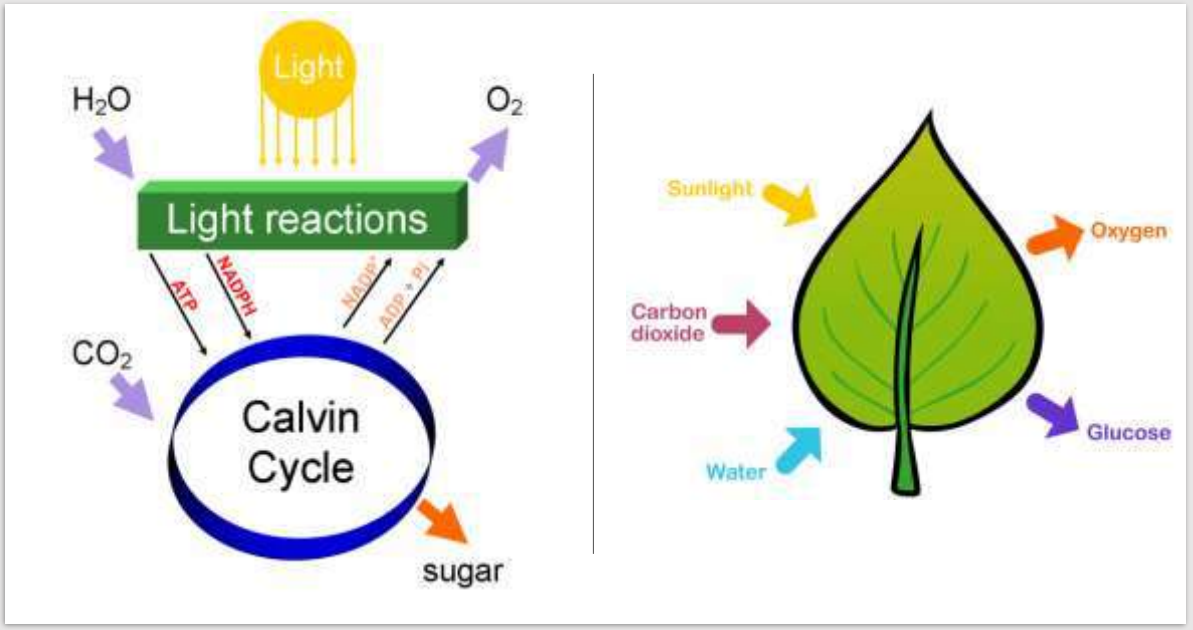
56


Polyuronides
Polyholosides
Carbohydrates
Photosynthesis Cycle
Glycerine
Glycocol
Purine alkaloids
Imidazole lkaloids
Indole alkaloids
Carboline alkaloids
Quinoline alkaloids
Isoquinoline alkaloids
Benzyl isoquinoline alkaloids
Aporphine alkaloids
Morphine alkaloids
Naphtophenantridine alkaloids
Tropolone alkaloids
Pyridine alkaloids
Pyperide alkaloids
Topane alkaloids
Fats
Glyco-resins
Fatty acids
Volatile oils
Resins
Balsam
Terpenes
Bitter substances
Phytosterols
Tirterpenic saponins
Sterols saponins
Cardiac glycosides
Sterols alkaloids
Carotenoids
Terpenoids
Pyruvic acids
Shikimic acid
Trytophan
Phenylalanin
Coumarines
Tannins
Lignans
Polyphenol
Flavonoids
Anthraderivatives
Naphtaderivatives
Phloroglucinol derivatives
Acetyl CoA
Krebs Cycle
Ornithine Lysine
Organic acids
Glucosinolates
Cyanogeartic glycosides

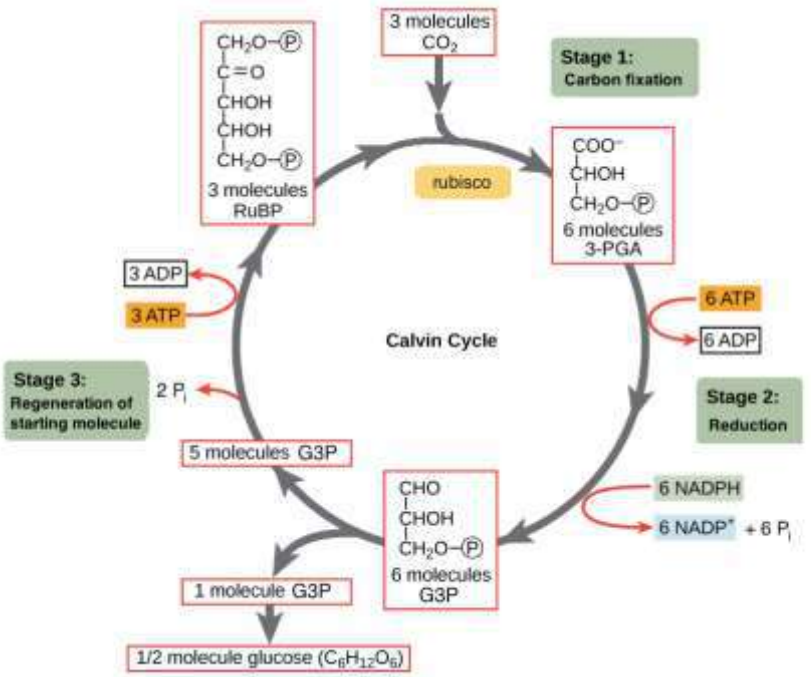
57


Photosynthesis
Respiration
6CO2
Carbon dioxide
+
6H2O
Water
Light
Chlorophyll
C6H12O6
Sugar
+
6O2
Oxygen

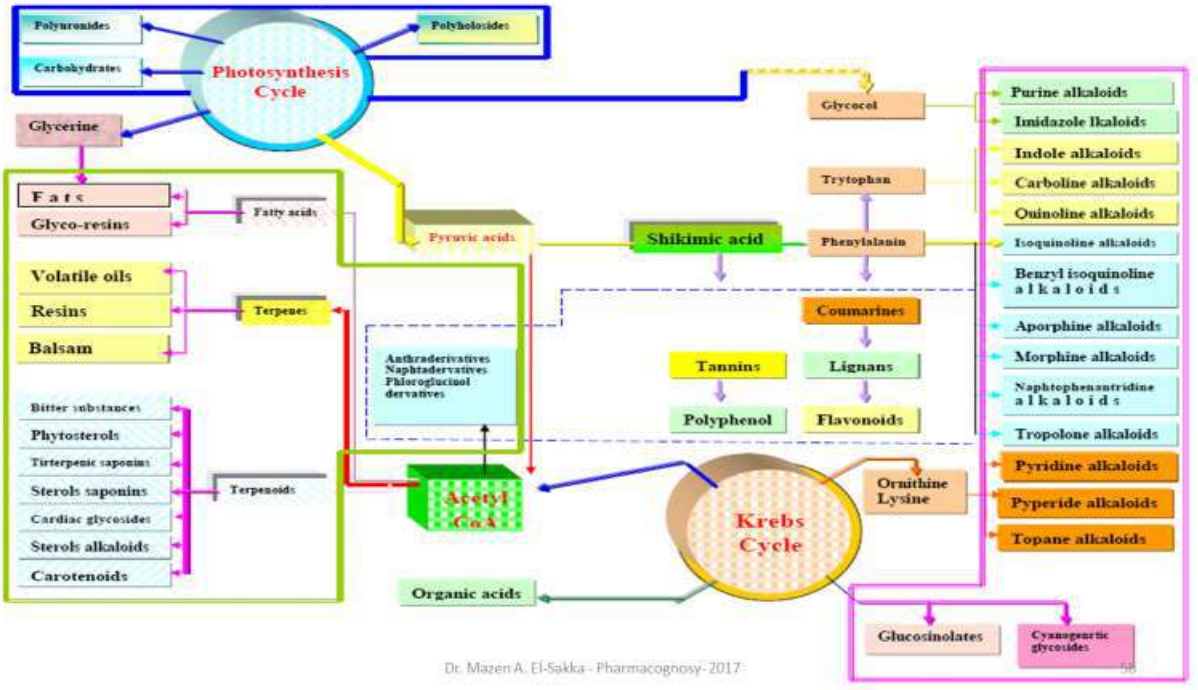
58


Light
H_2O
O_2
Light reactions
ATP
NADPH
NADP+
ADP + Pi
CO_2
Calvin Cycle
sugar
Sunlight
Oxygen
Carbon dioxide
Glucose
Water

59


3 molecules CO_2
Stage 1: Carbon fixation
3 molecules RuBP
rubisco
6 molecules 3-PGA
6 ATP
6 ADP
3 ADP
3 ATP
Calvin Cycle
Stage 3: Regeneration of starting molecule
2 P_i
Stage 2: Reduction
5 molecules G3P
6 NADPH
6 NADP+ + 6 P_i
6 molecules G3P
1 molecule G3P
1/2 molecule glucose ($C_6H_{12}O_6$)

60



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Biogenesis of Primary & Secondary Metabolites

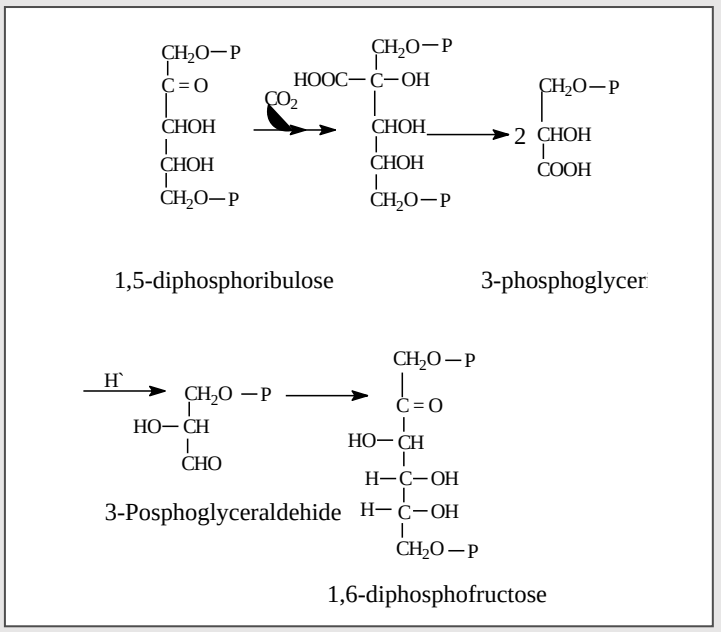
The first sugar in photosynthesis cycle is 1,6 di phospho**<u>fructose</u>** (NOT GLUCOSE).

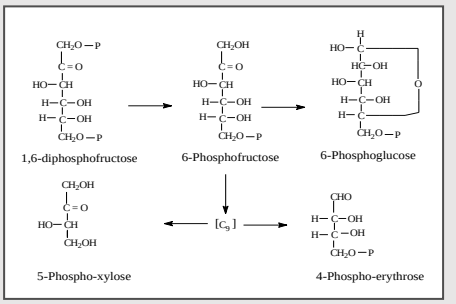
1,6 diphospofructose takes part in CO_2 passing through a series of other sugars such as **pentose, tetrose or heptose**.

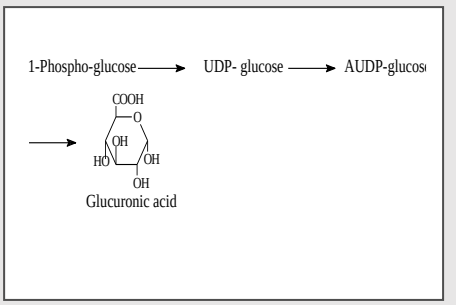
6-phosphoglucose isomerized to 1,6 diphosphoglucose, **by Uridine Phosphoric acid (UDP).**

Formation of **UDP-glucose** lead to formation of series of sugars called **URONIC ACIDS** (Glucuronic, galacturonic and mannuronic acid).

62


1,5-diphosphoribulose
3-phosphoglycer
3-Posphoglyceraldehide
1,6-diphosphofructose


1,6-diphosphofructose
6-Phosphofructose
6-Phosphoglucose
5-Phospho-xylose
4-Phospho-erythrose


1-Phospho-glucose
UDP- glucose
Glucuronic acid

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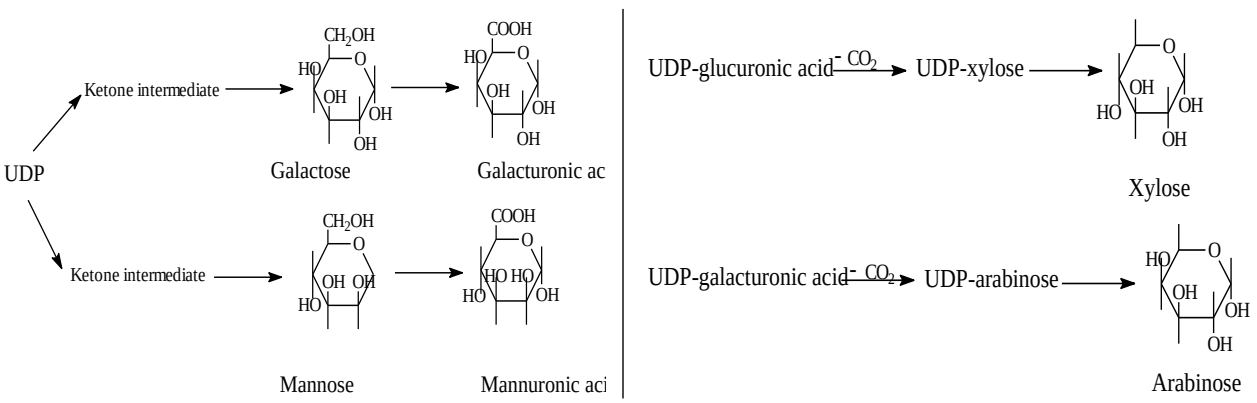
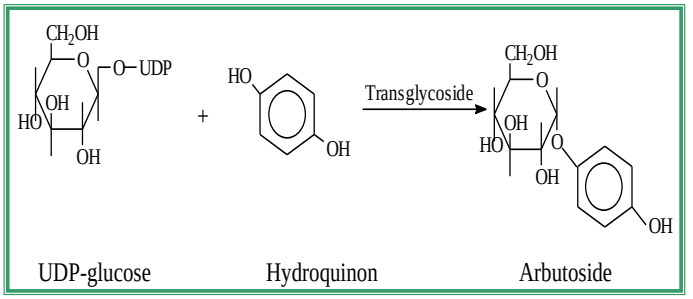
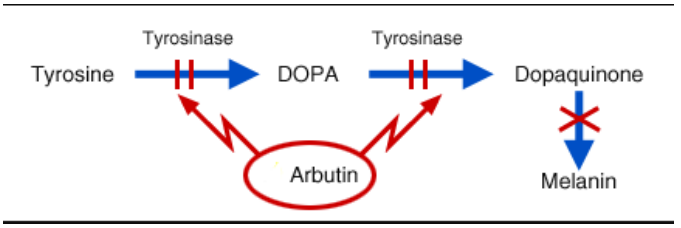

UDP
Ketone intermediate
Galactose
Galacturonic ac
Ketone intermediate
Mannose
Mannuronic aci
UDP-glucuronic acid
- CO2
UDP-xylose
Xylose
UDP-galacturonic acid
- CO2
UDP-arabinose
Arabinose

64

- **Arbutin** is a glycoside; a glycosylated hydroquinone extracted from the bearberry plant in the genus *Arctostaphylos*.
- It inhibit styrosinase and thus prevents the formation of melanin.
- Arbutin is therefore used as a skin-lightening agent.
- Arbutin is found in wheat, and is concentrated in pear skins.





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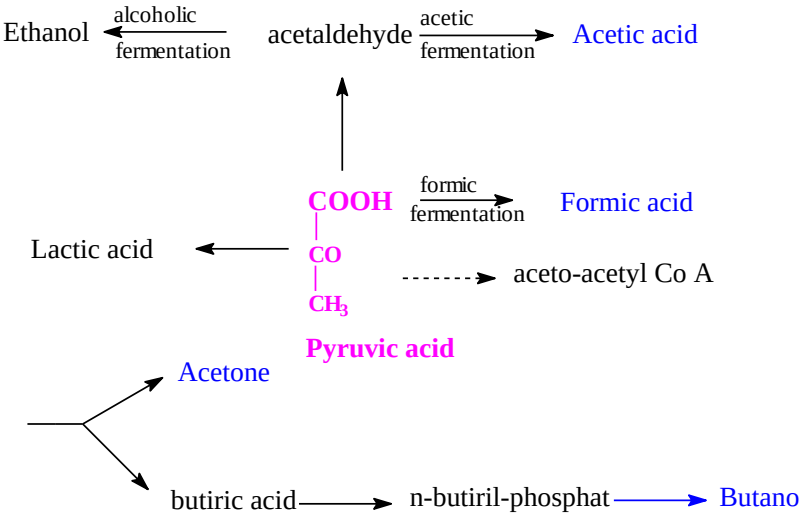
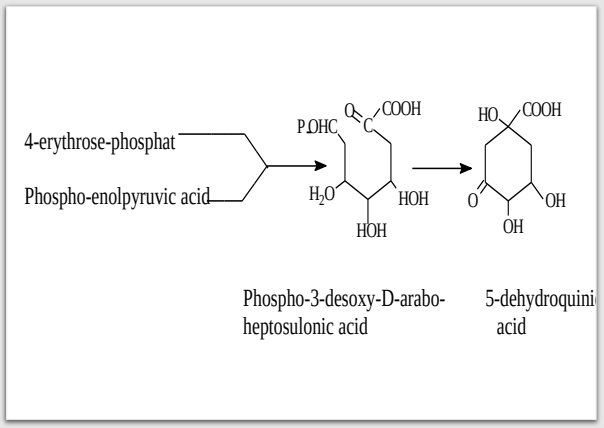
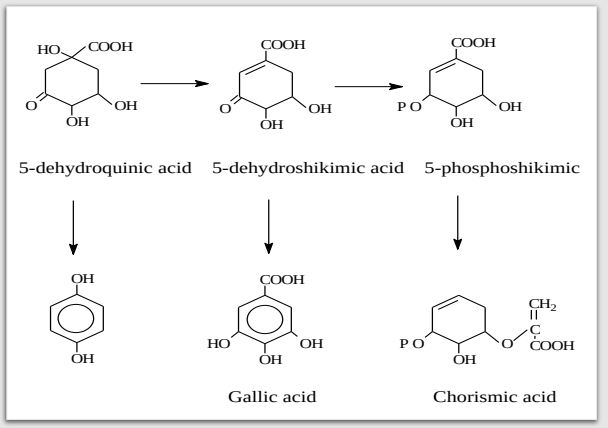
EMERGENCY MATERIALS



66





Formation of Polyphenols

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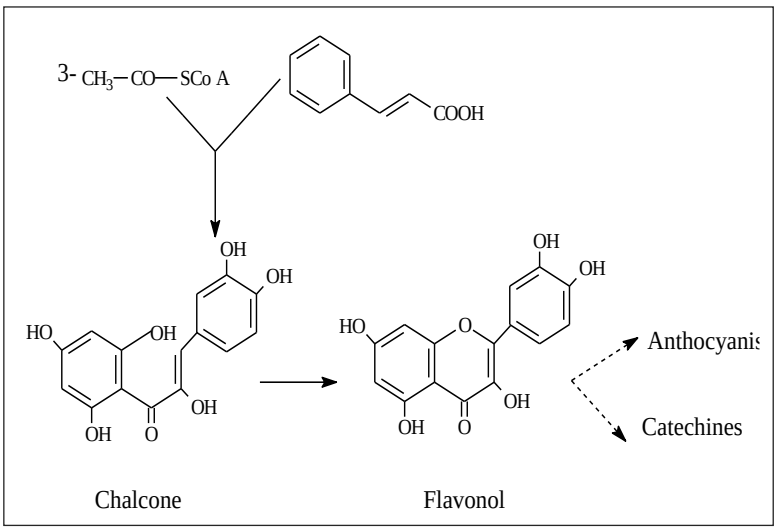
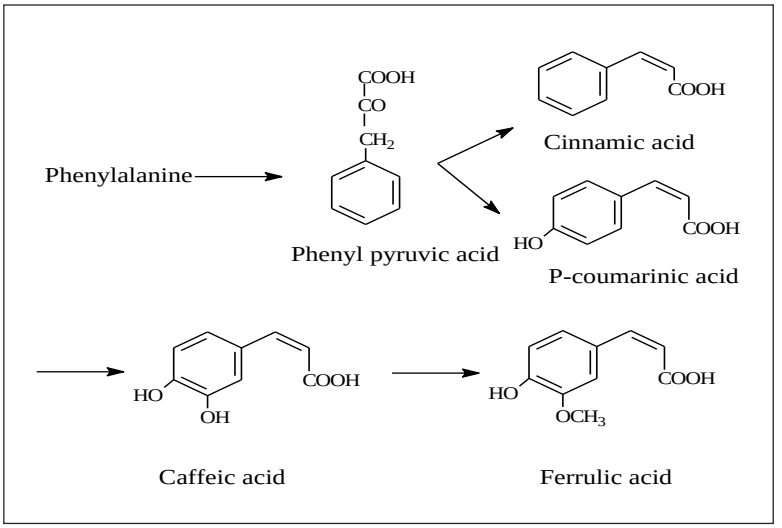
Level 3-2

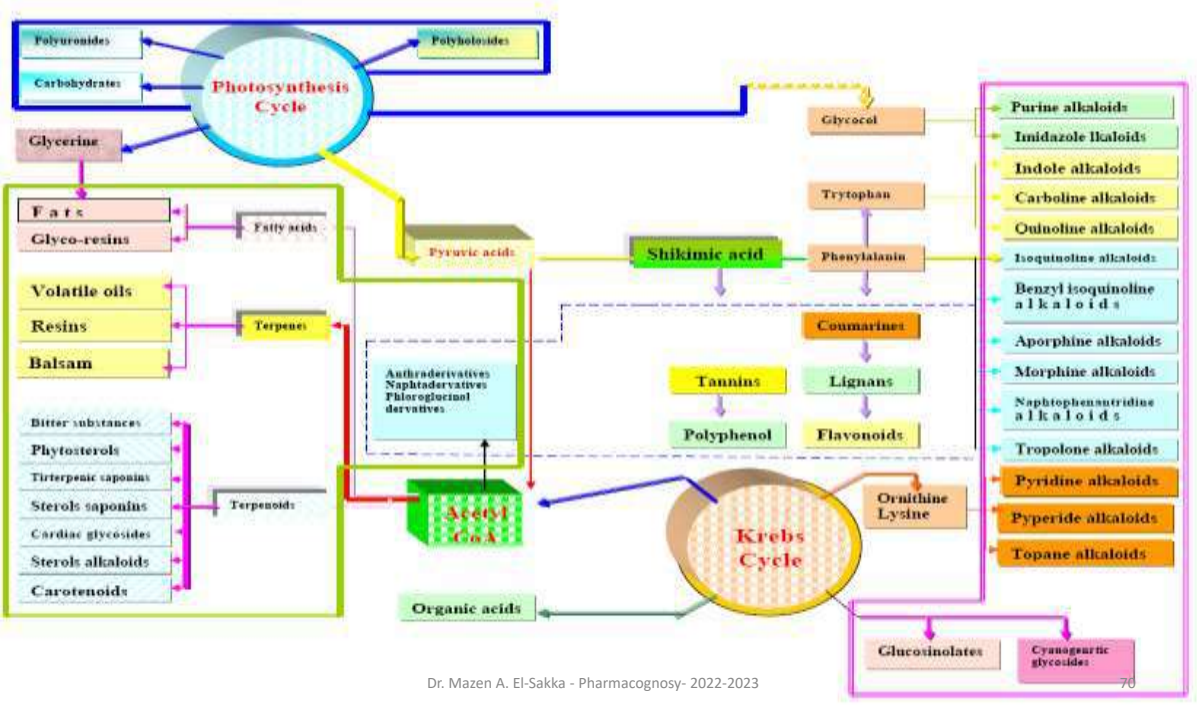


68

Level 4-2



69



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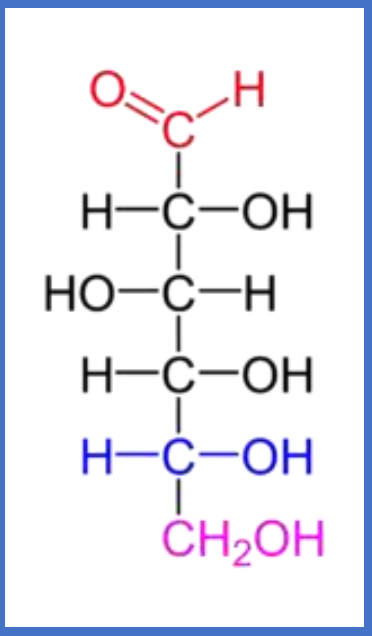

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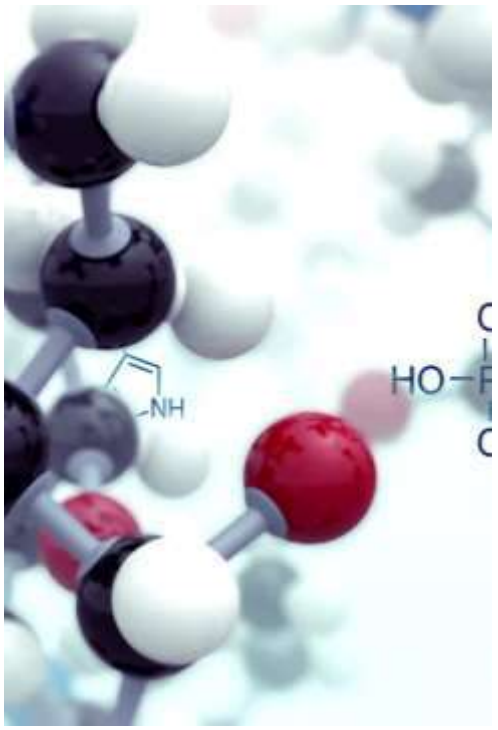

Carbohydrates

- Carbohydrates are called carbohydrates because the **carbon**, **hydrogen** and **oxygen** they contain are usually in the proportion to form water with the general formula $C_n(H_2O)n$.
- General names for carbohydrates include **sugars**, **starches**, **saccharides**, and **polysaccharides**.
- The term saccharide is derived from the Latin word " saccharārum" from the sweet taste of sugars.
- The name "carbohydrate" means a **"hydrate of carbon"**.
- The name derives from the general formula of carbohydrate is $\mathbf{C_x(H_2O)_y}$ **- x** and y may or may not be equal and range in value from 3 to 12 or more.
- For example glucose is: $C_6(H_2O)_6$ or is more commonly written, $C_6H_{12}O_6$.

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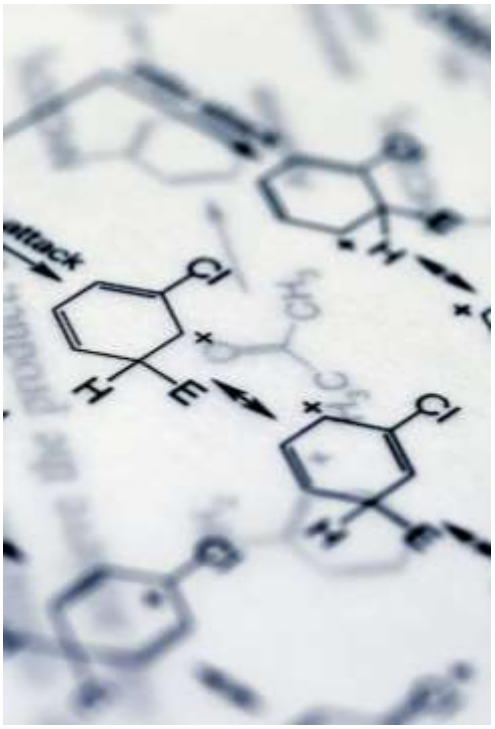

Carbohydrates

- The chemistry of carbohydrates most closely resembles that of **alcohol**, **aldehyde**, and **ketone <u>functional groups</u>**.
- As a result, the modern definition of a CARBOHYDRATE is that the compounds are **polyhydroxy aldehydes or ketones**.

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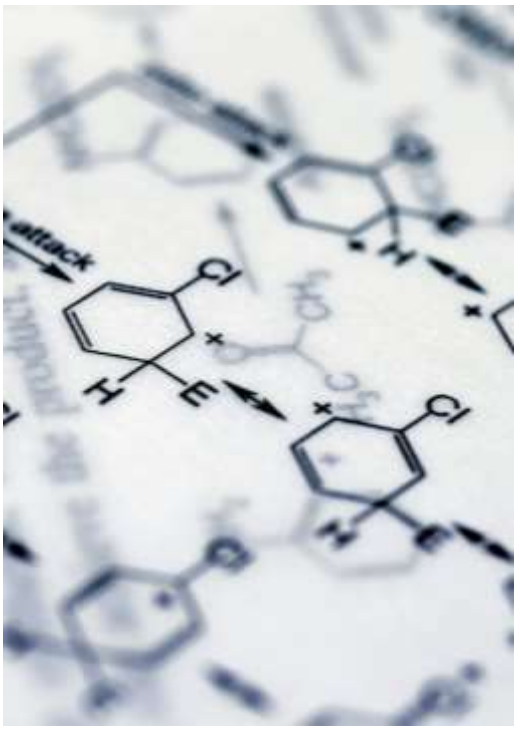

Carbohydrate Functions

- Carbohydrates are initially synthesized in plants from a complex series of reactions involving photosynthesis.
- **Store energy** in the form of starch **(photosynthesis in plants)** or glycogen (in animals and humans).
- **Provide energy** through metabolism pathways and cycles.
- **Supply carbon** for synthesis of other compounds.

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Physico-Chemical Characters

- **Condition:** Monosaccharides and most disaccharides are white, crystalline in shape and with sharp melting points.
- **Taste:** most of the simple and low molecular weight sugar a sweet taste.
- **Solubility:**
  - **Monosaccharides** are soluble in cold water and hot alcohol.
  - **Gums** are insoluble in water and insoluble in alcohol.
  - **Inulin, starch, pectin, mucilages** and glycogen are difficulty soluble in cold water, but more soluble in alcohol.
  - **Pentosans, galactans, mannans** and hemicellulose are insoluble in cold and hot water but soluble in dilute alkalis.
  - **Cellulose** is insoluble in all of the for mentioned solvents.

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Physico-Chemical Characters

- **Optical activity:**
  - **Monosaccharides and water-soluble oligosaccharides are optically active** and determination of their specific rotation is useful for their identification.
  - **Mutarotation** is the change in the optical rotation because of the change in the equilibrium between two anomers, when the corresponding stereocenters interconvert.
  - Cyclic **sugars** show **mutarotation** as α and β anomeric forms interconvert.

(***Anomers are cyclic monosaccharides or glycosides that are epimers, differing from each other in the configuration of C-1 if they are aldoses or in the configuration at C-2 if they are ketoses***).

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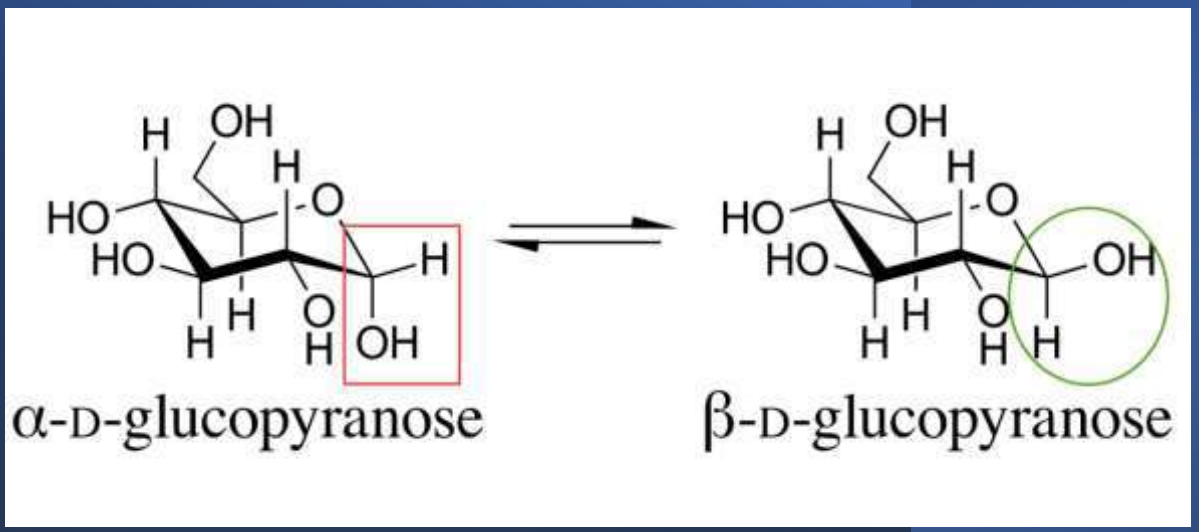
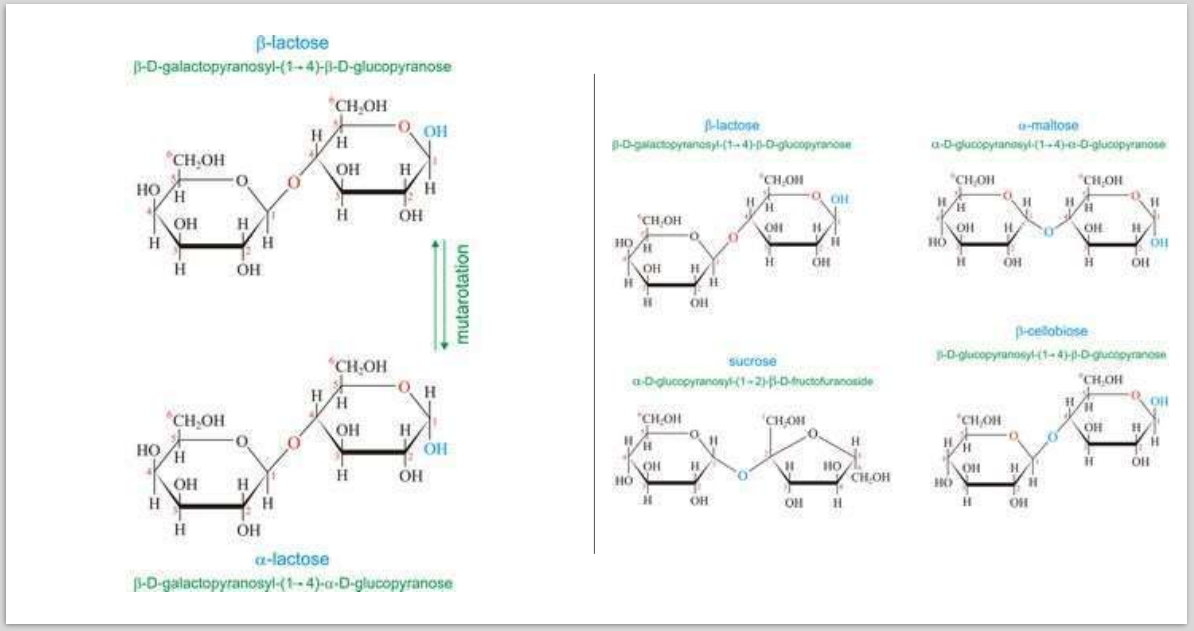

α-D-glucopyranose
β-D-glucopyranose

77

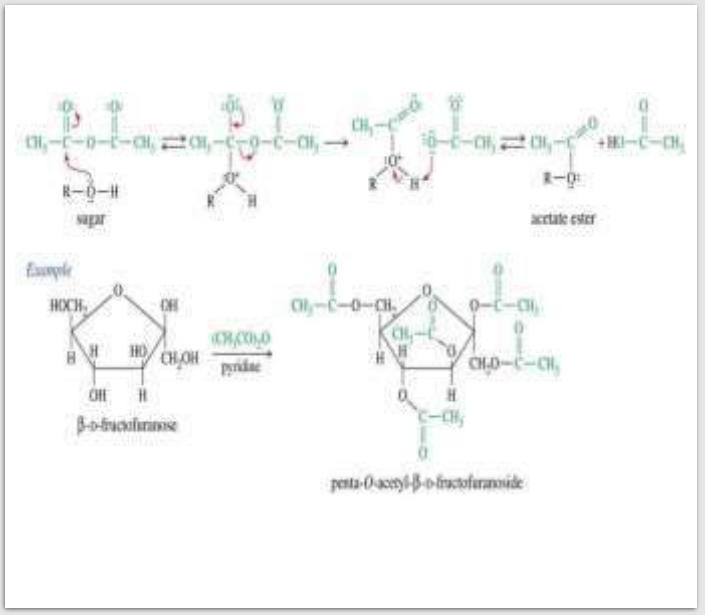

β-lactose
β-D-galactopyranosyl-(1→4)-β-D-glucopyranose
mutarotation
α-lactose
β-D-galactopyranosyl-(1→4)-α-D-glucopyranose
β-lactose
β-D-galactopyranosyl-(1→4)-β-D-glucopyranose
α-maltose
α-D-glucopyranosyl-(1→4)-α-D-glucopyranose
sucrose
α-D-glucopyranosyl-(1→2)-β-D-fructofuranoside
β-cellobiose
β-D-glucopyranosyl-(1→4)-β-D-glucopyranose

78

1

Specific Reaction: Ester formation

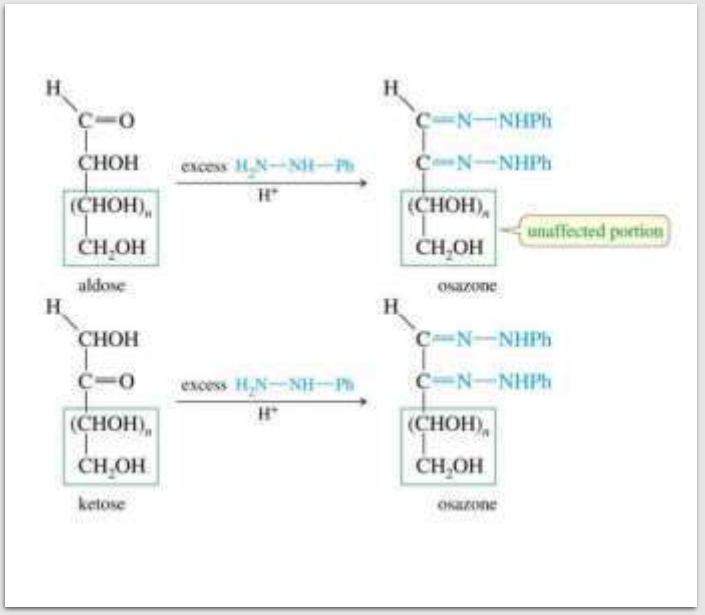
- Acetic anhydride with pyridine catalyst converts all the oxygens to acetate esters.



2

Specific reaction: Osazone Formation

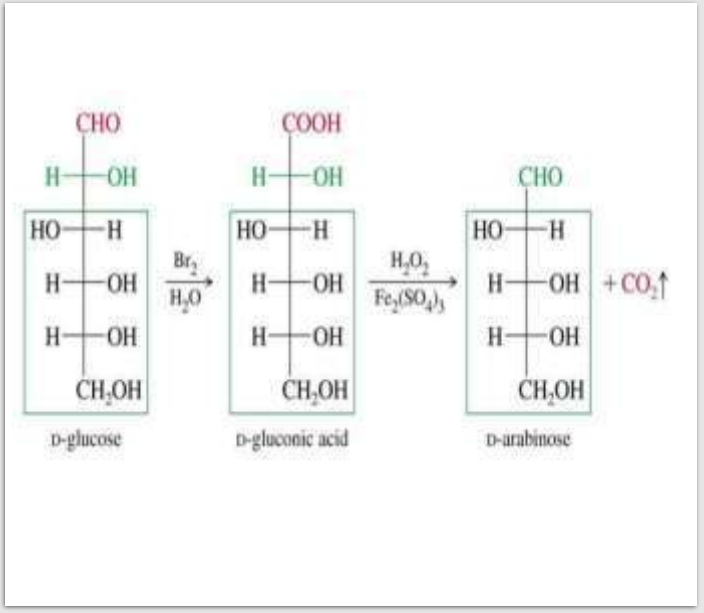
- Both C1 and C2 react with phenylhydrazine



3

Specific Reaction: Ruff Degradation

- Aldose chain is shortened by oxidizing the aldehyde to -COOH, then decarboxylation



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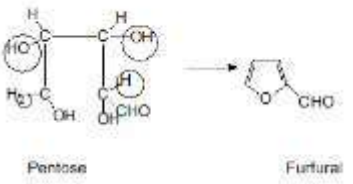
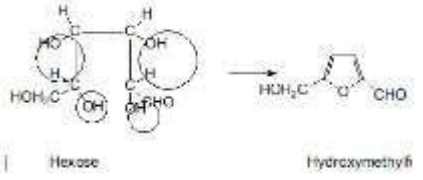
4

Specific Reaction: Formation of furfural

- Treatment with hot concentrated mineral acid (HCL or H_2 SO_4) leads dehydration of sugars.
- Pentoses and Methylpentoses give furfural and methyl furfural,
- respectively by the action of hot dilute hydrochloric acid, while ketoses and aldoses give hydroxymethylfurfural.





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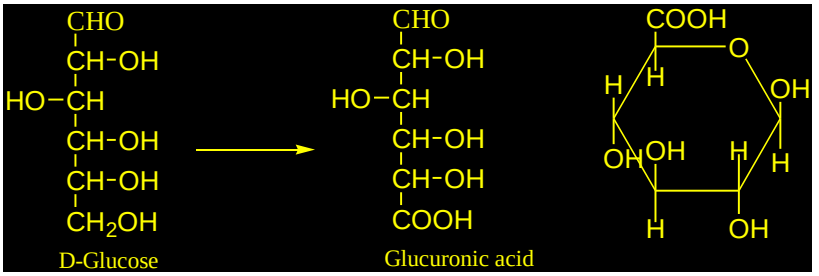
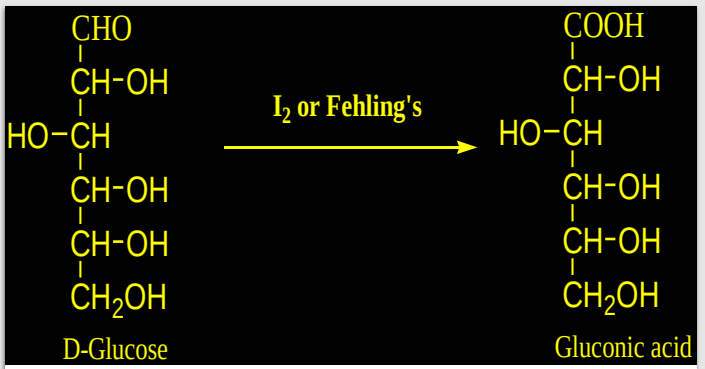
5 Specific Reactions: Enzymatic Reactions

- **Takes place in plants and resulted in the oxidation of the primary alcohol group only producing "uronic acids".**



6 Specific Reactions: Reaction with oxidizing cations

All monosaccharides and reducing disaccharides (i.e. all sugars containing free hemiacetal or are readily oxidized by metal ions as Cu^{+2} (fehling's and Benedict's reagents), Bi^{+3} and Hg^{+2} in alkaline medium.



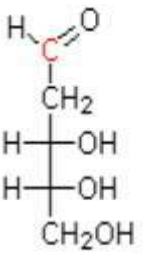
$$RCHO + Cu^{++} \longrightarrow RCOOH + Cu_2O$$

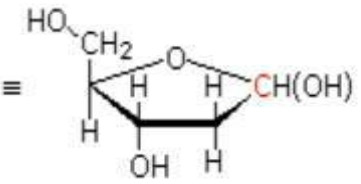
Common Modifications to Monosaccharides

- Deoxy sugars
- Amino sugars
- Glycosides (acetal)

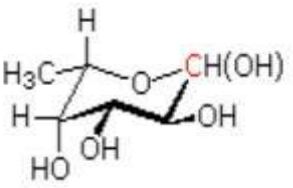
85

Deoxy sugars





2-deoxy-D-ribose
(an important component of DNA)



L-Fucose
6-deoxy-L-galactose
(found in seaweed)

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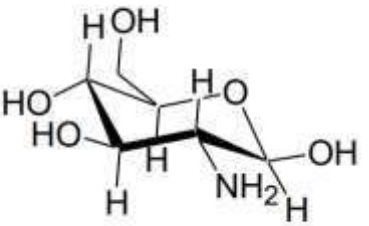
Glucosamine



Amino Sugar

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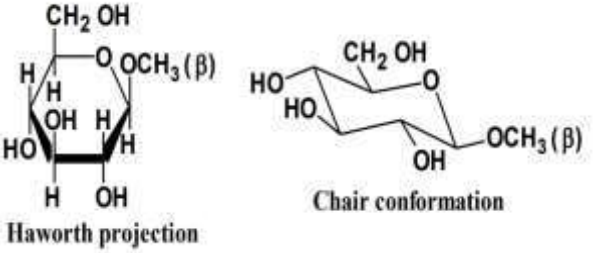
Glycosides - Acetals

- Glycoside bond: the bond from the anomeric carbon of the glycoside to an -OR group.
- Cyclic acetals are not in equilibrium with their open chain carbonyl-containing forms.
- **Glycosides do NOT suffer mutarotation**.



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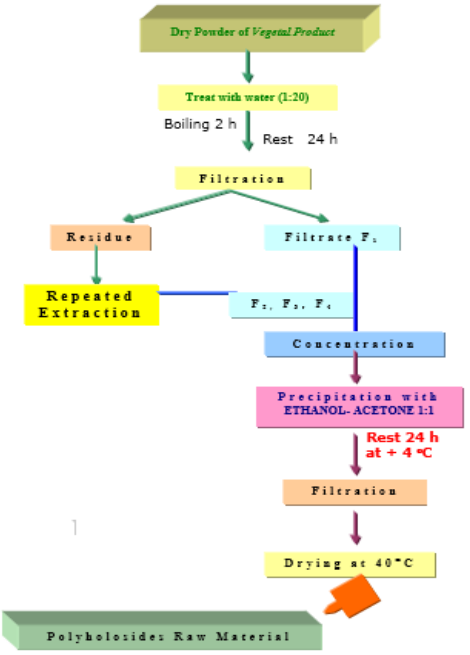
Preparation of Carbohydrates



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Identification of Carbohydrates

Chemical test

- Fehling reaction.
- Mollish reaction.
- Tollens reaction.

Chromatography

- Paper Chromatography (PC)
- Thin Layer Chromatography (TLC)
- Gas Liquid Chromatography (GLC)

Solvent Systems

- n-butanol-acetic acid- ether-water (9:6:3:1)
- n-butanol-acetic acid- acetone-water (35:10:35:20)

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Biosynthesis of Oses

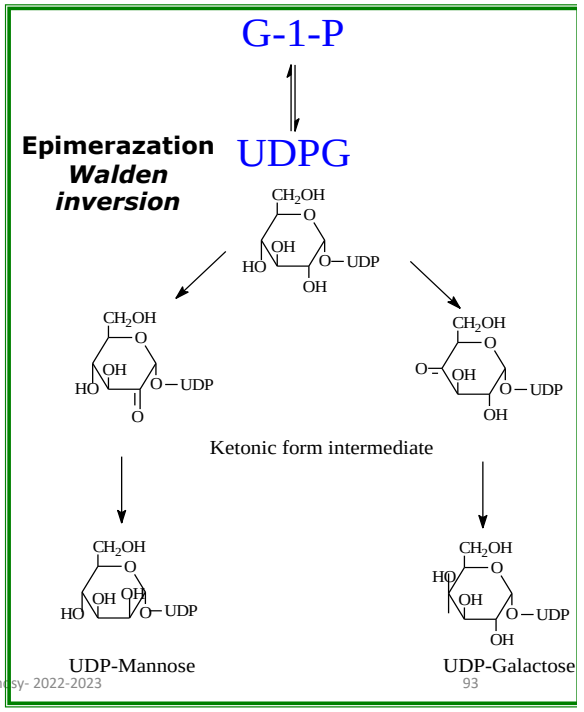
Esters

- F-6-P Neuberg ester.
- F-1,6-P Harden young ester.
- G-6-P Robinson ester.
- G-1-P Cori ester.

F-1, 6 P —Phospho-hexo-kenase→ **F- 6- P** —Phospho-hexo-isomerase→ **G-6 P** —Phospho-gluco-transferase→

G - 1 - P → **polysaccharides.**

Formation of Mannose & Galactose



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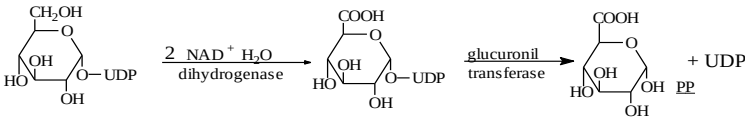
Formation of Uronic acids

1.

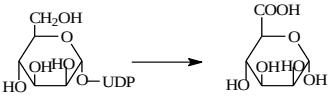


UDP-glucose AUDP-glucose Glucuronic acid

2.

UDP-galactose Galacturonic acid

3.



UDP-mannose Mannuronic acid

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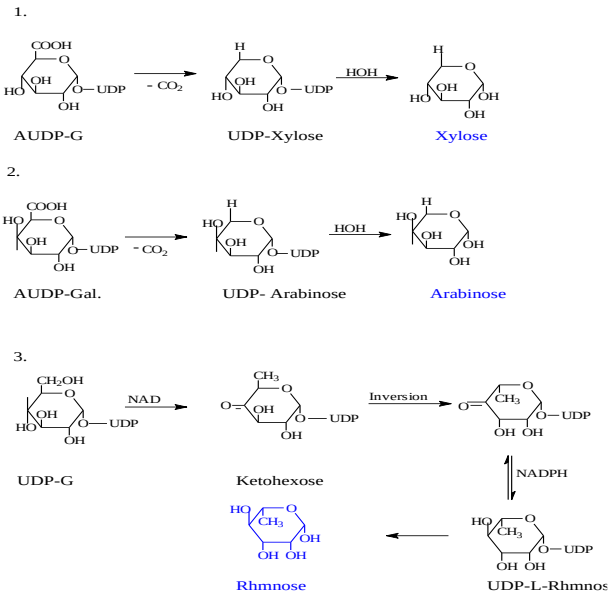
Formation of Xylose, Arabinose & Rhamnose



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Biological Activity of Carbohydrates

- Carbohydrates may directly influence human diseases by affecting physiological and metabolic processes.
- **Obesity:** Excess energy in any form will promote body fat accumulation.
- **Non-insulin Dependent Diabetes Mellitus (NIDDM) (Glycemic Load)**
- **Cardiovascular disease (electrolytes)**
- **Gastrointestinal tract (GIT)**

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Biological Activity of Carbohydrates

- **Endurance capacity /Physical activity**
- **Recovery from Excercise**
- **Dental caries (sugars easy broken α-amylase & L. acidophillus)**
- **Glycogen storage diseases** are caused by lack of enzymes glucose-6 phosphatase, maltase, glycogen phosphorylase needed to change glucose into glycogen.
  - Symptoms include weakness, sweating, confusion, kidney stones, and stunted growth.

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Biological Activity of Carbohydrates

- **Mucopolysaccharidoses** are a group of metabolic disorders caused by the absence or malfunctioning of lysosomal enzymes *(N-acetyl glucosaminidase)* needed to break down molecules called glycosaminoglycans. These long chains of sugar carbohydrates occur within the cells that help build bone, cartilage, tendons, corneas, skin and connective tissue.
- **Disorder of Pyruvate Metabolism**: caused by lack of the enzymes pyruvate carboxilase and dehydrogenase which are involved in pyruvate metabolism. These disorders cause a buildup of lactic acid and avariety of neurologic abnormalities (Intellectual disability, coordination disorder, muscle weekness).
- **Cancer**

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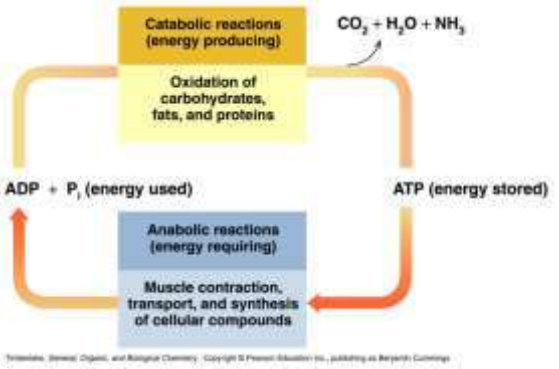
Metabolism



Metabolism involves

- **Catabolic** reactions that break down large, complex molecules to:
  - **provide energy and**
  - **smaller molecules**.
- **Anabolic** reactions that use ATP energy to **build larger molecules.**

Stages of Metabolism

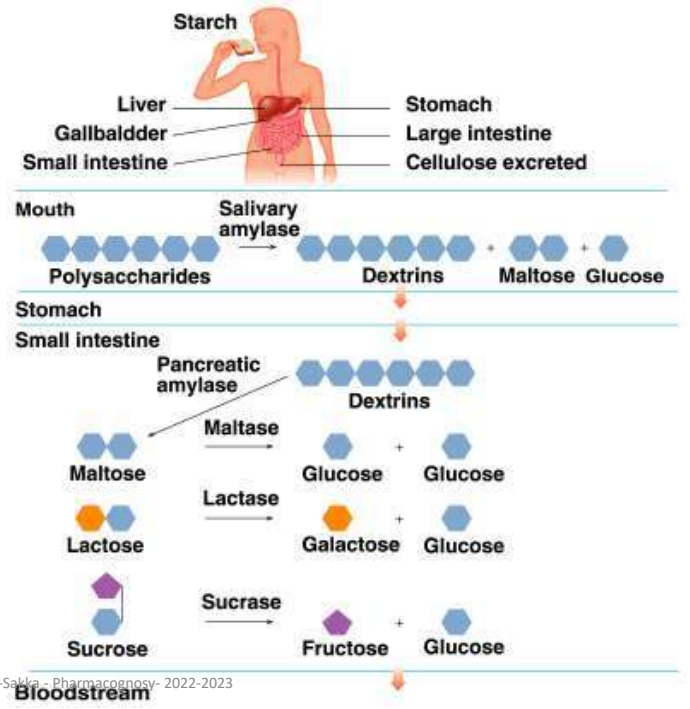
Catabolic reactions are organized as

Stage 1: **Digestion and hydrolysis break down large molecules to smaller ones that enter the bloodstream.**

Stage 2: **Degradation breaks down molecules to two- and three-carbon compounds.**

Stage 3: **Oxidation of small molecules in the citric acid cycle and electron transport provide ATP energy.**

Digestion of Carbohydrates



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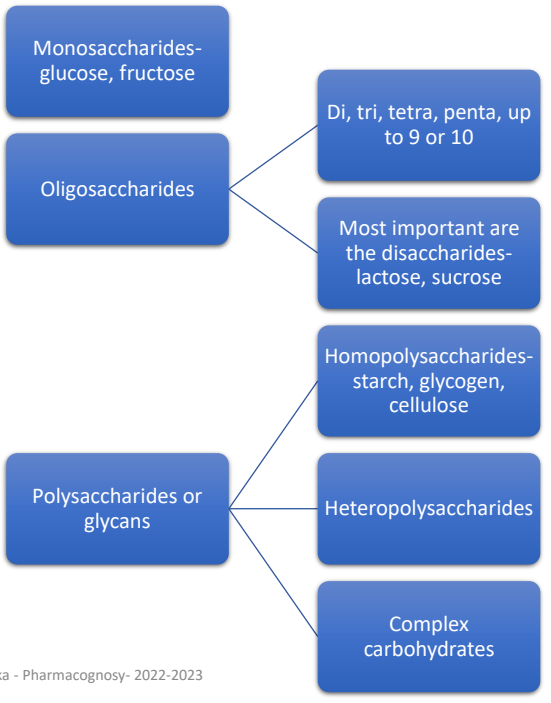
Classification of Carbohydrates



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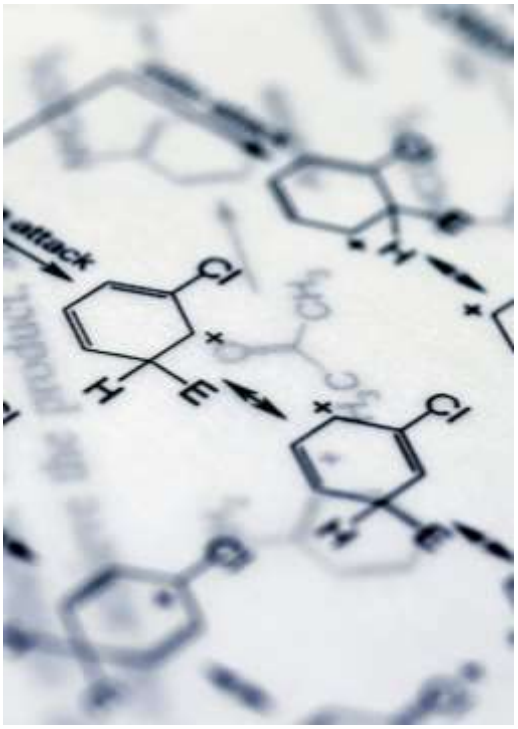

- Monosaccharides – carbohydrates that cannot be hydrolyzed to simpler carbohydrates; eg. Glucose or fructose.
- **Disaccharides** – carbohydrates that can be hydrolyzed into two monosaccharide units; eg. Sucrose, which is hydrolyzed into glucose and fructose.
- Oligosaccharides – carbohydrates that can be hydrolyzed into a few monosaccharide units.
- Polysaccharides – carbohydrates that are polymeric sugars; such as starch or cellulose.

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Monosaccharides

Known as simple sugars

Classified by:

1. the number of carbons and
2. whether aldoses or ketoses

Examples-glucose (blood sugar), fructose(sweetest sugar) are principal monosaccharides in food.

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Fructose is Directly Associated with Diabetes

- **A primary difference is that fructose is metabolized differently than glucose.**
- **Fructose is metabolized much more rapidly than any other sugar into fat via the liver.**
- **It is also primarily metabolized in the liver. Because of this it has also been associated with a high level of nonalcoholic fatty liver disease (NAFLD) and a rapid accumulation of a particular kind of fat (triglycerides) that is stored in both the liver and general fat tissue.**
- **This is related not only to NAFLD but also to heart disease and hypertension. Glucose, when combined with fructose (as in sucrose and high-fructose corn syrup), accelerates fructose absorption.**

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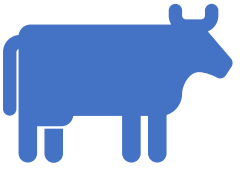
Oligosaccharides

- Most common are the disaccharides are Sucrose, lactose, and maltose
- **Sucrose** (glucose + fructose)
- **Lactose** (glucose + galactose)
- **Maltose** (2 molecules of D-glucose)-Malt Sugar-



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Polysaccharides(complex carbohydrates)

- **Homo**glycans (starch, cellulose, glycogen, inulin)
- **Hetero**glycans (gums, mucopolysaccharides)
- Characteristics:
  - polymers (MW from 200,000)
  - White and amorphous products (glassy)
  - not sweet
  - not reducing; do not give the typical aldose or ketose reactions)
  - form colloidal solutions or suspensions

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Starch

Most common storage polysaccharide in plants

Composed of 10 – 30% a-amylose and 70-90% amylopectin depending on the source

Common sources are grains , potatoes, peas, beans, wheat

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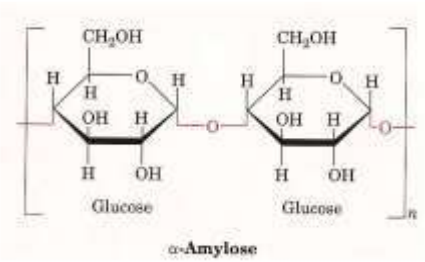
In PLANTS:

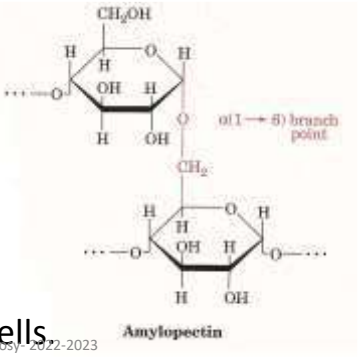
The major **glucose storage** substance is **STARCH**, which is a mixture of...

α-amylose,
an α(1→ 4)-linked glucan, usually several thousand glucose units long

&

amylopectin,
like amylose, but has α(1→ 6) branches every 24-30 residues on average; up to 10^6 glucose units/molecule





These are stored in the cytoplasm of plant cells.

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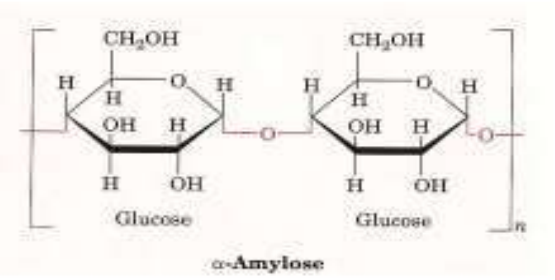
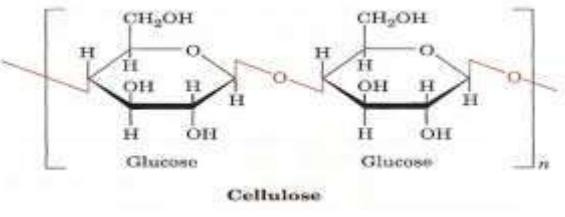
Compare **α-amylose**:



To cellulose:

The major **structural component** of plant cell walls. Is a linear polymer of up to 15,000 D-glucose residues.



WHAT'S THE DIFFERENCE?

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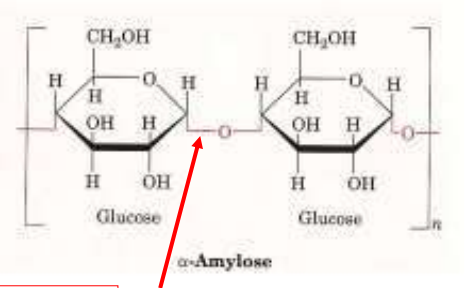
Answer

α-amylose:

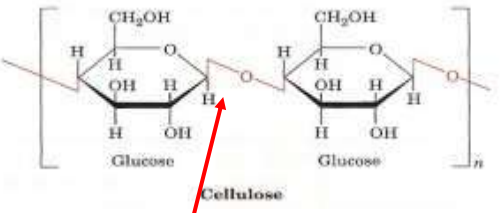
Compare (α-amylose structure)….



α(1 4) linkage

Cellulose:

to (cellulose structure) to see the structural consequences of these different linkages



β(1 4) linkage

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Glycogen

- Known also as animal starch
- Stored in muscle and liver
- Present in cells as granules (high MW)
- Contains both a(1,4) links and a(1,6) branches at every 8 to 12 glucose unit
- Complete hydrolysis yields glucose

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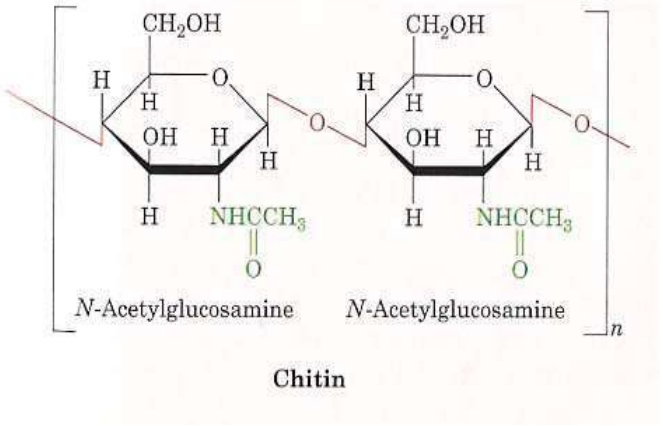
- **In ANIMALS**:
  - The **storage** glycan of animals is **GLYCOGEN**, which differs from amylopectin only in that the branches occur every 8-12 residues.
  - Glycogen occurs in **granules** of about **100-400 Å diameter** in cytoplasm of cells that use it most.
- *For example:*
- **Muscle** has a maximum of **1-2%** of its weight in glycogen.
- Liver has a maximum of **10%** by weight. Combined, this is about a **12hour** energy supply for the body (about 1 day).



Chitin

Chitin is the major **structural** component of the exoskeletons of crustaceans, insects, and spiders. It is also present in the cell walls of most fungi and many algae.

Fibers

Found in food derived from plants

Includes **polysaccharides** such as cellulose, hemicellulose, pectins, gums and mucilages

Also includes **non-polysaccharides** such as lignin, cutins and tannins

Fibers are **not a source of energy** because Human digestive enzymes cannot break down fibers

The bacteria in human GI tract can breakdown some fibers.

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Dietary Fibers

- The national **fiber recommendations** are:
  - 30 to 38 grams a day for **men** between 18 and older
  - 25 grams a day for **women** between 18 and 50 years old,
  - 21 grams a day if a woman is 51 and older.
  - **Another general guideline is to get 14 grams of fiber for every 1,000 calories in your diet.**
- **Fiber** slows the rate that sugar is absorbed into the bloodstream.
- Consuming **too much fiber can** cause adverse effects such as cramping, constipation or dehydration.

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Classification of Fibers Based on their Solubilities in Water

(1)Soluble fibers: includes gum, pectin, some hemicellulose and mucilages found in fruits, oats, barley and legumes .

Actions on body:

- Delay GI transit(benefits digestive disorders)
- Delay glucose absorption (benefits diabetes)
- Lowers blood cholesterol(benefits heart disease)

(2) Insoluble fibers: includes cellulose, many hemicellulose, lignin found in wheat bran , corn bran, whole grain bread, cereals and vegetables (carrot, cabbage)

Actions in body:

- Accelerates GI transit and increases faecal weight (promotes bowel movement)
- Slows starch hydrolysis and delays glucose absorption(Benefits diabetes)

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Drugs/Foods Containing Fibers

Drug

- Psyllium (*Plantago major & Plantago ovata*) لسان الحمل
- Psyllium is an edible soluble fiber and **prebiotic**.

Foods

- Beans
- Whole grains
- Brown rice
- Popcorn
- **Nuts**. Almonds, pecans, and walnuts have more fiber than other nuts.
- **Bran cereal**
- **Oatmeal**
- **Vegetables**
- **Fruits**

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Carbohydrates Containing Drugs

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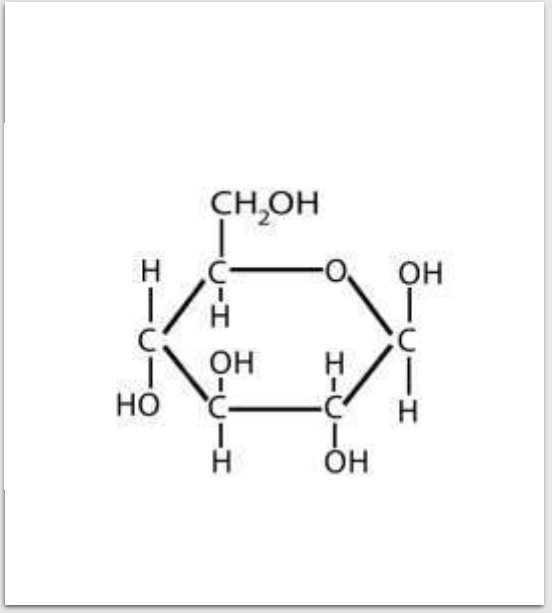
Monosaccharides: Dextrose

- **Dextrose**: Known also as **dextrorotatory** glucose.
- Dextrose is the name of a simple sugar that is made **from corn** and is chemically identical to glucose.
- Dextrose is often used in baking products as a **sweetener**, and can be commonly found in items such as **processed foods** and corn syrup.
- It may be **prescribed when a person is dehydrated** or has **low blood sugar** (***Insulin Shock***).
- Dextrose powder is sometimes used as a nutritional supplement by **bodybuilders** who are looking to increase weight and muscle.
- Dextrose is used **in sauces, cookies, cake mixes, candies, energy drinks, and frozen desserts**.
- It may also be included in savory foods like cured meats, canned foods, pretzels, pickles and crackers.
- **Dextrose has a high glycemic index 96 and GL 25/25g**, which means it quickly raises the blood sugar levels.



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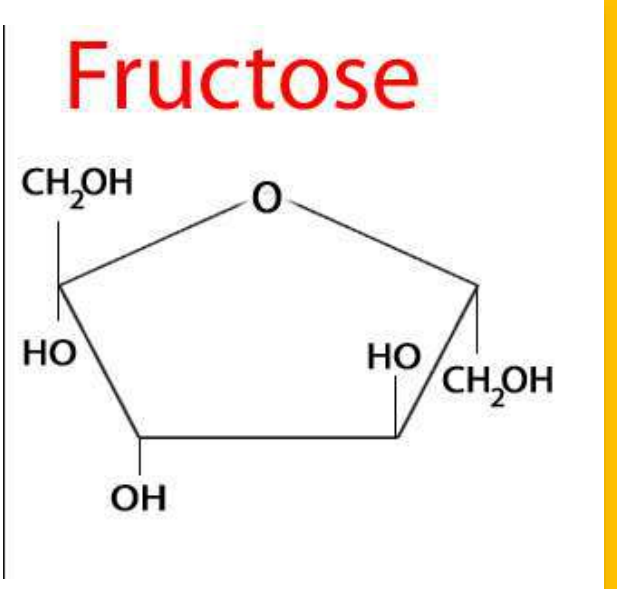
Monosaccharides: Fructose

Fructose, or fruit sugar, is a simple ketonic monosaccharide found in many plants, where it is often bonded to glucose to form the disaccharide sucrose.

Soda, candy, frozen junk food, breads, canned fruits, juices, salad dressing, coffee creamer, jelly and energy drinks are rich in fructose.



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Ten reasons to *limit* fructose consumption

1. Fructose can only be metabolized by the liver and **can't be used for energy** by your body's cells.

2. **Excess fructose damages the liver** and leads to **insulin resistance** in the liver as well as **fatty liver disease.**

3. Fructose **reacts with proteins and polyunsaturated fats** in our bodies 7 times more than glucose, which lead to **more oxidative damage**.

4. Fructose **increases uric acid production**, which, in excess, can cause gout, kidney stones, kidney failure and hypertension.

5. Excess fructose can **create gut flora imbalances**, promote bacterial overgrowth and promote the growth of pathogenic bacteria.

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Ten reasons to *limit* fructose consumption

6. chronic excess fructose **causes dyslipidemia**, which means that your blood lipid markers tend to shift towards numbers that indicate a risk for heart disease.

7. Fructose rapidly **causes leptin resistance**. *(Leptin is a hormone that controls appetite and metabolism to maintain a normal weight)*.

8. Excess fructose alone can cause all the problems associated with the **metabolic syndrome** (diabetes, obesity, heart disease).

9. **Cancer cells thrive and proliferate** very well with fructose as their energy source.

10. Excess fructose also **affects brain functioning**, especially as it **relates to appetite regulation**. It has also been shown to impair memory in rats.

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Fructose in Diet GI=21 GL=5

The **high-fructose fruits** include **apples**, **cherries**, **mangoes**, **watermelon** and pears.

The **low-fructose fruits**, such as **honey, melon**, **cantaloupe**, **bananas**, blueberries, strawberries and oranges,

Vegetables in larger quantities (fructans or inulin content): artichoke, asparagus, beans, broccoli, cabbage, chicory, dandelion leaves, garlic, leek, onion, peanuts, tomato, zucchini.

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Monosaccharides : Glucose: Vitis venifera

- Synonym: Activin, Black Grape Raisins
- *Grapes are very beneficial as a fruit as they contain lots of **vitamin C** as well as also flavonoids, which are potent antioxidants.*
- Grape seed extract contains a special class of water-soluble bioflavonoids called **proanthocyanidins** (PCOs).
- The proanthocyanidins found in grape seed extract have also been shown to help promote the structural strength of blood vessels, help stabilise collagen, and maintain elastin.
- Grape seed has also been used as a dietary source of **phenols** (tocopherols), which inhibit fungal infections, and certain steroids such as campesterol, which can be beneficial in lowering LDLs and cholesterol.

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Monosaccharides : Glucose: Vitis venifera

- One of the polyphenols contained in grape seed extract is called **resveratrol**. Resveratrol from grape seeds has appeared to interfere with cancer cell growth and division, as well as causing some cancer cells to disintegrate faster than they would ordinarily.
- It may be effective for slowing **retinopathy** and **reduce eye stress** caused by bright lights.
- Prevent and treat **Hemorrhoids.**
- As a natural antihistamine, grape seed extract may help to control the sneezing, congestion and other hallmarks of an allergic reaction.
- Dried grapes, raisins, or sultanas (white raisins) are used for cough.

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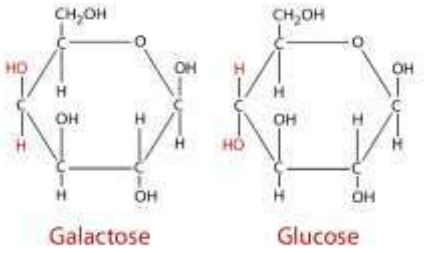
Monosaccharides: Galactose

- **Galactose** is a monosaccharide sugar that **is less sweet than glucose and fructose**. It is a C-4 epimer of glucose.
- **The major dietary source of galactose is <u>lactose</u>**, a disaccharide formed from one molecule of glucose plus one of galactose.
- **<u>Digestion of lactose produces glucose and galactose</u>**, both of which are transported through the hepatic portal vein directly to the liver.
- **Galactose is metabolized by conversion initially to glucose 1-phosphate, which can then be converted either to glucose 6-phosphate or to glycogen**.



Food rich in Galactose:

- **Honey**
- **Beets البنجر**
- **Cheese (Mozarella)**

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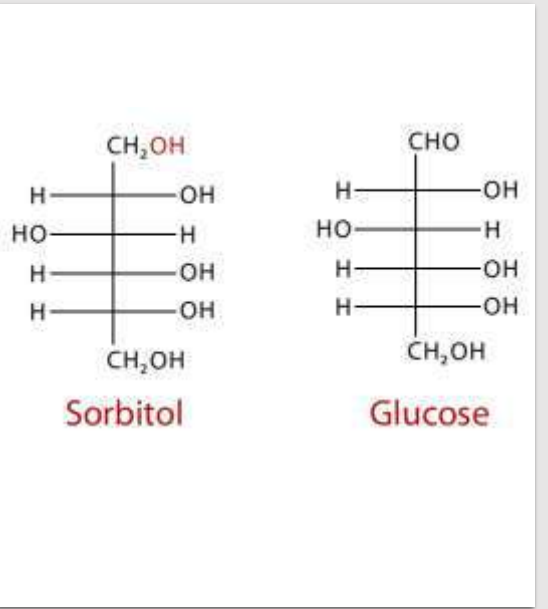
Monosaccharides: Sorbitol

- **Sorbitol**,($C_6H_{14}O_6$) less commonly known as **glucitol**, is a sugar alcohol with a sweet taste which the human body **metabolizes slowly**.
- It can be **obtained by reduction of glucose**, which **changes the aldehyde group to a hydroxyl group**.
- It is often used in diet foods (including diet drinks and ice cream), mints, cough syrups, and sugar-free chewing gum.
- It also **occurs** naturally in many stone fruits and berries from trees of the genus Sorbus.
- **Laxative** Sorbitol can be used as a non-stimulant laxative via an oral suspension or enema.
- **Sorbitol has less of an effect on blood sugar levels than sugar**, which can benefit people at risk of developing diabetes. ...



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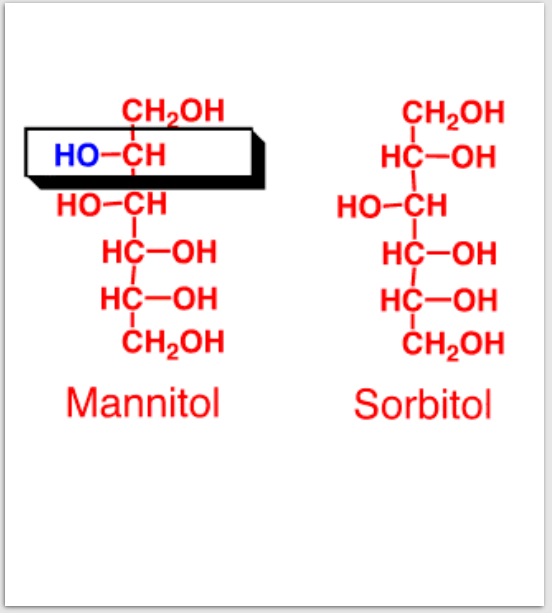
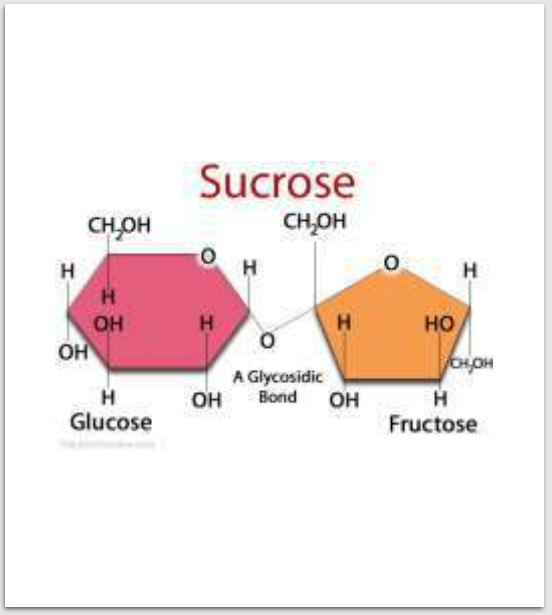
Monosaccharides: Mannitol

- **Mannitol, ($C_6H_{14}O_6$),** is a type of **sugar alcohol** which is also used as a medication.
- As a sugar, it is often used as a **sweetener in diabetic food**, as it is poorly absorbed from the intestines.
- As a medication:
  - It is used to get rid of extra fluid.
  - It is used to treat brain swelling.
  - It is used to lower high eye pressure.
  - It is used to help get rid of unwanted substances in the body.



Disaccharides: Sucrose-Lactose-Maltose

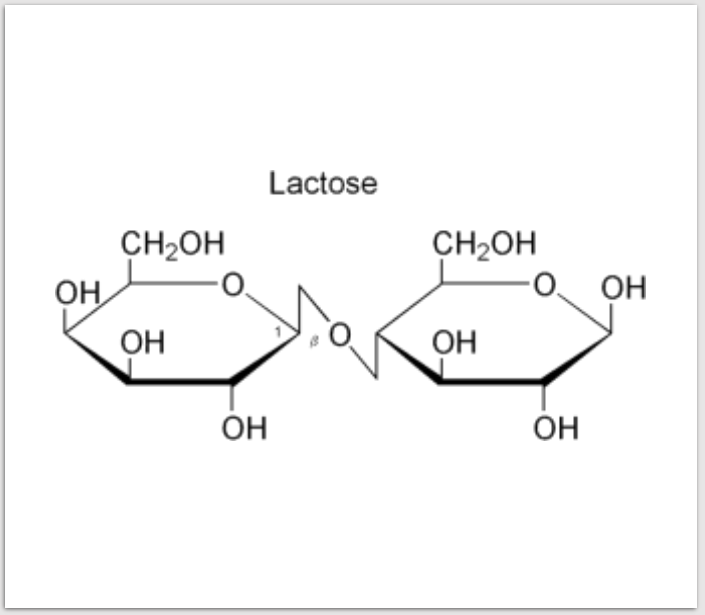
- **Sucrose** ($C_{12}H_{22}O_{11}$)is a disaccharide made up of **50% glucose and 50% fructose** and has a glycemic index of 60 & Gl=15/25g serving.
- **Sucrose** is common table sugar.
- **Sucrose** is obtained from sugar cane or sugar beets.
- Fruits and vegetables also naturally contain sucrose. When sucrose is consumed, the enzyme beta-fructosidase separates sucrose into its individual sugar units of glucose and fructose. Both sugars are then taken up by their specific transport mechanisms.
- The body will use **glucose as its main energy** source and **the excess energy from fructose**, if not needed, will be poured into fat synthesis, which is **stimulated by the insulin released in response to glucose**.
- **Sucrose is a good environment for bacterial growth (Tooth Decay).**



Disaccharides:

Sucrose-Lactose-Maltose

- **Lactose** ($C_{12}H_{22}O_{11}$) is a disaccharide sugar composed of galactose and glucose that is found in milk.
- In order for lactose to be absorbed from the intestine and into the body, it must first be split into glucose and galactose. The glucose and galactose are then absorbed by the cells **lining** the small intestine.
- The easiest way to diagnose **lactose intolerance** is to avoid **dairy** products such as milk, cheese, yogurt, and ice cream and see **if** the symptoms go away.
- **If**, after one week, you consume a glass of milk and the cramps and diarrhea return, it's highly likely you are **lactose intolerant**.



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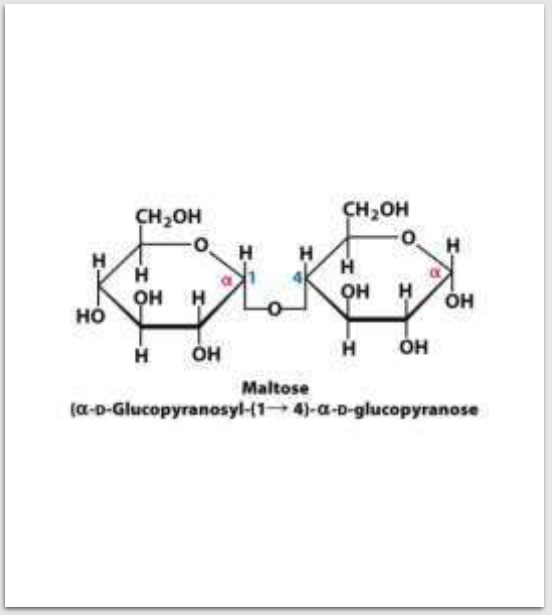
Disaccharides: Sucrose-Lactose-Maltose

- **Maltose** ($C_{12}H_{22}O_{11}$), also known as maltobiose or malt sugar, is a disaccharide formed from two units of glucose joined with an α(1→4) bond.
- In the isomer isomaltose, the two glucose molecules are joined with an α(1→6) bond.
- **Maltose** is **broken down** by the enzyme maltase so that there are two glucose molecules from which the glucose metabolism obtains energy. The glucose so produced is either utilized by the **body** or stored in the liver as glycogen.



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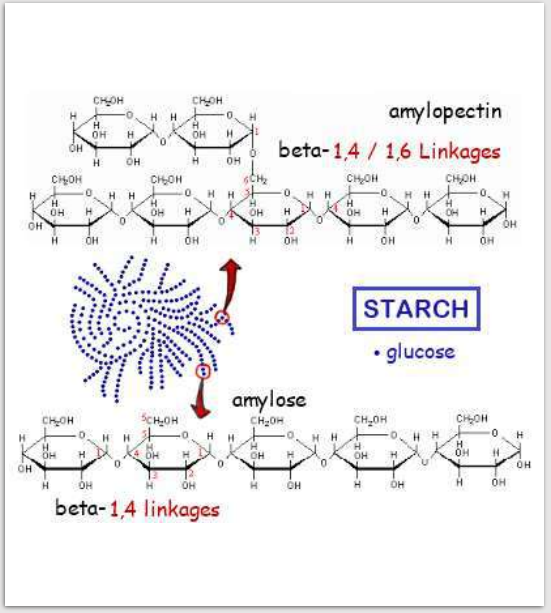
Polysaccharides: Starch

- **Starch** or amylum is a polymeric carbohydrate consisting of a large number of glucose units joined by glycosidic bonds.
- **Starch** is a very important source of sugars in our diet. We get starch when we eat corn, potatoes, wheat and rice. Our body has amylase, which is an enzyme found in saliva and the pancreas that break down starch. The brokendown starch can be used as energy or stored as glycogen
- When eat starchy foods, the starches are broken down into sugars, including glucose, and maltose, by an enzyme called amylase found in saliva and small intestine.



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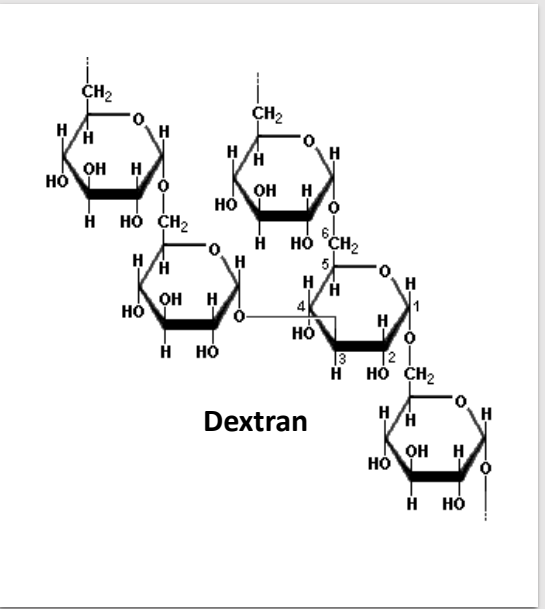
Polysaccharides: Dextran

- **Dextran** is a complex branched glucan,$(H(C_6H_{10}O_5)x\ OH)$.
- The straight chain consists of α-1,6 glycosidic linkages between glucose molecules, while branches begin from α-1,3 linkages.
- **Dextran 40** used for:
  - Shock
  - Prophylaxis of Thromboembolic Disorders
- **Dextran 70** used for
  - to expand blood volume
  - Shock caused by bleeding or burns when blood transfusions are not quickly available.



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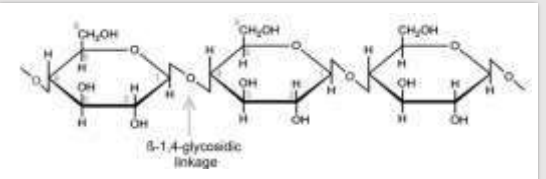
Polysaccharides: Cellulose

- **Cellulose** ($(C_6H_{10}O_5)_n$) is an important structural component of the primary cell wall of green plants, many forms of algae and the oomycetes.
- **Cellulose** is the most abundant organic polymer on Earth.
- It is a linear β-glucan polysaccharide
- **Cellulose** is an excellent fiber. Wood, cotton, and hemp rope are all made of fibrous cellulose.
- **Cellulose** is the major constituent of paper.
- **Cotton**:
  - Gossypium is the cotton genus. It belongs to the tribe Gossypieae, in the mallow family, Malvaceae,
  - Cotton is the primary natural fibre used by modern humans,
  - Cotton is used to make a number of textile products.



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Polysaccharides: Gums: Acacia –Gum Arabic

- Gum Arabic, also known as **acacia gum**
- **Gum arabic** used as hydrocolloids is obtained from two tree species,**Acacia** senegal and **Acacia** seyal.
- **Senegal grade** is an emulsifier, much used in beverage emulsions.
- **Seyal grade** is used in confectionery, coatings and as a soluble dietary fiber.
- As a medicine, **acacia** is taken by mouth to reduce cholesterol levels and to help increase weight loss, soluble fiber can help to encourage intestinal regularity and emollient.

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Polysaccharides: Gums: Acacia –Gum Arabic

- Gum arabic formatted from 2 parts:
  1. **Soluble part:** Arabian 250.000 D which by hydrolysis give arabinic and gummic acid. Arabinic acid by acid hydrolysis gives glucose + arabinose + ramnose + uronic acid (osuronic nucleus).
  2. **None - soluble part :** represent 1 % from the product which by hydrolysis give gel.

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Polysaccharides: Gums: Acacia - Tragacanthae

- **Gum tragacanthae, Dried gummy exudation obtained from incisions on stems and branches of *Astragalus gummifer* .**
- **Chemical Constituents :**
  - **Water soluble portion : 8 to 10% Tragacanthin**
  - **Water insoluble portion : Bassorin**
    - **Traces of starch and Tragacanthic acid**
    - **Galacturonic acid, D-galacto-pyranose, D-xylo-pyranose, L-arabino-rhamnose**
- **With strong iodine solution, it gives Green color.**
- **It is used as demulcent, emulsifying agent, suspending agent and in stomatology (cement dent) .**

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Polysaccharides: Gums: **locust gum, *Ceratonia siliqua* (Carob)**

- Carob is best known to us as a substitute for chocolate.
- The Egyptians used it for an adhesive for mummy bindings.
- Carob gum has been found to treat **infantile diarrhea** and to control **hyperlipidemia** (high cholesterol). Carob germ, with its good amino acids profile and its high content of polyunsaturated n-6 fatty acid, has been found to be suitable both as a major dietary item and for medical use, once cooked to **destroy natural toxicants** such as trypsin inhibitors.
- A pioneer source of seed galactomannans.

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Polysaccharides: Gums: ***Tamarindus indica* تمر هندي**

- **Tamarind (*Tamarindus indica*) is a leguminous tree in the family Fabaceae**
- **Rich in polysaccharides and fibers.**
- **Rich in mineral (k, p, Mg, Fe),vitamins (C, folate, B_1, B_2, B_3, B_6), choline, unsaturated fatty acids, and protein.**
- **Benefits:**
  - **Improves Digestion:** considered a natural laxative and its dietary fiber content is a major reason for this property.
  - **Protects Heart Health** Studies on tamarind have shown it to be effective in reducing blood pressure and cholesterol. The fiber content in tamarind certainly has something to do with the reduction in cholesterol and potassium in tamarind may be responsible for a reduction in blood pressure.
  - **Improves Circulation** Tamarind is a very good source of iron.
  - **Improves Nerve Function**
  - **Weight Loss**
  - **Manages Diabetes**
  - **Anti-inflammatory agent**
  - **Boosts Immunity**

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Polysaccharides: Mucilage: Plantago - Plantain

- Plantain is a low growing perennial plant belonging to the Plantaginaceae family.
- Plantain is found all over the world, and is one of the most abundant and accessible medicinal herbs. It contains many bioactive compounds, including allantoin, aucubin, ursolic acid, flavonoids, and asperuloside.
- Scientific studies have shown that plantain extract has a wide range of biological effects, including "wound healing activity, anti-inflammatory, analgesic, antioxidant, weak antibiotic, immunomodulating and antiulcerogenic activity

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Polysaccharides: Mucilage: *Althea officinalis* - Marsh mallow- خبيزة

- Part used: folium and flos
- Benefits:
  - Anti-inflammatory agent (stomach ulcer)
  - Helps to rejuvenate the deterioration of the skin
  - Enhances the immunity power of the cells
  - Antibacterial agent
  - Common cold, flu, bronchitis, and cough.
  - Very effective in curing and healing the cysts that build up in the body.
  - Rich in minerals and vitamins

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Polysaccharides: Mucilage: Tilia flos- الزيزفون

- Tilia flos (lime flower) consists of the whole dried inflorescence of *Tilia cordata* Miller
- Chemical constituents
  - **Carbohydrates** - Mucilage polysaccharides (3%). Five fractions identified yielding arabinose, galactose, rhamnose, with lesser amounts of glucose, mannose, and xylose; galacturonic and glucuronic acids
  - **Acids** - Caffeic acid, chlorogenic acid and p-coumaric acid
  - **Amino acids** - Alanine, cysteine, cystine and phenylalanine
  - **Flavonoids**
  - **Volatile oil**
  - **Saponin**
  - **Tocopherol**

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Polysaccharides: Mucilage: Tilia flos- الزيزفون

- **Benefits:**
  - Traditionally it has been used for migraine, hysteria, arteriosclerotic hypertension, feverish colds, and specifically for raised arterial pressure associated with arteriosclerosis and nervous tension
  - The Commission E approved lime flower for colds and cold-related coughs
  - Lime flower is stated to possess sedative, antispasmodic, diaphoretic, hypotensive, emollient, diuretic and mild astringent properties.
  - Pancreatic lipase inhibition
  - Antimicrobial and antifungal activity
  - Hepatoprotective activity
  - Antidiabetic activity
  - Diuretic,

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Mel Depuratum (Appidae)

- Chemical composition of honey:
  - Water
  - D-Fructose 38%
  - D-Glucose 32%
  - Sucrose 1%
  - Maltose 7%
  - Higher sugar 1.5%
  - Protein
  - Minerals & Vitamins
  - Amino acids
  - Enzymes
    - Invertase
    - Diastase
    - Glucose oxidase
    - Catalase

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Mel Depuratum (Appidae)

- Apis mellifica (Honey) is a sweet fluid made by honeybees from the nectar of flowers. It is generally safe,
- Honey has been used to heal burns and prevent infection for thousands of years. It has been used as a wound cover in studies on treating burns and is found in many licensed medical products.
- Honey used together with chemotherapy may be a promising and inexpensive way to prevent low white blood cell count caused by chemotherapy.
- Honey may be an inexpensive treatment for cough in children with upper respiratory tract infections (URIs).
- Honey has been proposed as a potential sugar substitute.
- Honey applied to the skin may be a cost-effective treatment for diabetic foot ulcers, due to its antibacterial and tissue-healing properties.
- Honey has been studied for the treatment of Fournier's gangrene. However, it is often used with antibiotics,

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Polysaccharides: Mucilage: *Ficus carica* L. (Moraceae)

- Phytochemicals:
  - Carbohydrates: ribose, xylose, arabinose, **fructose, glucose, galactose, sucrose**, maltose, lactose and dextrose
  - Phenols: acids, aldehydes, flavonoids, anthocyanin pigments, quercetin rutinoside.
  - Volatile compounds
  - Triterpenoids
  - Phytosterols
- In traditional medicine, it is useful in nose bleeding, blood leprosy, inflammation, weakness, paralysis, thirst, diseases of liver and spleen, pain in the chest, constipation, piles, and stimulates hair growth.
- The fruit is antipyretic, tonic, purgative, aphrodisiac, and lithotriptic (تفتيت الحصى),hepatoprotective, hypoglycemic, hypolipidemic, and antimicrobial activities.

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Polysaccharides: Mucilage: *Ficus carica* L. (Moraceae)

- **Fresh Vs Dried Figs**
  - Dried figs are easily accessible and easy to store with a much longer shelf life.
  - There is a loss of some water soluble vitamins in the drying process, the fat soluble vitamins, minerals and other beneficial compounds increase.
  - Dried figs contain pectin, which is thought to lower blood cholesterol.
  - Dried figs are a better source of phenolic compounds and antioxidants than the fresh ones.
  - Laxative effects of some dried fruits are more than fresh fruits including figs.
  - Figs are one of the most fiber rich foods available. High amounts of fiber in the diet can benefit overall health by preventing certain types of abdominal cancer, as well as colon cancer.
  - Dried figs are high in potassium and low in sodium.

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Artificial Sweeteners

- The FDA has approved five **artificial sweeteners**: **saccharin (3500 times sweeter than sucrose)**, acesulfame, **aspartame (1500 times sweeter than sucrose)**, neotame, and sucralose.
- It has also approved one natural low-calorie **sweetener**, **stevia**. Stevia is 200 to 300 times sweeter than table sugar.
- **Top 5 Sugar Substitutes**
  - Raw Honey.
  - Dates.
  - Coconut Sugar.
  - Maple Syrup.
  - Agave Syrup.

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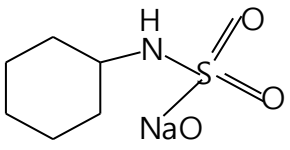
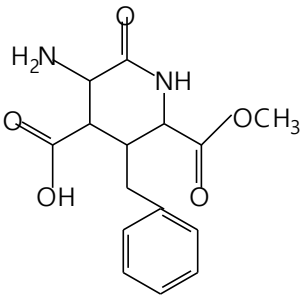
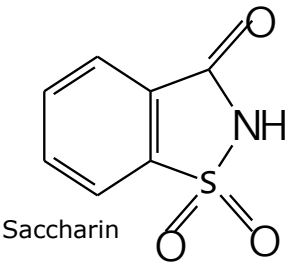


Cyclamate



Aspartame



Saccharin

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Artificial Sweeteners

- **Human reports to FDA, too, have associated aspartame to adverse reactions and life-threatening conditions that include:**
  - Migraines.
  - Change in vision.
  - Nausea and vomiting.
  - Insomnia / sleep problems.
  - Abdominal and joint pains.
  - Change in heart rate.
  - Increase triglyceride levels.
  - Depression.
  - Memory loss.
  - Brain cancer