

**COVENANT UNIVERSITY
NIGERIA**

*TUTORIAL KIT
OMEGA SEMESTER*

PROGRAMME: BIOCHEMISTRY

COURSE: BCH 421

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BCH 421: Plant Biochemistry

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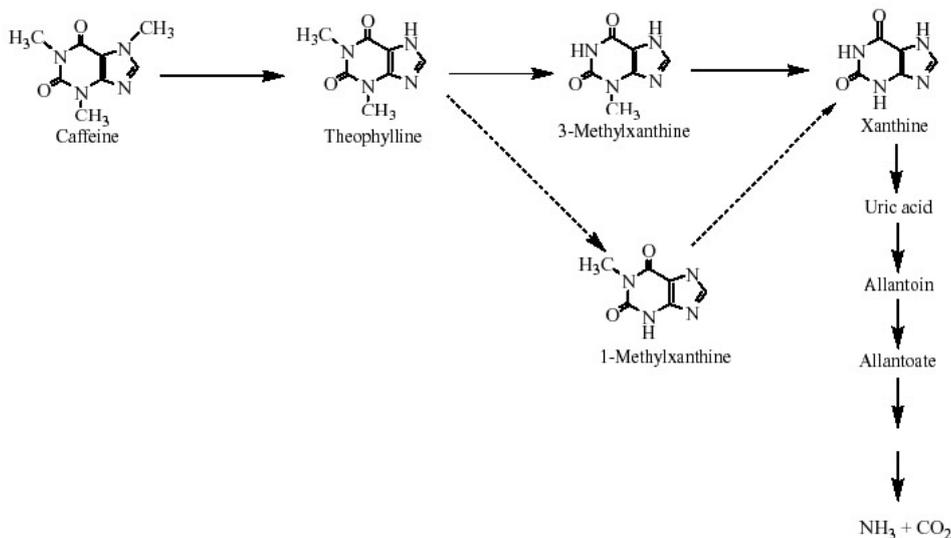
Tutorial Questions and Answers

1) What do you understand by “bioassay guided fractionation”?

- Activity-guided fractionation is the most frequently cited technique for separating plant compounds and isolating only those that exhibit the desired activity.
- It involves various techniques of high-performance liquid chromatography (HPLC)-piloted column chromatography for separating plant components, as well as biological testing to detect the desired activity within each separated fraction.

2) Explain how isolated compounds from traditional medicinal plants are characterized.

3) Propose a possible degradative pathway for caffeine metabolism in coffee plants



Possible degradation pathways of caffeine in coffee plants. The major pathway is shown in arrows with a solid line, and minor routes with a dotted line.

- Caffeine is slowly degraded with the removal of the three methyl groups, resulting in the formation of xanthine.
- Xanthine is further degraded by the conventional purine catabolism pathway to CO_2 and NH_3 via uric acid, allantoin and allantoate.
- Since exogenously supplied theophylline is degraded to CO_2 far more rapidly than caffeine, the initial step, namely the conversion of caffeine to theophylline, seems to be the major rate-limiting step of caffeine catabolism.

4) WHAT DO YOU UNDERSTAND BY THE ‘Z-SCHEME’

- In plants, light-dependent reactions occur in the **thylakoid membranes** of the chloroplasts and use light energy to synthesize **ATP and NADPH**.
- The light-dependent reaction has two forms: cyclic and non-cyclic. In the non-cyclic reaction, the photons are captured in the light-harvesting antenna complexes of **photosystem II** by chlorophyll and other accessory pigments.
- When a chlorophyll molecule at the core of the photosystem II reaction center obtains sufficient excitation energy from the adjacent antenna pigments, an electron is transferred to the primary electron-acceptor molecule, **pheophytin**, through a process called photoinduced charge separation.
- These electrons are shuttled through an electron transport chain, the so-called *Z-scheme* that initially functions to generate a chemiosmotic potential across the membrane.

- An ATP synthase enzyme uses the chemiosmotic potential to make ATP during photophosphorylation, whereas NADPH is a product of the terminal redox reaction in the *Z-scheme*. The electron enters a chlorophyll molecule in **Photosystem I**.

5) WITH THE AID OF AN APPROPRIATE DIAGRAM, DISCUSS THE CALVIN- BENSON CYCLE

6) DIFFERENTIATE THE Z-SCHEME FROM OXIDATIVE PHOSPHORYLATION

Z-SCHEME	OXIDATIVE PHOSPHORYLATION
It occurs in the chloroplast	It occurs in the mitochondria
It produces NADPH in addition to ATP	ATP is the major product of the reaction
Water is oxidized to oxygen	Oxygen is reduced to water
It is made up of two photosystems (I and ii)	It is made up of five integral membrane protein complexes
Photons excites electrons for transport from light harvesting molecules	The source of electron is from oxidative breakdown of macromolecules mainly glucose

7) GIVE A BRIEF ACCOUNT ON THE BIOSYNTHESIS OF THE CELL WALL

8) WRITE SHORT NOTE ON THE FOLLOWING TERMS

- a) Primary cell wall b) Secondary Cell wall c) Collenchyma cell d) Sclerenchyma cell

9) Describe the metabolism of alkaloids in a named plant

10) Discuss with structural illustrations the roles of plant flavonoids and alkaloids in disease management.

11) Discuss briefly the African traditional system of medicine

- African traditional medicine is the oldest and perhaps the most diverse of all medicine systems. Africa is considered to be the cradle of mankind with a rich biological and cultural diversity marked regional difference in healing practices.
- Unfortunately, the systems of medicines are poorly recorded and remain so till date.
- Yet, the documentation of medicinal uses of African plants is becoming increasingly urgent because of the rapid loss of the natural habitats of some of these plants due to anthropogenic activities.
- The African continent is reported to have one of the highest rates of deforestation in the world.
- The paradox is that it is also a continent with a high rate of endemism with the Republic of Madagascar topping the list at 82%.
- African traditional medicines in its varied forms, is holistic involving both the body and the mind.
- The healer typically diagnoses and treats the psychological basis of an illness before prescribing medicines to treat the symptoms.
- In sub-Saharan Africa, the ratio of traditional healers to the population is 1/500, while that for medical doctors to the population is 1/40 000.
- In some African countries, up to 70% of the general population receives treatment from traditional healer.
- Across the Southern African Development Community, there exists an extensive network of traditional health providers that has an important role in health-care delivery, particularly in rural areas where western medical care is limited.
- Traditional healers occupy a central place in the primary health care of these communities.

- They serve not only as practitioners but also as educators, counselors, support workers, custodians of indigenous knowledge, and teachers of traditional culture and spirituality.

12. Describe the metabolism of gibberellins.

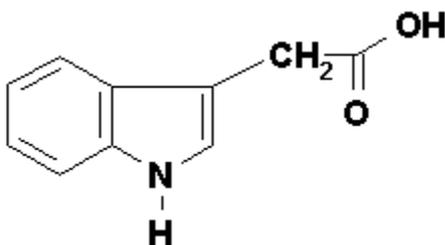
13. Explain the role of auxin in phototropism.

- auxin is a plant hormone;
- produced by the tip of the stem/shoot tip;
- causes transport of hydrogen ions from cytoplasm to cell wall;
- decrease in pH / H⁺ pumping breaks bonds between cell wall fibres;
- makes cell walls flexible/extensible/plastic/softens cell walls;
- auxin makes cells enlarge/grow;
- gene expression also altered by auxin to promote cell growth;
- (positive) phototropism is growth towards light;
- shoot tip senses direction of (brightest) light;
- auxin moved to side of stem with least light/darker side
- causes cells on dark side to elongate/cells on dark side grow faster;

14. Explain the degradation of cytokinins.

15. Describe the active auxin

- The term auxin is derived from the Greek word auxein which means to grow. Auxins were the first plant hormones discovered. Compounds are generally considered auxins if they can be characterized by their ability to induce cell elongation in stems and otherwise resemble indoleacetic acid (the first auxin isolated) in physiological activity. Auxins usually affect other processes in addition to cell elongation of stem cells but this characteristic is considered critical of all auxins and thus "helps" define the hormone.



STRUCTURE OF INDOLE ACETIC ACID

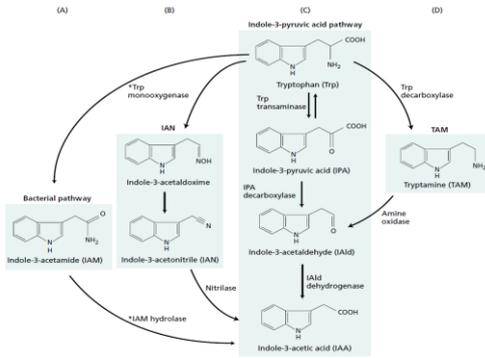
16. Explain the degradation of cytokinins

17. State the different types of plant hormones

- Auxins
- Cytokinins
- Gibberellins
- Abscisic Acid
- Ethylene

18. State the roles of giberellin in plant growth

19. Highlight the mode of synthesis of indole acetic acid (IAA).



Multiple Pathways Exist for the Biosynthesis of IAA. IAA is structurally related to the amino acid tryptophan, and early studies on auxin biosynthesis focused on tryptophan as the probable precursor. Auxin (IAA) synthesis occurs by two primary pathways in plants.

–A tryptophan-dependent pathway

–A tryptophan-independent pathway

The tryptophan-dependent pathway is generally a three step pathway in plants

20. Outline the functions of auxin

- Stimulates cell elongation
- Stimulates cell division in the cambium and, in combination with cytokinins in tissue culture
- Stimulates differentiation of phloem and xylem
- Stimulates root initiation on stem cuttings and lateral root development in tissue culture
- Mediates the tropistic response of bending in response to gravity and light
- The auxin supply from the apical bud suppresses growth of lateral buds
- Delays leaf senescence

BCH 422: PHARMACOLOGICAL AND TOXICOLOGICAL BIOCHEMISTRY

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1. What are chemotherapeutic agents and how do they act?

Chemotherapeutic agents are chemical compounds used to treat diseases, infections, or other disorder. It can be endogenous compounds or exogenous compounds. They produce a pharmacological response by binding to a receptor or interacting with a cellular component to elicit their response. It may also produce a response by prevent the binding of an endogenous substance to the receptor. The binding of the drug to the receptor produces a physiologic effect/response

2. What are receptors? How do you measure the effect of a drug on a receptor?

3. What are agonist and antagonists? An agonist is a drug (or endogenous substance) that binds to a receptor and activates the cell's response. It must bind to the receptor to initiate a functional response. Agonists can be full, partial or inverse. Antagonists are drug that blocks the binding of or reduces the action of an agonist is called *antagonist*. Antagonists reverse the effects of agonists. Antagonists can be competitive or non-competitive.

They both both bind to the receptor but only agonists activates the receptor, they lack specific and selective effects. They are called non-specific and have non-specificity properties i.e. each receptor can produce a variety of physiologic responses.

4. Discuss 5 types of receptors, Describe different types of Agonist/antagonist-receptor types

5. What are possible mechanism of action of chemotherapeutic drugs?

Chemotherapeutic agents can produce their effects by acting on:

Receptors E.g. antihistamines inhibit histamine receptors in allergy treatment

By Inhibiting carriers (molecules that transport one or more ions across plasma membrane e.g. omeprazole blocks Na/H⁺ pump in the gastric parietal cell in ulcer E.g. Sulfonylurea inhibit K⁺ channels to treat non-insulin dependent diabetes

By modulating or blocking ion channels e.g. calcium channel blocker (nifedipine) used for treating heart diseases and hypertension E.g. Local anaesthetics block Na⁺ channel, no action potential within the area

By inhibiting enzymes E.g. Trimethoprim hihibits dihydrofolate reductase in bacterial infection, e.g Anticancer drug inhibit DNA polymerase, E.g. Zidovudine inhibit viral reverse transcriptase in HIV patients

Acting on Ligand-gated ion channels and G-protein-coupled receptors are important in anaesthesia.

6. What is modulation of receptors. Describe 5 specific receptors and mention how agonist and antagonists can inhibit or activate such receptors

7. What are antimicrobial agents, mention the types and classes of antimicrobial drugs?

Antimicrobial agents are chemotherapeutic agents that inhibit the growth of or kill pathogens. They were originally obtained from microorganisms such as *Penicillium notatum* but can also be synthetic. They can be classified based on how they act or where they act in the microorganism.

Based on how they act: Bacteriostatic antimicrobial agents only inhibit the growth or multiplication of the bacteria giving the immune system of the host time to clear them from the system. Bactericidal agents kill the bacteria and therefore with or without a competent immune system of the host, the bacteria will be dead.

Based on the site of action: Inhibitors of the cell wall synthesis e.g. Penicillin, Inhibitors of ribosome function e.g. Tetracycline, Inhibitors of nucleic acid synthesis e.g. quinolones, Inhibitors of folate metabolism e.g. sulfonamides, Inhibitors of cell membrane function.

8. Discuss the mechanism of action of the Penicillin, quinolones, and sulphonamides

9. What is antimicrobial resistance, what are the mechanisms of resistance to antimicrobial?

It is the ability of an organism to withstand damaging effect of a drug i.e. to survive in the presence of drug. Drug resistance can be **Intrinsic (natural) resistance**, naturally do not possess target sites for the drugs and therefore the drug does not affect them or **Acquired resistance** develops as a consequence of infectious agents' adaptation to exposure to antimicrobials or disinfectants used in humans or agriculture

Generally, resistance can develop through: the presence of an enzyme that inactivates the antimicrobial agent, the presence of an alternative enzyme for the enzyme that is inhibited by the antimicrobial agent, mutation, horizontal gene transfer, efflux of drugs, target bypass and target modification.

10. Discuss development of resistance to a named antimicrobial agent

11. Define the following terms: Dose, Internal/absorbed dose, Delivered/effective/target organ, Acute exposure, Subacute, Subchronic and Chronic exposure.

Dose—the total amount of a toxicant administered to an organism at specific time intervals. The quantity can be further defined in terms of quantity per unit body weight or per body surface area. **Internal/absorbed dose**—the actual quantity of a toxicant that is absorbed into the organism and distributed systemically throughout the body. **Delivered/effective/target organ dose**—the amount of toxicant reaching the organ (known as the target organ) that is adversely affected by the toxicant. **Acute exposure**—exposure over a brief period of time (generally less than 24 h). Often it is considered to be a single exposure (or dose) but may consist of repeated exposures within a short time period. **Subacute exposure**—resembles acute exposure except that the exposure duration is greater, from several days to one month. **Subchronic exposure**—exposures repeated or spread over an intermediate time range. For animal testing, this time range is generally considered to be 1–3 months. **Chronic exposure**—exposures (either repeated or continuous) over a long (greater than 3 months) period of time. With animal testing this exposure often continues for the majority of the experimental animal's life, and within occupational settings it is generally considered to be for a number of years.

12. Toxicants/pollutants affect the synthesis and function of haemoglobin. Discuss.

13. Outline the principles of teratogenesis

Susceptibility to teratogenesis depends on the embryo's genotype that interacts with adverse environmental factors (G × E interaction).

The developmental stage of exposure to the conceptus determines the outcome.

Teratogenic agents have specific mechanisms through which they exert their pathogenic effects.

The nature of the teratogenic compound or factor determines its access to the developing conceptus/tissue.

The four major categories of manifestations of altered development are death, malformation, growth retardation, and functional deficits.

The manifestations of the altered development increases with increasing dose (i.e., no effect to lethality).

14. Explain the role of genes in carcinogenesis.

15. Differentiate between benign and malignant neoplasms.

TABLE 13.1 Distinctions between Benign and Malignant Neoplasms

Benign	Malignant
Well differentiated; resembles a cell of origin	Poorly differentiated or anaplastic
Grows by expansion	Grows by expansion and infiltration
Well circumscribed, often encapsulated by a peripheral rim of fibrous tissue	Poorly circumscribed and invades stroma and vessels
Grows at a normal rate	Growth rate usually increased
Few mitotic figures	Frequent mitotic figures
Growth may be limited	Progressive growth
Does not metastasize, seldom dangerous	Metastasis usual; can be fatal
Adequate blood supply	Often outgrows blood supply, becomes necrotic

16. Describe the mechanism of action of anti-inflammatory drugs.

17. Describe the multistep process of carcinogenesis

18. Describe the metabolism of acetaminophen (paracetamol)

19. Explain the mechanism of action of cytochrome P450 in metabolism.

20. Discuss the role of ADME in toxicology.