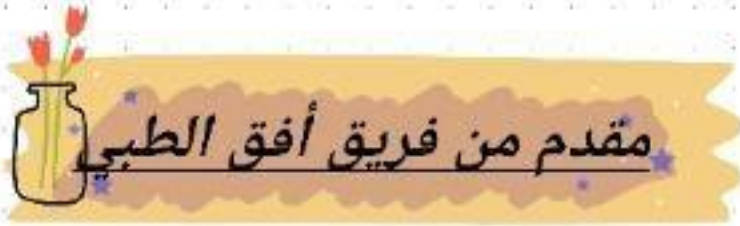
مقدم من فريق أفق الطبي


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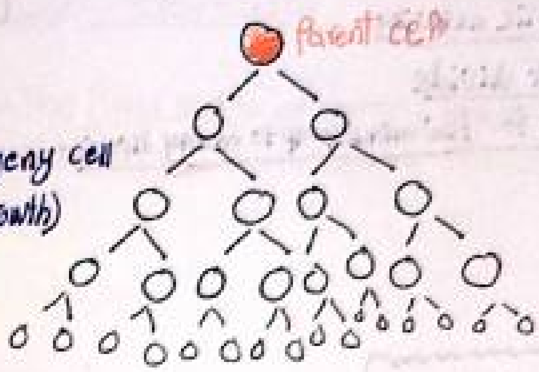
حركة الشبيبة الفتحاوية
جامعة الأزهر
Fateh Youth Movement

CHAPTER (3): Growth

*Growth cycle

* bacteria reproduce by: binary fission
* binary fission: Parent cell divides to form 2 progeny cell
* bacteria undergo: exponential growth (logarithmic growth)



No. of cell : 1 2 4 8 16 32 64
Exponetial : 2^0 2^1 2^2 2^3 2^4 2^5 2^6
(0 → generation)

* 1 bacteria with produce $2^4 = 16$ bacteria after 4 generation.
* doubling time (generation) time of bacteria rangs from as
  * little as 20 minutes E.coli
  * to as long as 18 hours for mycobacterium tuberculosis
  * Clostridium perfinges 10 minutes → one of the fastest bacteria
  * Pyrifera → fastest bacteria (fastest growing bacteria in the world)
  * M leprae longest known generation time of about 14 days
    (M = mycobacterium)

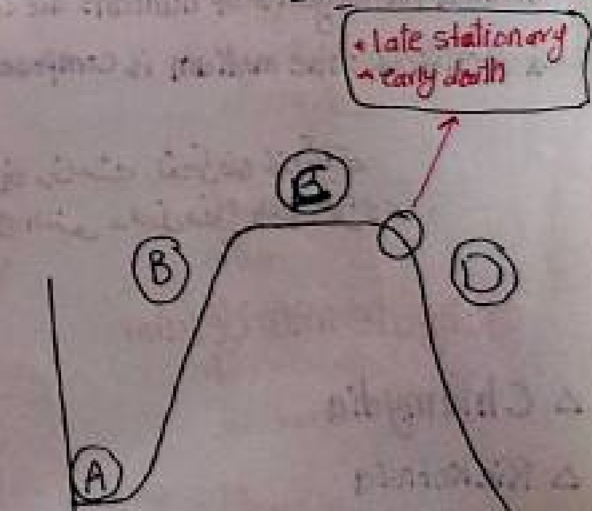
* Slow growth bacteria has less mutation
* Antibiotic resistance more in fast growing bacteria

* Short doubling (generation) time due to → produce large number of bacteria.
* Example

E coli will produce over 1000 Progeny in about 3 hours
over 1000 000 in about 7 hours

* doubling time various from bacteria to another حسب
  A) Species
  B) amount of nutrients
  C) Temperature
  D) PH
  E) environmental factor

أكثر منطقة بصير افراز لل Toxins



* The growth cycle of bacteria has 4 major phases:

A) ~~log phase~~ lag phase
B) log, exponential (logarithmic) growth phase)
c) stationary phase
D) Death phase (logarthemic decline)

Growth cycle:

[1] log phase

* metabolic activity
* cell not divide
* can last for few minutes up to many hours.

[2] log (logarthmic) phase (exponential phase)

* rapid cell division
* many antibiotics are most efficacious [Penicillin]
  ↳ because they act by disrupting biosynthesis processes carried out by bacterial cell during active growth

لانها تعمل من خلال تعطيل عمليات التخليق الحيوي التي تقوم بها الخلية البكتيرية أثناء النمو.

* (هي أكثر منطقة لتفاعل البكتريا)

[3] Stationary phase

* nutrient depletion
* product such as toxic
* No. of new cell = No. of die cells [steady state]

* [chemostat]
  ↳ apparatus جهاز
  ↳ nutrints يضخ

waste عشان نخلصها منه ونخلي البكتريا في log phase

+ نخليها توصل على stationary phase

[4] Death phase (decline phase) تناقص الحياة

marked by decline in the number of viable bacteria.

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*Obligate intracellular growth

* most bacterial Pathogens of humans are capable of growing on: artifical media in the clinical laboratory
* Artifical: the medium is composed of purified chemial such as A) sugar B) amino acid C) salt (Nacl)

*غالباً ما يضاف الدم على شكل دم الحراف وذلك لأغراض غذائية وليس لأن البكتريا تحتاج الى النمو داخل خلايا الدم الحمراء.

obligate intra cellular

- Δ Chlamydia
- Δ Rickettsia
- Δ Ehrlichia
- Δ Anaplasma

سبب التسمية

* لانهم لا يستطيعون انتاج ATP بكمية كافية فلذلك يدخلوا داخل الخلية عشان يستخدموا الـ ATP الذي تنتجه الخلايا.

robic + Anaerobic Growth

* supply of oxygen enhances metabolism and Growth

* The oxygen act as Hydrogen acceptor in the final steps of energy production Catalyzed by flavoproteins , cytochromes because the use of oxygen generate 2 toxic molecules :

A) Hydrogen peroxide (H_2O_2)

B) Free radical superoxide (O_2^-)

* Bacteria require 2 enzymes to detoxify these molecules when oxygen is used .

A) Superoxide dismutase → catalyzes the following reaction

$$2O_2^- + 2H^+ \longrightarrow H_2O_2 + O_2$$

B) Catalase → catalyzes the following reaction

$$2H_2O_2 \longrightarrow H_2O + O_2$$

oxygen is an important Criterion for Classifying bacteria

→ Micraerophilic
Need to live in low O_2

→ Aerotolerant Anaerobe
* Dont O_2 but can tolerate it
* has dismutase or catalase

O_2 ✓ O_2 X O_2 X

Obligate aerobes

* require oxygen because its
• ATP generation system dependent on oxygen as a hydrogen acceptor

* mycobacterium tuberculosis (M. tuberculosis)

* Bichlamidia

* rickettsia

Facultative anaerobes

* use oxygen if present to generate energy by respiration

* Can use fermintation pathway to synthesis's in the absence of sufficient oxygen

* E. Coli

obligate anaerobes

* Cannot grow in the presence of oxygen.

↓

because they lack either

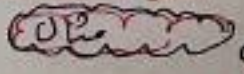
A) superoxide dismutase

B) Catalase

or both.

* different in their response to oxygen exposure

Some can survive but are not able to grow → others are killed rapidly



clostridium tetani

↳ important in Clinical ... Pathogens is ... sugar

Example 1

Neisseria gonorrhoeae X Neisseria meningitids

glucose ✓ / X maltose — glucose maltose

تميز بينهم على اساس تخمير

α [Glucose or maltose]

E.coli X Salmonella and Shigella

تميز بينهم على اساس تخمير

[lactose]

maltose → glucose + glucose

lactose → glucose + galactose

Fermentation mean ⟶ Break down of sugar (glucose - maltose - galactose) To pyruvic acid and then usually to lactic acid

(glycolytic) — glyco: sugar, lytic: break down

sugar ⟶ pyruvic acid ⟶ lactic acid

Notes

1. Fermentation called [glycolytic]
2. glyco mean [sugar] and lytic mean [break down]
3. lactose is a [disaccharide] composed of [glucose | galactose] so you shoud cleaved by [β glactosidase] in E.coli before Fermentation can occur.

[Fermentation] ← هي العملية الي تتقوم بيها Facultative bacteria بتوليد الطاقة في غياب O_2

[Krebs cycle] في دورة Fermentation الناتج من Pyruvate يدخل الـ O2 *في حال وجود

(Krebs cycle = oxidation cycle = tricarboxylic acid cycle) ويصيراله metabolize ويطلع الناتج $CO_2 + H_2O$

* Krebs cycle بتنتج طاقة > من glycolytic cycle

لذلك Facultative bacteria بتنمو faster في وجود الـ O2

* Facultative + aerobic — Fermentation بتعمل الاهم ولكن

*+ anarebic — aerobes which can only grow in presence O2

aerobic ↓ لا تتخمر — مثل Pseudomonas aeruginosa

[على سبيل المثال]

* Sugar in fermented in the presence of phenol red (indicator)
the PH become acidic the mediam turns yellow

* Sugar Not fermented → no acid is produced + phenol red remain Red.

* Iron metabolism

* Iron in the form of Ferric ion (Fe^{+3})
* Fe^{+3} → Requrie for the growth of bacteria.
→ essential component of cytochromes + other enzyme.

* amount of iron avaliable for pathogenic bacteria in human body is very low
because the iron sequestered (مُعزول) in iron binding protein such as Transferrin.

To obtain iron for their growth, bacteria produce iron binding compound
called Siderophores (حاملات الحديد)

siderophores → such as Enterobactin → Produced by E. coli
→ secreted by bacteria
→ capture iron by (يلتقط) chelathing (مسكة الحديد) it →
then attach to specific receptors on the bacterial surface and
are → actively transported into → cell → where (حيث) the iron becomes avaliable for use.