Respiration

Aerobic Decomposition of glucose

we know that a small fraction about 5% of the chemical potential energy in a glucose molecule has been liberated by the time pyruvic acid is formed in glycolysis which is still available for release in aerobic oxidation of pyruvate to carbon dioxide and water .this is the most important source of energy in all aerobic cells and since these reaction occur in mitrochondrial matrix, the later have been called the power house of the cell (siekevitz,1957).

pyruvic acid is decomposed in a series of step wise reaction. pyruvate combines with CO-A and is decarboxylated that is carbon dioxide is split out of the carboxyl group of the acid, resulting I the formation of acetylCOA. Hydrogen is passed through co-enzyme I NAD(Nicotinamide adenine dinucleotide).The two carbon fragment (acetyl) is no added to a four carbon acid(Oxalo acetic acid)to form a six carbon acid(citric acid), the beginning of series of reaction is called the Tricarboxylic acid cycle or some times the citric acid cycle.citric acid first undergoes internal rearrangement and then is dehydrogenated.After this it is decarboxylated ,giving rise to a five carbon caid (α keto glutaric acid).The five carbon acid inturn is decarboxylated in the presence of COA(Succinyl COA), giving rise to a four carbon acid (Succinic acid).The four carbon acid undergoes series of the dehydrogenation ending with the formation of oxalo acetic acid, which again become a recetor for an acetyl fragment. A considerable amount of energy amounting to 40000-50000cal/mole is liberated in each oxidative decarboxylation. part of this energy is stored in high energy phosphate bonds which is given as-

fig-

Reaction	Net gain in ATP
1.Initiation phosphorylation	-2
2.Substrate phosphorylation×2	+2
3.Hydrogen ion and ETC	
a.from oxidation of 1,3diPGALD×2	+4
b.from pyruvic acid to citric acid× 2	+6
c.from isocitric acid to oxalo succinic acid × 2	+6
d.from $\propto -$keto glutaric acid to succinic acid× 2	+6
e.from GTP to ATP	+2
f.from succinic acid to fumaric acid× 2	+4
g.from Malic acid to oxalic acid× 2	+4

for their elucidation of these reactions Krebs and Lipmannreceived Nobel prize in 1953.

anerobic decomposition of glucose-

The series of steps in glucose breakdown in the cell upto the formation of pyruvic acid , which don´t require oxygen are called glycolysis in animals and fermentation in microorganism and plants. The various steps in the direct anerobic decomposition of glucose are known as Embeden Meyerhoff Pathway after two pioneer investigators. Glucose must first be phosphorylated at the expense of high energy phosphate from ATP.

Glycogenolysis on the other hand liberated a phosphorylated glucose ,which already has one high energy phosphate bond.in either case a second ATP is needed before the hexose phosphate split into to triose phosphates. It should be noted that in the break down of triose phosphates hydrogen is removed by dehydrogenases, and after a series of reactions pyruvic acid appears. Anerobic process is stored in compounds of high phosphate transfer potential, converting ADP to ATP.Since some ATP is used in phosphorylating glucose at the outset,th net gain of ATP is the total stored that minus used. In making calculation of such an ATP gain, It should be remembered that each glucose give rise to two trioses and for each trioses decomposed to pyruvic acid ,to ADP molecules are converted to ATP molecules.Later on pyruvic acid acts as the hydrogen acceptor ,forming lactic acid.In Yeast the the pyruvic acid is decarboxylated and the acetaldehyde thus formedto reduced reduced alcohol,in which the enzymes required for the reactions are also used.

GLUCOSE

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GLYCERALDEHYDE 3PHOSPHATE

↓

1,3 di PGA

↓

PYRUVIC ACID

↓

Lactic acid CO_2+acetaldehyde

↓

Ethanol

This figure showing diagrammatic sketch of anerobicdecomposition or or transformation of glucose into lactate

In terms of this energy this means that anerobic oxidation of glucose nets about 14600 cal/mole starting with glucose or about 2900cal/mole starting with glycogen .Neither reduction of pyruvic acid to lactic acid nor decarboxylation of pyruvic acid to acetaldehyde liberates energy, this can be inferred from the heat of combustions of each of these compunds.The efficiency of glycolysis Is calculated on the basis of the chemical potential of the ATP produced at the expense of free energyreleased in production of lactate from glucose (47000cal/moleglucose) then the efficiency is 14600divided by 47000cal/mle(31%,Lehinger,1971)

$$\text{efficiency}=14600/47000\times100 \cong 31\%$$

Process of mitochondrial Electron Transport Chain and its coupling with phosphorylation

The mitochondrial electron transport starts with the NAD^+ hic hiss reduced to NADH.IT carries to electrons and one proton .Each molecule of NAD^+

accepts two electrons and one proton and is reduced to NADH.NADH donates electrons and a proton to FMN and is oxidized back to NAD^+.Now FMN accepts the two electrons and the protons from NADHand another protons from the internal medium and is reduced to $FMNH_2$. Later on $FMNH_2$ now given up to protons and two electrons and is oxidized to FMN.The electrons are acquired by the iron sulfur (fe-s) protein which however cannot accept the protonsThe protons are transported outside the mitochondria.The iron sulfur protein donates the pair of electrons to ubiquionone(UQ), also called coenzyme Q(COQ).Ubiquinone exist in three forms of oxidations –quinone, semiquinone and hydro quinine.

I..Quinone (Q)is the fully oxidised form with two oxygen atoms connected to the ring by double bonds.

II.Semi quinone (QH) It is reduced form of quinone with a hydrogen atom attatched to one oygen.

III.Hydro Quinone QH_2 I the fully reduced form hydrogen atom attatched to both oxygen.

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according to quinone cycle proposed by Mitchel ubiquinone undergoes changes in the oxidation states during electron transfer . Ubiquinone is considered to be mobile carrier which migrates one side of the membrane to the other. It is assumed that two molecules of ubiquinone are involved in the cycle.

a.fes protein donates one electron to each of two quinone (Q)molecules.The molecules take up a proton (H^+) each from the internal medium and to molecules of semi quinone (QH) are formed.

b.Each QH receives one electron from cyto chrome b and one electron from the interior of the mitochondrion to form hydroquinone(QH_2).

c.It is assumed that two hydro quinone molecule , wiyha total of four protons(H^+) received from the inner surface of the membrane, cross over to the outer surface .Here each QH_2 donates an electron to cyt.c_1 and the proton is released outside. In this process QH_2 is converted to the semi reduced QH state.

d.Each semi quinone QH transfers an electron to cytb and a proton to the external medium and become fully oxidized to Quinone(Q).a total of four protons transported outside the mitochondrion during the Q cycle.

After COENZYME Q, the hydrogen are split up into electrons and protons .The electrons pass down cytochrome b and c and are accepted by cyt,c oxidase.The protons are released into the aqueous environment.cyt.c oxidase contains four units (cyt a,cyt a_3 cu a and cu b)which can carry one electron each.the four electrons are stored in the enzyme prior to discharge.The four electrons combine with four protons form the aqueous medium and one molecule of oxygen to form two molecules of water.

$4H^{+}+4e^{-}+O_2=2H_2O$

Regarding the action of cyt c oxidase two mechanism ie sequential mechanism and quasi mechanism are concentrated. According to sequential mechanism the four electron carrier (cyt a,cyta$_3$,cu$\propto$,cuβ) form a chain between cyt c and oxygen. .Each component carries one electron at a tme.

fig

finally it has been that for each pair of electrons transfer from NADH down the respiratory chain. Six protons are translocated across the mitochondrial membrane from the inside to outside .This increases the proton concentration outside the membrane, set up the proton gradient. The resulting electric potential forces the protons through complex (f_o-f_{1o}).complex ATP ase molecule back into mitochondrion and provides energy for synthesis for ATP. Thus for three pairs of protons passing through the ATPase complex, three molecules of ATP are generated

Role of plant growth substances in Agriculture and horticulture

considerable progress has occurred in the recent past in the identification of new plant growth regulators. They are synthetic hormones such as indole butyric acid napethlene acetic acid ere found useful as resting hormone for woody and herbaceous plants and they are widely used for this purpose.Other compound such as 2,4D were found to be potent inhibitor of plant growth and have been used as weed killers. The use of synthetic auxins as herbicides accounts for about one half the money spent world wide on agricultural chemicals.The other half includes chemicals used as insecticides , fungicides and growth regulators.

(In 1980 it was estimated that about 8000 million dollars was spent on agrichemicals world wide .Interest in the use of growth regulators in crop production arises from the beliefs of plant physiologists and agriculturalists hat maximum levels of plant productivity have been reached by current technology. The large increase in crop yields achieved over the past 30 years, have utilized the technology of the green revolution,improved seeds ,new varieties of plants, fertilizers,irrigations,pesticides and mechanization.Thus agriculturalists and horticulturist are looking for ways to break present yields limits by chemical modification of the plant through the use of chemical growth regulators.Biological screening procedures can be developed for selecting compounds for growth stimulations ,yield enhancement,abscission,dwarfing,and other aspects of plant growth development.Many agricultural chemical companies no combine basic research on studying mechanisms of growth substances activity and empirical screening of new and extra ordinary organic molecules.Therefore it should be evident that growth substances play momentum role in agri horticulture either it is advantageous or dangerous in some extent.Mostly it is more advantageous.

Role of plant physiology in agriculture

The plant physiology play momentous role in all fields of applied Botany, agronomy, floriculture ,forestry, horticulture, land scape gardening ,plant breeding , plant pathology, pharmacognosy, and so forth. Plant physiology probably also assume in increasingly important role agricultural ,research program.As world population increases ,mankind faces enourmosly complex problems.One of the primary task of the future will be to increase food ,forage ,fibre,and wood production substantially through out the world.Future agricultural research programes will be continue, as in the present, to have as their major goals the prediction of new and better varieties and strains of crop plants,the improvement of plant protection against insect diseases and weeds, the control of soil fertility and an increase in mechanization efficiency .But in addition there will be a sharp intensificationof demands of plant physiologist not only to supply basic information regarding how plants grow and develop but also to undertake research programs designed specially to increase yield of plant products.

many aspects of practical agriculture can benefit from more intensive research in plant physiology.The efficiency of photosynthetic conversion of solar radiation in the production of food crops acceptable to human diets can be increased by one or more of several means ,including a decrease in the rate of photorespiration and breeding genetic changes in plant with goal of increased display of leaves so as to create better light capturing systems.improved biological N_2 fixation will offset the enormously expensive chemical synthesis of commercial nitrogen fertilizers. Techniques of tissue culture and cell fussion developed by plant physiologists during the past several years may be used to breed desirable strains of crop plants. Means of avoiding or reducing environmental stresses ,such as drought, frost, and pest can be developed.crop yields can be increased by learning how and when the application of of plant growth regulators to plant is most effective.Now useless of weeds and jungle can be converted to high quality fodder by the addition of fats and proteins produced through large scale culture of algal and yeast cells.Greater efficiency of nutrients uptake from soil can be realized by obtaining superior strains of microorganism for formations of mycorhizal symbiosis with roots.These and other potential applications of research in plant physiology to the solution of practical problems in agronomy forestry, horticulture ,and other fields give an added dimension to the already recognised importance of research in basic plant physiology..

Role of ATP in conservation and transfer of energy

on reviewing the chief functioning of ATP in conservation and transfer of energy ,we know that complex nutrient molecule such as glucose contain much potential energy because of their high degree of structural order .When the glucose molecule is degraded by the oxidation to form the simple small end products CO_2 and H_2O, much free energy becomes available. However ,unless there is some way of capturing or conserving the free energy released when glucose is oxidized. It will simply appear as heat. Although heat energy is useful in maintaining body temperature in higher animals ,it cannot be used to do the mechanical work of muscle contraction or the chemical work of biosynthesis. Heat can do at constant pressure only when it can flow from a warmer to colder body, which is impossible in living cells, since they are isothermal .The temperature is the same in all their parts .Instead of much of the free energy released from glucose and other cellular fuels during their catabolism is conserved by the coupled synthesis of ATP from ADP and pi, ATP ,ADP and pi are present all living cells and serve universally as energy transmitting system.

fig

The chemical energy so conserved in the form of ATP can do work of four kinds

I. It can provide the energy required for the chemical work of biosynthesis. In this process the terminal phosphate group or group of ATP are transferred building block of molecules which thus become energied and prepare for their assembly into micro molecules.

II. ATP is also the energy source for cell motility contraction.

III. For the transport of nutrients through membranes against concentration gradient.

IV. ATP energy is also used in subtle ways to ensure accurate genetic informationtransfer their biosynthesis of DNA/RNA and proteins , indeed information itself I a form of energy,whenever the chemical energy of ATP is used to cell work ,its terminal phosphate group is lost and appears as inorganic phosphate leaving ADP the discharged form of energy carrying system.The ADP can be recharged with a phosphate group ,thus regenerating ATP in reaction that are coupled to the energy yielding degradation of cell fuels.Thus we have an energy cycle in cells,in which ATP serves as the energy carrying link between energy yielding and energy requiring cellular process