

RESPIRATION IN PLANTS

THE RESPIRATORY BALANCE SHEET

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To calculate the net gain of ATP for every glucose molecule one need to follow certain assumptions.

1. There is a sequential, orderly pathway functioning, with one substrate forming the next and with glycolysis, TCA cycle and ETS pathway following one after another.
2. The NADH synthesised in glycolysis is transferred into the mitochondria and undergoes oxidative phosphorylation.
3. None of the intermediates in the pathway are utilised to synthesise any other compound.
4. Only glucose is being respired – no other alternative substrates are entering in the pathway at any of the intermediary stages.

But this kind of assumptions are not really valid in a living system. All pathways work simultaneously and do not take place one after another. Substrates enter the pathways and are withdrawn from it as and when necessary, ATP is utilised as and when needed. Hence, there can be a net gain of 36 ATP molecules during aerobic respiration of one molecule of glucose.

Production of ATP molecules in various processes are as follow –

TABLE

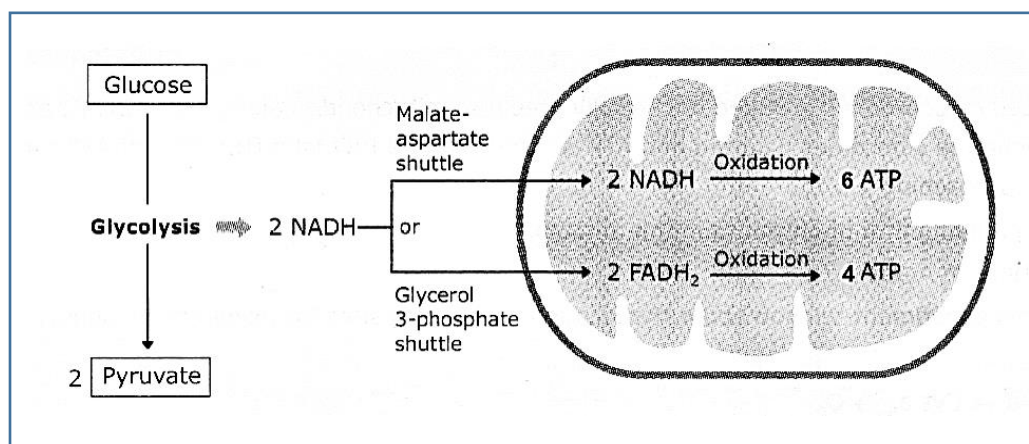
Stage	Production of ATP by substrate level phosphorylation	Formation of NADH +H ⁺ /FADH ₂	Synthesis of ATP by ETS in Mitochondria (NCERT)
Glycolysis	2	2 NADH + H ⁺	2 × 3 = 6

Oxidative decarboxylation of Pyruvic acid	—	2 NADH + H ⁺	2 × 3 = 6
Krebs Cycle	2	6 NADH + H ⁺ 2 FADH ₂	6 × 3 = 18 2 × 2 = 4
	4		34
Total production of ATP by oxidation one molecule of glucose (NCERT) = 34 + 4 = 38 ATPs			

- The production of 38 ATP or 36 ATP in respiration depends upon types of shuttle system.
- The NADH of glycolysis is produced in cytoplasm which has to be carried inside the matrix of mitochondria to carry out ETS.

This NADH is carried to cytoplasm by means of two shuttle systems -

- Malate aspartate shuttle (Heart, Liver, Kidney etc.)
- Glycerol 3- phosphate shuttle (Plants, Nerves, Muscles etc.)



If malate aspartate shuttle is active then the amount of ATP produced by oxidation of one molecule of glucose will be 38 and if glycerol 3-phosphate shuttle is active then amount of ATP would be 36.