Effect of the nature of different substrates on the rate

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Cellular respiration is defined as an enzyme mediated process in which organic compounds such as glucose is broken down into simpler products with the release of energy (Duka, Diaz and Villa, 2009). It is a series of metabolic processes and oxidation-reduction reactions. Oxidation of substrates, such as glucose, is a fundamental part of cellular respiration (Mader, 2009). As a catabolic process, it may or may not require the presence of oxygen. The process that requires oxygen is called aerobic respiration while the process that does not require the presence of oxygen is called anaerobic respiration. Duka, et. al. 2007) Despite of its low yield of only two ATP (energy used by the cells to perform its duties), anaerobic respiration is essential because it continuously synthesizes ATP albeit oxygen is temporarily in short supply. Although anaerobic respiration synthesizes a low yield of ATP (which is the energy used by the cell enables it to perform its duties), it is essential because it is a way to produce ATP even though oxygen is temporarily in short supply. Though this process brings benefits usually, these are accompanied by drawbacks.

One of these downsides is the formation of lactate in the muscles because of “ oxygen debt”, causing it to “ burn” and eventually fatigue, until pyruvate is reduced from lactate (Madur, 2009). Anaerobic respiration can be further divided into two types; namely, alcohol fermentation and lactic acid fermentation. In alcohol fermentation, pyruvate (product of glucose in glycolysis) is converted to 2 molecules of ethanol (C_2H_5OH) and 2 molecules of carbon dioxide (CO_2) while in lactic acid fermentation, pyruvate is reduced directly into lactic acid (Campbell and Reece, 2008).

A good example of organism which produces ethyl alcohol and carbon dioxide through the process of alcohol fermentation is yeast (Madur, 2009). As a unicellular fungus, yeast is also an example of a facultative anaerobe, which depicts an organism with metabolic versatility to harvestfoodenergy by either respiration or fermentation (Campbell and Reece, 2001). Baker's yeast (Saccharomyces cerevisiae), is an important example of yeast for its practical uses and applications in the industry.

The cells release carbon dioxide which leavens the dough that is used to make bread or crackers. The ethyl alcohol produced by fermenting yeast evaporates during baking. Saccharomyces also ferments sugars to alcohol. Wine is produced then yeasts ferment the carbohydrates of fruits, while beer is resulted from the fermentation of grains. Furthermore, the carbon dioxide produced explains why beer and champagne are bubbly when opened (Madur, 2009). As enzymes are needed to be activated in cellular respiration, several factors can affect cellular respiration.

These factors are namely; the presence of co-factors, temperature, and substrate concentration. Cofactors are required by the enzymes so as to activate them, thus, speeding up the rate of the reaction. Also, the temperature affects the rate of the reaction in cellular respiration in a way that if the temperature increases, enzyme activity also increases. Lastly, if the substrate concentration is increased, enzyme activity is also increased because as more substrate molecules fill active sites, more product results per unit time. Madur, 2009) A substrate may be defined as the fuel of cellular respiration, wherein it is the organic substance broken down to generate

energy. Macromolecules such as carbohydrates, fats, or proteins may serve as substrates. However, in yeast, carbohydrates are opted primarily as substrates. Carbohydrates may be classifies according to the number of sugars or its complexity such as monosaccharaides, disaccharides and polysaccharides (Duka, et. al. , 2009).

In order to formulate a hypothesis regarding cellular respiration, yeast was used as the tested substance in the absence of oxygen or anaerobically. Factors such as temperature, substrate concentration and also the amount of distilled water were held constant. The nature of substrate, however, was altered and different substrates were used for the experimentation. Therefore, a hypothesis was formed that if the nature of different substrates affect the rate of cellular respiration in yeast, then the simpler the substrate, the faster the rate of cellular respiration.

The effect of the nature of different substrates on the rate of cellular respiration of yeast can be further studied and examined using the Smith fermentation tube method wherein different substrates were used with the constant amount of concentration, distilled water and yeast suspension. Starch (polysaccharide), lactose and sucrose (disaccharide), glucose and fructose (monosaccharide), and distilled water, which are the variable factors, were used as different substrates, because they differ in structure and nature.