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Strategic Learning of Oxidation Reduction Reaction through Blue Bottle Experiment

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ABSTRACT
Natural dyes are living chemical compound which showed color in presence of oxygen and color less in presence of hydrogen. The addition of oxygen and hydrogen results in an oxidation and reduction of dye. This change in color was used for the demonstration of oxidation and reduction visually in one day open activity of chemical show of oxidation reduction reaction where students gain knowledge very easily about the oxidation and reduction reaction just by showing the change in color of reaction mixture.

Keywords: dyes, oxidation, reduction, learning, color

1. INTRODUCTION
The students find great difficulty in verbal demonstration of loss and gain of electron during learning of oxidation and reduction reactions or explanation of addition of oxygen and hydrogen but perception of oxidation and reduction reactioncan be developed by using famous blue bottle experiment as dyes showed following important aspects

- Dyes have many properties of changing color[1-4]
- Interaction of light gives excitation of electron which results in change in color
- Addition of "H" gives color less state[5]
- Removal of Oxygen gives color less state[2]

This study was planned for the development of the visual concept of oxidation reduction reaction by the color of dye.

2. EXPERIMENTAL
1. Before starting the visual demonstration of blue bottle experiment a theoretical concept of redox reaction of about 20 - 30 minutes was delivered.
2. All required solution of dye,reducing sugar and alkaline medium (NaOH)were prepared by usual methods as reported earlier[1].
3. Shaking of solution allow to dissolve the oxygen in reaction mixture which give blue color
4. Upon standing color permanently change.

2.1 *The demonstration of methodology*
1. Flask which contains dye, mannose and sodium hydroxide solution was shaking vigorously to show that blue color appear due to the dissolve oxygen from atmosphere.
2. The blue color of the dye showed the oxidized state of the dye or oxidation of dye occurs.
3. Now allow to stand the flask, blue color will change into the color less which showed that oxygen is consumed by the sugar which converted into respective acid and now hydrogen from sugar acid will abstracted by the dye or "H"will added into the dye molecule for its reduction and reduction is indicated by the color less state after addition of hydrogen[1] (Figure).

3. RESULTS AND DISCUSSION
Verbal learning of oxidation reduction reaction at grade twelve levels is a difficult task for the students. Blue bottle experiment can now be applied to teach oxidation reduction reaction to grade twelve students visually through which they can understand the redox reaction easily. Dyes are mysterious compounds, showed color in presence of oxygen while colorless when hydrogen is added[6; 7].This property of dyes gives good demonstration of the oxidation–reduction. For this purpose methylene green (MG) and mannose were found to be suitable in alkaline medium to demonstrate the dissolved oxygen in an alkaline reaction mixture. Students from grade 12 find this reaction excellent and it is considered a classic clip in chemical demonstration shows.

Addition of oxygen or oxidation of dyes can simply be explained by appearing color in a half-full bottle of colorless liquid of MG, turns blue when shaken due to dissolve oxygen, and when the bottle is allowed to sit still, the color fades. Figure showed that solution which is in contact with the air gives blue color whereas inside colorless state showed that oxygen consumed in the oxidation of mannose due to which reduction of dye was occurred by hydrogen abstraction from the respective acid of sugar[3,4,7]. On the molecular level, the blue bottle experiment is a complex system composed of water, the simple sugar mannose, the dye methylene green, the hydroxide ion, and oxygen from the atmosphere. The color change occurs to a pair of competing reduction-oxidation reactions. Hence, the blue bottle

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experiment[1] is an astonishing tool for introducing the key concepts of reduction and oxidation. In thefirst stage of the blue bottle experiment, the methylene green acts an oxidizing agent and the mannose acts as a reducing agent. When the bottle is shaken, more oxygen will dissolve in the reaction mixture. The additional oxygen acts as an oxidizing agent and changed methylene green to its blue (oxidized) form. The result is a dramatic color change from colorless to blue and best visual explanation of oxidation and reduction reaction simultaneously through famous blue bottle experiments (Fig).

4. TEACHING COMMENTS

- A white background helps is required for demonstration redox reaction visually[1].
- Methylene green is a redox indicator like methylene blue and is colorless when reduced but color restore on oxidation[1].
- The removal and regeneration of the color is due to oxidation-reduction reaction, under alkaline conditions, and shaking the solution allows oxygen enter into solution which shift the equilibrium in backward direction and re-oxidizes the methylene green back to the blue form[1].
- This experiment can be a popular "**Open Day activity** "but can also be used to demonstrate the oxidation reduction reaction visually

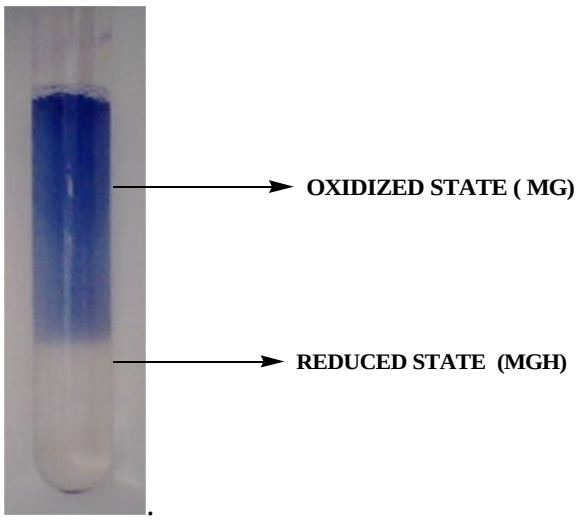

Fig-1: A visual demonstration of oxidation reduction reaction by methylene green and Mannose

5. REFERENCES

1. Azmat, R., Irshad, M., and Farooqi, I., Pak. J. Chem. **(2011),** 1(1): 19-21, http://dx.doi.org/10.15228/2011.v01.i01.p03.
2. Azmat, R., "Reduction of Methylene Blue with Reducing Sugars" Publisher VDM Verlag Dr. Müller e.K. **(2009)**.
3. Azmat, R., and Uddin, F., Chinese Journal of Chemistry. **(2009)**, 27(7): 1237-1243, http://dx.doi.org/10.1002/cjoc.200990207.
4. Azmat, R., and Uddin, F., Canadian J. Pure and Appl. Sci. **(2009)**, 2(1) 275-279.
5. Azmat, R., Uddin, F., and Mohammed, F. V., Appl. J. of Chemical Research. **(2008)**, 6: 7-21.
6. Azmat, R., Uddin, F., Appl. J. of Chemical Research. **(2010)**, 13(5): 72-54.
7. Ahmed, K., Uddin, F., and Azmat, R., Chinese Journal of Chemistry **(2009),** 27(7): 1229-1242, http://dx.doi.org/10.1002/cjoc.200990206.