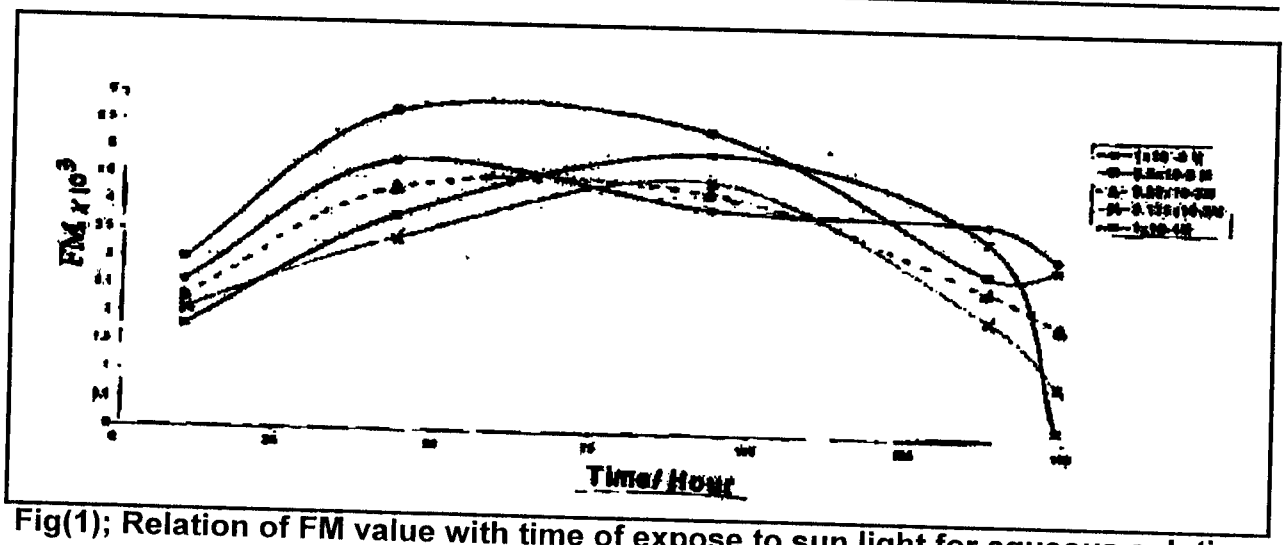
مقارنة كفاءة التحويل الحراري والضوئي للمحاليل المائية لأصباغ الثايونين والسافرانين O والرايبوفلافين

حسن عباس حبيب
قسم الكيمياء/ كلية التربية
جامعة القادسية

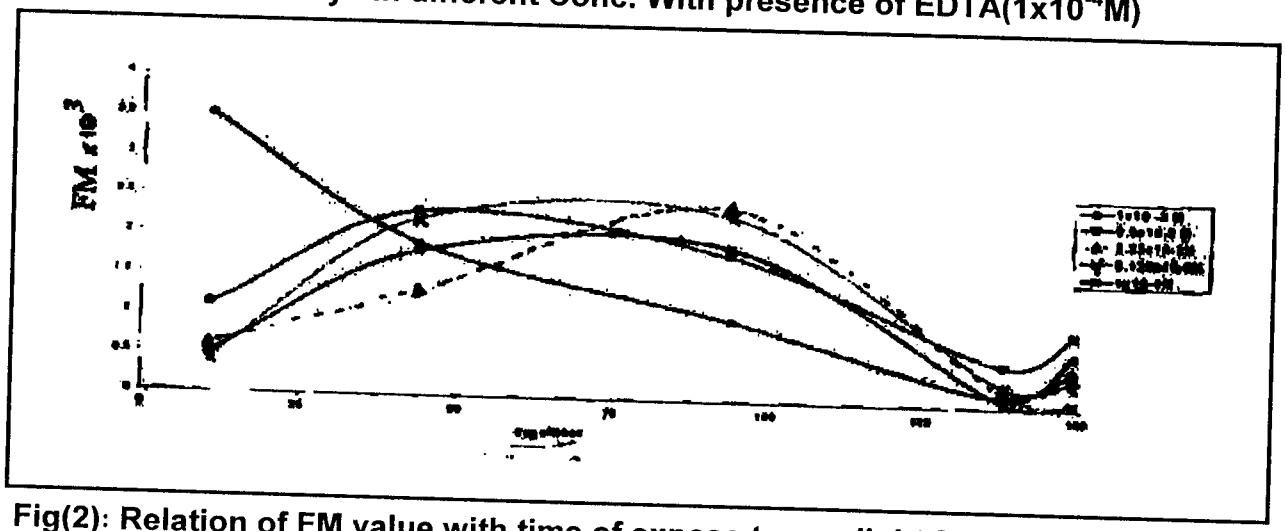
الخلاصة

أجريت دراسة لاختبار ومقارنة كفاءة التحويل الحراري والضوئي لبعض الأصباغ لعضوية الذائبة في الماء وهي الثانيونين والسافرانين O والرايبوفلافين بوساطة تشعيع المحلول المائي لكل صبغة بضوء الشمس المباشر، وتم فحص الكفاءة بوساطة قراءة الفرق في درة الحرارة العظمى لمحلول الصبغة ودرجة الحرارة العظمى للمذيب (الماء). وتم دراسة تأثير تركيز الصبغة ووجود EDTA $1x10^{-4}$ مولاري.

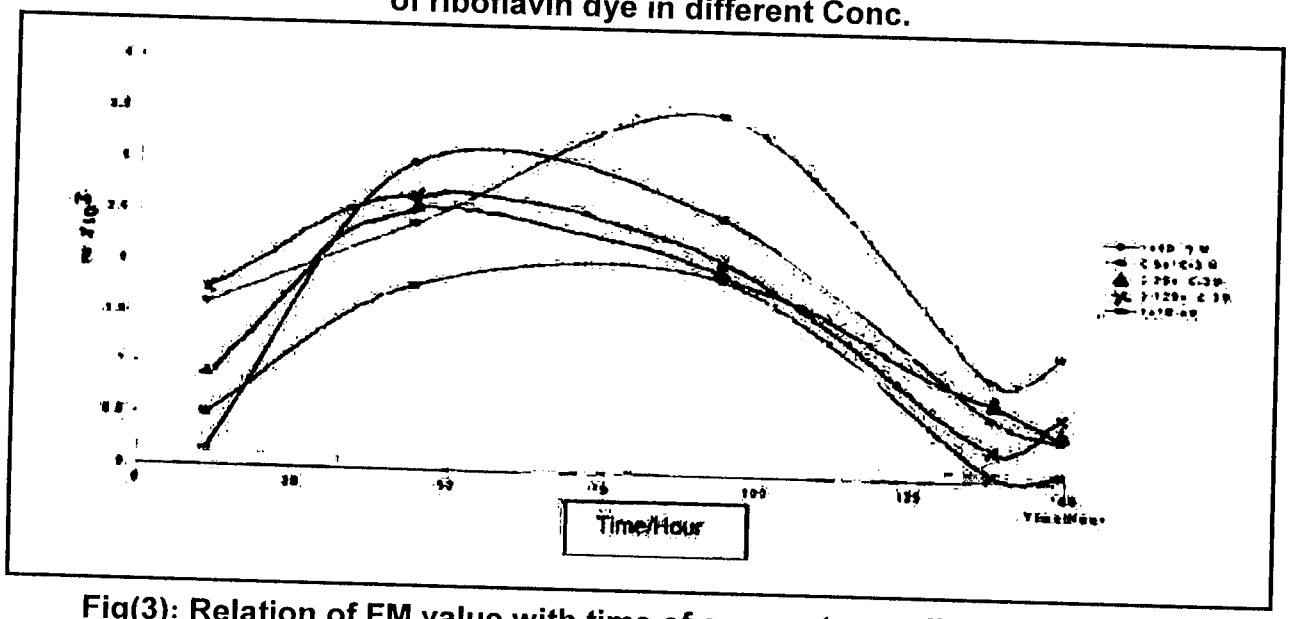
دلت النتائج إن وجود EDTA مع صبغة السافرانين O أعطى أعظم تحويل ووجد كذلك إن لإضافة EDRA تأثير إيجابي على التحويل الحراري لصبغة الثايونين، فيما وجد له تأثير طفيف في حالة الرايبوفلافين. ووجد بصورة عامة إن تركيز الأصباغ الأمثل لمعظم الحالات هو $0.5x10^{-3}$ مولاري رتم الحصول على أفضل تحويل لمعظم المحاليل بالقرب من منتصف فترة التعرض لضوء الشمس.



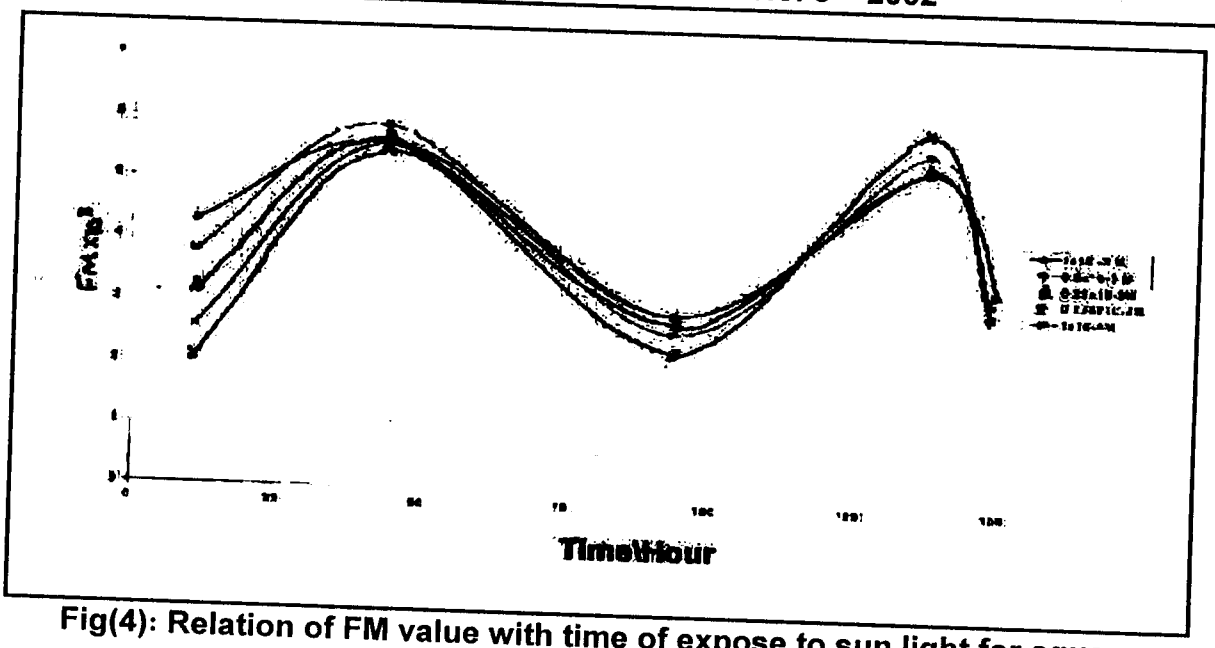
Fig(1); Relation of FM value with time of expose to sun light for aqueous solution of thionin dye in different Conc. With presence of EDTA($1x10^{-4}$M)



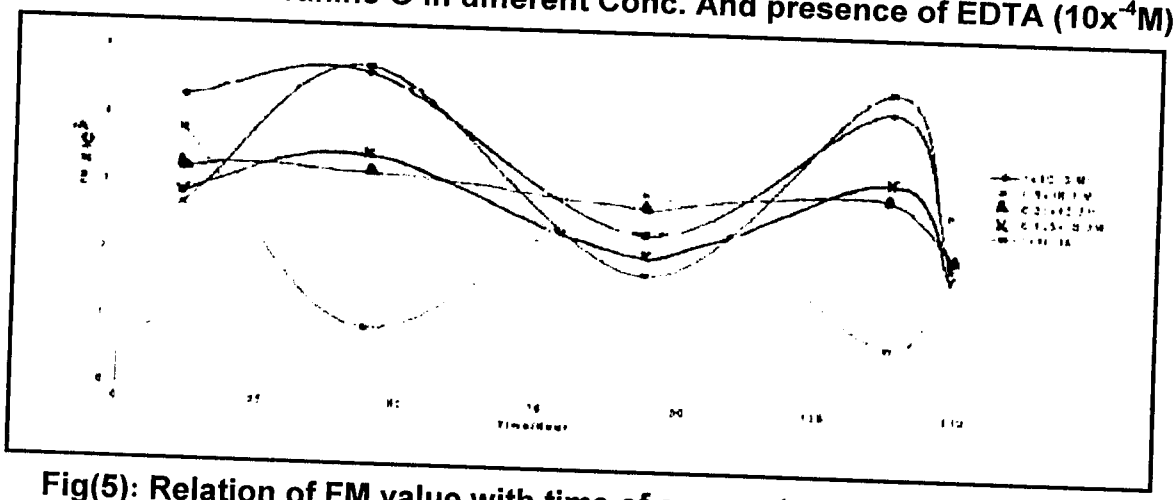
Fig(2): Relation of FM value with time of expose to sun light for aqueous solution of riboflavin dye in different Conc.



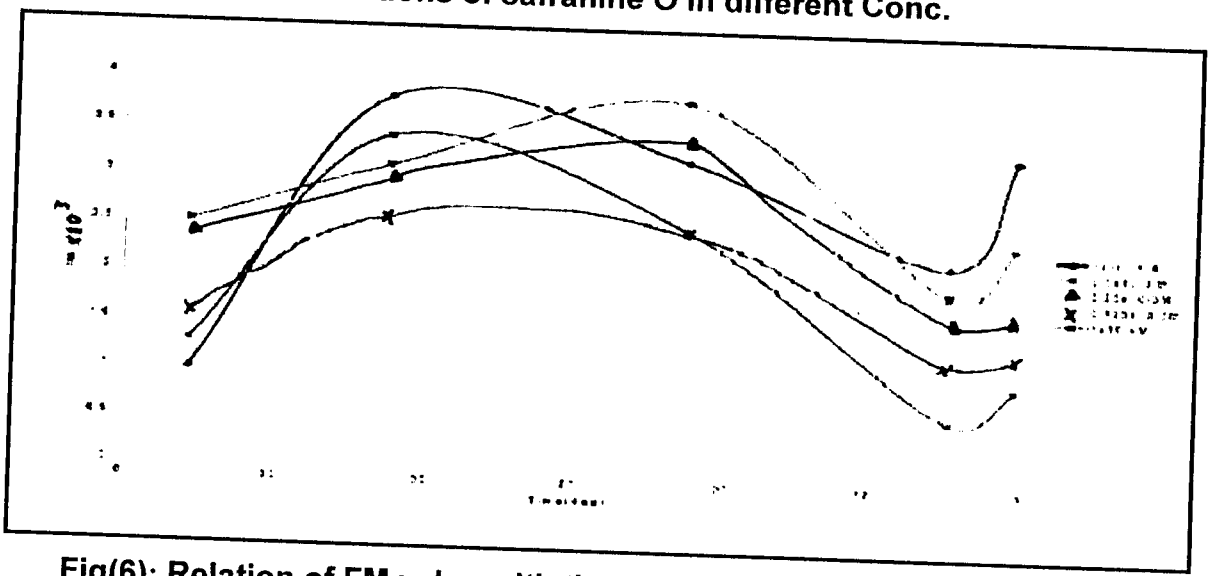
Fig(3): Relation of FM value with time of expose to sun light for aqueous solutions of riboflavin dye in different Conc. And presence of EDTA ($10x^{-4}$M)



Fig(4): Relation of FM value with time of expose to sun light for aqueous solutions of safranine O in different Conc. And presence of EDTA ($10x^{-4}M$)



Fig(5): Relation of FM value with time of expose to sun light for aqueous solutions of safranine O in different Conc.



Fig(6): Relation of FM value with time of expose to sun light for aqueous solutions of thionin in different Conc.

according to the following figure of merit[1].

$$FM=\frac{\Delta T\,max}{\hat{i}\,.\,t\,\Delta T\,max}$$

Where ?^{T} max is the difference between maximum temperature of dye solution and temperature of refence solution, t ?^{T} max the time required to the arrival of ?^{T} max and ī is the average of light intensity in this period of time.

Experimental

The chemicals obtained in this work were used without further purification. Thionin and EDTA were received from Fluka, safronin O was supplied by BDH and riboflavin by Aldrich.

The Irradiation Experiments

The dyes solutions in concentration ranging from 1X 10^{-3} M to 1X 10^{-4} M both in absence and presence of 1 X 10^{-4} M EDTA have been prepared using 1 liter pyrex flasks as container solution. The dyes powders were dissolved into water and slightly heated to complete the dissolving, then all vessels were exposed to direct sun light for a limited period, the temperatures within this period were measured using Bekman thermometer. The intensity of light through the same period was recorded using pannel solarmeter. The absorbance of dyes solutins has been measured using Shemadzu- UV- 120 Spectrophotometer.

Result and Discussion

The dyes selected in this work have an acceptable solubility in water except riboflavin, and they have a good absorbency at visible region except riboflavin as shown in table (1). Thionin has a very high absorbence in solar spectrum, and for this purpose it is used to generate the photocurrent in photogalvanic cells[6], but this dye undergoes from photobleaching process in high intensity light[9,10].

Table (2) contains the maximum FM values of three dyes in presence and absence of EDTA. It is clear that the safranin O gave the best values as a result of its stability in comparison with thionin, and values obtained with riboflavin are less then the other two dyes which attributes to its absorbence at a narrow range of visible light as table (1) illustrates.

The addition of EDTA gave a positive effect on FM values of thionin and safranin O. The literturesb(11,12) reveal that the EDTA has the virtue of donating of electrons to reduce the oxidized species of dye, so it may lead to the increasing of the absorber molecules in solution.

Figures (1)-(6) show the relation of FM value with time of exposing of three dyes at different concentrations. It is clear that the most of maximum values were obtained with concentration of 0.5× 10-3M, which may be due to the best absorbance of the dyes in this concentration, which is related to the removal of the some solution phenomena such as dye aggregates(13) and dimerization(14), which reduce the dye absorbance through the time of exposition. These processes are observed in high concentration solution. The values of FM are changed with a non- linear relation, which are related to the exterme change of temperature within the time of testing. Figures mentioned above show that the most of maximum FM values are obtained near the mid of the period of irradiation.

References

1. A. J. Abdul Ghani, M. A. AL-Abbassi and B. A. Ziada, Proceeding of the 4th scientific conference, scientific Research council, V3, October 1986, Baghdad, Iraq.
2. J. A. Minardi and H. N. Chuang, Solar Energy, 1975, 17, 179.
3. K. S. V. Santhanan and M. Sharon, Photoelectrochemical Cells, Elsevier, 1988.
4. S. C. Ameta, and K. M. Gangotri, Proceeding of the 3rd Arab International Solar Energy Conference, Solar energy Research Center, February 1988, Baghdad, Iraq.
5. M. Kaneko, and Ayamada, J, Phys. Chem. 1977, 81, 1213.
6. E. Rabinowitch, J. Chem. Phys., 1940, 8, 551.
7. H. A. Habeeb, M. Thesis, Babylon University, Iraq, 1998.
8. F. H. Hussein and A. Abdul-Sahib, Sci. J. Babylon University, 1997, 2.
9. S. W. Radi, M. Thesis, Salah Alden University, Iraq, 1989.
10. Falah H. Hussein and H. A. Habeeb, Iraqi J. Sci., 2000, 41A, 94.
11. Falah H. Hussein, Ph. D. Thesis, Notingham Uviv., UK, 1984.
12. K. Z. Ismail, Qatar Univ. Sci. J., 1994, 14, 199.
13. S. Das, K. G. Thomas, K. J. Thomas, P. V. Kamat, and M. V. George, J. Phys. Chem., 1994, 98, 9292.
14. A. J. Abdul Ghani, and S. Abdul Kareem, J. Hydrogen Energy, 1989, 14, 303.

Table (1): Spectroscopic Properties of Dyes

No.	Dye	Renge of Absorption, nm	λ max, nm	Color of Solution
1.	Thionin	500-640	598	Blue
2.	Riboflavin	300-520	445	Yellow
3.	Safranine o	400-580	530	Orange

Table (2): The highest FM values (X 103) in relation to concentration of dyes in absence of EDTA (1X10-4M)

No.	Dye	$1X10^{-3}M$	$0.5X10^{-3}M$	$0.25X10^{-3}M$	$0.125X10^{-3}M$	$1X10^{-4}M$
1.	Thionin	3.8	3.8	3.4	2.6	3.4
2.	Thionine+ EDTA	4.8	5.7	4.3	4.5	5.0
3.	Riboflavine	3.5	2.3	2.4	2.3	1.9
4.	Riboflavine+ EDTA	3.0	3.5	2.6	2.7	1.7
5.	Safranine O	4.7	3.8	3.3	3.5	4.8
6.	Safranine O+ EDTA	5.6	5.9	5.7	5.5	5.6