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NOTE

Kinetics Study of Oxidation of Medroxyprogestrone in Presence Alkaline Potassium Permanganate

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Medroxyprogesterone is a progestin (a from of progesterone), a female hormone that helps regulate ovulation (the release of an ovule from ovary) and menstrual periods. Medroxyprogesterone is used to treat condition such as absent or irregular menstrual periods and abnormal uterine bleeding. Medroxyprogesteroneis also used to prevent overgrowth in the lining of the uterus in postmenopausal women who are receiving estrogen hormone replacement therapy. The rate of oxidation of this drug with alkaline potassium permanganate in aqueous solutions has been studied at five different temperature by UV-visible spectroscopic method. In this work, we estimated the value of reaction rate constants and reaction order at 25 ºC under pseudo-order rate kinetic model ($R^2 > 0.996$). The activation energy has been calculated from plotted Ln k *vs*. 1/T at temperature ranges between 25º-45 ºC is 579. 26 J/K mol.

Key Words: Medroxyprogesterone, UV-VIS spectroscopy, Kinetic model.

Medroxyprogestrone [MDP], pregn-4-ene-3,2-odione (17-(acetyloxy)-6,10,13-trimethyl-tetra-decahydro-cyclo-penta[a] phenan thren-30-one-is a progestin, a synthetic variant of the human hormone progesterone. Progesterone also known as p_4 (pregn-4-ene-3,20-dione) is ac-21 steroid hormone involved in the female menstrual cycle, pregnancy and embryogenesis of human and other specie[1,2]. Progesterone belong to a class of hormones called progestogens and is the major naturally occurring human progestone. Progesterone is commonly manufactured from the yam family, discover, produces large amounts of a steroid called diosgenin, which can be converted in to progesterone in the laboratory[3]. The literature is still poor in analytical procedures based on kinetics, especially for pharmaceutical preparations or biological fluids; furthermore, some specific advantages in the application of kinetic methods can the expected, such as the. Selectivity due to measurement of the evolution of the absorbance with the time of the reaction instead of the measure of a concreted absorbance value[4-7]. Possibility of no interference of the coloured and/or turbidity backgrounds of the sample. Possibility of no interference of other active compound present in the commercial product if they are resisting the chemical reaction conditions established for the proposed kinetic method. Potassium permanganate has been used for the many pharmaceutical compounds in alkaline medium. The method involved the reaction of medroxyprogestrone with $KMnO_4$ in an alkaline medium. The produced colour was measured at 609 nm.

Double beam UV-Vis spectrophotometer (Perkin-Elmer Lambda 25) with matched 1 cm quartz cells was used for all the spectrophotometric measurements.

The following reagents were used. Potassium permanganate (Ridel-dehaen, Germany) 5×10^{-3} M aqueous solution was used. Sodium hydroxide (BDH), pool (UK) 1 M aqueous solution was prepared. Medroxyprpgesterone was pergease from drug store are common in Iran.

Calibration graph: Transfer 2 mL of 0.005 M $KMnO_4$ and 3 mL of 1 M NaOH in to a series of 50 mL measuring flask. Add aliquot volumes of medroxyprogesterone solution so that the final concentration is in the rage of 0.2-4.75 mg L^{-1}. Make up to volume with distilled water. Shake well and then scan the evolution of the absorbance at 609 nm with the time during 1 h at ambient temperature (25 ºC).

Pharmaceutical preparations: Lomg crushes tablets in to fine powder, transferred in to a 50 mL calibrated flask. The filter in to a 50 mL measuring flask and complete to volume with distilled water.

Kinetics and optimization of the reaction conditions: The reaction between medroxyprogestrone and $KMnO_4$ in alkaline medium yields a green colour due to the production of manganate radical, which absorbs at 609 nm. The absorbance of the oxidation products remains stable for at least 1 h as the intensity of colour increases with time. The reaction was studied under various conditions of reagent concentration. The reaction rate and maximum absorbance increased with time and with increasing $KMnO_4$ concentration. It was found that (2 mL) of 5×10^{-3} $KMnO_4$ was adequate for maximum absorbance as shown in Fig. 1.

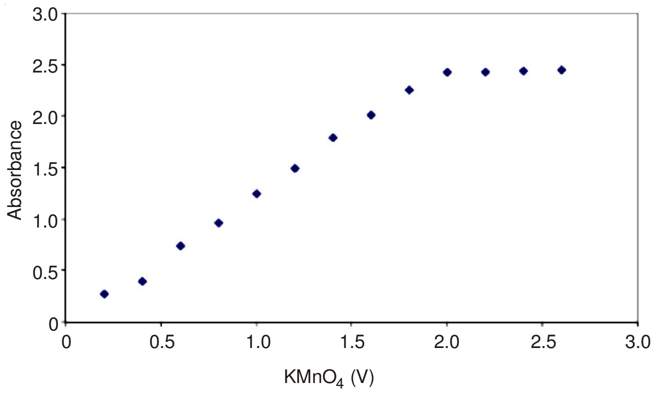

Fig. 1. Absorbance-concentration NaOH. The absorbance for $KMnO_4$ solution containing was measured at 609 nm

At room temperature, the reaction increased substantially, as the colour development increased. There fore, room temperature was selected as the optimum temperature. Heating the solution was found to increase the rate of the reaction but MnO_2 was precipitated. Fig. 2 shows the intensity of the colour increased with time.

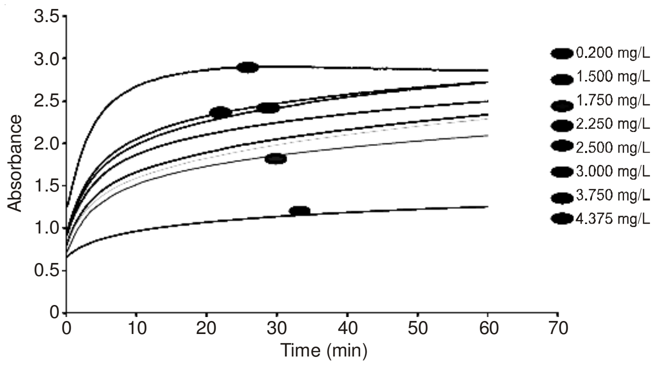

Fig. 2. Plot of absorbance *versus* time with various concentration of medroxyprogestrone

The rate of the reaction was monitored at room temperature with various concentration of medroxyprogestrone over the range 0.2-4.75 mg L^{-1} while the $KMnO_4$ was kept constant. The graph shown in Fig. 3 indicates the reaction rate of medroxyprogestrone obeys the following equation:

$$\text{Rate} = k'[\text{MDP}]^n \quad (1)$$

where k' is the pseudo-order rate constant and n is the order of the reaction. The rate of the reaction may be estimated by the variable-time method measurement, where A is the absorbance and t is the time in seconds, $\Delta A/\Delta t$.

As taking Ln of rates and concentrations, eqn. (1) is transformed in to:

$$\text{Ln}(\text{rate}) = \text{Ln}\frac{\Delta A}{\Delta t} = \text{Ln}\,k' + n\,\text{Ln}[\text{MDP}]$$

Regression of Ln (rate) *versus* Ln [MDP] gave the following equation:

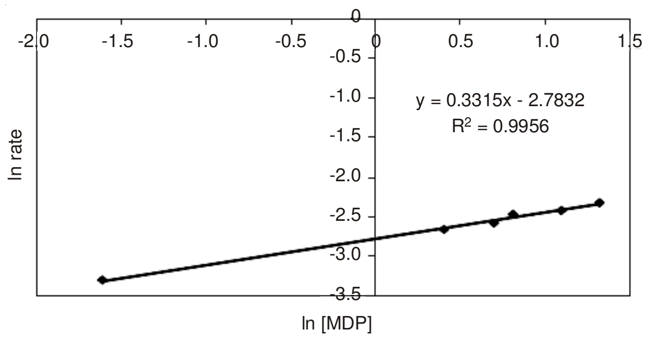

Fig. 3. Plot of in reaction rate *versus* concentration of medroxyprogestrone at 609 nm

$$\text{Ln rate} = -2.78 + 0.33\ \text{Ln [MDP]}\ (R^2 = 0.99)$$

Hence $k' = 1.02\ \frac{\text{mol}^{1-0.33}}{\text{lit}^{0.33-1}.\text{min}}$ and the reaction is an order reaction (n = 0.33) with respect to medroxyprogestrone.

Absorbance-time curves at different temperatures (25-45 ºC): Were generated using fixed concentration (3×10^{-3} g $L^{-1} \times 1/344.4$ mol g^{-1}) and $KMnO_4$ (0.005 M). From these curves the apparent rate constants were calculated.

The activation energy, defined as the minimum kinetic energy that a molecule possess in order to undergo a reaction, was determined using Arrhenius equation:

$$\text{Lnk} = \text{lnA} - \text{Ea/RT}$$

where k is the apparent rate constant, A is the frequency factor, Ea is the activation energy, T is the absolute temperature and R is the gas constant. The values of lnk were plotted as a function of 1/T. Straight lines white slope (= -Ea/RT) value 579.86 (Fig. 4).

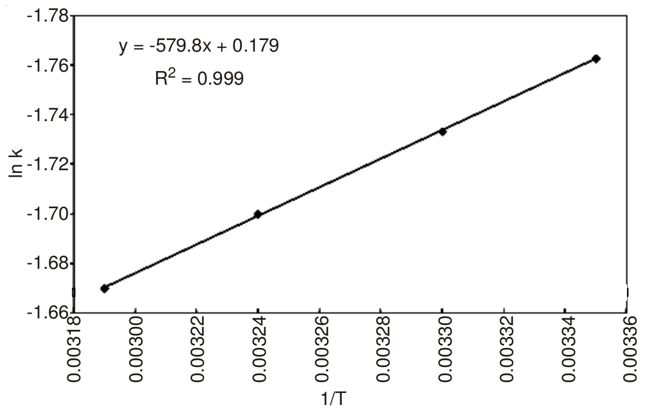

Fig. 4. Arrhenius plot for the reaction of $KMnO_4$ (0.005 M) with MDP in presence of NaOH (1 M)

REFERENCES

1. E. Zeiger, B. Anderson, S. Haworth, T. Lawlor and K. Mortelmans, *Environ. Molecular Mutagenesis*, **19**, 2 (1992).
2. M. Schumacher, R. Guennoun, D.G. Stein and A.F. De Nicola, *Pharmacol. Therap.*, **116**, 77 (2007).
3. M. Hartmann and A. Wettstein, *Helv. Chim. Acta*, **7**, 878 (1934).
4. M.A. Omar, O.H. Abdelmageed and T.Z. Attia, *J. Anal. Chem.*, **12** (2009).
5. I.A. Darwish, M.A. Sultan and H.A. Al-Arfaj, *J. Res. Sci.*, **1**, 43 (2010).
6. W.-X. Ma, Y.-H. Liu and O. Sha, *Asian J. Chem.*, **23**, 3481 (2011).
7. Y.-H. Liu, F.-Y. Peng and W.-X. Ma, *Asian J. Chem.*, **23**, 4533 (2011).