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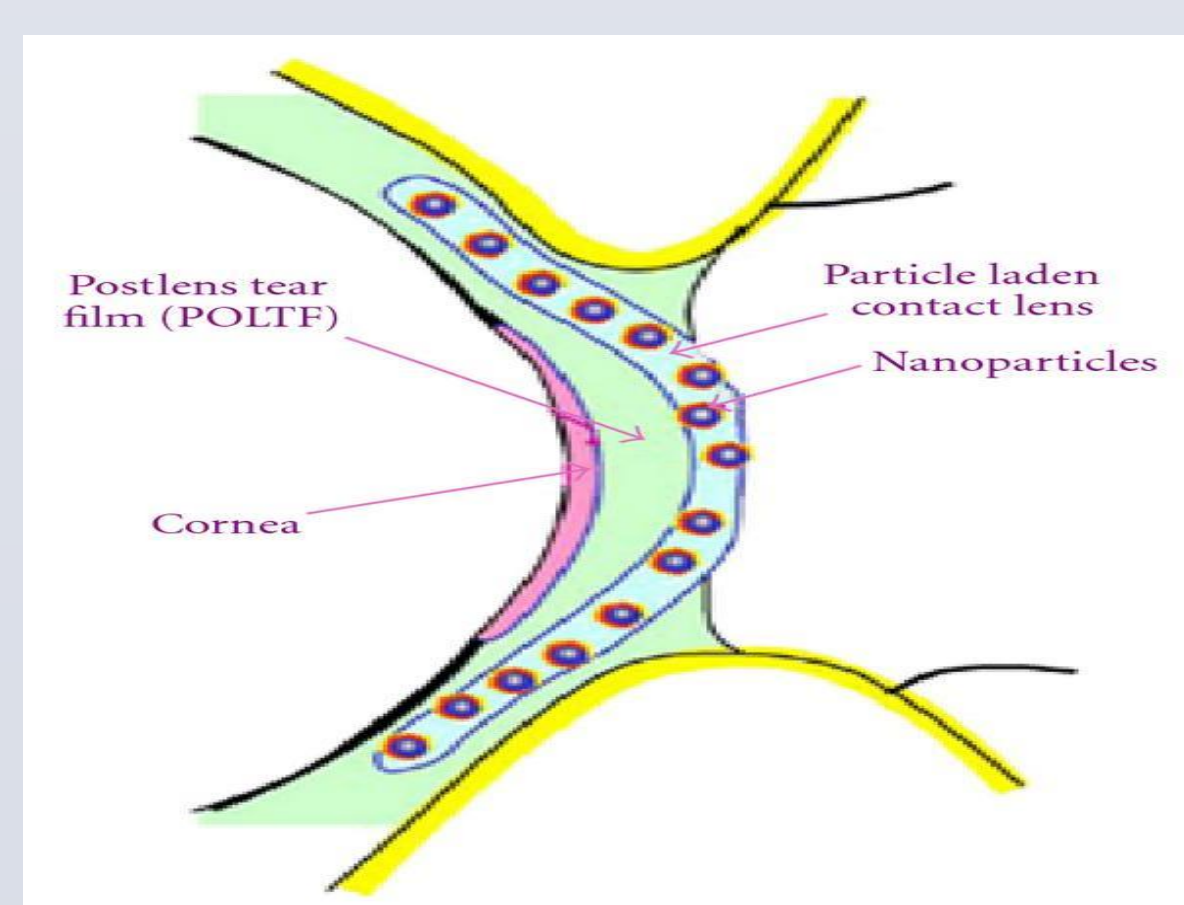
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## INTRODUCTION

Nowadays contact lenses use is becoming a well established practice. They are mainly used for correction of refraction, protection of ocular surface, etc. Recently, interest on drug delivery through contact lenses is becoming very high after realizing the inefficiency of eye drops where only 5% of applied drug succeeds to penetrate the cornea and thus reaches the ocular tissue. Unfortunately, the rest of drug is not only lost but does reach other organs in the body which creates side effects.(1-3). Such other organs are namely conjunctiva and/or lacrimal sac. The worst with the lost drug is when it reaches the bloodstream through lacrimal sac and nasolacrimal duct. It has been proved (4,5) that not only use of drops as drug delivery limits the efficacy of the therapeutic system but also as example,  $\beta$ -blockers such as timolol, used in the treatment of wide-angle glaucoma, have a deleterious effect on heart.



We propose a new vehicle for ophthalmic drug delivery, a disposable soft contact lens using a co-polymer made from a composite MMA-HEMA (Hydroxyethyl methacrylate hydrogels and Methyl methacrylate) polymerization process, where each of these two based polymers give a specific property to the soft contact lens loaded with the encapsulated drug. The idea behind involving MMA, although known to make hard polymers, is to slower more the swelling of the HEMA based soft contact lens which may result in a longer drug residence and by consequence a slow releasing of the encapsulated drug over days, say weeks.



## OBJECTIVES

We propose here, for the first time for ocular drug delivery, an alternative material based contact lens, a co-polymer based contact lens using a hydrophilic (p-HEMA) and a hydrophobic (p-MMA). This is intended to reduce swelling thus increase release time over a week or weeks. For this, following objectives are:

- Prepare Lidocaine powder by evaporating pharmaceutical solution based drug.
- Prepare 5 samples solutions based MMA-HEMA with different composition ratios 10, 20, 30, 40 and 50%.
- Incorporate same amount dissolved Lidocaine drug into each sample solution with long term stirring
- Start polymerization process and terminate with high vacuum heater to remove residual solvent
- Use UV-Vis spectrometer to study drug release over many days

## METHODS

### Materials:

Chemicals needed for the experiments are: HEMA monomer ( Hydroxyethyl methacrylate hydrogels ), MMA ( Methyl methacrylate ), EDGMA ( Ethylene glycol dimethacrylate ), AIBN ( Azobis- iso – butyrylonitrile ), and Octadecyltrimethoxysilane ( OTMS )

Sample	HEMA (ml)	MMA (ml)	Solvent (ml)	AIBN (mg)	Drug (g)	Time (h)	Temperature (°C)
A	9	1					
B	8	2					
C	7	3	5	32	0.2	2	60
D	6	4					
E	5	5					

- We extract the drug by using the vacuum.

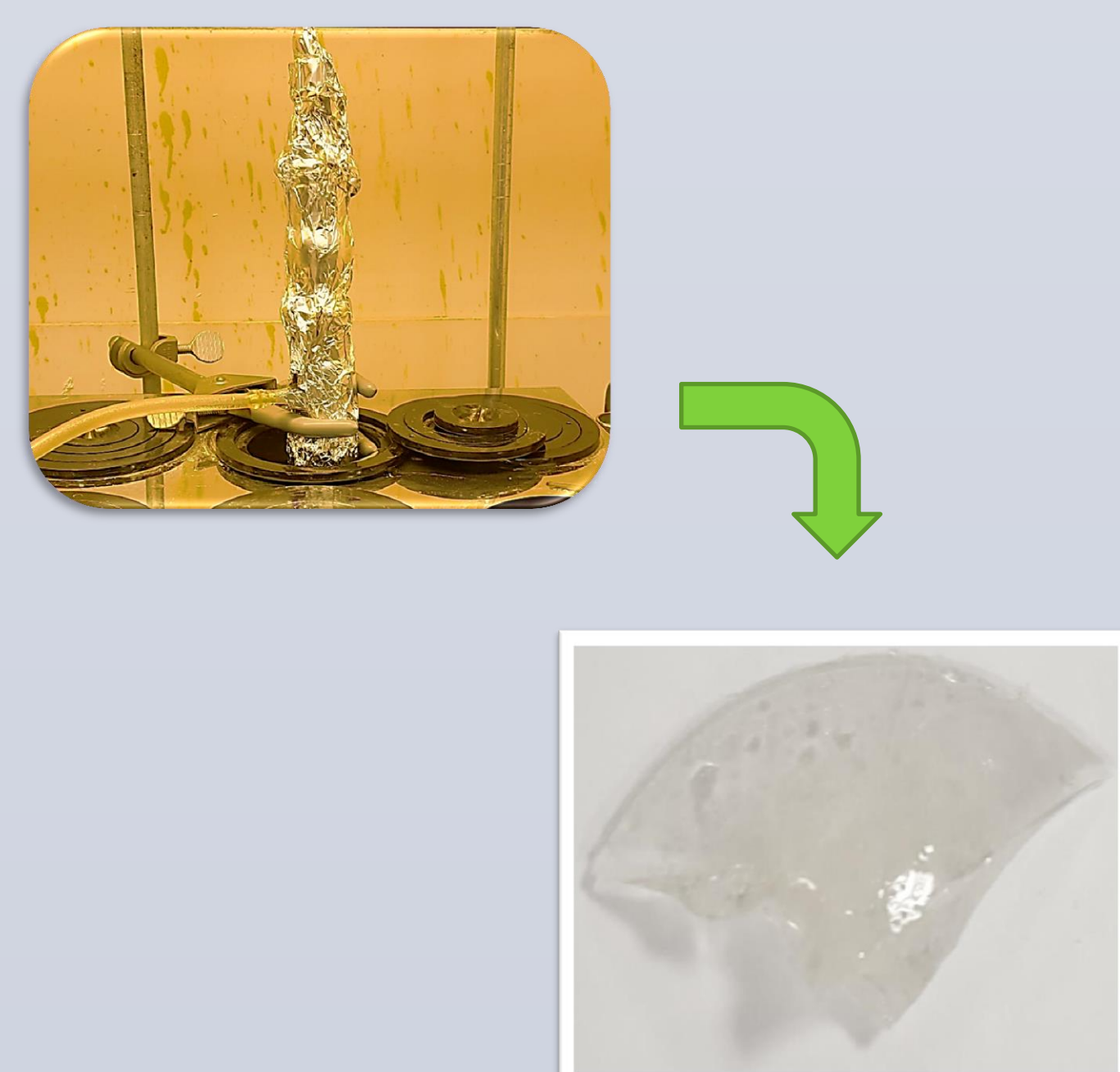


### First: Synthesis of HEMA-MMA copolymer:

- 1- 5 mL of HEMA + 2 mL of MMA + 0.001 mg of AIBN.
- 2- The polymerization is 60°C under gas nitrogen during 4 h.
- 3- The film preparation: the reaction mixture containing copolymer is spread on Teflon plate and dried at ambient temperature during 24 h then under vacuum at 50°C during 24 h.

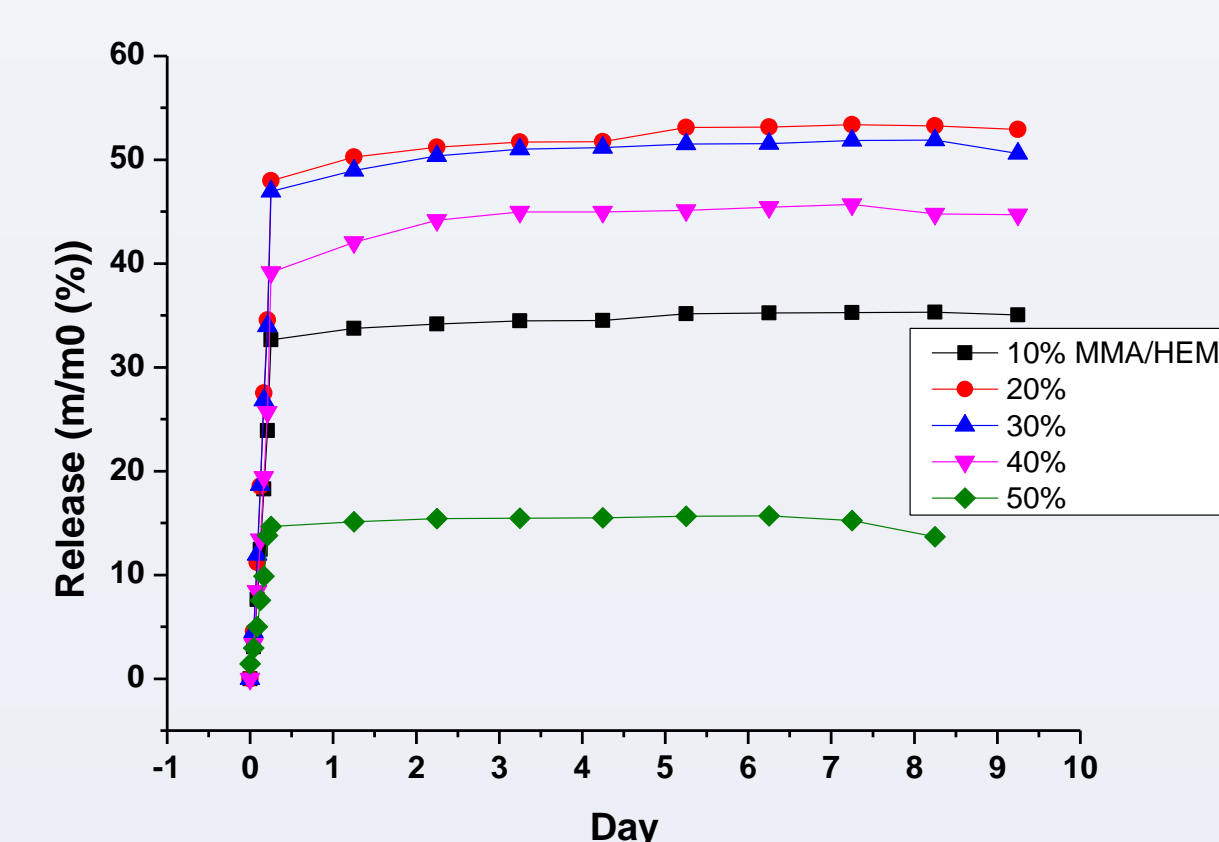
### Second: Preparation of drug/HEMA-co-MMA composite:

0.2 g of drug powder dissolved into ethanol and then mixed with HEMA-MMA in its half polymerization process under stirring for 30 min until formation of limpid solution. This solution was kept in a dark atmosphere during polymerization. The prepared solution is then spreaded on a Teflon plate and kept overnight at ambient temperature during 24 h then under vacuum at 40°C oven.

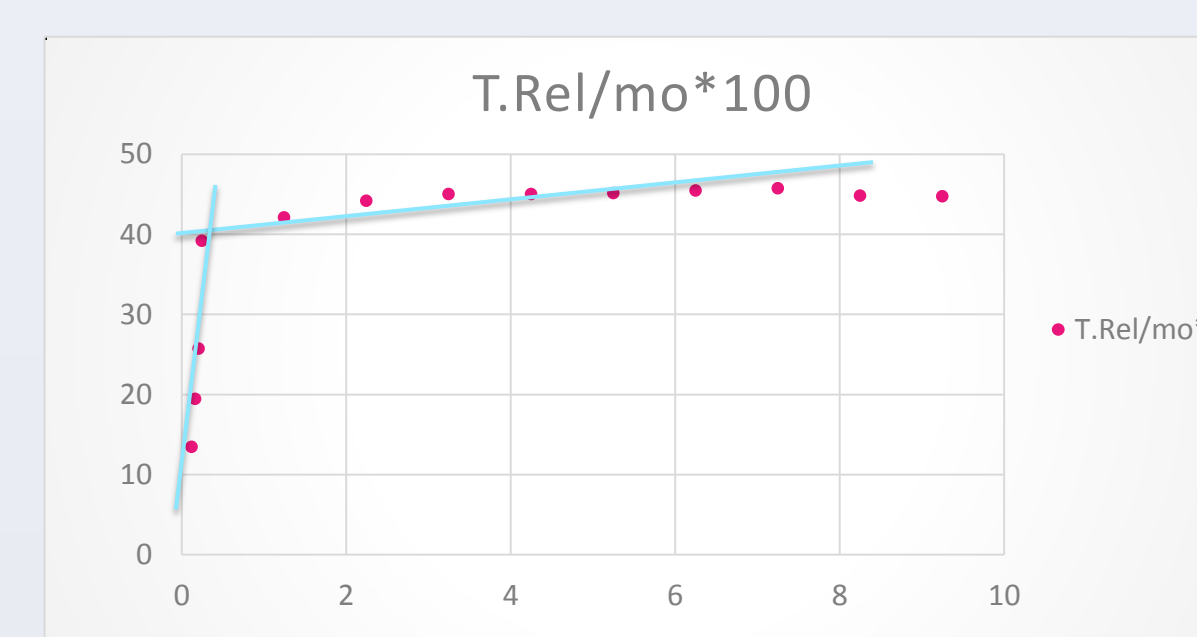


## RESULTS

To achieve the results, we put a small piece from each polymer samples inside 15ml water of PH7 and under the temperature 25°C.



Drug release over days for different MMA/HEMA ratio composition



Drug release over days for 40% MMA/HEMA ratio composition

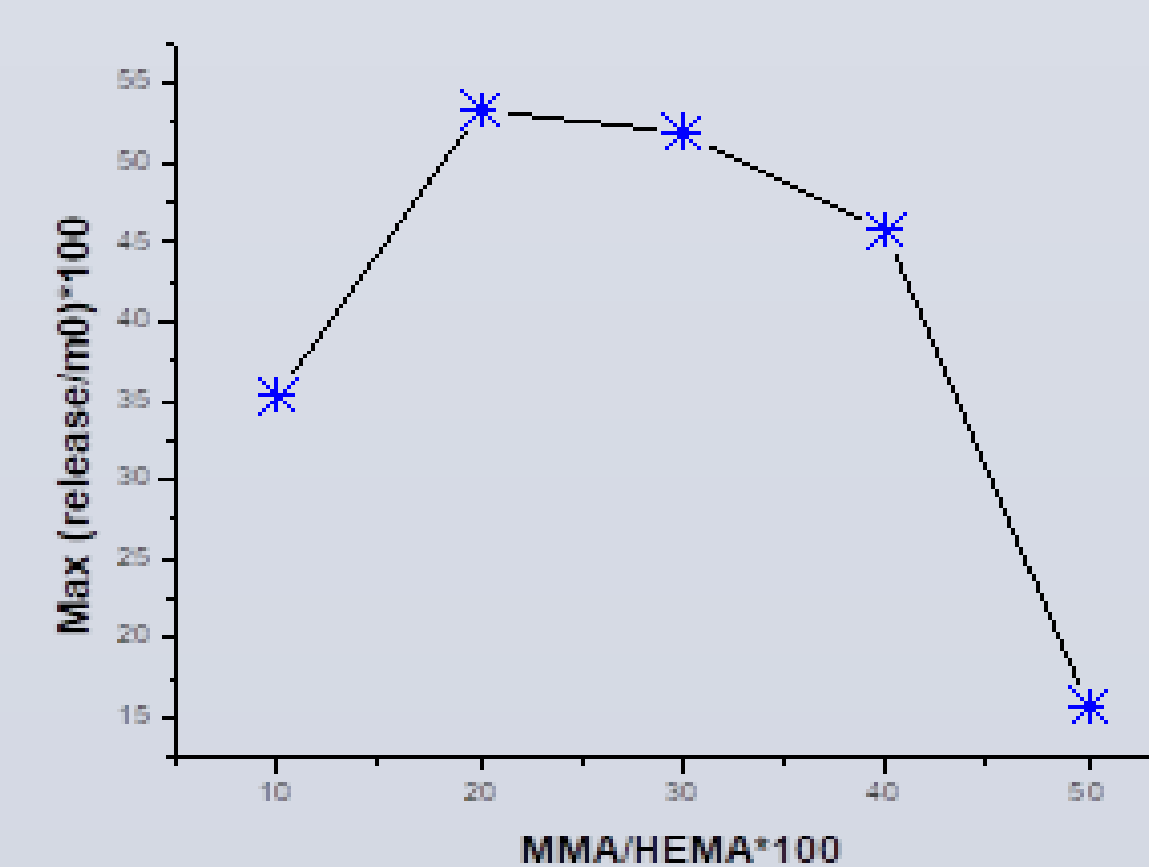
Each sample showed a specific amount of release according to MMA/HEMA ration composition. At first day the amount of release was fast in every sample because of the drug washing at the surface of the contact lens, after that only the amount of the drug inside the contact lens released as following:

The table below explains well the three time transitions of release:

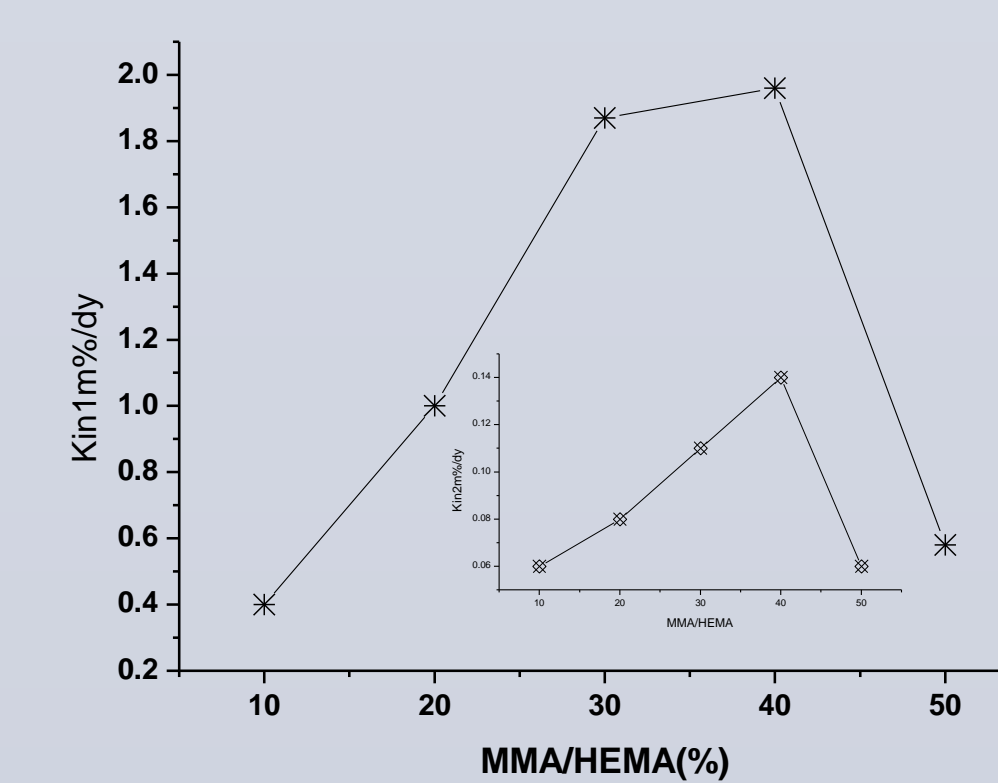
- Very fast Wash release
- Stable and fast release over 1-5 days
- Stable and slow release over 4-9 days

MMA/HEMA (%)	Stable zone (day)	Lidocaine released (wt %)	Release rate (wt %/day)
10	1-5 4-9	1.60 0.31	0.4 0.06
20	1-4 4-9	3.00 0.37	1.0 0.08
30	0.25- 2.5 2.5- 9	4.20 0.70	1.87 0.11
40	0.25- 3 3- 9	5.40 0.82	1.96 0.14
50	0.25- 3 3- 9	1.58 0.32	0.58 0.06

Table Stable zones and instantaneous release rate of Timilol from Timilol/xMMA/(1-x)HEMA drug carrier systems at 25°C and in different MMA/HEMA ratio



Max drug release for different MMA/HEMA ratio composition



Drug release kinetic for zone 2 and 3 for different MMA/HEMA ratio composition

## CONCLUSION

The present study was only a pilot study. Co-polymer p-MMA-p-HEMA based new soft contact lenses are promising candidates for drug delivery. They have proved to allow longer release time by reducing the swelling. Two main transitions release processes have been identified to allow a selected control of type of drug release wanted.

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## ACKNOWLEDGMENT

Thanks go to the following for their help in polymerization, Prof. Taieb Aouak and Mr Wasem Alhamadi. "The authors extend their appreciation to the Deanship of Scientific Research at King Saud University for funding this work through the Undergraduate Research Support Program, Project no. (URSP 17-69)."