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Original Research Article

Photo and UV degradation of Ciprofloxacin Antibiotic

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A B S T R A C T

Keywords

Ciprofloxacin, UV degradation, Photo degradation.

The Ciprofloxacin acts mostly against the Gram positive but rarely against the Gram negative bacteria. The concentration ranging from 50-500 ppm of the ciprofloxacin was exposed to the sun light and UV radiation. The duration of the exposure for the degradation, was 1 to 7 hrs. The UV rays (15W and 30W) lamps were used for the study. The degradation was determined by the by zone of inhibition. The maximum degradation was demonstrated by the exposure of UV 30W after 6 hrs of duration. The photodegradation was also at its maximum after 6 hrs. of the exposure. The UV and the photodegradation proved to be the significant mode to control the pollution in the environment caused by Ciprofloxacin residue.

Introduction

Antibiotics are used as medicine against bacterial infection. Their accumulation in higher concentration in the soil as well as in aquatic environment causes pollution and become very harmful to human and animal health. These antibiotics are organic compounds and can reach the environment via different routes like: human or animal wastes, pharmaceutical manufacturing plants effluents, wastes of nursing home, hospital wastewater,and animal fertilizer and through municipal waste water treatment plants [Garoma *et al.,* 2010; Pauwels et al., 2006].

These are also present in house hold wastes in small amount and are causing different kinds of environmental pollution. In current years, the pesticides, endocrine disrupting chemicals (EDC) in aquatic environment and drugs like antibiotics, have become more environment distorting and become new emerging polluting agents [Benjamin *et al.,* 2008; Imai *et al.,* 2007]. Ciprofloxacin is a class of synthetic antibiotic and the second generation fluoroquinolones (Okeri *et al.,* 2008). This compound has a broad range of activity against the Gram-positive organisms (Hubicka et al., 2013; Hayder et al. 2012) and the Gram-negative bacteria (Hubickaet al., 2013). The drug is used commonly for the treatment of tuberculosis, digestive disorders, anthrax (Hayder et al. 2012), urinary tract infections and pneumonia (Thomas *et al.,* 2002; Arizona *et al.,* 2012). When antibiotics pass through sewage treatment plants (STPs) these wastes are eliminated by biodegradation and hydrolysis process (Gartiser et al., 2007).

Photodegradation is a process of detoxification and transformation of active organic compounds, including the pharmaceuticals products, which affect the environment in several ways. Chen et al. (2011) have recorded that degradation of several pharmaceutical compounds was possible under sunlight, UV, Ozone and in other advanced oxidation conditions. The chief mode of degradation was the photolysis by the absorption of light energy and such rate was affected by ability of light absorption of the compound (Jasim et al., 2010). When the antibiotic substances enter municipal sewage and sewage treatment plants (STPs) and are not eliminated during sewage treatment they enter the surface water as well as in drinking water. The main focus of this study was to record the degradation of Ciprofloxacin compounds under the sun light and different UV intensities of radiations.

Material and method:

Chemicals and media

Ciprofloxacin 500mg (Cipla industry, Sikkim, India) was used. The Muller-Hinton agar media (High media) was used for the determination of the zone of inhibition.

Experimental setup

Experimental petriplates, containing antibiotics solutions, were exposed to sun light during day time in the month of March in the Gwalior region (Madhya Pradesh, India). The temperature 30^0 C was recorded and the exposure time for the photodegradation of antibiotic solution was ranging from 1-7 hrs. and for UV exposure, the UV-lamp (Philips, 15W and 30W) were used. The antibiotic discs were prepared by dipping it in the 50,100,200,300,400and 500 ppm concentrations of antibiotic solution. Then petriplates containing the antibiotic disc in the Muller-Hinton media, were exposed to air for bacterial culture. The controls petriplate, contained the antibiotic disc in the media, were not exposed to sun light. The inhibition zones were measured in millimeters (Chen et al., 2011; Jasim *et al.,* 2010; Hernandez *et al.*, 2012).

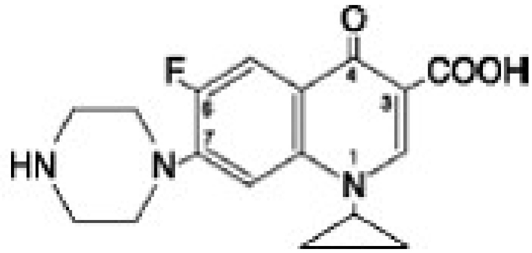
Results and Discussion

The antibiotic compounds are generally stable for biodegradation and biochemical process. In the nature, the antibiotics are directly photolysed and thus the photolysis is the known factor for its degradation .Photolysis of the antibiotics compounds was recorded as a result of the energy gained by absorption of sun light. The light absorbing ability of the compound also determined the process of photolysis (Jasim *et al.,* 2010).

Jasim*et al.,* (2010) studied the effects of the sun light degradation of tetracycline and cephalexin and observed that the zone of inhibition of tetracycline and cephalexin was smaller than the controls and the zone of inhibition of tetracycline was significantly smaller to that of the cephalexin and concluded that this is because of the degradable ability of the sunlight. Hernandez *et al.,* (2012) recorded that the photochemical degradation of different concentration of ciprofloxacin (50, 100, 200, 300, 400 and 500ppm) was accomplished with the implementation of UV/H_2O_2 and $UV/H_2O_2/O_3$system and they recorded the complete mineralization of the entire samples.

The present study indicated that the antibacterial activity of ciprofloxacin was suppressed by UV and Sun light.

Fig.1-Chemical Structure of Ciprofloxacin



Sun light UV (15W)

UV (30W)

Fig.2a one of inhibition of 500ppm solution of ciprofloxacin without treatment

Fig.2b Zone of inhibition of 500ppm solution of Ciprofloxacin after treatment

Table. Zone of inhibition (in mm) of the ciprofloxacin with UV (15W) treatment

Con. / Time	50ppm	100ppm	200ppm	300ppm	400ppm	500ppm
0hrs	10	13	16	17	19	21
1hrs	8	11	14	15	17	17
2hrs	7	9	12	13	15	15
3hrs	5	7	9	8	12	11
4hrs	4	6	6	7	9	7
5hrs	3	4	4	5	6	4
6hrs	2	2	2	3	3	2
7hrs	2	2	2	3	3	2

Table.2 Zone of inhibition (in mm) of the ciprofloxacin with UV (30W) treatment.

Con. / Time	50ppm	100ppm	200ppm	300ppm	400ppm	500ppm
0hrs	10	13	16	17	19	21
1hrs	7	10	12	12	16	15
2hrs	6	8	10	10	14	12
3hrs	4	6	7	7	11	10
4hrs	2	5	4	6	8	6
5hrs	2	3	2	4	5	3
6hrs	1	1	1	2	2	1
7hrs	1	1	1	2	2	1

Table.3 Zone of inhibition (in mm) formed by the ciprofloxacin with the sun light treatment.

Con. / Time	50ppm	100ppm	200ppm	300ppm	400ppm	500ppm
0hrs	10	13	16	17	19	21
1hrs	9	12	15	16	18	19
2hrs	8	11	13	14	16	16
3hrs	6	9	10	10	13	13
4hrs	5	7	8	9	10	8
5hrs	4	6	6	6	7	5
6hrs	3	3	3	4	4	3
7hrs	3	3	3	4	4	3

Figure.3 50ppm concentration of Ciprofloxacin showing degradation with UV (15W, 30W) and sun light.

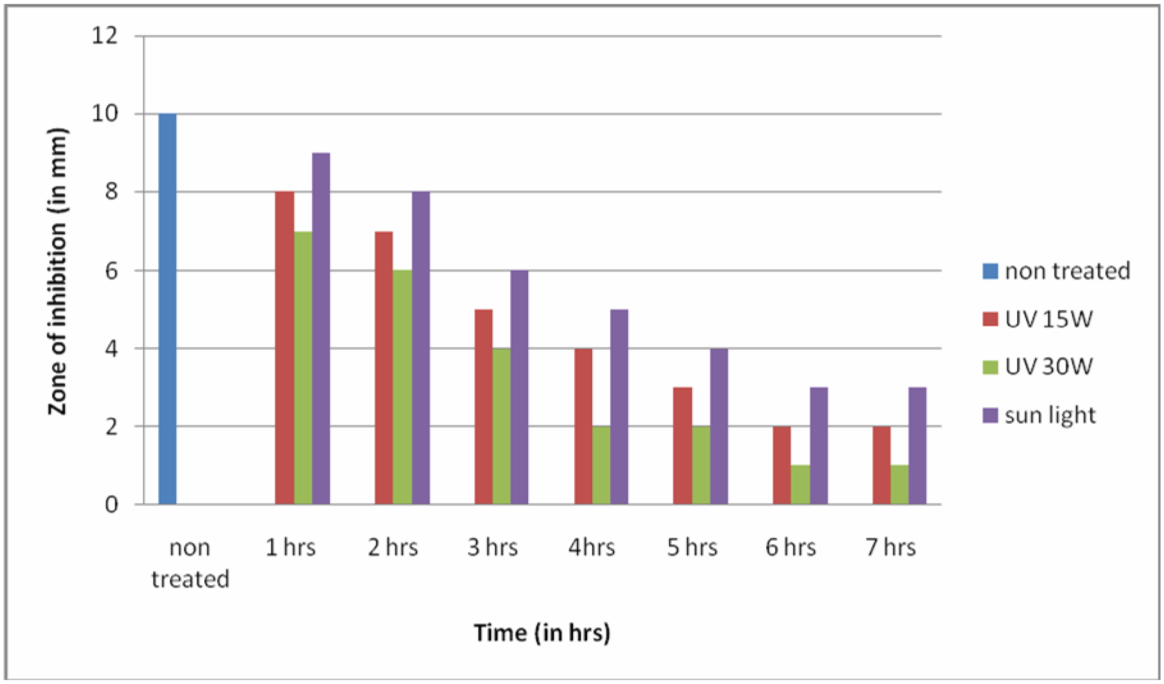


Figure.4 100ppm concentration of ciprofloxacin showing degradation with UV (15W, 30W) and sun light.

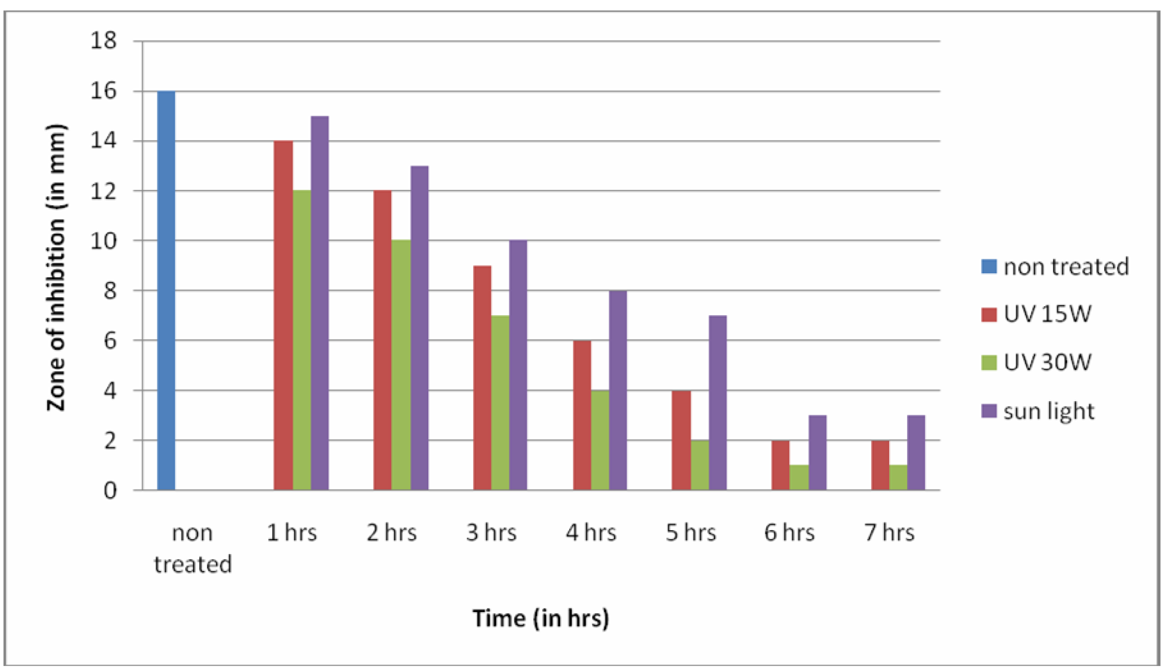


Figure.5 200ppm concentration of ciprofloxacin showing degradation with UV (15W, 30W) and sun light.

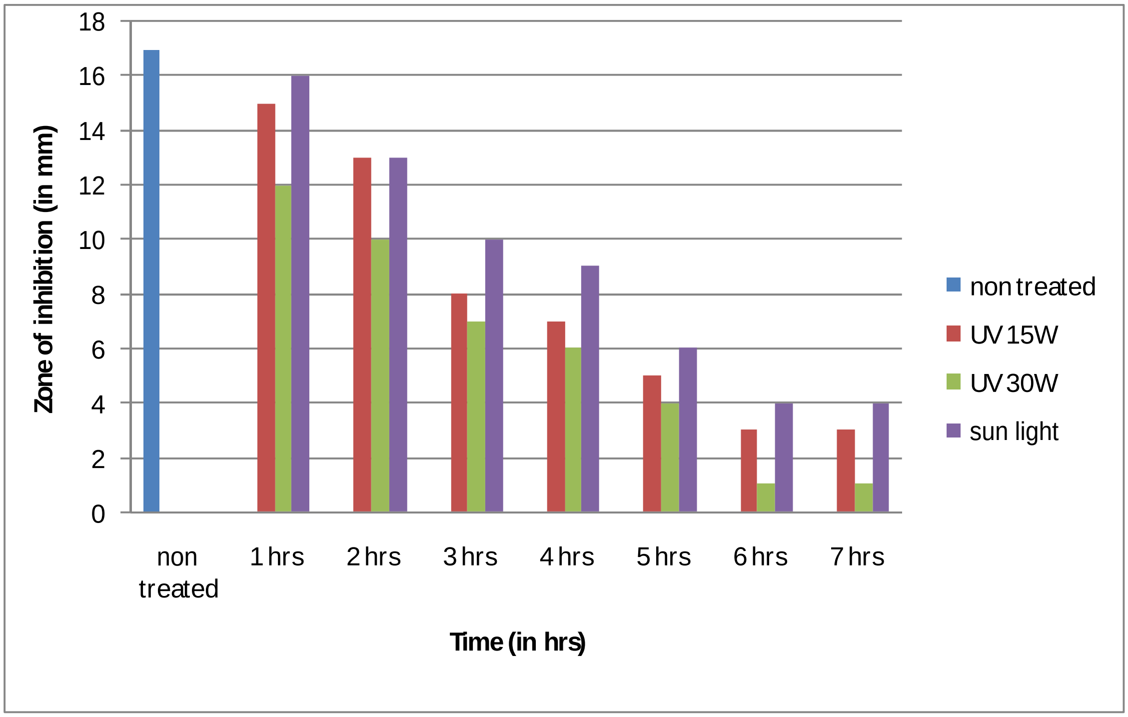


Figure.6 300ppm concentration of ciprofloxacin showing degradation with UV (15W, 30W) and Sunlight

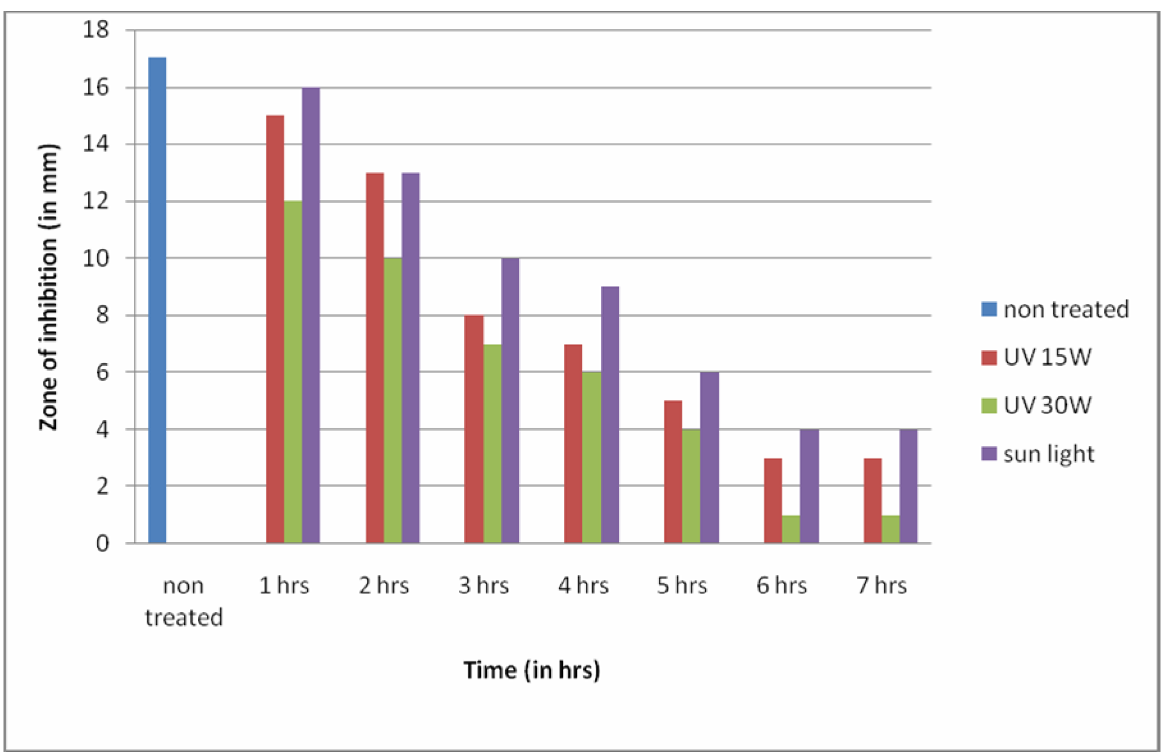


Figure.7 400ppm concentration of ciprofloxacin showing degradation with UV (15W, 30W) and sun light

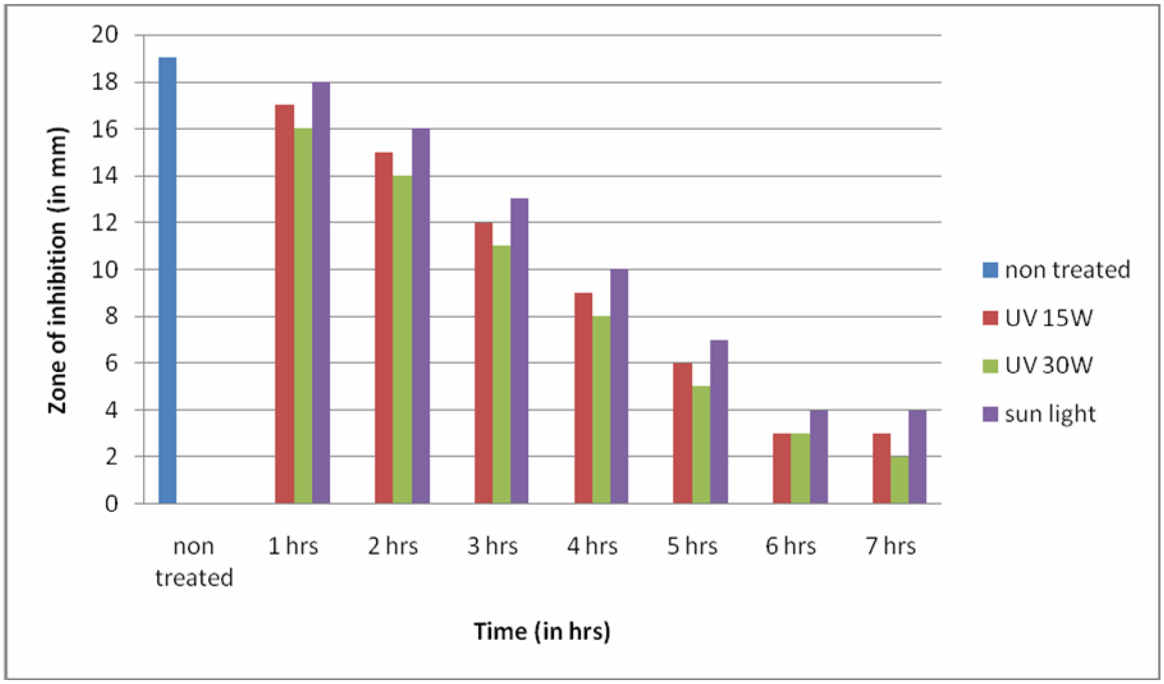
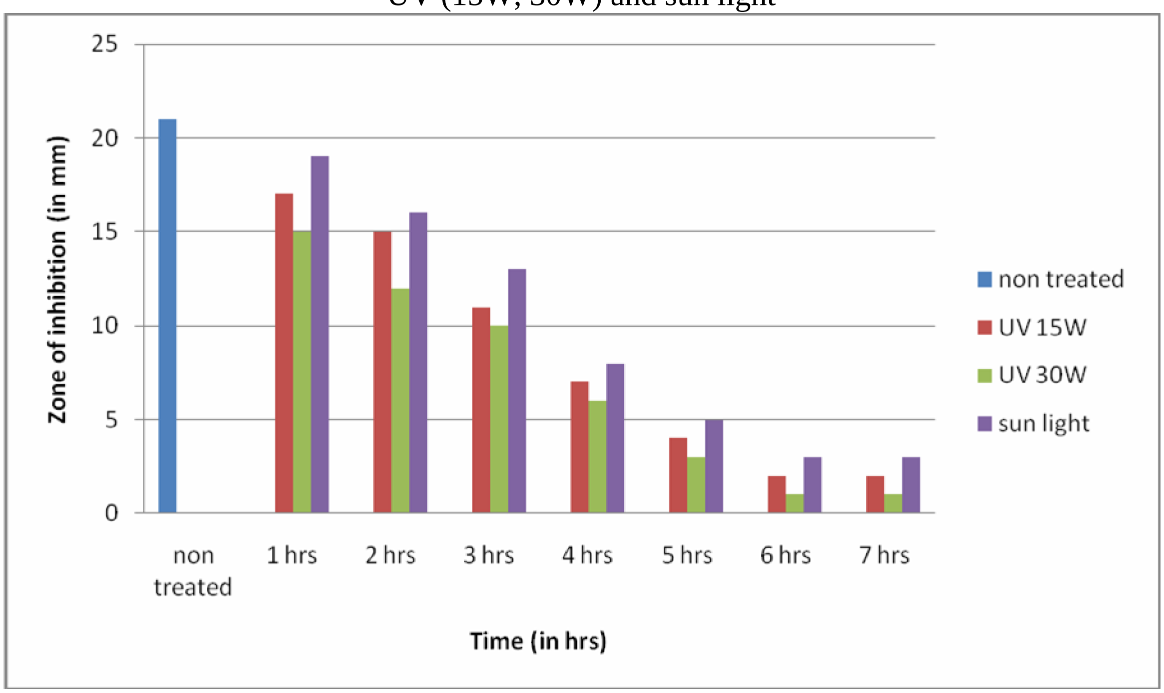


Figure.8 500ppm concentration of ciprofloxacin showing degradation with UV (15W, 30W) and sun light



The zone of inhibition of ciprofloxacin when treated with UV (15W) and sun light was smaller than the controls but after 30W UV treatments, the zone of inhibition was still smaller to the above treatments (fig.2a, 2b,3,4,5,6,7,8 and table.1,2, & 3.

The UV and photodegradation of the different concentration of ciprofloxacin (50,100,200,300,400 and 500) were observed and the photodegradation in comparison to the UV radiation was observed comparatively slower. In the environment, the higher intensities of UV radiation do not exists, thus the studies were performed at lower radiation level i.e. 15 and 30 W. The rate of degradation of ciprofloxacin at 30W was higher. With the increase in the UV and sun light treatment duration, the rate of degradation increases, resulting in the gradual inactivation of the antibiotic.

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