EFFECT OF CHLORINE ON TINTED HYDROGEL LENSES

Mark Liebetreu

Advisor: Gerald E. Lowther, O.D., Ph.D.
College of Optometry
Ferris State College
Big Rapids, MI 49307

ABSTRACT

The effect of soaking tinted Bausch and Lomb and Ciba hydrogel contact lenses in chlorinated water on the light transmission was made determined. Each lens was soaked for 96 hours with transmission curves measured after each 24 hour period. Measurable bleaching occurred in amber, blue, and green Ciba lenses, however, no bleaching occurred in the Ciba aqua or the Bausch and Lomb lenses.

INTRODUCTION

With the increased popularity of tinted hydrogel contact lenses, cases of loss of color have been reported by patients and practitioners. Since common substances can cause bleaching, it is important for the practitioner to know which tinted lens and substance combination can bring about a loss of color.

One of the most common substances which might cause loss of tint is chlorine (1), an oxidizing agent. Since chlorine is commonly used to prevent microbial growth in swimming pools, it was decided to determine if the chlorine concentration in pool water could bleach tinted lenses. If bleaching did occur, the differences in brands, the color and the length of time for measurable bleaching to occur was to be determined.

METHODS

Eight tinted hydrogel lenses were chosen for the investigation. The tints of aqua, blue, green, and amber Bausch and Lomb and Ciba lenses were used. These tints are each of the available colors from both manufacturers. Each new lens was measured to determine the percent transmission before being soaked in the chlorinated pool water. To graph the transmission curves of each lens a Beckman DB spectrophotometer interfaced to an IBM-PC computer with a Tecmar Lab Master Data Acquisition board was used to record the data directly on computer diskette for analysis (2). The transmission curves were recorded at 10 nm steps from 350-750nm. This initial graphing was prior to exposure to the chlorine for the base-line data for each lens. Control lenses not exposed to the chlorine were graphed at the same intervals as the test lenses.

Pool water, containing chlorine as the antimicrobial agent,

was then collected from a local swimming pool. Samples were taken fresh each day to assure full chlorine concentration. Both the chlorine concentration and the pH were measured using a swimming pool water test kit (Lifegard). The water samples had a chlorine concentration range of 0.8-1.0 parts per million (ppm) and a pH of 7.2-7.8. These are normal values for chlorinated swimming pools.

Each lens was then placed in the first sample of pool water and soaked for 24 hours before being graphed. The pool water contained an initial chlorine concentration of 0.8ppm and a pH of 7.2. After 24 hours the lenses were removed from the chlorine water and the transmission curves were recorded. The lenses were then placed into a new sample of pool water and run through another 24 hour cycle. This sequence was continued for a total of four cycles or 96 hours of soaking. In each case the initial and final chlorine concentration and pH were recorded (Table 1).

RESULTS

Figures 1-8 show the effect of soaking the lenses in chlorinated pool water. Figures 1 and 2 indicate that there was no significant change in the transmission of the B&L aqua or Ciba aqua lenses. Figure 3 indicates no change in the light transmission of the blue B&L lens. However, Figure 4 shows a significant increase in the transmission, lightening, of the Ciba blue lens at wavelenghts above 520 nm. The blue Ciba lens had a baseline minimum transmission of 76% at 605 nm. After 48 hours of soaking, the transmission increased by 15% to a final average of 91%. The instrumentation is accurate to a standard deviation of $\pm$3%.

Figure 5 shows that there was no significant change in the transmission of the green B&L lens. Figure 6 indicates the transmission increased slightly in the 380 nm to 480 nm range for the Ciba green lenses. The transmission increased from 54% at 400 nm at the baseline measurement to 60% after the 48 hours of soaking.

Figure 7 indicates no change in the transmission of the B&L amber lens. The Ciba amber lens, figure 8, shows an increase in transmission 380 to 520 nm range. At 470 nm, the minimum transmission point, 48% of the light was transmitted at the baseline measurement with 63% transmission after 48 hours of soaking for a 15% increase in transmission.

In the three lenses that changed, it was found that very little bleaching occurred in the first 24 hours but maximum bleaching occurred within 48 hours. After 48 hours virtually no further bleaching occurred.

The control lenses measured on the same schedule as the test lenses showed no change in transmission.

DISCUSSION

When comparing the transmission curves of the eight lenses, the amount of bleaching did not seem to be dependent upon the wavelength absorbed by the tint but rather upon the type of tint process. It appears that the Bausch and Lomb tints are unreactive to the chlorine concentration of swimming pool water. The aqua Ciba lens was also unreactive even though the transmission curve has an absorption near the same wavelength as the blue Ciba lens.

It has not been shown from this investigation whether the increase in transmission was due to the dye being chemically

altered or if the dye was removed from the lens matrix by the chlorine. Since the Ciba dye is covalently bonded to the lens polymer it may be that some of the chemical bonds within the tint that result in light absorption may have been altered with no actual loss of dye from the lens.

CONCLUSION

It appears from this investigation that the chlorine concentration in swimming pool water can bring about tint bleaching in certain lenses. The amber, blue, and green Ciba lenses are the most susceptible. None of the B & L lenses or the aqua Ciba lens showed any measurable tint bleaching. It is not know if the lower concentrations of chlorine in drinking water will cause such an increase in light transmission. However, due to possibility of bleaching, as well as other obvious reasons, patients should be cautioned from using chlorinated water of any type with their tinted lenses.

TABLE I

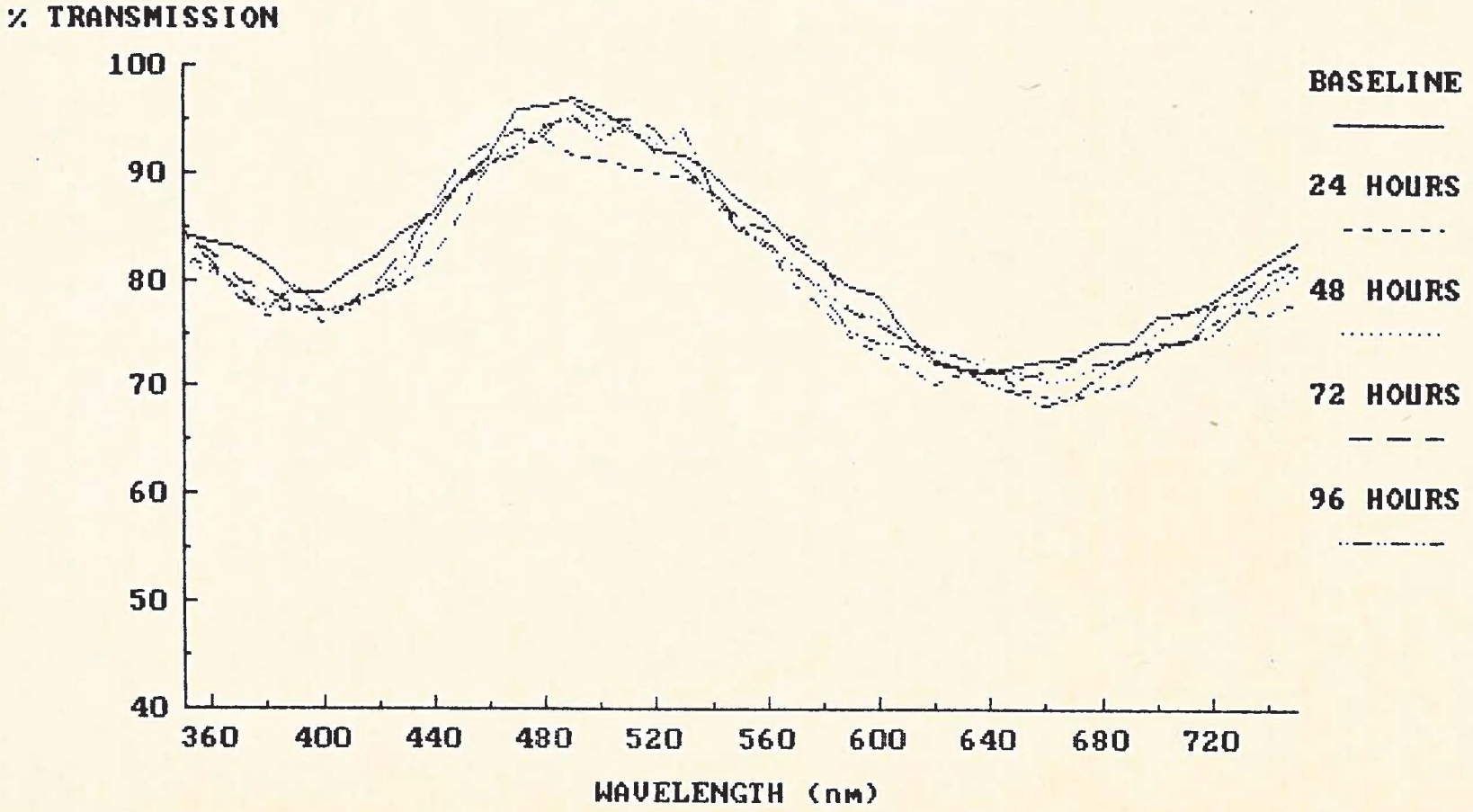
Cycle#	Initial(CL)	Final(CL)	Initial(pH)	Final(pH)	Time(hrs
Base-line					
1	0.8	0.0	7.2	7.2	24
2	1.0	0.0	7.6	7.6	48
3	0.8	0.0	7.6	7.6	72
4	0.8	0.3	7.8	7.8	96

REFERENCES

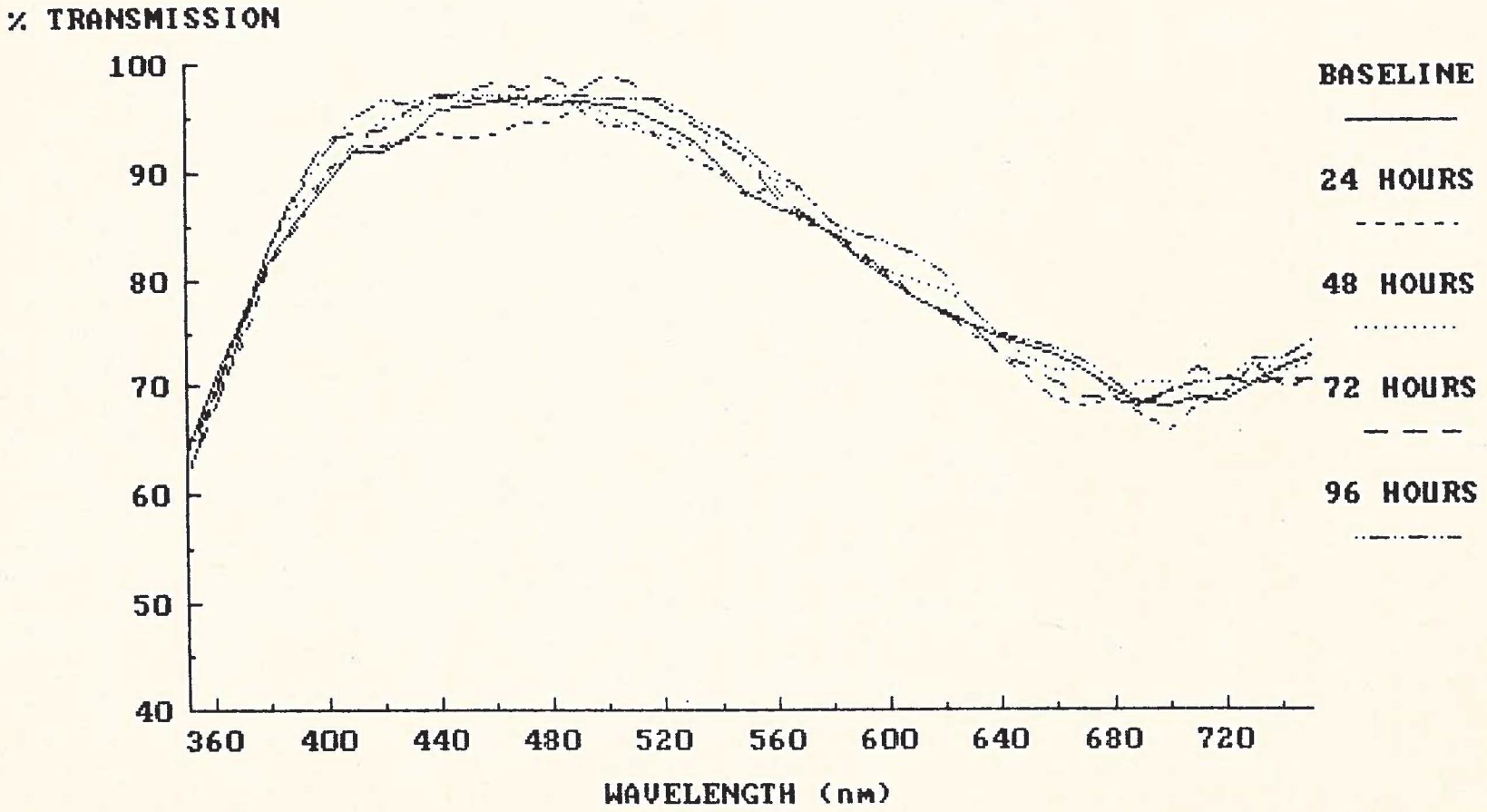
1. Hanks, A., Cosmetic Tinted Lenses: A New Soft Lens Option, Eye Contact 1(2):5-10, 1984.

2. Hammack, G. and G. E. Lowther, Transmission Curves of Tinted Hydrogel Lenses, in press.

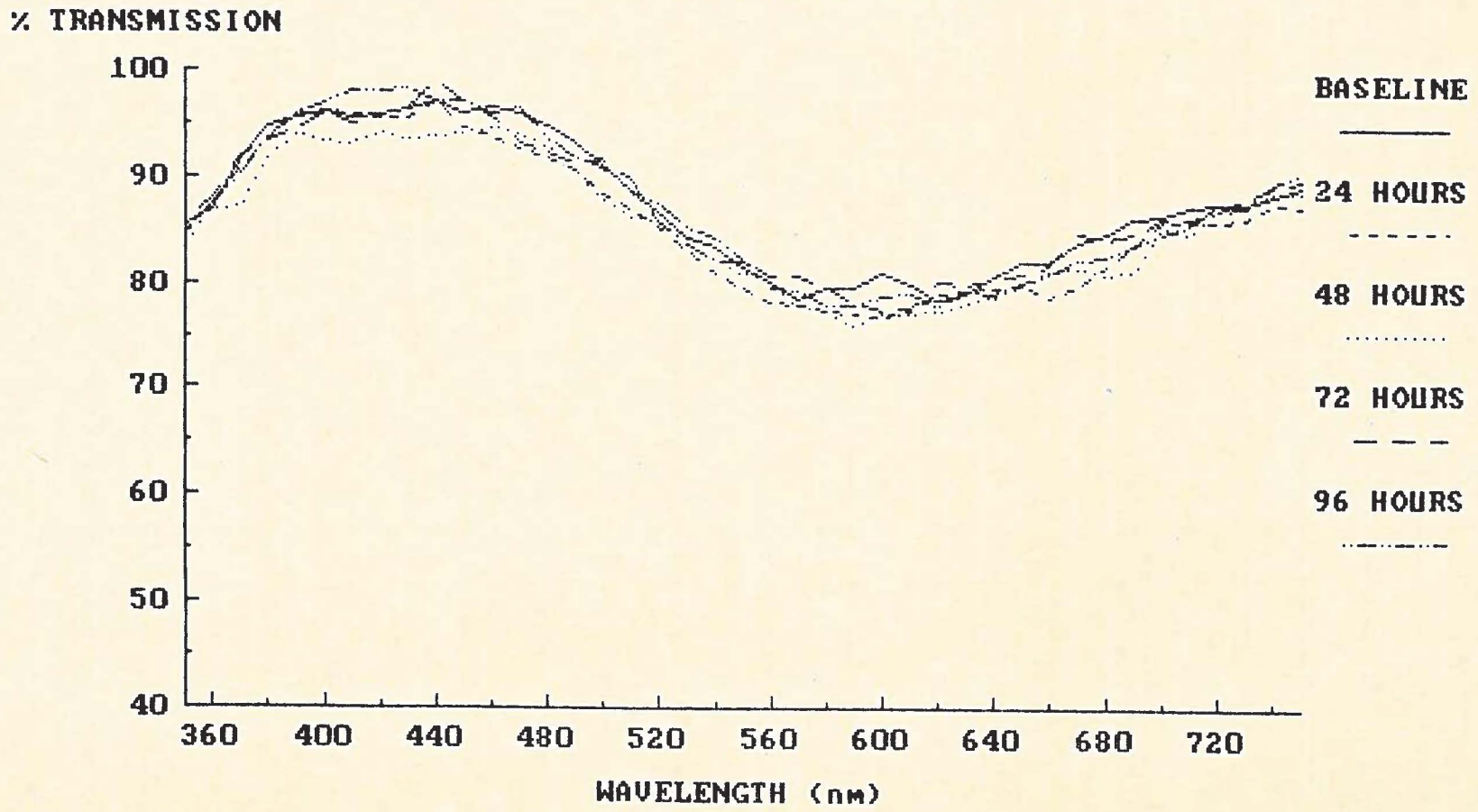
CHLORINE SOAKED
AQUA B&L LENS
TRANSMISSION CURVES



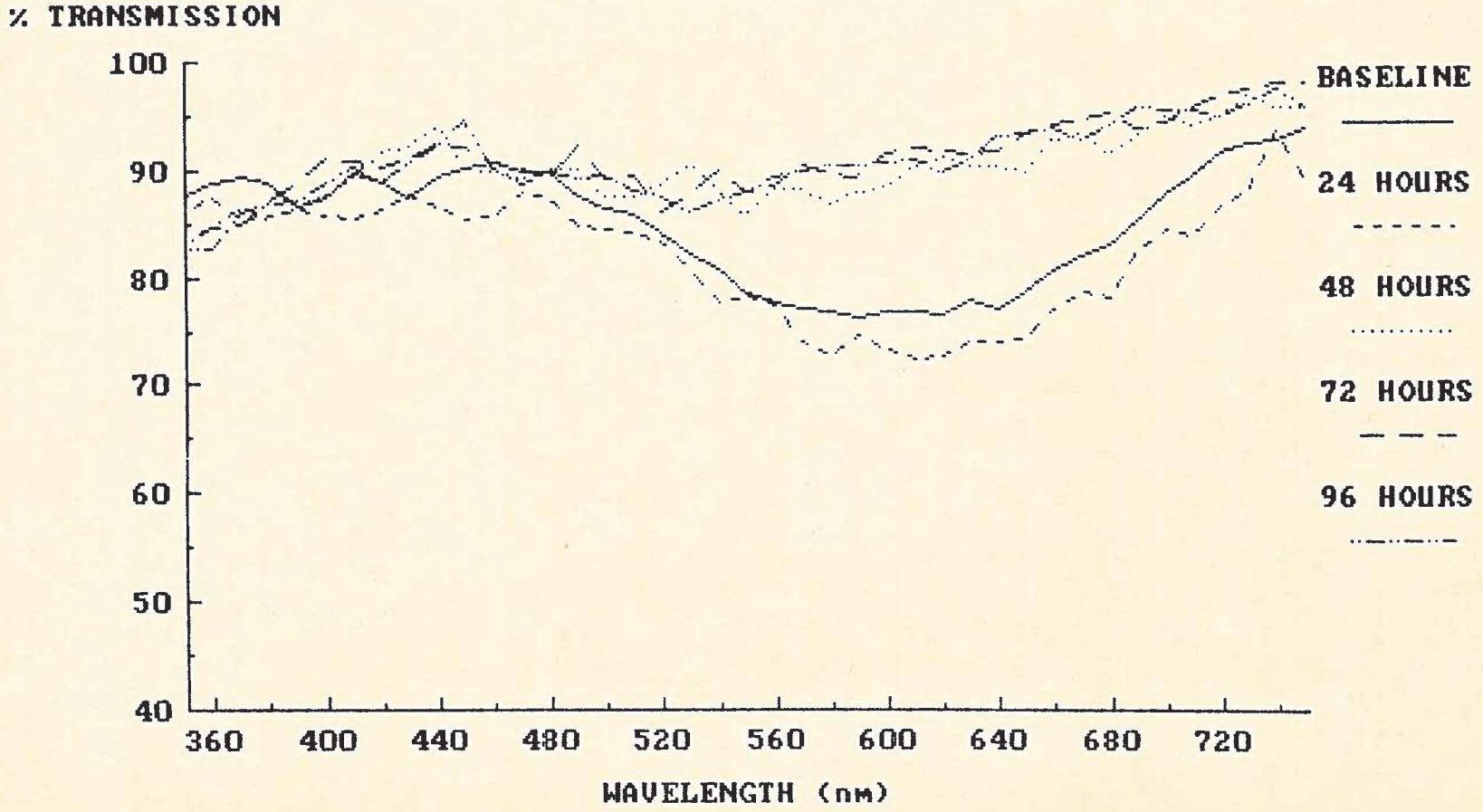
CHLORINE SOAKED
AQUA CIBA LENS
TRANSMISSION CURVES



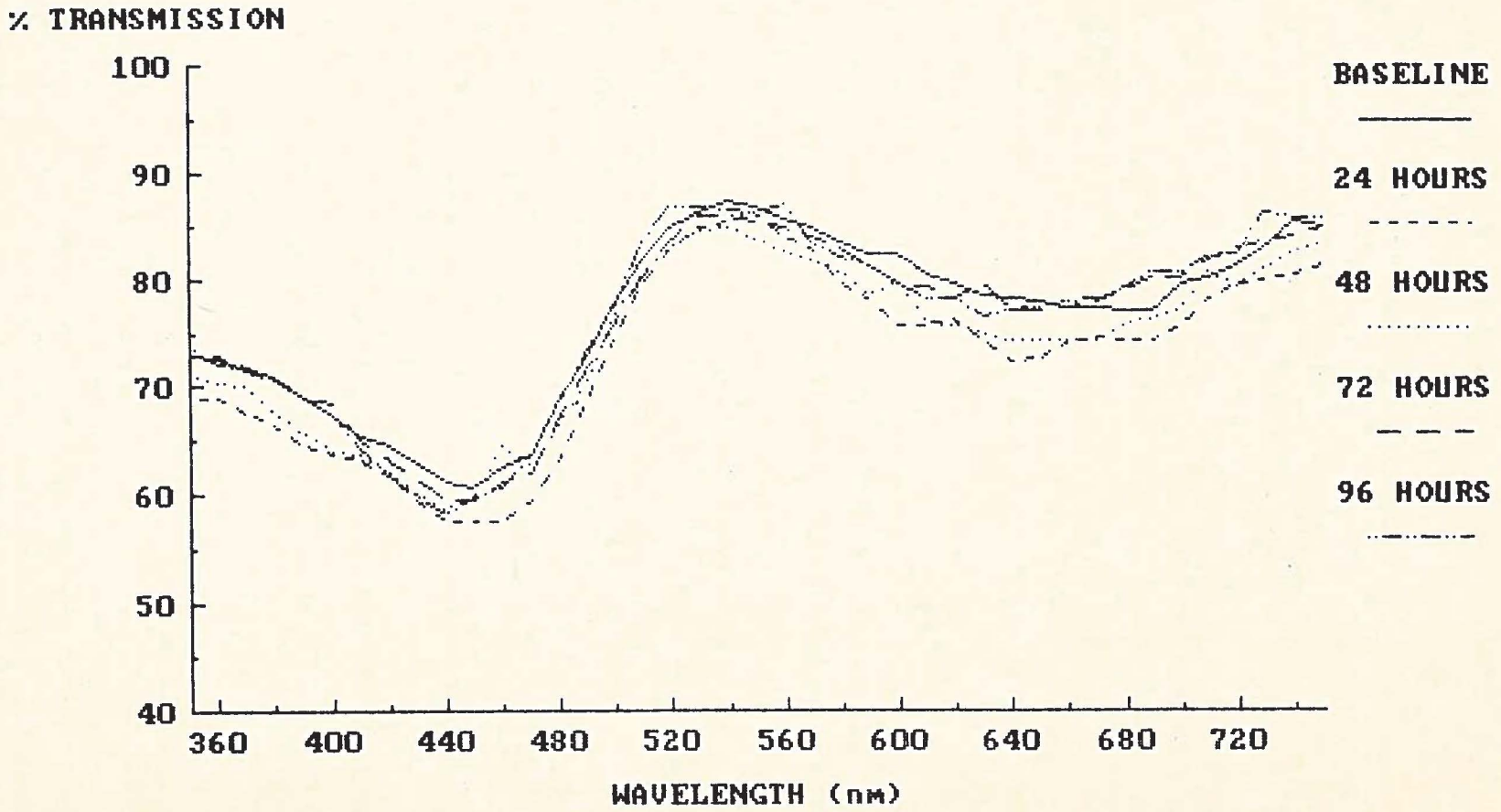
CHLORINE SOAKED
BLUE B&L LENS
TRANSMISSION CURVES



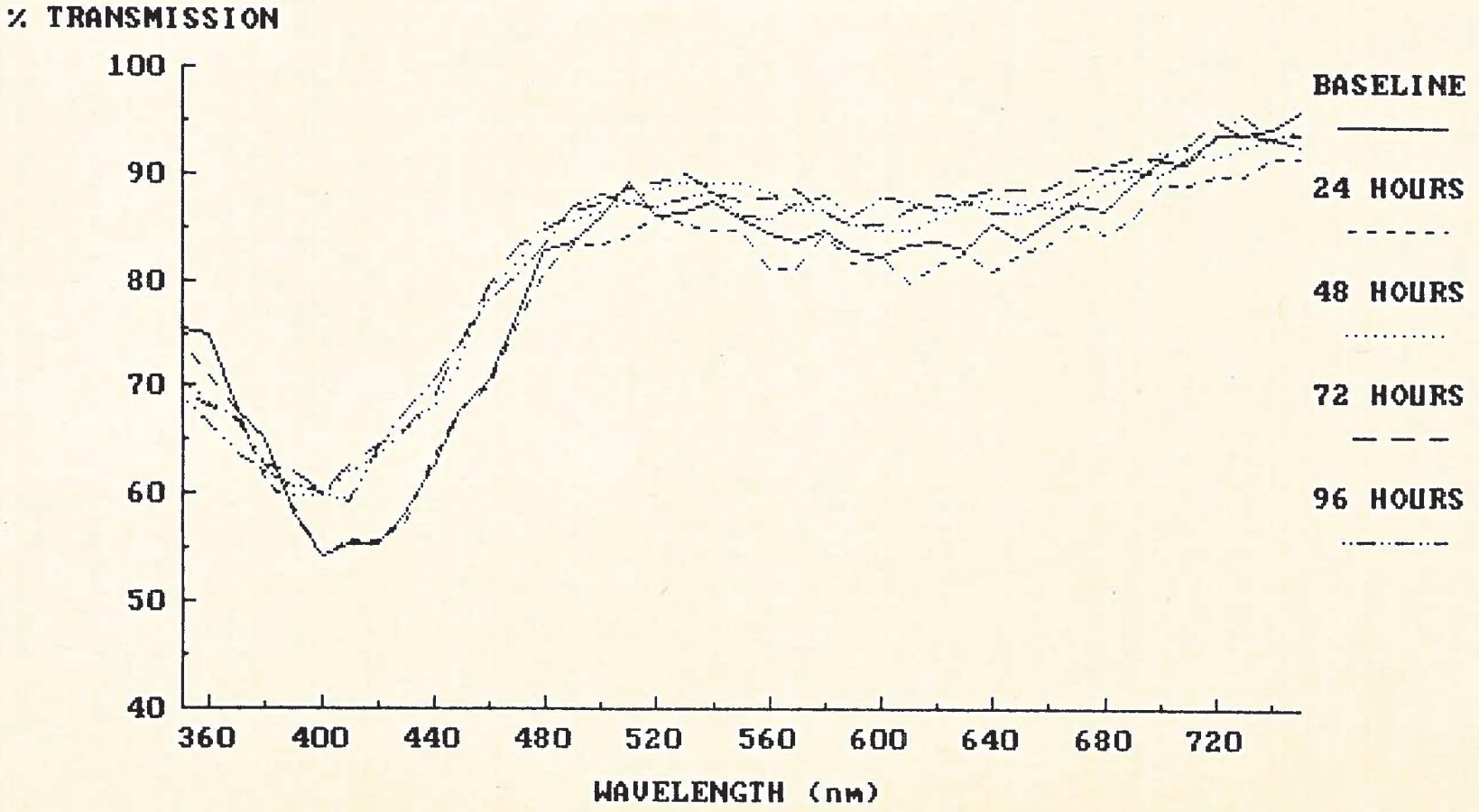
CHLORINE SOAKED
BLUE CIBA LENS
TRANSMISSION CURVES



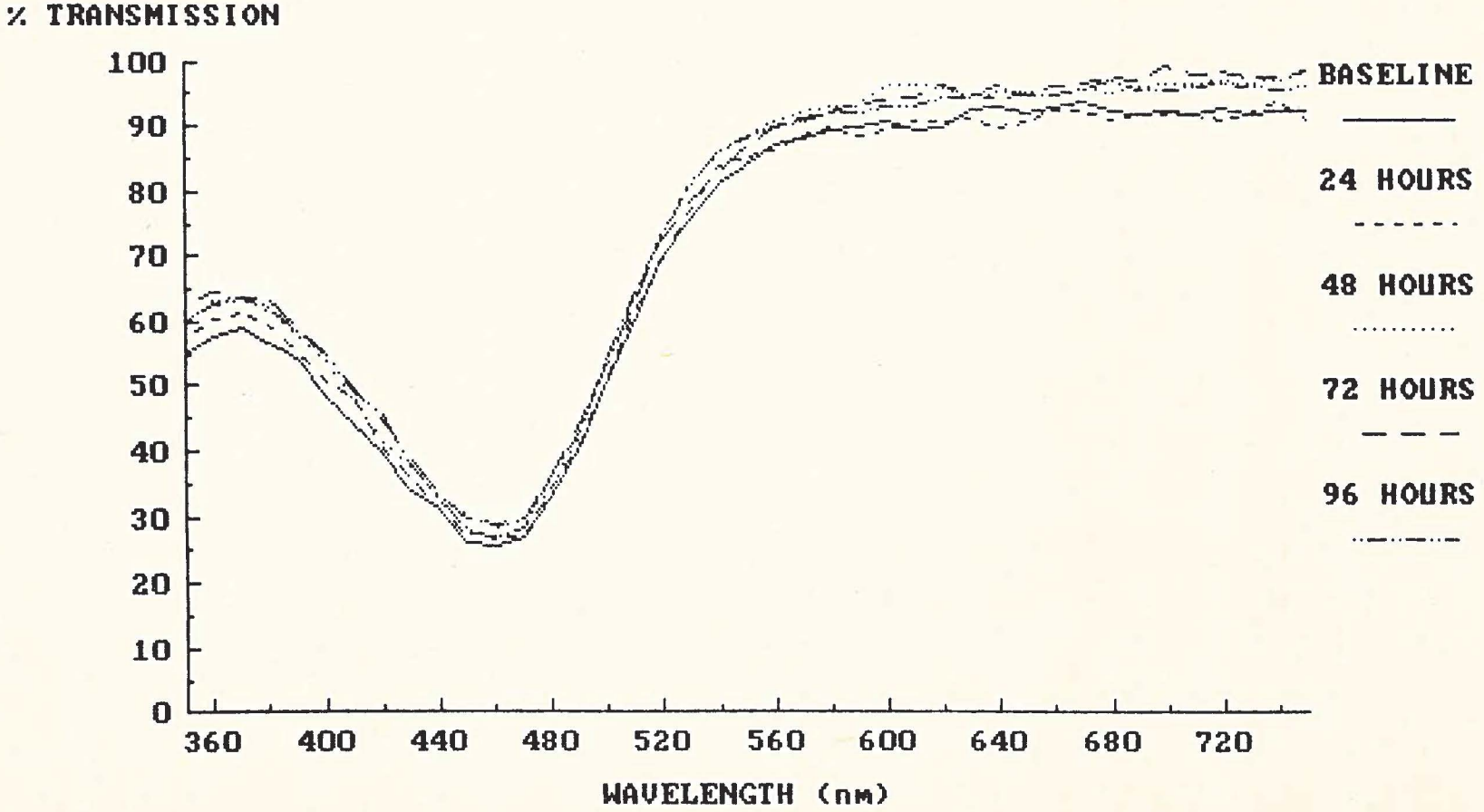
CHLORINE SOAKED
GREEN B&L LENS
TRANSMISSION CURVES



CHLORINE SOAKED
GREEN CIBA LENS
TRANSMISSION CURVES



CHLORINE SOAKED
AMBER B&L LENS
TRANSMISSION CURVES



CHLORINE SOAKED
AMBER CIBA LENS
TRANSMISSION CURVES