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Research Article

Blue Light Biosafety and Blue Light Protection Technology Analysis

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Abstract – Today, with the development of the technological age, the human body has increased exposure to blue light from devices such as tablets, light emitting diodes, smartphones, and laptops. Blue light, which is located between the 380 and 495 nm wavelengths of the electromagnetic spectrum, has high energy and has a visible wave characteristic. When exposed to blue light too much, many eye problems and irreversible vision loss are inevitable. In addition, its harmful effects on the brain and circadian rhythm have been studied extensively recently. For this reason, studies on the biosafety of blue light and blue light protection technology are increasing day by day. In our study, green and blue filter glasses that filter the blue light region were analyzed. In addition, as the diopter value changes, the change in the spectrum and blue light filters were also examined. While the transmittance of zero diopter glass at 550 nm is 92.52%, the light transmittance of minus one diopter glass is 91.25%, and the light transmittance of minus two diopter glass is 89.13%. It has been observed that zero diopter glass transmits a lot of blue light (380-495nm). It is observed that green coated glasses do not transmit blue light in the wavelength range of 300-407nm and partially filter blue light in the wavelength range of 407-435nm. It is observed that blue light filter glasses absorb light in the range of 300-407nm and do not transmit it to the eye. It is observed that some of the blue light is transmitted to a certain extent after the wavelength of 407nm. This multidisciplinary study, which is related to optics and physics, is very important in terms of raising awareness and informing people and is thought to make a significant contribution to the literature.

Keywords –Blue Filter Glasses, Blue Light, Blue Light Protection, Green Filter Glasses, Transmittance.

I. INTRODUCTION

Blue light is a high-energy visible wave found between 380 and 495 nm wavelengths of the electromagnetic spectrum. Today, there are an increasing number of sources that cause excessive blue light exposure, which is not natural but has a major impact on human life. For example, smartphones, laptops, tablets, fluorescent lamps, modern flat panel displays, liquid crystal displays (LCDs), light emitting diodes (LEDs) [1, 2].

Blue light is thought to cause many eye problems, from digital eye strain to macular degeneration, and therefore irreversible vision loss. In children and adolescents, the rate of blue light passing from the corneal surface to the retina is higher than in adults. It is also known that blue light has harmful effects on the brain and circadian rhythm, and therefore negative effects on sleep patterns [3, 4]. Exposure to blue light in the evening and at night is associated with difficulty falling asleep and poor sleep quality due to the process of

suppressing melatonin production. This can increase people's risk of mood disorders and other health problems [5, 6].
The quality and analysis of blue filter glasses in the field are very important in terms of blue light biosafety, there are many studies in every country on this subject and the analyses are still ongoing[2, 4-9]. In Turkey, the measurement and interpretation of these analyses are also very important.
For these reasons, many researchers are working on blue light biosafety and blue light protection technology. Blue light protective glasses are very important to prevent the harm of blue light. Blue light filtering glasses selectively reduce or block the transmission of UV radiation and short-wavelength visible light.
In this study, many blue-coated glasses sold in Turkey, the ones with good quality were analyzed. Uncoated, anti-reflective coated (green coated), and blue filter glasses were analyzed. As the diopter numbers of the glasses changed, their light transmittance and blue light transmittance were analyzed.

II. MATERIALS AND METHOD

There are many brands of glass sold in Turkey. Uncoated, green, and blue-coated glasses purchased from an optical company were analyzed. For each coated/uncoated glass, 3 different diopter glasses were analyzed. Zero, minus one, and two diopter glasses were taken as samples. For the analysis of the glasses, the transmittance of the blue light region in the visible region (300-700nm) was examined. Measurements were taken in the 300-700 nm wavelength range with a Shimadzu brand, SolidSpec 2550 UV-VIS-NIR device at Eskisehir Osmangazi University.

III. RESULTS

When the optical analyses of uncoated glasses are examined in the transmittance spectrum in the 300-700nm wavelength range (Figure 1), the transmittance of zero diopter glass is 92.52% at 550nm, while the light transmittance of minus one diopter glass is 91.25%, and the light transmittance of minus two diopter glass is 89.13%. It is observed that zero diopter glass transmits blue light (380-495nm) quite a lot, while minus one and minus two diopter glasses transmit light after 377nm wavelength.

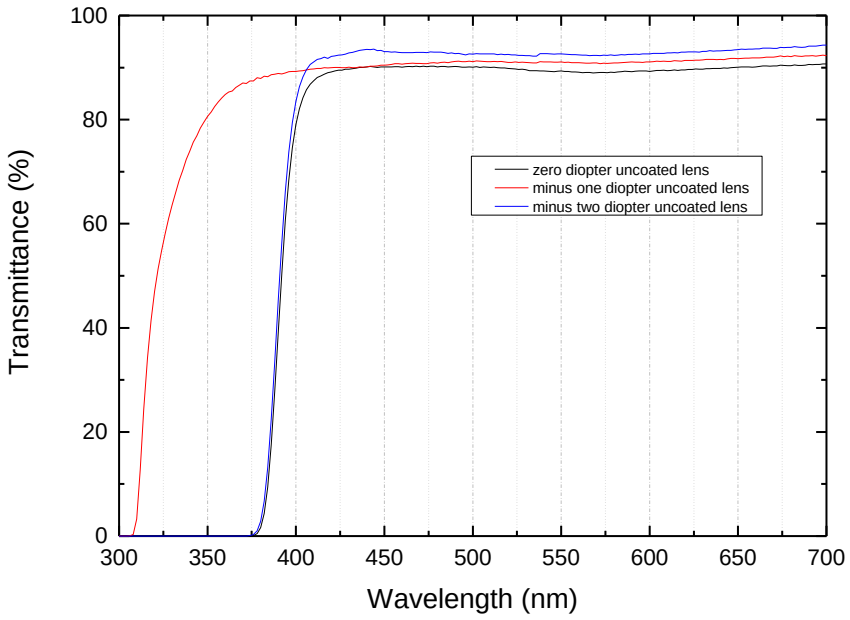

Fig. 1 Transmittance of uncoated zero, minus one, and two diopter glasses

When the transmittances of green coated unnumbered, minus one, and minus two diopter glasses are examined in the 300-700 nm wavelength range (Figure 2), while the zero-diopter glass provides 94.70% transmittance at 550nm wavelength, the minus one numbered glass provides 97.39% and the minus two diopter glass provides 98.94% light transmittance. It is observed that green-coated glasses do not transmit blue light in the 300-407nm wavelength range and partially filter blue light in the 407-435nm wavelength range.

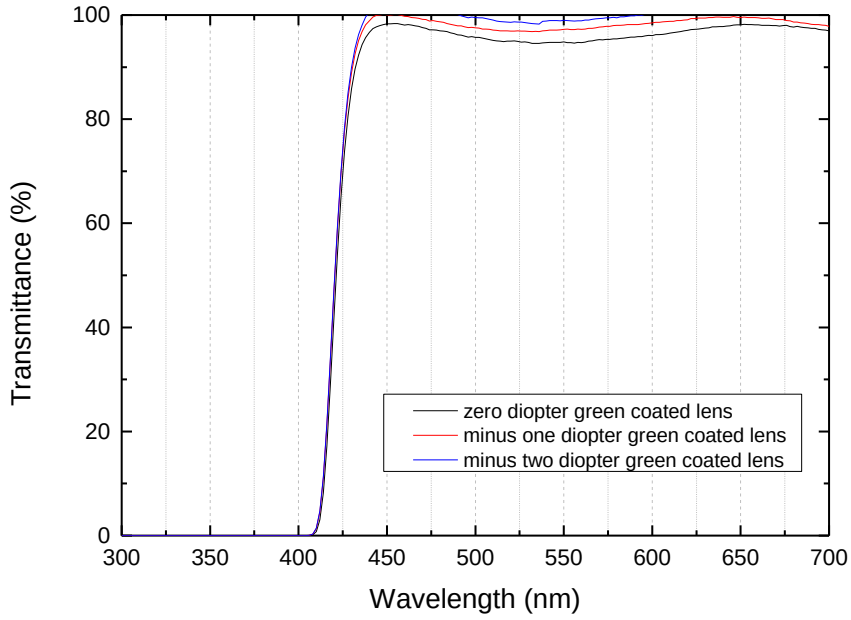

Fig. 2 Transmittances of green coated zero, minus one, and minus two diopter glasses

When the transmittance analyses of blue-coated glasses in the electromagnetic spectrum in the 300-700 nm wavelength range are examined (Figure 3), it is seen that blue light filter glasses absorb light in the 300-407 nm range and do not transmit it to the eye. It is seen that after the 407 nm wavelength, some of the blue light is transmitted to a certain extent. When examined in terms of blue light absorption, it is seen that the electromagnetic spectrum transmits light after the 407 nm wavelength. When the transmittances are discussed in the spectrum at the 550 nm wavelength, it is seen that the zero-diopter blue-coated glass transmits 95.03%, the minus one-diopter glass transmits 98.50%, and the minus two-diopter glass transmits 98.50%.

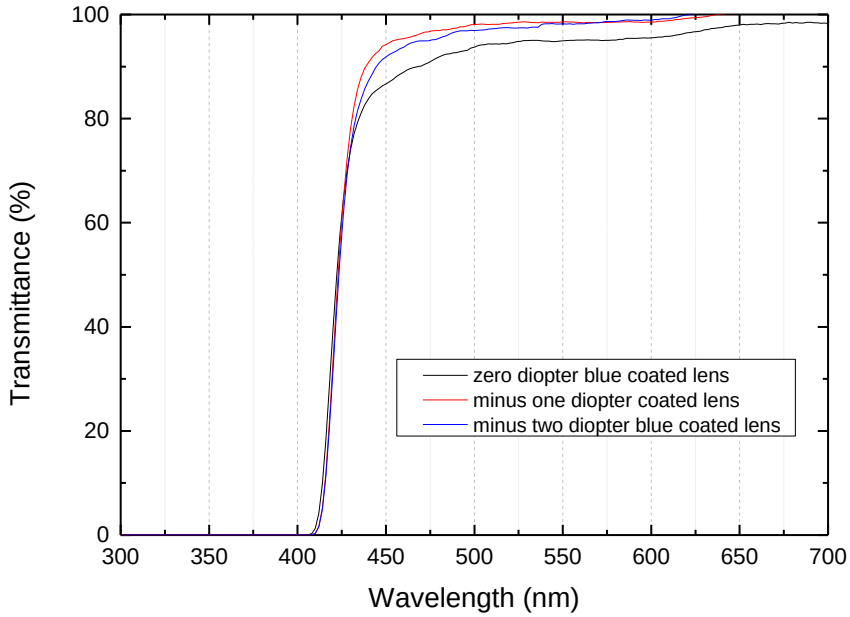

Fig. 3 Light transmittances of blue light coated zero, minus one, minus two diopter glasses

When the transmittances of uncoated, green, and blue-coated glass are examined in the 300-700 nm wavelength range (Figure 4), it is seen that uncoated glass transmits blue light. When the transmittances of green and blue-coated glass are examined, it is seen that it does not transmit blue light in the 300-407 nm wavelength range and partially transmits blue light in the 407-437 nm wavelength range. At the same time, the light transmittance of green and blue-coated glass is 6.27% (550 nm) higher than uncoated glass in visible light.

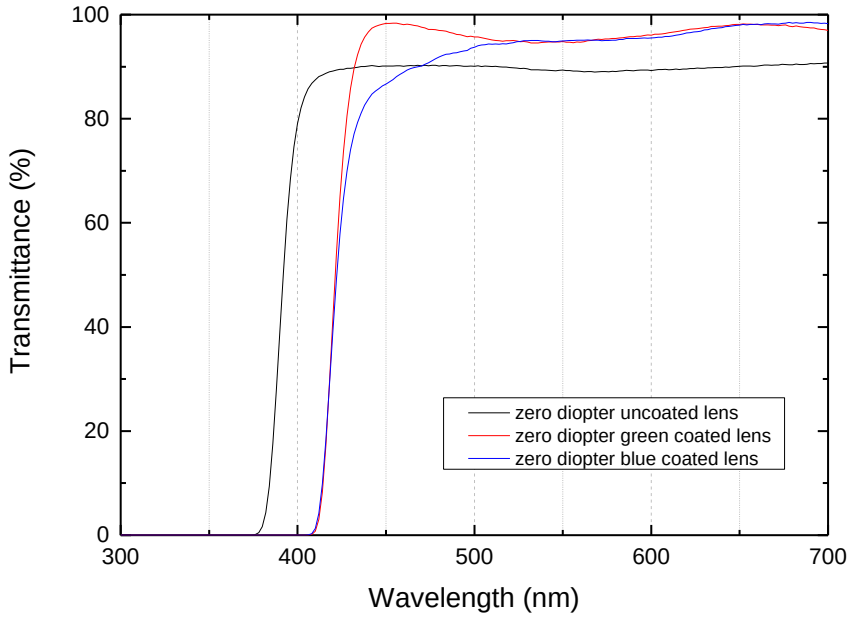

Fig. 4 Transmittance analysis of uncoated, green-coated, and blue-coated glass at zero diopter

IV. DISCUSSION

The light transmittance of uncoated lenses was similar to that in the study conducted by Leung et al., it was seen that they almost completely blocked UVA, UVB, and near UV (380-400 nm) rays.

In a study [10] conducted with blue-filtered glasses, when the filtering of the glasses in the field was examined, it could be said that the green-filtered glasses we examined were of better quality because the filtering stage did not allow light transmission up to 407 nm wavelength and allowed a high rate of light transmission in the visible region.

In a study [10] conducted in the field, the analysis of "BlueControl", Hoya, Japan; "BlueProtect", Zeiss, German; "Crizal Prevencia", Essilor, France; "StressFree" and "Noflex", Swiss Lens, Hong Kong lenses were examined in the range of 300-780 nm. According to this study, it is seen that blue-filtered the lenses we examined completely filter blue light (up to 407 nm) and filter it better. The light transmittance at higher wavelength blue light is accompanied by an increasing graph, similar to the study by Leung et al. [10].

A study [9] conducted with different glass colours has shown that blue glass transmits blue radiation, which is unhealthy for our eyes, so it is correct to choose a lens in a different color. Since the glass color was selected as blue in this study, efficiency could not be achieved, and in our example, the filter color was selected as blue.

In a study [7] examining the analysis of different colored glasses that are damaged by sunlight, it is seen that some of the lenses are permeable in the UV region and do not transmit light well in the visible region. According to this study, the lenses we examined have very good performance.

Other study conducted in South Korea highlighted that manufacturers are likely to increase their performance by comparing blue-filtered glasses and that manufacturers need to secure their technologies to evaluate performance by international standards [8].

V. CONCLUSION

Blue light is emitted from sources such as smartphones, laptops, tablets, fluorescent lamps, modern flat panel displays, liquid crystal displays (LCDs), light emitting diodes (LEDs) and causes many eye problems due to excessive exposure to this light. In addition to recent studies on blue light biosafety, the transmittance analyses of uncoated/green and blue-coated glasses, which are frequently preferred in Turkey, have been examined. As the diopter values change, the blue light transmittances of the glasses have also been analyzed. When the transmittances of uncoated, green, and blue-coated glasses are examined in the wavelength range of 300-700 nm, it is seen that uncoated glasses transmit blue light. When the transmittances of green and blue coated glasses are examined, it is seen that they do not transmit blue light in the wavelength range of 300-407 nm and partially transmit blue light in the wavelength range of 407-437 nm. It is thought that this multidisciplinary study, which is related to physics and optics, will make a significant contribution to the literature.

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REFERENCES

[1] Pelit, A., "Mavi Işık Tehlikeli midir?", *Arşiv Kaynak Tarama Dergisi*, 2022. vol. 31, pp. 231-236, 2022.

[2] Brockmann, C., M. Schulz, and T. Laube, "Transmittance characteristics of ultraviolet and blue-light-filtering intraocular lenses", *Journal of Cataract Refractive Surgery*, 2008. vol. 34, pp. 1161-1166, 2008.

[3] Zhao, Z.-C., et al., "Research progress about the effect and prevention of blue light on eyes", *International journal of ophthalmology*, 2018. vol. 11, pp. 1999, 2018.

[4] Dillon, J., et al., "Transmission of light to the aging human retina: possible implications for age related macular degeneration", *J Experimental Eye Research*, 2004. vol. 79, pp. 753-759, 2004.

[5] Lawrenson, J.G., C.C. Hull, and L.E. Downie, "The effect of blue-light blocking spectacle lenses on visual performance, macular health and the sleep-wake cycle: a systematic review of the literature", *J Ophthalmic Physiological Optics*, 2017. vol. 37, pp. 644-654, 2017.

[6] Cougnard-Gregoire, A., et al., "Blue light exposure: ocular hazards and prevention—a narrative review", *J Ophthalmology therapy*, 2023. vol. 12, pp. 755-788, 2023.

[7] Abdulrahim, S., Y.M. Abubakar, and I.T. Bello, "Evaluation of the level of transmission of solar radiation by eyeglasses (spectacles) and its effects on the human eye", *J Journal of Asian Scientific Research*, 2015. vol. 5, pp. 489, 2015.

[8] Kim, C.-J., et al., "Evaluation of blue-light blocking ratio and luminous transmittance of blue-light blocking lens based on international standard", *Journal of Korean Ophthalmic Optics Society*, 2014. vol. 19, pp. 135-143, 2014.

[9] Pietrusiewicz, P., "The Effect of Coloring on the Transmission of Electromagnetic Radiation in Eyeglass Lenses", *J Materiale Plastice*, 2018. vol. 55, pp. 640, 2018.

[10] Leung, T.W., R.W.-h. Li, and C.-s. Kee, "Blue-light filtering spectacle lenses: optical and clinical performances", *J PloS one*, 2017. vol. 12, pp. e0169114, 2017.