

## NOTES

# Effects of Polyphenol on Visual Fatigue Caused by VDT Work

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*Visual fatigue of VDT (visual display terminal) operators poses a serious problem for corporations where VDT work is a major part of operations. In this study, an investigation in a corporation was carried out to examine the effect of polyphenol on recovery from visual fatigue of the visual function caused by working at a VDT. Three kinds of parameters were used for evaluating the effect of polyphenol. As a subjective evaluation, the first was a questionnaire to ascertain subjective feelings of fatigue. As aspects of a physiological evaluation, the second and third parameters were the accommodative function and the flicker value.*

polyphenol    VDT work    visual fatigue    accommodative function

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## 1. INTRODUCTION

Today, word processing, computer control, data processing, data analysis and database searching using visual display terminals (VDT) are all common tasks in administrative work, production control, scientific work and many other fields [1]. Therefore, many corporations are taking measures to prevent the occurrence of VDT disorders. As a social problem, visual fatigue is one of the most frequent types of fatigue complained about in association with working at a VDT [2]. The relationship between VDT operation and health, especially visual fatigue, has been examined extensively [3, 4, 5]. Visual fatigue due to working at a VDT can be attributed to a variety of causative factors, such as the visual organs, the work environment, and certain psychological factors [6, 7]. Its evaluation has been undertaken from various perspectives, including the field of view, visual acuity and the accommodative function [8, 9]. However, little is known about the process of

recovery from visual fatigue caused by working at a VDT.

In recent years, polyphenol has gotten a lot of publicity because it is effective in suppressing symptoms of physical stress and in promoting recovery from fatigue. The Bioscience Laboratory of Meiji Seika Co. Ltd. reported that polyphenol had the effect of suppressing false nearsightedness and improving night blindness [10]. To explain these effects, it stated that polyphenol improved the circulation within the capillaries and prevented a decline in the ability of the muscles to accommodate the lens. It is also known that polyphenol is effective in promoting circulation so that visual fatigue is alleviated and stiffness in the shoulders and poor circulation are reduced.

We intended in this study to clarify the effect of polyphenol on the recovery of visual fatigue caused by VDT work. We carried out an investigation at a corporation where much of the work consisted of using VDTs. The polyphenol used for this study was extracted from peanut seed shells.

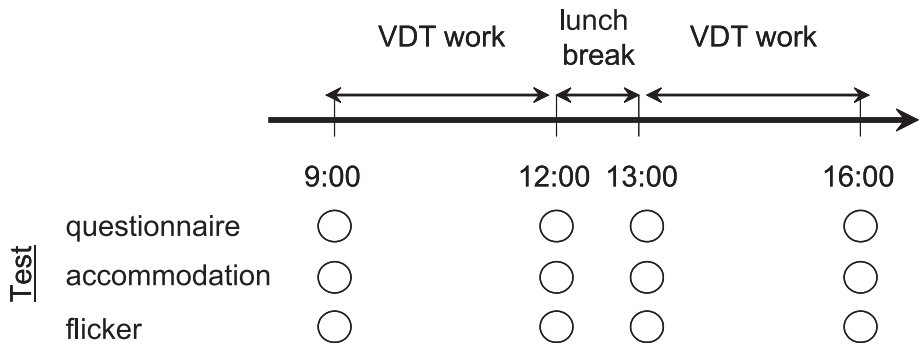


Figure 1. Investigation protocol. Notes. VDT—visual display terminal.

2. INVESTIGATION

2.1. Protocol

Figure 1 shows the protocol for this investigation. Its subjects carried out their usual duties; they started their tasks at 9:00 and worked until 16:00, with a one-hour lunch break. During the course of this study, our investigation examined the process of recovery from visual fatigue.

We evaluated the recovery from visual fatigue immediately after the end of each operation and at the end of the lunch break, by using a questionnaire for subjective feelings of fatigue and also by measuring the accommodative function and the flicker value. We used the same questionnaire to examine the subjects before the next workday began.

To examine the effect of polyphenol on recovery from visual fatigue caused by working at a VDT, we carried out a total of 2 days of testing. On the first day, cloth pads moistened with a polyphenol solution were applied to the eyes for 5 min at the end of the lunch break. On the second day, the subjects spent their lunch break without the cloth pads moistened with a polyphenol solution.

2.2. Evaluation Indices

2.2.1. The questionnaire for subjective feelings of fatigue

In the subjective evaluation, the feeling of fatigue was investigated using a questionnaire compiled by the Working Group for Occupational Fatigue,

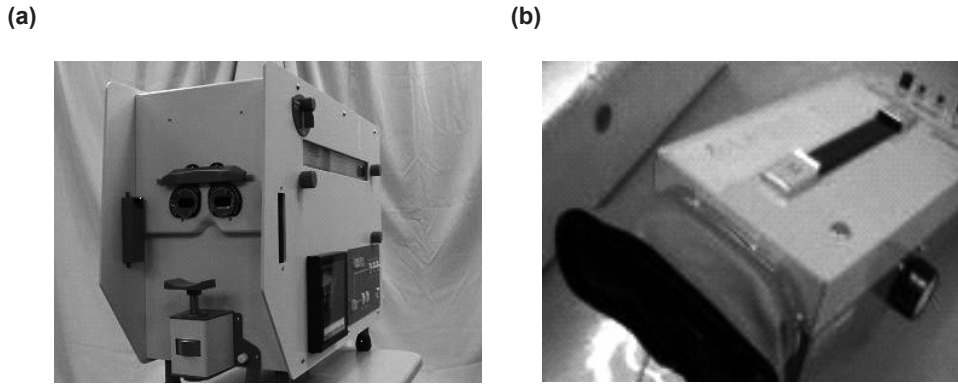
Japan Society for Occupational Health [7]. This questionnaire consisted of 25 items subdivided into five groups in which each provided a different measure of evaluation: 1—drowsiness; 2—feeling of instability; 3—discomfort; 4—weakness; 5—blurred vision. Visual fatigue as examined in this study was evaluated on the basis of responses to items in group 5. The results were rated on a 5-point scale from *not at all applicable* to *applies completely*.

2.2.2. The accommodative function

Concerning the accommodative function and visual fatigue, the accommodation near point and accommodation time were measured with an accommodo-poly recorder (Kowa Company, Ltd., Japan, HS-9E) (Figure 2a). The accommodation near point was measured with a near-point optotype (Landolt ring) that was moved away in a continuous movement to a point where the subject could recognize it clearly. On the other hand, to measure accommodation time, near-point and far-point optotypes were set up at the near and far points of the subject’s visual range. These optotypes blinked alternately for 5 s each. Both optotypes continued blinking until the subject could clearly recognize both the near and far points. Accommodation time was measured 10 times, and the mean values of the results were used as the value of accommodation time.

2.2.3. Flicker test

Light appears to be on the same continuum when the frequency of light flickering increases. The frequency of flickering per unit of time is called



**Figure 2. Measurement hardware: (a) accommodo-poly recorder (Kowa Co. Ltd., Japan, HS-9E), (b) flicker test equipment.**

flicker value; it correlates remarkably with the level of activity of the cerebral cortex [11]. In this investigation, the flicker value was measured with a blinking light-emitting diode. The flicker value was measured 5 times, and the mean value of the results was used as the flicker value. Figure 2b shows the apparatus for measuring the flicker value.

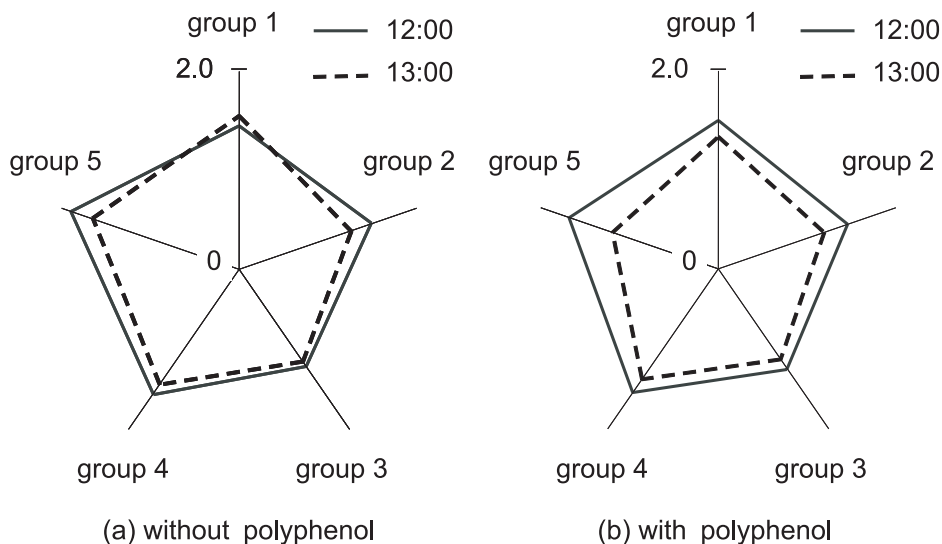
### 2.3. Subjects

Forty office workers ranging in age from their 20s to their 50s, without any visual function impairments, were selected as subjects. The VDT work they performed was broadly divided into two types: simple data entry work and interactive work. They worked at a VDT for ~7.6 h a day.

## 3. RESULTS AND DISCUSSION

### 3.1. The Questionnaire for Subjective Feelings of Fatigue

In Figure 3, radar graphs show the scores from “The questionnaire for subjective feelings of fatigue” [7] obtained immediately before and after the lunch break. Figure 3a shows the results of the questionnaire for subjects without cloth pads in their lunch break, whereas Figure 3b the results for subjects who had moist cloth pads during their lunch break. An examination of both figures showed an increase in the scores of group 5, a measure of visual fatigue. This result suggests that working at a VDT has a strong effect on the degree of visual fatigue.



**Figure 3. Results of the questionnaire.**

In addition, the scores of group 5 were compared with all the subjects for before and after the lunch break. When the subjects spent their lunch break without cloth pads, the scores were 1.91 before the lunch break and 1.65 after it, for a calculated ratio of .88. On the other hand, when cloth pads moistened with a polyphenol solution were used, the scores of group 5 were 1.61 before and 1.20 after the lunch break, for a calculated ratio of .71. These results show the effectiveness of the use of cloth pads moistened with a polyphenol solution in helping subjects to recover from visual fatigue.

3.2. Accommodative Function

Figure 4 shows the results of the differences between the groups with and without cloth pads moistened with a polyphenol solution, in the lunch break. In this figure, (a) represents the results of measuring the distance of the accommodation near point and (b) represents the results of measuring accommodation time.

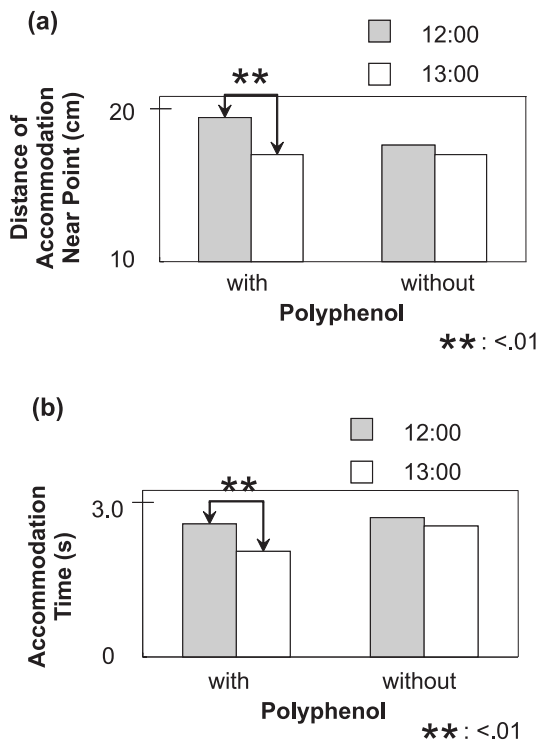


Figure 4. Accommodative function:  
(a) accommodation near point,  
(b) accommodation time.

With the *t* test, the number of scores of the two groups when they are paired is the same and thus the difference in paired data  $d_i = X_{Ai} - X_{Bi}$  ( $1 \leq i \leq n$ ;  $n$ —the number of pairs of data) can be tested for independence. This test method [12] determines whether the population means  $\mu_d$  of  $d_i$  is 0, i.e., whether or not there is any difference between *A* and *B*. Therefore, the difference in means is tested using this method.

The results showed that when a polyphenol solution was used, the accommodative functions such as the accommodation near point and time tended to recover. On the other hand, when it was not used, the accommodative functions showed little recovery. In addition, for when a solution was used, the result of the *t* test also showed a significant difference, with the level of significance greater than .01 for the accommodative functions compared before and after the lunch break. When a polyphenol solution was not used, there was no difference in the measures of both the accommodation near point and time. These results show polyphenol seems to be effective in aiding recovery of the accommodative functions after visually demanding work.

3.3. Flicker Test

Figure 5 shows the results of the mean value from the flicker test. The two series in the figure represent the group where a polyphenol solution was used in the lunch break and the group where it was not. There was little difference in the flicker value between the times before and after

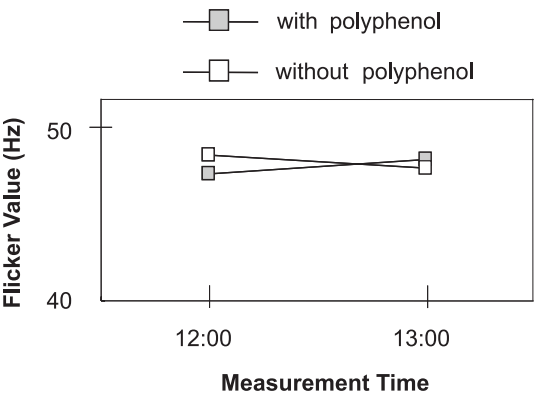


Figure 5. Results of the flicker test.

the lunch break, both for the group that used a polyphenol solution and for the group that did not. From the results of the flicker test, we were not able to find a relationship between the use of polyphenol and the level of activity of the cerebral cortex.

#### 4. CONCLUSION

Our study sought to clarify the effect of polyphenol on visual fatigue for those working at a VDT. The conclusions are as follows: (a) on a subjective evaluation, we showed that polyphenol was effective in bringing about recovery from visual fatigue caused by VDT work; (b) we verified statistically that polyphenol was especially effective in the recovery of accommodative functions such as the accommodation near point and time.

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