THE EFFECTS ON THE HUMAN BODY OF BREATHING AIR POSSESSING 30% OXYGEN- EFFECTS ON BLOOD GLUCOSE LEVELS, BODY WEIGHT/BODY FAT RATIOS, VISUAL ACUITY & STRATUM CORNEUM RENEWAL

T. Oketa[1*], J. Nawama1, N. Hayashi, Y. Moriya, M. Yamura[2*]

1 Home Appliance and Housing Electronics Research Laboratory, Matsushita Electric Industrial Co., Ltd.
1-2 Kamisu-cho, Toyonaka City, Osaka 561-0823, Japan
2 Department of Molecular Life, Sciences Basic Medical Science and Molecular Medicine
Tokai University School of Medicine, Bohseidai, Isehara City, Kanagawa 259-1193, Japan

ABSTRACT

This research studies the physiological changes that occur when breathing oxygen-enriched air. Glucose levels, body weight, body fat ratios and visual acuity were selected as evaluation items. Glucose levels were significantly lowered in 3 out of 9 test subjects after they breathed oxygen-enriched air. 5 out of 14 subjects exhibited statistically significant decreases in body weight and body fat ratios. Although improvements in visual acuity were observed in 3 out of 13 subjects, the differences recorded were not considered to be statistically significant. When breathing oxygen-enriched air, 4 out of 10 subjects exhibited an improvement in stratum corneum renewal speed (turnover).

The 8OH-dG content in urine was measured to observe the impact of oxidative stress. For a period of 24 hours commencing immediately after breathing oxygen-enriched air, measurement of 8OH-dG in the urine, an indicator of active oxygen generation, did not exhibit any significant increases among test subjects.

INDEX TERMS

Oxygen, glucose levels, body weight, body fat ratios, visual acuity, reactive oxygen

INTRODUCTION

Extensive literature is available on studies conducted regarding the effects of 30-40% oxygen concentrations on the human body. There have also been studies that evaluated how irregular oxygen concentrations impact the speed with which lactic acids disappear from bloodstreams during post-exercise recovery processes(Maeda et al. 1997, Nishino et al. 1995). Another study genre has been the use of electroencephalography and subjective responses to assess the effects of variations in oxygen concentrations on stress reduction.(Usami et al. 1993) Yet another set of studies relate to drowsiness and the recovery of the powers of concentration(Katsuura et al. 1993), while still another group of studies has examined the results of using enriched oxygen as part of beauty treatments (though its effects could not be confirmed).(Shimaue et al. 1992) Moreover, there are some studies that have raised questions about the effects of breathing air with high oxygen concentrations from the point-of-view of oxygen-partial pressures and oxygen saturation.(Hirase et al. 1988) Still other studies have considered how safe it is to breath air with oxygen concentrations of over 50% for extended periods of time.

Using an oxygen supply system set at a flow rate of 2 liters per minute, the present study reports on the effects of breathing air with 30% oxygen concentration. Specific attention was paid to its impact on body weight, body fat ratios, glucose levels, visual acuity and stratum corneum renewal. The study also compared the generation of reactive oxygen when air with an oxygen concentration of 40% was inhaled.

RESEARCH METHODS

Production of oxygen-enriched air:

The study used an oxygen supply system (Product number: MS-X1, Matsushita Electric Industrial Co., Ltd). Using this system we supplied air with an oxygen concentration of 30% at a flow rate of 2 liters per minute.

* Corresponding author email: oketa.takemi@national.jp

Effects on glucose levels:
Subjects for this study were 9 males whose age range was 40s to early 50s. The subjects inhaled enriched air for 30 minutes every day in the morning. Their blood sugar levels were then measured before lunch (Gluco-card, Arkray Co., Ltd.).

Effects on body weight and body fat ratios:
Subjects for this study were 14 females whose age range was 20s to early 40s. The subjects were not overweight and their average Body Mass Index (BMI) was 21.03±1.75 %.

Subjects were observed over a period of two months. For the first month, subjects did not use the oxygen supply system. In the second month, subjects used the oxygen supply system for 10-20 minutes a day. After this, body weight and body fat ratios were measured (Product number: DM-W2, Matsushita Electric Industrial Co., Ltd.).

Effects on visual acuity:
Subjects for this study were 10 males whose age range was 20s to 40s, and 3 females who were in their 30s. The total sample number was 13.

Subjects used the oxygen supply system for 30 minutes a day. Their vision was measured once a week (TOPCON SS-3, Tokyo Optical Co., Ltd.).

Effects on stratum corneum:
Subjects for this study were 2 females in their early 20s. The same method of evaluation was conducted on each subject twice, giving a total of 4 results. Testing was conducted using the method developed by Denda, et al.[8] We determined the initial rate of trans-epidermal water loss (TEWL) (T_0) on the inside of the subjects' forearms in a controlled environment, with room temperature at 25 degrees Celsius (±0.5 degrees) and relative humidity (R.H.) at 50% (±5%). After this, we took samples of the stratum corneum using the tape stripping method.[3] Next, the subjects took a one-hour Color-Word Test while breathing either air with 30% oxygen concentration or non-enriched normal air. The rate of TEWL was measured again after 1.5 hours (T_1) and the recovery rate of TEWL was calculated using the T_0/T_1 formula.

Renewal of the stratum corneum was assessed using a trans-epidermal water loss meter (VapoMeter SWL3, Delfin Technologies Ltd.).

Reactive oxygen analysis:
The effects of reactive oxygen at the oxygen concentration levels used in this study were analyzed. The quantity of 8OH-dG in the urine was measured to determine the impact of oxidative stress. Subjects for this study were 8 males whose age range was 30s through 50s.

RESULTS
Glucose levels:

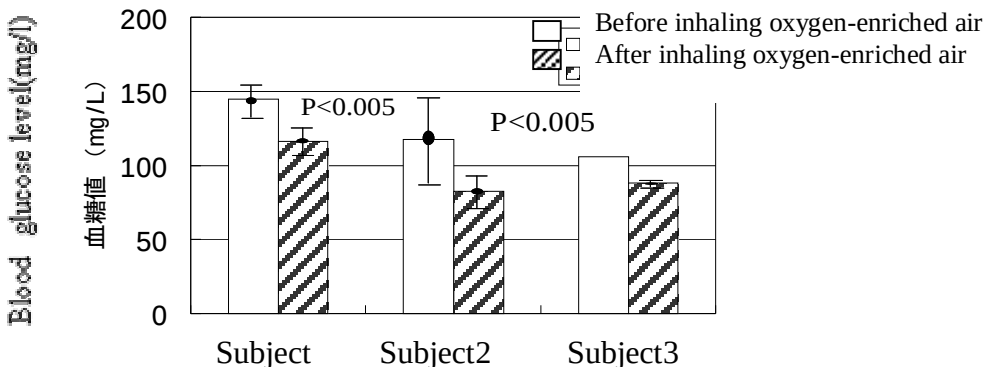

Figure 1. *Changes in Blood Glucose Due to Oxygen Supply System Usage*

A statistically significant drop in glucose levels was observed in 3 of the 9 subjects after they had used the oxygen supply system (Figure 1). No major changes were observed in the other 6 subjects. All 3 subjects who exhibited a drop in glucose levels had recorded an initial blood sugar level of 110mg per liter or more.

Body weight:

Figure 3 shows the impact of using the oxygen supply system on body weight (Decreased group：Group whose body weight decreased, Remained group：Group whose body weight remained the same). Of 14 subjects, 5 experienced a statistically significant decrease in body weight. No important changes were reported in the other subjects.

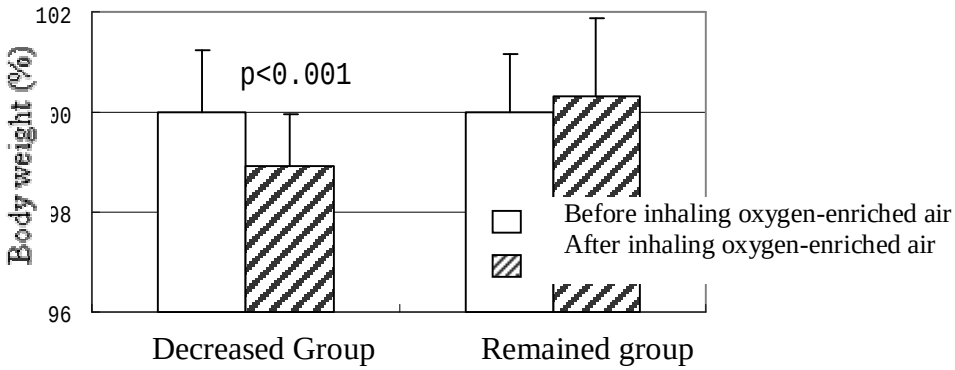

Figure 3. *Changes in Body Weight Due to Oxygen Supply System Usage*

In Figure 3, the average body weight of subjects prior to using the oxygen supply system is denoted as 100. Average weight loss among the subjects who lost weight was 0.73kg, with the greatest weight loss being 2kg. Statistically significant reductions in body fat ratios were observed among 5 subjects. Among 8 other subjects, there was no statistically significant change noted. Finally, there was 1 subject who recorded a statistically significant increase in their body fat ratio.

The results of the visual acuity study indicated that vision improved among 3 of the 13 subjects after they had used the oxygen supply system. The basis of this recovery is thought to be associated with a reduction in accumulated stress on the ciliary corpus (the muscle within the eye ball that controls vision) resulting from breathing air with a 30% oxygen concentration.

The results of the study also showed the possibility for significantly improved TEWL recovery rates when oxygen-enriched air, rather than normal air, is inhaled (Figure 3).

Results indicated that when renewal of the stratum corneum (metabolism) is slowed due to psychological stress, breathing oxygen-enriched air can show some restorative effects.

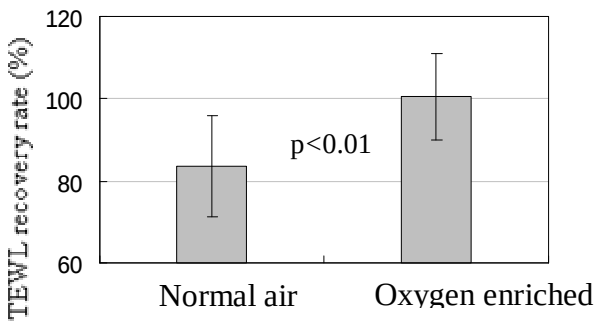

Figure 3. *Changes in TEWL Recovery Rates Due to Oxygen Supply System Usage*

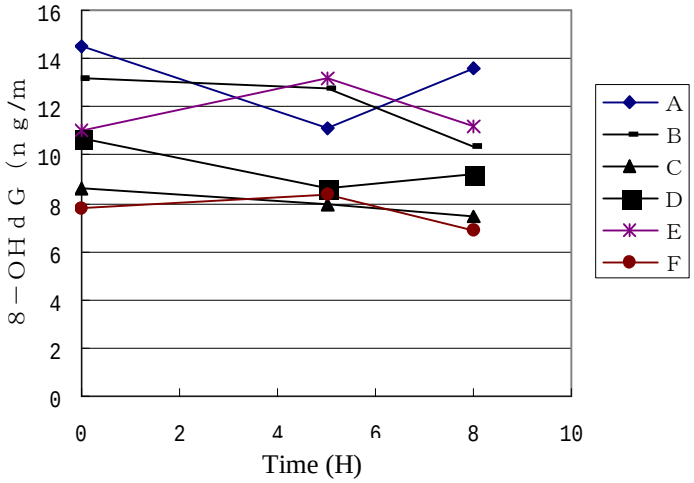

Figure 4. *Changes in 8OH-dG Rates in Urine Due to Inhaling 30% Oxygen-Enriched Air*

The influence of reactive oxygen was investigated using 8OH-dG as a marker. After subjects had inhaled air with a 30% oxygen content for 30 minutes, the level of 8OH-dG in the urine was measured at 5, 8 and 24 hours after inhalation. The results of this exercise are shown in Figure 4. As can be seen, there was no statistically significant difference noted either before or after respondents had inhaled air with a 30% oxygen concentration.

DISCUSSION

Our findings suggest that for adult males and females, breathing air with a 30% oxygen concentration can decrease blood glucose levels, body weight and body fat ratios. It can also contribute to recovery of both visual acuity and the stratum corneum. It is believed that all of these conditions are closely related to oxygen depletion. The accumulated data suggests that the supply of oxygen to the body through the inhalation of oxygen-rich air may result in restoring conditions of health. Put in other words, it restores the condition of homeostasis to normal.

For example, with regard to the manner in which oxygen works in reducing blood glucose levels, studies by K. Kapas et al.[9] indicate that conditions of oxygen depletion result in low cell activity. The research conducted by Kapas et al. suggests that when oxygen is supplied, β cells are revitalized and the level of insulin secreted increases. Regarding reduced body weight and body fat ratios, in line with the results obtained by Kawano et al.[10] in their study of rats, our study suggests that oxygen induces an upsurge in Lipase activity as well as in fatty acids. This in turn influences metabolic activity. In addition, along the lines of previous studies conducted by Denda et al.,[3] our study demonstrates that stress relief results in a healthy stratum corneum renewal speed. This improves the recovery rate of trans-epidermal water loss (TEWL). It is hypothesized that the improved TEWL is due to regularization of the secretion of intercellular lipids rather than to the corneum renewal. What is called for now is further research concerning the secretion of intercellular lipids and sebum.

We propose to look into the correlation between the results obtained and the oxygen concentrations using biochemical measurements.

CONCLUSIONS AND IMPLICATIONS

Our data demonstrates that breathing air with 30% oxygen concentration using an oxygen supply system may result in physiological improvements. Furthermore, the results obtained suggest that breathing oxygen-rich air actively may result in cells being revitalized and metabolism being normalized. Evidence indicates that lowered metabolism due to psychological stress or oxygen depletion can be improved effectively by the inhaling of air with 30% oxygen concentrations.

ACKNOWLEDGEMENTS

The authors would like to thank the Home Appliance and Housing Electronics Research Laboratory and the Eco Clean Life Department of Matsushita Electric Industrial Co., Ltd for their help in the analysis of the results. We are also grateful to Matsushita Home Appliances Company of Matsushita Electric Industrial Co., Ltd.

REFERENCES

Maeda. et al., (1997): "Blood Lactate Disappearance During Breathing Hyperoxic Gas After Exercise in Two Different Physical Fitness Groups" in *Appl Human Sci*, 16(6), pp. 249-255.

Nishino. et al., (1995): "The Impact on Recovery of Breathing Enriched Oxygen After Sports" in *Nippon Sanso Engineering Report*, No. 14, pp. 68-69.

Usami. et al., (1993): "Improving the Air in Automobile Cabins" in *Automotive Technologies*, Vol. 47, No. 9, pp. 52-57.

Katsuura. et al., (1993): "Effects of Enriched Oxygen Breathing on Sleepiness After Taking Lunch" in *International Symposium 93 on Design of Amenities*, pp. 291-296.

Shimaue. et al., (1992): "Environmental Evaluation for Beauty Treatments" in *Meeting Papers of the Conference of The Society of Heating, Air-Conditioning & Sanitary Engineers of Japan*, pp. 617-620.

Hirase., et al., (1988): "The Effects of Breathing Oxygen" in *Toyaku Magazine*, Vol. 10, No. 11, pp. 18-21

Arai, (1983): "Oxygen Poisoning" in *Kokyu*, Vol. 2, No. 2 , pp. 174-181.

Denda., et al., (2000): "The Influence of the Irritating Properties of Perfume on the Homeostatic Mechanism of the Skin" in *Jiritsu Shinkei*, Vol. 37, No. 3, pp. 419-424.

Papas KK. et al., (1996): "Effects of Oxygen on Metabolic and Secretory Activities of βTC3 Cells" in *Biochem Biophys Acta* 1291: 163-166.

Kawano., et al., (2003): "Increase in the Lipase Activity of Rats Exposed to Air with High Concentrations of Oxygen for Prolonged Periods of Time and Intermittently" in *58th Congress of the Japanese Society of Physical Fitness and Sports Medicine*, (2003), pp. 206.