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WHITE PAPER

# NEGATIVE IONS: A BENEFICIAL ATMOSPHERIC PHENOMENON

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This paper describes the observable and potential effects on human physiology produced by elevated levels of negative ions.

### 1. What are negative ions?

Negative ions are odorless, tasteless, and invisible molecules that we inhale in abundance in certain environments.

Ions are charged particles — either positive or negative — found in the air. Under certain conditions, increased amounts of these ions are created naturally. For example, the action of ocean waves on a beach creates a large number of negatively-charged ions. Conversely, electrical activity (such as the operation of electrical equipment) is known to project positively-charged ions into the surrounding air.

The presence of increased amounts of negative or positive ions has been reported as affecting mood or health in the sense of feeling well or unwell. It is a widely recognized anecdotal effect that many people feel a sense of renewed vigor or well-being when visiting the seashore or a forest, two environments in which high amounts of negative ions are present [1]. In contrast, frequent exposure to electrical equipment in operation (which produces positive ions) has been reported to cause a feeling of fatigue or even illness in some people.

Although nature produces negative ions, the environments in which most of us live do not do not afford a higher than average level of these ions. However, in areas where electrical equipment is present, positive ions are generated in amounts significantly higher than are found naturally. For those who feel the effect of these ions, a negative-ion generator might be a practical remedy for neutralizing their exposure [2].

**Table 1.** Average ion count, in number of ions per cubic meter of air

| | NEG. IONS | POS. IONS | TOTAL |
|---|---|---|---|
| Clear mountain air | 2000 | 2,500 | 4,500 |
| Normal sea-level air | 1,500 | 1,88 | 3,300 |
| Before a storm | 750 | 2,500 | 3,250 |
| After a storm | 2,500 | 750 | 3,250 |
| Typical modern office | 150 | 200 | 350 |
| Closed moving vehicle | 50 | 150 | 200 |

### 2. Effects of exposure

Negative ions appear to contribute to positive changes in mood and behavior [1, 2]. It also appears that it is impossible to get an “overdose” of these negative ions, i.e., there is no upper limit that would counteract the beneficial effect reported. Generally, the more negative ions a person is exposed to, the better and more uplifted he feels.

Positive ion exposure, or the lack of sufficient negative ions, may cause serotonin hyperfunction syndrome or “irritation syndrome.” This condition may include sleeplessness, irritability, tension, migraine, nausea, heart palpitations, hot flashes with sweating or chills, tremor and dizziness. In addition, elderly persons may become depressed, apathetic and extremely fatigued.
Human mood disorders (depression) are effectively treated with drugs which specifically block the reuptake of serotonin into the presynaptic axon terminal, for example fluoxetine (Prozac) and Zoloft. This suggests that positive ions may play a part in this condition and the condition may be safely treated with negative-ion therapy [3].

Research suggests that some allergy-provoking substances, such as dust and pollen, have a positive electrical charge [2].

Negative ions appear to counteract the allergenic effects of these positively charged ions on respiratory tissues [4][5]. Negative ions also have other beneficial effects for the respiratory system [6][7].

### 3. Negative-ion observation and research

In his medical practice, a physician, Jonathan Wright, M.D., reports that although his patients note varying responses, exposure to negative ions generally led to favorable effects, and many individuals experience relief from respiratory allergies. Some allergy sufferers report considerable relief, with allergic reactions resolving completely after negative-ion therapy. According to Dr. Wright, the majority of allergy sufferers can reduce reliance on other treatments (nutritional, biochemical, or prescription medication) during negative-ion therapy [8].

A Hiroshima University study found that the most effective means of decreasing allergic inflammation reactions is avoidance of the aeroallergen. Yet ion irradiation resulted in a remarkable decrease in in vitro and in vivo allergenicities of atomized Japanese cedar pollen extracts [9].

Goel at the Department of Psychology at Wesleyan University compared the short-term effects of bright light, an auditory stimulus, and high- and low-density negative ions on mood and alertness in mildly depressed and non-depressed adults. The auditory stimulus, bright light and high-density ions all produced rapid mood changes — with small to medium effect — in depressed and non-depressed subjects, compared with the low-density placebo, despite equivalent pre-study expectations. Thus, these stimuli improve mood acutely in a student sample, including a subset with depressive symptoms [11].

High concentrations of negative ions are essential for high energy and positive mood [12]. Marian Diamond, a professor of neuroanatomy at the University of California, Berkeley, has found that levels of negative ions are inversely related to levels of serotonin in the brain. Negative ions suppress serotonin levels in much the same way that natural sunlight suppresses melatonin. Hence the invigorating effect of fresh air and sunshine and the correspondingly depressed feelings associated with being closed in and dark. If negative ions are depleted, subjects experience an increase in serotonin and its attendant drowsiness and relaxation. Diamond's research [13], along with other information on ions, is summarized in Yepsen [14].

In other research, male and female subjects participated in two studies designed to investigate the impact of negative ions on cognitive performance. The findings of these studies suggest that negative ions can indeed exert appreciable effects on performance. However, contrary to claims often associated with advertising for commercially produced ion generators, these effects are neither simple nor uniformly beneficial in nature [15].

Studies at Yokohama City University Medical Center examined negative ion effects in vivo. Water-generated negative ions (WNI) were evaluated with respect to physical properties as well as immunologic activation and anti-tumor activity (inhibition of carcinogenesis and tumor growth) in mice. Water-generated negative ions had a long life, significantly enhanced the cytotoxic activity of natural killer cells, significantly decreased the incidence of cancer and inhibited tumor growth. Anti-tumor effects were attributed to enhancement of natural killer cell activity [16].

In a study by Livanova et al [21], blood pressure in mice exposed to negative ions was lower compared to mice without negative-ion exposure. The results indicated that negative ions might help to release stress. Another study using mice showed possible prevention of DNA damage from free radicals [19]. Mice were exposed to negative ions (10,000/cm3) for one week and showed a reduced rate of free radicals (8-OHdG/dG) in urine, brain and blood. In another study using mice, the results suggested that mice raised in a negative-ion environment for 20 days had lower serotonin rates compared with mice raised outside of this environment [23].

Central Aizu General Hospital studied the potential mechanism by which negative ions improve aerobic metabolism, changes in venous blood lactate levels, pH, erythrocyte deformability, plasma superoxide dismutase activity and ceruloplasmin levels. This research shows that negative ions created by the water shearing method improve aerobic metabolism following a 1-hour exposure, which may be caused by improvement of erythrocyte deformability, but negative air ions created by corona discharge have no effects [17]. In a study supervised by Dr. Yamada, eight-week-old mice were given food high in cholesterol for six days. In the group exposed to negative ions, red blood cells showed separation and smoothness compared

with clumped blood cells evident in the group without negative ion exposure [18].

Another potential area of benefit with negative ions is in postoperative recovery. Patients who were given negative ion exposure (2100/cc) after surgery were found to show lower levels of lactic acid after four hours and recovered faster [20]. At the recovery stage, during a bicycle pedaling exercise, negative ions helped to lower the serotonin rate, which indicated improved recovery [24]. Out of eight manic-depressive patients who were exposed to negative ions (40,000-60,000 ions/cm3, ozone density 50 ppb), seven of them showed an improvement in symptoms of sleep disorder and improved concentration, from lowered serotonin levels in the brain [22].

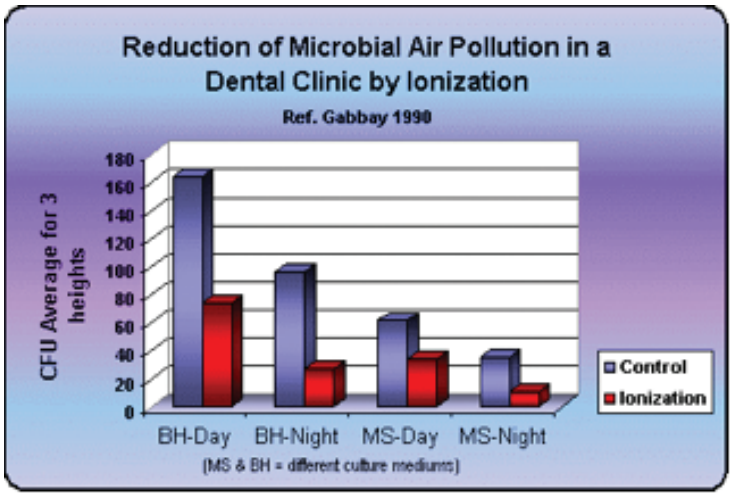


**Figure 1.** Reduction of microbial air pollution in a dental clinic by ionization (Pennsylvania State University, Aerobiological Engineering)

Figure 1 shows the Colony Forming Units (CFU) measured with and without ionization in a dental clinic by Gabbay et al [25]. Airborne microbial levels were reduced by 32-52% with ionization. Gabbay also found that horizontal plates picked up considerably more cultures than vertical plates, strongly suggesting that settling-out of ionized particles was the primary mode of removal.

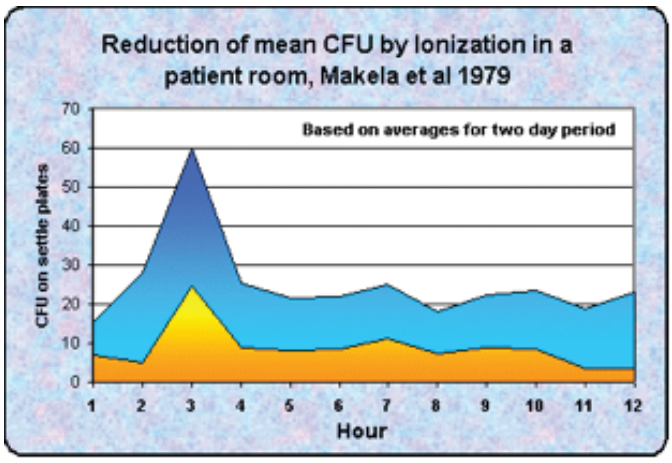


**Figure 2.** Reduction of Mean CFU by ionization in a patient room (Pennsylvania State University, Aerobiological Engineering)

Figure 2 summarizes the results of studies by Makela et al [26], who found that bacterial aerosols in patient rooms of a burn and plastic surgery unit could be reduced with air ionization. Variations in the bacterial levels were associated with bed-changing and other room activities. The humidity in the rooms was low, which may have enhanced the effect.

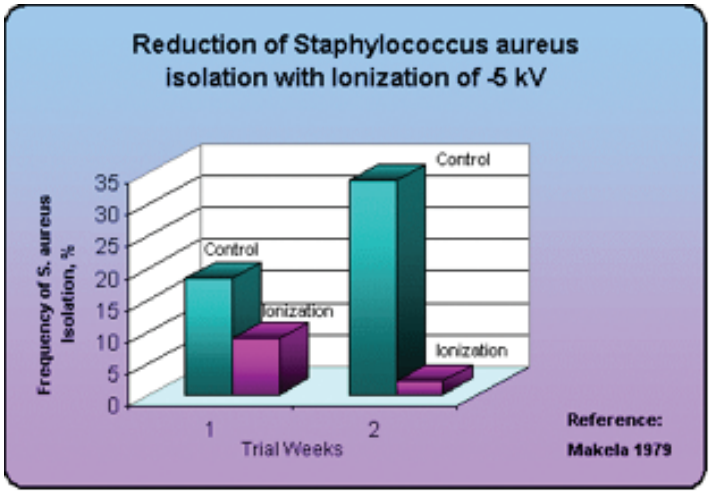


**Figure 3.** Reduction of Staphylococcus aureus isolation with ionization of –5kV (Pennsylvania State University, Aerobiological Engineering)

Figure 3, also based on results from Makela et al [26], specifically identified Staphylococcus aureus levels in a room with and without ionization. The average for two days of monitoring indicated a definitive reduction in airborne levels. Staphylococcus aureus is a potential nosocomial infectious agent of wounds and burns.

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