

Development of a Gas Measurement Method with Cucumber as a Bio-sensor

Hideyuki KOKUBO, Osamu TAKAGI and Mikio YAMAMOTO

Bio-Emission Laboratory, International Research Institute (Chiba, Japan)

Abstract: Using biophotons from cucumber, the authors previously developed a quantitative measurement method for non-contact healing (bio-PK). A biophoton measurement method can estimate a healer's controlled healing power in just one or two trials. However, expensiveness of the equipment for biophoton measurements has obstructed widespread use of the method. The authors took notice of a gas being generated simultaneously with the emission of biophotons, and tried to develop an easy method in which this gas is measured by a gas-measuring detector tube. There is no specialized tube for cucumber gas, but the authors found that a short-term quick-measuring detector tube for ethyl acetate (141L, Gastec, Japan) can be used. Then, an easy and inexpensive method was developed in which pieces of cucumber are set in a sealed container and their gas emission is measured with the gas detector tube 24h later.

Keywords: gas detector tube, ethyl acetate, biosynthesis of green odor, cucumber, bio-sensor, non-contact healing, bio-PK, biophoton

1. Introduction

In 2006 using biophotons from cucumber, the authors developed a quantitative measurement method for non-contact healing (bio-PK) and have carried out many studies using it¹⁻¹⁵⁾. The biophoton measurement method can estimate a healer's controlled healing power in just one or two trials. However, the expensiveness of the biophoton measurement equipment has obstructed widespread application of the method. Therefore inexpensive and easy-to-use methods should be developed to promote further studies.

During their work, the authors took notice of green odor generated from cucumber. Two mechanisms are identified as sources of cucumber biophotons⁸⁾. One of them is the oxidation reaction of ascorbic acid and the other is biosynthesis of C9/C6 aldehyde and alcohol (the green odor)^{8,16)}. Because the amount of gases will correspond to the intensity of biophotons, a healer's controlled healing power can be estimated by measuring the amount of gas released. The authors tested this hypothesis and succeeded in developing an easy-to-use and inexpensive measurement method using a gas detector tube. The details of the method are described in the present paper.

2. Goals of Development

Three items were set as goals of development of the method.

- 1) Detection power of the method is equal to or more than the biophoton measurement method.
- 2) The method is inexpensive and easy-to-use.
- 3) The method has good applicability. For example, multiple subjects or positions can be measured simultaneously.

The amount of gas from cucumber is expected to correlate with the emission intensity of biophotons from cucumber. Therefore the gas measurement method should have the same detection ability as the biophoton measurement method. Running cost of the gas measurement method is low because a gas detector tube sells for about 300 yen (about US\$ 3), and its operation is easy. Moreover multiple subjects and positions can be measured in a day if many gas containers are used.

3. Gas Measurement Method

3-1. Principle

Cucumber (*Cucumis sativus* "Shiro-ibo kyuuri") is used as a bio-sensor for non-contact healing. The way of making samples was the same as in the

biophoton measurement method¹⁾. One hour before an experiment, the surface of the cucumber was disinfected with ethanol. Then, 4 circular slices (thickness: 2 cm) were cut from the cucumber. Each slice was cut again into 2 slices (thickness: 1 cm); this gave 8 paired pieces. One of each paired pieces was the experimental sample and the other (follower side) was the control (Fig. 1). Four pairs of targets were made from one cucumber. Controls and experimental samples were placed symmetrically in two glass Petri dishes which had been previously wrapped with a plastic wrap sheet. Both Petri dishes were covered with glass lids.

Experimental samples were treated by non-contact healing for 30 min, while controls were set at a different place where non-contact healing was considered to not reach. After treatment, the lids were removed from both Petri dishes, and the dishes were put into separate 2.2 l sealed plastic containers. Containers were kept in a room at 24 °C for 24 hours, without exposure to sunlight. Biosynthesis of green odor products gases proceeded using oxygen in the air in the container. After 24 h, 100 ml samples of gas were taken 3 times (totally 300 ml) from each container using the short-term gas-measuring detector tube for ethyl acetate (141L, Gastec, Japan) and the sampling pump (GV-100, Gastec, Japan)(Fig. 2). The concentration of gases in each sample was measured.

The same as in the biophoton method, the *J* value

(*J*-gas) which is the natural logarithm of the ratio of gas concentrations of experiment C_E and control C_C , is introduced as an index of the effect of non-contact healing.

$$J\text{-gas} = \ln(C_E / C_C)$$

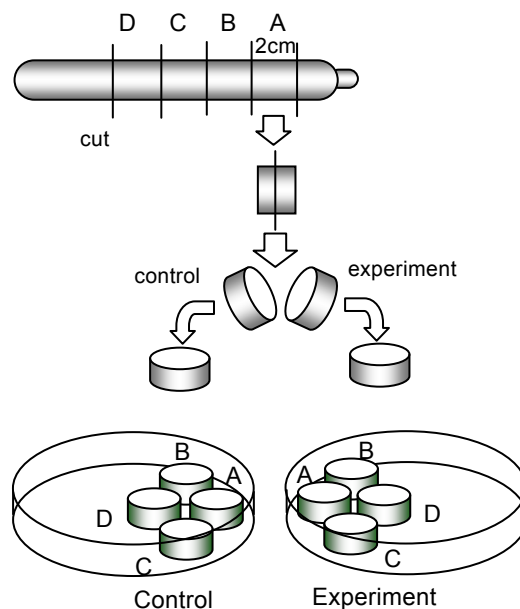


Fig. 1 Making Sample Pairs

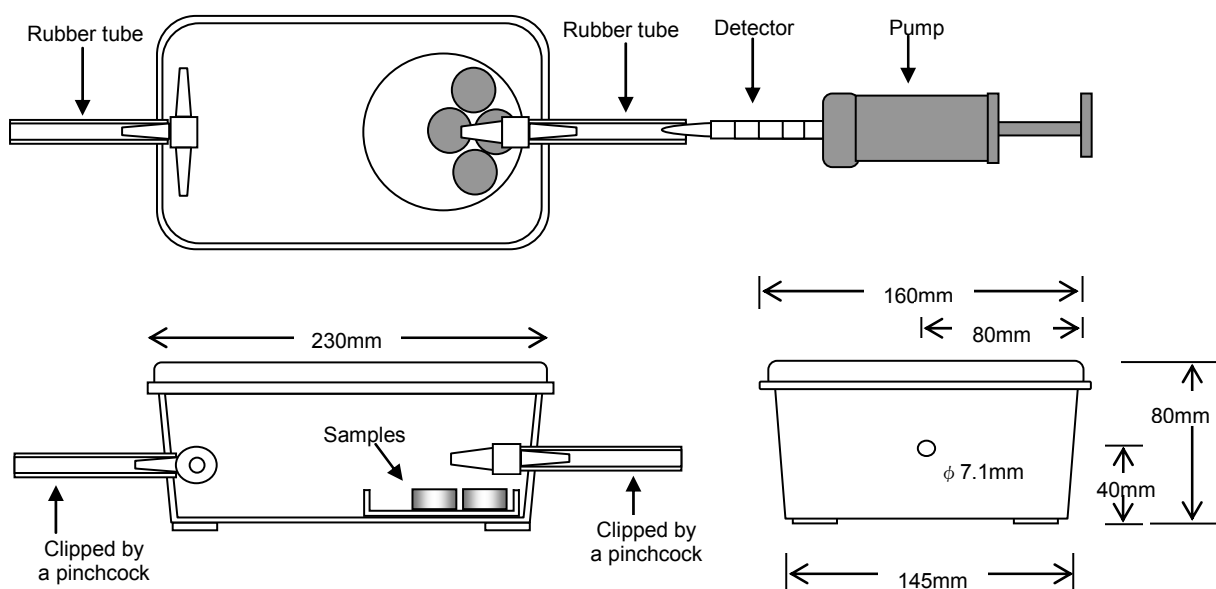


Fig. 2 Container

3-2. Gas-measuring Detector Tubes

Many gas-measuring detector tubes show color reactions against plural affinity gasses, not only one. Although there is no specialized tube for cucumber gas, some tubes can be used as substitutes if they show color reactions for some components of cucumber gas. However, there was no tube for any components of cucumber gas among the 311 kinds of tubes listed for the maker Gastec¹⁷⁾. Moreover, there has been no study using gas-measuring detector tubes for cucumber gas. Therefore, the authors made a preliminary test of the following two kinds of tubes.

- 1) Cucumber gas includes a little hexanol^{7,14)}. This suggested a possibility that the 141L tube (Gastec, Japan) would show a color reaction. The 141L tube is for ethyl acetate and it also can detect 2-hexanol. (Later, the authors found that this expectation was not correct. Because calculation showed that amount of hexanol was very small and it would be impossible to detect such a small amount by gas-measuring detector tubes.)
- 2) There is a possibility that the 91D tube (Gastec, Japan) for formaldehyde reacts to C9 and C6 aldehydes which are the main components of cucumber gas. 91D is a passive dosimeter to measure time-weighted average gas concentrations over longer periods (maximum time: 10h), and it reacts to multiple aldehydes.

Table 1 Tested Tubes

All tubes are made by Gastec. The letter D denotes a passive dosimeter (maximum 10h).

Name of tube	ID	Color reaction	Comment
Ethyl acetate	141L	Yes	Useful
Formaldehyde	91D	Yes	Slight color, low value
Formaldehyde	91L	Yes	Slight color and diffusion
Acetaldehyde	92L	No	
Carbon monoxide	1D	No	
Ammonia	3D	No	
Ammonia	3DL	No	
Hydrogen sulfide	4D	No	
Hydrogen fluoride	17D	No	
Acetic acid	81D	No	Indicator color decreases ?.
Ethanol	112D	No	
Toluene	122DL	No	
Trichloroethylene	132D	No	
Acetone	151D	No	
Methyl ethyl ketone	152D	No	
1,3-Butadiene	174D	No	

As a result of the preliminary test, both 141L and 91D showed color reactions against cucumber gas. 141L was considered as useful. However, 91D was not useful because its color was very slightly and it was difficult to recognize the value from the scale provided with the tube.

Then, the authors tested more than 10 kinds of tubes (**Table 1**). However, none were more suitable than 141L which was found by inspiration at first.

3-3. Containers and Gas Sampling Pump

The experimental set-up for collecting the gas is shown in **Fig. 2**.

The plastic polypropylene containers (2.2 l) with a polyethylene lid were used which were designed for food storage (B-1716FL Foods Case XL, Iwasaki Industry, Japan). Two holes (diameter: 7.1mm) were drilled into each container and then tube connectors and rubber tubes were inserted tightly into the holes. The rubber tubes (Crown Eight Eco-tube, inner diameter 4mm, outer diameter 6mm, length 65mm, Sanplatec Co., Japan) were clipped with pinchcocks. Two kinds of connectors were used: a T-shape tube connector (PP-PT-S, As One, Japan) and a different-diameter tube connector (PP-PD-SM).

These containers were chosen because they had a large enough volume to hold the gas to be sampled (total: 300ml).

Cucumber samples were set under the different-diameter tube connector. The T-shape tube connector was used to prevent outside air from reaching the 141L detector tube directly.

New containers should be washed and dried for a week before use. In addition, a check should be made that there are no water drops in the tube connectors.

The gas sampling pump was the GV-100 (Gastec, Japan).

4. Test 1

4-1. Measurement 1

Measurement 1 was done on December 14, 2008. The subject was a veteran healer T011 (male, 55 y) who had showed J-bio = 0.073 (n=4) in a test on November 10, 2008. J-bio is the J value of the biophoton measurement method. After a biophoton test¹⁵⁾, he had a rest for about 30 min and then tried a 30-min gas measurement test. At that time, the experimenter did not explain to the healer that this was a gas measurement test. The experimenter gave the same instructions as for the biophoton tests:

"Please do non-contact healing to let the cucumber become more vivid and increase its photon intensity."

In measurement 1, the containers were 2.2 l plastic sealed containers without the drilled tube holes for sampling. A Petri dish with cucumber slices was set into the container. Also, 91D (for formaldehyde, passive dosimeter for time-weighted measurements, maximum 10h) was put into each container and the scale values were noted every 30 min through the lid of the container.

After 10h, the lid of the container was opened slightly and the top of the 141L tube was inserted into the container, and then 100 ml of gas was collected 3 times (totally 300 ml, about 5 min).

4-2. Measurement 2

Measurement 2 was done by a beginner healer Y004 (m, 31 y) on December 26 and 27, 2008. Y004 had shown $J\text{-bio} = 0.174$ (n=8) in a study¹⁵⁾ in the summer of 2008. However, at the time of the present experiment he had jet lag because he just came back to Japan from USA. In this test, Y004 did 30-min healing for both samples of biophoton and gas measurements simultaneously. New containers with the drilled holes were used (Fig. 2). Ten hours after the healing, pinchcock was removed to the 141L tube. Then 100 ml of cucumber gas were sampled 3 times (total 300 ml, taking about 5 min).

In the December 26 test, a 91D tube was also set into each container and values of 91D were recorded every 30 min. Additionally, a blank test was also done.

4-3. Results of Formaldehyde Tube (91D)

Fig. 3 shows recorded values of 91D in the tests of T011 and Y004. E is data of experimental samples and C is controls. Formaldehyde is never generated in cucumber, therefore the apparent value of 91D is a reflection of high moisture content (humidity 100%) and complexity of components of cucumber gas.

Both values of 91D of T011 and Y004 were very small and also color reaction was very slight and difficult to recognize. Moreover, the value reached the maximum 3 h after healing, and color faded out gradually. The color completely vanished after more than 10h. Vanishing of color of 91D occurs if the measurement gas has a high moisture content or the gas includes alcohol. In the present tests, the reasons for vanishing color are considered to be the high moisture content and that after 5 h the amount of one specific gas increases which shows the color reaction of the 141L tube (for ethyl acetate).

In addition, it is considered that the color reaction of 91D does not have a relationship with the plus/minus sign of $J\text{-bio}$. 91D seems to relate to chemical reaction systems without a direct relationship to biophotons.

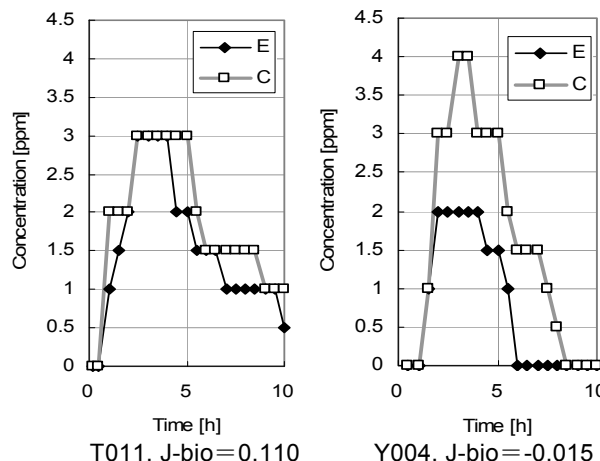


Fig. 3 Recorded Values of 91D
E: Experiment C: Control

4-4. Results of Ethyl Acetate Tube (141L)

Table 2 shows $J\text{-gas}$ of 141L at 10 h and corresponding $J\text{-bio}$ (18 h).

$J\text{-gas}$ was zero in the blank test. Plus/minus signs of $J\text{-bio}$ and $J\text{-gas}$ were opposite. This suggests that the gas method measures chemical reaction systems which compete against the chemical systems to generate biophotons. Also, there is a possibility that the detection power of the gas method is larger than the biophoton method because the absolute values of $J\text{-gas}$ are larger than $J\text{-bio}$.

Table 2 $J\text{-bio}$ and $J\text{-gas}$ of 141L

	C_E [ppm]	C_C [ppm]	$J\text{-gas}$	$J\text{-bio}$ and 95% confidence interval (n=4)
T011	2.5×100	3.5×100	-0.336	0.110 ± 0.188
Y004	4.0×100	2.9×100	0.322	-0.015 ± 0.161
Y004	2.2×100	2.8×100	-0.241	0.077 ± 0.211
Blank	4.0×100	4.0×100	0.000	

5. Test 2

Test 2 was done from March 23 to April 5, 2009. Nine healers did one 30-min trial in which they gave non-contact healing to both samples of biophoton and gas measurements simultaneously (Table 3). Fig. 4 shows results of Tests 1 and 2.

Test 2 did not successfully detect non-contact healing effects because intensities of biophotons were weaker. However, it was considered that at least a relationship between $J\text{-bio}$ and $J\text{-gas}$ was confirmed.

Table 3 Results of Test 2

ID, gender, y			C _E [ppm]	C _C [ppm]	J-gas (10h)	J-bio
J001	m	56	4.8 x100	4.0 x100	0.182	-0.039
T009	m	61	3.8 x100	4.0 x100	-0.051	-0.066
M004	m	32	5.6 x100	4.5 x100	0.219	0.002
U003	m	71	4.0 x100	4.0 x100	0.000	-0.070
F001	m	37	6.5 x100	6.2 x100	0.047	-0.079
M008	f	44	4.8 x100	4.8 x100	0.000	0.039
F008	m	35	6.0 x100	5.8 x100	0.034	-0.114
S012	f	43	4.0 x100	5.0 x100	-0.223	0.012
A005	m	43				-0.032

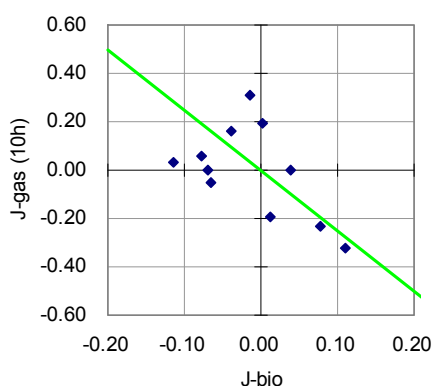


Fig. 4 Results of Tests 1 & 2
The line is drawn assuming J-gas = -2.5*J-bio

6. Ethyl Acetate Tube 141L

Results of Tests 1 and 2 showed that the ethyl acetate tube 141L can be used to detect non-contact healing (bio-PK) for cucumber.

6-1. Times of Gas Sampling

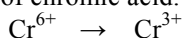
The 100 ml gas sampling was repeated 3 times in tests 1 and 2. However, in summer, gas concentration often reaches over 800 ppm (the maximum scale of the tube) because the amount of gas increases. In that case, 2 gas sampling times is better.

6-2. Waste Handling

The 141L tube has 0.34 mg of Cr⁶⁺. Therefore waste tubes should be kept in a safe way until then can be collected by professional handlers of toxic wastes.

6-3. Color Reaction

The color reaction of the 141L tube uses the reduction reaction of chromic acid.



The 141L tube usually shows the color reaction given in Fig. 5(a), but for cucumber gas it is as shown in Fig. 5(b). If wet paper filters are put into the container and humidity reaches 100%, the 141L tube gives a value of 20ppm (minimum value) as shown in Fig. 5(c). Indeed, high moisture content influences the 141L. However, the reasons for the color reaction of (b) are unknown presently.



Fig. 5 Color Reaction of 141L
a) Normal, b) Cucumber gas, c) Air at 100% humidity

6-4. Measuring Time

The value reached by 141L after 10 h becomes stable (Fig. 6). However, Fig. 6 is based on data collected in winter (January to February 2009). Fig. 7 shows the seasonal change of emission intensity of biophotons of cucumber. Intensity is large in summer and small in winter. Winter is not suitable for biophoton measurements. Similarly, results of the gas measurement method are possibly depending on the season. Although not enough summer data are available yet, the rising time and maximum amount of gas are larger than in winter. Therefore, 24 h-measurement is considered as convenient to obtain data stably in the gas method. In addition, non-vivid cucumber is not suitable for measurement because gas amount reaches a maximum in a few hours and also the peak value of amount is too low to discuss J values.

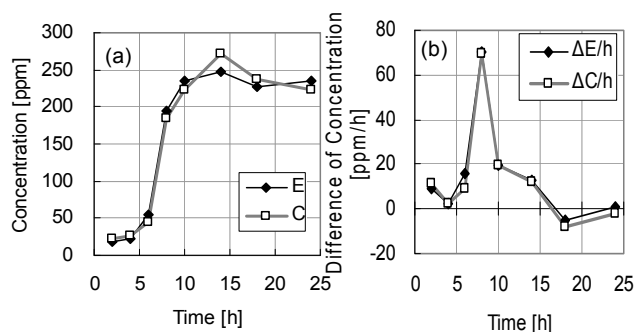


Fig. 6 Value of 141L (a) and Difference per Time (b) in Blank Test

Data: January and February 2009.
E: Experiment C: Control

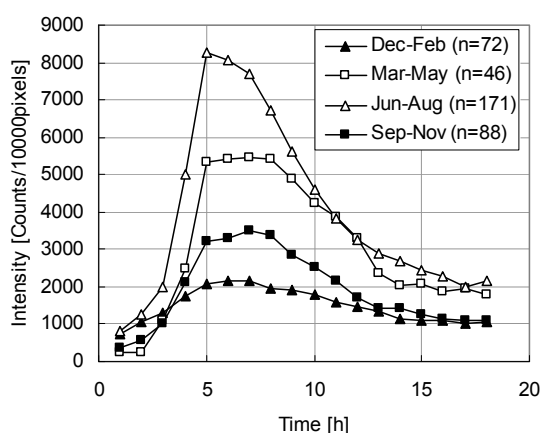


Fig. 7 Seasonal Change of Biophoton Intensity
From March 2006 to August 2008

7. Others

Other critical points are described below.

7-1. Temperature

The containers should be kept in a place without sunlight and they should be kept at constant temperature. Especially, if air temperature is high when gas is sampled, chemical reactions will be activated in the tube and the value of color index often reaches beyond maximum. The authors kept the containers at room temperature 24 °C during and after healing.

7-2. Selection of Cucumber

If the diameter of the control (follower side) of the cucumber slice is obviously smaller than the experiment slice, such a cucumber is not suitable for tests. Suitable cucumbers have a uniform diameter from top to bottom. Especially, all cucumbers should have a similar length and be as round as possible if multiple cucumbers are used. Moreover, it is better that experiments are done in suitable seasons because the amount of enzyme in cucumber is depending on the harvest season (hours of daylight chiefly).

7-3. Blank test

Before experiments, a sufficient number of blank tests should be done. Experimenters should confirm that average J-gas of 4 trials is nearly 0.0 ± 0.1 .

There are five possible reasons for false results. A) Improper selection of cucumber. B) Inconsistent gas sampling (absorption) time. This may be caused by rough handling when cutting both tips of the gas detector tube. C) Ways to carry out the gas sampling were different between experimental and control containers. D) Exhaust gas of the pump entered the other side of the container, and it affected secondary absorption. E) The containers were set improperly.

A) and B) depend on the degree of experimental skills. Therefore experimenters should train repeatedly. C) is a kind of order effect. It can be cancelled if the experimenter alternates the order of sampling of the control and experimental containers every experiment. D) often occurs when plural simultaneous measurements are being made. In this case, for example, the experimenter should change the place where sampling is done for each set of containers. E) is caused by various factors such as temperature, light, vibration, and the electromagnetic environment. Moreover, the possibility should always be considered that an unknown special effect is also caused by the matter¹⁵⁾. However, such effects will be detected only if important conditions are set coincidentally because the matter can never act by its own will.

8. Possibility and Future Task

Presently, the only identified bio-sensor for the gas measurement method is *cucumis sativus* "Shiro-ibo kyuuri". This is because it was desired to make comparisons with the biophoton measurement method. However, other kinds of cucumber are also possibly useful. More suitable bio-sensors will possibly be found in the future because in principal almost all green plants can be used as bio-sensors. Additionally, the gas measurement method has merits of portability and no electric power supply is needed. Therefore, it is possible to measure a shaman who lives in a remote jungle if suitable bio-sensors can be identified.

Instructions given for the biophoton method were "Please do non-contact healing to let cucumber become more vivid and increase its photon intensity." and the instructions of gas method were same. However, it was not confirmed whether the instructions were suitable or not.

The authors tested more than 10 kinds of gas detector tubes. Other kinds of tubes should be tested in further studies. Some tubes may detect healing effects although they do not relate to biophotons.

In the present gas method, it is difficult to record the time transition of gas amount. However, it would become possible with a specialized passive dositube if the details of the color reaction of 141L are resolved. Moreover, more sensitive detector tubes may be developed too.

9. Conclusion

The gas measurement method can be carried out by many researchers even if they do not have other expensive equipment. Although the present method has some weak points because of this easiness, the

authors expect the advantages of the gas method to outweigh its disadvantages.

Acknowledgement

A part of the present study was supported by Sakamoto Masamichi Frontier Project.

References

- 1) Kokubo H, Yamamoto M and Kawano K: Evaluation of non-contact healing using biophotons. *Journal of International Society of Life Information Science*, **24**: 320-327, 2006.
- 2) Kokubo H, Yamamoto M and Kawano K.: Study of non-contact healing using biophotons. *Japanese Journal of Parapsychology*, **11**(1&2): 21-28, 2006. [in Japanese]
- 3) Kokubo H, Yamamoto M and Kawano K: Standard evaluation method of non-contact healing using biophotons. *Journal of International Society of Life Information Science*, **25**: 30-39, 2007.
- 4) Kokubo H, Yamamoto M and Kawano K: Aging develops a person's spiritual healing ability for pain - Application of standard evaluation method of non-contact healing using biophotons. *Journal of International Society of Life Information Science*, **25**: 40-62, 2007.
- 5) Kokubo H and Yamamoto M: Discussion on standard evaluation method of non-contact healing using biophotons -Normality of J value, and comparing non-contact healing with thermal/lighting conditions-. *Journal of International Society of Life Information Science*, **25**: 219-232, 2007.
- 6) Kokubo H and Yamamoto M: Comparing non-contact healing with thermal and lighting conditions. *Thesis-The World Qigong Forum 2007*, Tokyo, Japan, pp.24-27, 2007.
- 7) Kokubo H and Yamamoto M: Discussions on characteristic points of healers and ways - Study of non-contact healing using biophotons -. *Japanese Journal of Parapsychology*, **12**: 32-39, 2007. [in Japanese]
- 8) Kokubo H and Yamamoto M.: Research on emission mechanisms of biophotons from cucumber. *Journal of International Society of Life Information Science*, **26**: 53-58, 2008.
- 9) Kokubo H: Biophotons reveal properties of non-contact healing - New perspective from quantitative index -. *Proceedings of 4th Psi Meeting*, Curitiba, Brazil, pp. 171-187, 2008.
- 10) Kokubo H and Yamamoto M: Quantitative measurements of non-contact healing using biophotons. *Proceedings of 51st Annual Convention of Parapsychological Association*, 348-351, 2008.
- 11) Kokubo H, Yamamoto M and Kawano K: Magnetic Stimuli for Pieces of Cucumber -Quantitative Measurement Using Biophotons-. *Journal of International Society of Life Information Science*, **26**: 213-222, 2008.
- 12) Kokubo H, Yamamoto M and Kawano K: Kyuuri no baiofoton-hakkou ni ataeru jiki-sigeki to hi-sesshoku hi-ringu no eikyou (Magnetic and healing effects on biophotons from cucumber). *Journal of Japan Medical Conference on Magnetism*, **33**: 19-24, 2008. [in Japanese]
- 13) Kokubo H and Yamamoto M: Electromagnetic Stimuli for Cucumber -Quantitative Measurements Using Biophotons-. *Japanese Journal of Parapsychology*, **13**(1&2): 27-35, 2008. [in Japanese with an English abstract]
- 14) Kokubo H and Yamamoto M: Wave Length and Photon Emission from Cucumber - Effects of 70GHz Extremely High Frequency (EHF) and Non-contact Healing -. *Journal of International Society of Life Information Science*, **27**: 78-89, 2009.
- 15) Kokubo H and Yamamoto M: Controlled healing power and ways of non-contact healing. *Journal of International Society of Life Information Science*, **27**: 90-105, 2009.
- 16) Hatanaka A: *Midori no Kaori - Shokubutsu no Idainaru Chie (Green Odor - Great Plants)*. Tokyo: Maruzen, 2005. [in Japanese]
- 17) Gastec Corporation: *Gasutekku Gasu-kenchi-kan risuto (List of Gas Detector Tubes)*, **13**: 19, 2008. [in Japanese]