Basic Research into Japanese Moxibustion – Introduction –

Shigekatsu Aizawa
Department of Basic Medical Research
Tokyo Eisei Gakuen College

Introduction

Therapy forms using heat stimulation of the skin are considered to have developed independently in numerous locations all over the world. Up to the present day a treatment modality closely resembling its original form is still used clinically in Japan and China. In particular, in Japan subtle changes have been made to adjust it to the characteristics of the people, numerous different forms of moxibustion have been contrived and are currently in use. Particularly noteworthy is form of moxibustion used currently in Japan. It is considered to have originated in Japan. It is seldom used in China, where the moxa is burned directly on the skin: direct moxibustion. This form of moxibustion differs from indirect moxibustion, where an attenuated heat stimulus is used like in stick moxibustion as a representative form of this treatment modality. It is considered not only to apply local warming, but rather also exerting considerable effects on distant sites like acupuncture. Yet, direct moxibustion causes, even if only temporarily, moxibustion marks. The heat stimulus when compared to indirect moxibustion is fairly strong and the preparation of the small moxa cones requires some skill so that recently its use has declined. It has not yet been properly investigated from the standpoint of which of these forms is the more effective one and whether there are possible differences in indications. Here I would like to present a brief summary of the research into moxibustion as it is performed in Japan, crude materials, the manufacturing process and the influence moxibustion has on the body.

Moxa raw material, manufacture, quality

The region of Ibukiyama has been famous as a growing district for moxa, but Oda conducted a detailed investigation of the subject and reported the following.[1] There are two sites called Ibukiyama: one in Shiga prefecture and another in Tochigi prefecture, both of which are famous production sites of moxa. The noted production site called Ibukiyama, that has been famous since the Heian period, is located in Tochigi prefecture, whereas Shiga emerged as a growing region following the Azuchi-Momoyama period. The Ibuki moxa varieties of both Tochigi and Shiga have their respective characteristics not found in the other location. Both Ibukiyama regions have a place called 'Shimeji ga Hara' and both regions have similar Buddhistic legends. By the Edo period, the Shiga region flourished, while the Tochigi region declined. Again, regarding the raw mugwort (yomogi) material botanical investigations were performed showing that most of the yomogi material from the Niigata, Toyama and Ishikawa prefectures was Artemisia princes Pamp, while some of it was oo-yomogi (yama yomogi = Artemisia Montana Pamp., whereas all the materials from Shiga prefecture was reportedly of the yomogi variety.[2] Regarding the growing conditions for yomogi, Aizawa et al. compared yomogi grown in sunlight and in shade and reported that the yomogi grown in sunlight is the better suited variety.[3] Regarding the manufacturing equipment Oda has conducted a detailed investigation. The investigation included such aspects as structure, size, power and scale of manufacture for the various types of machinery used during the yomogi manufacture. In particular, the rough stones for stone mortars are obtained from quarries from the upstream region of Itoigawa city in Niigata prefecture of which hornblende andesite or enstatite hornblende andesite materials are reportedly the main products. Reportedly each manufactory uses these stones in particular forms.[4]

Classified by their use, there are about 10 different product types. The moxa used for indirect moxibustion or needle warming moxibustion contains besides the principal component of the T-shaped cilia a fair amount of fragments of leaves or stalks, while superior quality products for direct moxibustion does not contain any impurities. Aizawa used electron microscopy for his related examinations and published a detailed report. This showed that the previously known T-shaped cilia themselves also show differences among high and low grade products and are related to the feel of the material when forming the little moxa cones.[5] Moreover, according to previous hypotheses,

the temperature characteristics and fragrance of high grade moxa was considered due to the fat and oil content in the cilia, but the above mentioned report by Aizawa and the below described report by Shimomura showed[6], that is a mistake in that high grade moxa almost does not contain any oils or fats. It seems highly likely, that the fragrance of the moxa is due to the essential oils contained in the stalk cells of the T-shaped trichome.

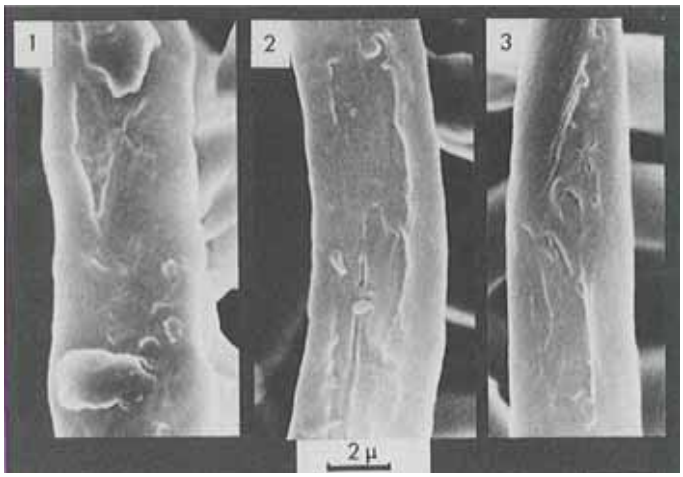


Photo: Comparison of T-shaped cilia of high and low grade products (1: low 2: medium 3: superior)

Essential oil components of moxa

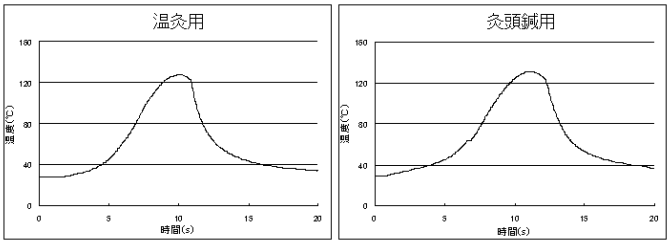
Nakao et a. reported that the moxa leaves contain approximately 0.02% essential oils of which the main component, comprising 50%, is cineol, followed by thujone, sesquiterpene alcohol and similar compounds, where the fragrance of moxa is most likely due to these components.[7] Yet, these reports deal mainly with the moxa leaves and are not the results of an analysis performed using therapeutic moxa material. Generally, moxa is said to contain tricosanol, hentricontane, arachinacohol, thujone and similar substances. In recent years, Toda et al. have identified n-non-acosane and n-hentriacontane using liquid gas chromatography[8] and the results of their essential oil component analysis of commercially available moxa (highest, high, normal grade) showed that the highest grade product contains lower saturated aliphatic hydrocarbons, but in high and normal grade products reportedly higher levels of saturated aliphatic hydrocarbons are present.[9]

Kobayashi et al. isolated from moxa a new tannin composed of the lipophilic heptatriacontene and catechols. Comparing the ratios by weight of the heptatriacontene and tannins among the various moxa varieties for a given moxa weight showed that the ratio by weight for heptatriacontene is approximately the same in all moxa varieties. However, the tannin content varies with the product quality, being low in the highest grade moxa and increased with increasing coarseness of the moxa. The combustion temperature – time curve for moxa treated to extract the lipophilic components und untreated moxa showed, that there were no differences in peak temperature, but for moxa from which the lipophilic components were extracted, the time required after ignition of the moxa to reach the peak temperature from 25°C increased and removing the heptatriacontene tended to make combustion more difficult. These workers thus reported that heptatriacontene affects the time for the rise in temperature in the combustion temperature – time curve.[10]

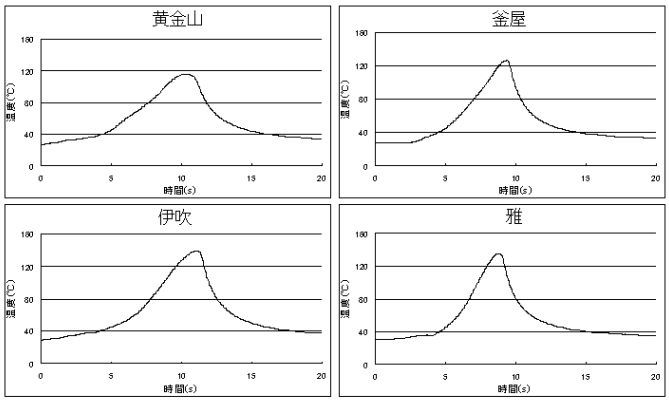
Temperature characteristics during moxibustion treatment

Reports pertaining to the temperature characteristics observed during direct moxibustion have been published for a long time[11], but few papers dealt with the amount of heat generated by the moxa and the large size of the temperature measurement probe did not allow exact measurements. Aizawa et al.[12] and Sugeta et al.[13] reported on their use of microscopic thermocouples to measure the temperature characteristics on and below the skin of mice. They reported that in contrast to what was believed in the past, skin temperature was significantly higher than 60**℃**, while the subcutaneous temperature was lower than the temperature on the skin and even continuous performance of moxibustion did not produce an increase in temperature proportional to the number of moxa cones burned. Commonly the fact that moxibustion treatment using low grade moxa felt hot was ascribed to a large amount of heat generated. Yet, quite recently, Aizawa's research showed that the difference in the amount of heat generated by different qualities of moxa is minimal and the effect is more likely due to differences in heat sensation and the burning technique.[14]

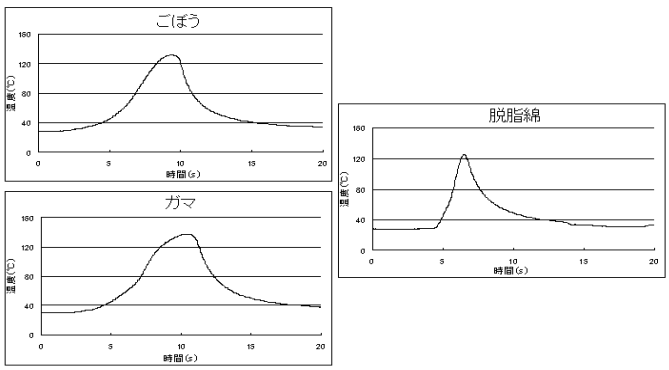
Figures: Moxibustion temperature curve



The left graph is for warming moxibustion
The right graph is for needle warming moxibustion
(vertical axis indicates Temperature (°C), and horizontal axis indicates Time (s).)



The upper left is Ogonzan; the upper right is Kamaya; the lower left is Ibuki; and the lower right is Miyabi.
(vertical axis indicates Temperature (°C), and horizontal axis indicates Time (s).)



The upper left is Burdock root; the right is Bulrush; and the lower left is Absorbent cotton.
(vertical axis indicates Temperature (°C), and horizontal axis indicates Time (s).)

Considerable research has been conducted into warming moxibustion or indirect moxibustion. Ozaki[15] and Ueda[16] performed a detailed examination of the temperature characteristics of moxibustion using a moxa tube or moxibustion on pedestals of intervening materials and reported considerable differences depending on products used regarding the temperature and its sustenance. Onishi reported that with indirect moxibustion, also used as frequently as warming moxibustion, it is not only the warming effect, but the components of the material used as pedestal may possibly also exert some effect.[17]

Tissue changes at the site of moxibustion treatment

Aizawa et al. observed the effects of direct moxibustion on mouse skin over a period of 14 days following treatment and found that after application of three moxa cones the skin had recovered almost to its normal state after 14 days, without moxa scar. In the case of treatment using 20 cones there was some hypertrophy of the epidermis after 14 days, but after about 20 days the skin was considered to have recovered almost to its normal state.[18] Menjo et al. electron microscopically observed morphological changes in cutaneous collagen microfibrils using both electron and light microscopy. He found that the local alterations were the most marked, where the greater the amount of moxa was and these effects did not disappear even after 24 hours. This is a highly interesting fact when considering the influence of the temperature reached during moxibustion treatment on the body. Moreover, the heat stimulus provided by moxa treatment on the one hand and burns on the other hand may be considered to differ in the degree of their invasiveness for the body and will need further study in the future. The effects of moxa treatment are considered to be mediated via local inflammatory reactions, but it should be taken into account that the term inflammation could imply that the effects of inexplicable heat stimulation may also be considered as being included in the moxibustion effects.[19] In this respect, this report was very interesting. In other words, burns in general and burns caused by moxibustion are completely different regarding the degree of invasiveness and size. Accordingly, the inflammatory reaction alone caused by a simple burn cannot conceivably be considered to have the effects moxibustion does. Rather, the heat stimulus applied

during the moxibustion is considered to be important.

Influence of moxibustion on blood circulation

There are also many reports dealing with local and distant changes in blood flow. Takeda et al. have investigated the changes in local and distant cutaneous blood flow depending on the number of applied moxa cones and found that the application of a single moxa cone may produce locally a maximal increase of 580%, while application of 10 cones resulted in an increase of 720%. The stimulus intensity dependent increase in blood flow and sequential changes subsequently gradually decreased and returned reportedly after about 30 minutes to the control value set for the experimental time.

Almost no changes are observed in the peripheral blood flow after application of 1 cone, but moxibustion using 3 to 10 cones produced a transient reduction in blood flow that subsequently returned close to the control value, after which a tendency towards a slight increase was reportedly observed.[20] Ueda et al. applied various types of warming moxibustion to the forearm to examine the temperature characteristics and then used the laser Doppler method and a thermocouple thermometer to observe the changes in dermal blood flow both locally and on the dorsum of the hand as a distant reference site. In case of moxibustion on pedestals, the duration of the high temperature phase was short and the temperature curve cone-shaped, where the peak temperature varied with product type. For moxibustion using moxa tubes, the duration temperature was long and was maintained near the peak temperature with the temperature curve trapezoidal. Locally at the site of moxibustion an increase in blood flow was observed with all forms warming moxibustion, but the rate of increase depended on the peak temperature and quantity of the stimulus. Moreover, it was reported, that no obvious changes were observed in the periphery both in dermal blood flow and temperature. Yet, the rate of increase in blood flow increased with the quantity of the stimulus, but very strong warming moxibustion sometimes caused burns. There are marked individual differences in the rate of increase in blood flow and intensity of thermal pain sensation. Thus, these authors stated that it is important during clinical application of warming moxibustion to choose a type of warming moxa which provides a suitable quantity of stimulus within a scope not causing burns.[16]

Regarding indirect moxibustion, Matsuhata et al. performed "ginger moxibustion" on Ashi no sanri (zusanli, ST36) and observed the effects on the blood flow through the lower extremity and deep plantar tissue temperature. Local blood flow through the lower extremity increased over a period of 2 to 4 minutes following the stimulation, but no changes were observed on the contralateral side.[21] They also reported to have observed no changes in deep tissue temperature at the site of measurement. Recently, warming moxibustion providing a mild heat sensation tends to be favored, but there are certain differences pertaining to the changes caused in blood flow by direct and indirect moxibustion. Regarding the other actions, similar differences may well be expected. The lighthearted concept of moxibustion being the use of moxa, or else whatever is warm may also be called moxibustion needs to be revised. It seems necessary to investigate the different actions of direct, warming and indirect moxibustion.

Immune system, blood etc.

Furuya et al. performed moxibustion on mice to observe changes in phagocytosis using the carbon clearance method and reported an increase.[22] Effects on blood coagulation capacity have been reported by Sakamoto et al., observing a slight increase in liver function and obvious effects on the clotting system.[23] Okazaki et al. examined the influence on blood clotting capacity and observed a tendency toward activation of the coagulation induced by burning a single cone of moxa, but intermittent continuous moxibustion apparently did not maintain this increase. Moreover, platelet aggregation tended to be inhibited over a period of 1.5 hours after application of 5 mg of moxa, while after application of 15 mg of moxa a tendency towards ATP release over a period of 1 hour, as well as a tendency towards shortening of the lag time by 1 to 5 hours was observed. ADP induced platelet aggregation after application of 15 mg of moxa showed a tendency

towards continued elevation over a period of 24 hours, while the moxa application produced in both the 5 and 15 mg treatment groups an apparent increase in ATP after 1 and 3 hours respectively. The above results showed that a single application of moxa produced responses in the platelet system of mice that were not observed after intermittent continuous moxibustion stimulation, so that in case of a repeated moxa stimulation the effects may be considered to disappear.[24)]

Matsukuma et al. applied an amount of moxa used during daily clinical practice in humans (0.3 mg of moxa, 5 cones) for the treatment of adjuvant arthritis in rats on a point corresponding to Ashi no sanri (zusanlin, ST36) in humans and reportedly observed an anti-inflammatory effect.[25)]

While the amount of moxa usually used in clinical practice on humans when applied during research using normal animals is relatively greater, no obvious changes were obtained. In contrast, in research using animal disease models the amount of moxa usually used during daily clinical practice in humans produced observable effects. Thus, since the stimuli of acupuncture and moxibustion are very subtle, it may conceivably be difficult to demonstrate their effects during experiments using normal animals.

hsp

After maintaining the subcutaneous temperature for 15 minutes at 45℃ and within the muscle layer at 39-40℃ following the application of moxibustion, extraction of proteins from the gluteal regional muscle samples obtained after 3 and 24 hours showed that 3 hours after the performance of moxibustion on rats hsp70 and hsp71 were detected. Immediately after the moxibustion and 24 hours after it hsp71 was detected in the rats, hsp70 was not observed. Hsp71 was observed, however, in the control rats. Heat shock proteins (hsp) are synthesized as one form of physiological stress proteins. This suggests that the local application of heat in the form of moxa stimulation leads to the synthesis of hsp and thus exerts a physiological effect.[26) 27)]

These reports indicate that hsp are involved in the modes of action of moxibustion so that warming moxibustion provides a method of increasing hsp. Yet, while methods to increase hsp concentration generally require a certain degree of equipment and time, moxibustion can be considered to be a very simple method to achieve an increase in hsp concentration.

Anti-ageing

Sakamoto et al. investigated the effects of moxibustion treatment on age induced locomotor ataxia using Marshall's method applied to 4- and 9-month old Wistar female rats, treating the animals continuously at a rate of once per week with a total amount of moxa of 15 mg/body on points corresponding to Hyakue (Baihui, GV20) and Keimon (Jingmen, GB25). Regarding the vigor, no significant improvements in the locomotor ataxia were observed, the moxa treatment caused some improvements in locomotor ataxia regarding success.[28) 29) 30) 31)]

Since anti-ageing has recently become a common topic, this report suggests that moxibustion treatment may be expected to have some anti-ageing effects.

Antioxidation

For a methanol extract of moxa and the combustion products of moxa, radical, eliminating effects have been observed.[32)]

Activity differs depending on the type of moxa, where the radical eliminating activity of warming moxa was weak, but that of moxa for direct moxibustion strong. Based on these results, it was considered that the inhibiting activity of moxa for direct moxibustion of lipoperoxidation is stronger than that of warming moxa.[33)]

The above described results show that there are differences between direct moxibustion and warming moxibustion. As described above, the differences in the effects of direct, warming and indirect moxibustion are considered to require further thorough investigation.

Closing remarks

It is not easy to introduce all the research pertaining to the entire scope of moxibustion induced actions. Research into the both ancient and modern treatment modality of moxibustion is progressing with results used in treatment form for people of the world.

It is my goal to finish my research results in the hope that this treatment form may be helpful for promoting health.

References

1) Ryuzo Oda: Studies of Moxa (II) - About Mt. Ibuki -, Journal of the Japan Society of Acupuncture and Moxibustion 35(1): 66-72, 1985
2) Ryuzo Oda: Studies of Moxa. (I) The Latest Process of Manufacture in Moxa and Its Raw Material, Journal of the Japan Society of Acupuncture and Moxibustion 33(3): 427-430, 1984
3) Shibekatsu A. et al.: Fundamental Study of Moxa (Report I) Comparison with Altemisia vulgaris grown in the sunlight and in the shade, Journal of the Japan Society of Acupuncture and Moxibustion 31(1): 27-33, 1982
4) Ryuzo Oda: Studies of Moxa (part 3) a study of millstones used in producing moxa, Journal of the Japan Society of Acupuncture and Moxibustion 43(2): 135-141, 1993
5) Shibekatsu A. et al.: Fundamental Study of Moxa (Report II) - Morphological Changes in the Producing Stage of Moxa / Morphological Differences in the Quality of Moxa -, Journal of the Japan Society of Acupuncture and Moxibustion 32(3): 242-249, 1983
6) Tsutomu S. et al.: Pharmacognostical Studies on the Artemisiae Folium., Journal of Natural Medicines 20(2): 84-91, 1966
7) Manzo Nakao, Chuzo Shibue: Regarding the components of mugwort leaves, Journal of Pharmacology 44: 636-643, 1924
8) Shizuo T. et al.: Research on Essential Oil of Moxa (No. 1), Journal of the Japan Society of Acupuncture and Moxibustion 38(3): 330-333, 1988
9) Shizuo T. et al.: Research on Essential Oil of Moxa (No. 2), Journal of the Japan Society of Acupuncture and Moxibustion 40(4): 380-382, 1990
10) Kazuko Kobayashi: Organic Components of Moxa Analyzed by NMR Spectroscopy, The Bulletin of Meiji University of Oriental Medicine 3: 45-51, 1987
11) Katsusuke Serizawa: The Science of Acupuncture and Moxibustion, Theory, 2nd Edition, Ishiyaku Shuppan: 17-28, 1964
12) Shigekatsu A. et al.: Effect of moxibustion on skin tissue - Changes of skin temperature during moxibustion - Journal of the Japan Society of Acupuncture and Moxibustion 35(2): 105-110, 1985
13) Ryoujin S. et al.: A Study on Temperature-Changes in vivo with Moxibustions, Journal of the Japan Society of Acupuncture and Moxibustion 38(3): 326-329, 1988
14) Shigekatsu Aizawa: Characteristics of moxa and research into its use for thermal stimulation, Journal of the Japan Society of Acupuncture and Moxibustion 57 (3): 290, 2007
15) Akihiro Ozaki: A Special Quality of Themal Stimulus on the Indirect Moxibustion, The Bulletin of Meiji University of Oriental Medicine 3: 85-99, 1987
16) Tomofumi Ueda, Yoshiko Egawa, Takao Kawahara, Shunji Koike, Masame Sakamoto: Temperature characteristics of warming moxibustion and comparison of hemodynamics – local and peripheral changes depending on different varieties, Tokyo Eisei Gakuen College, Department of Oriental Medicine, collection of graduation theses 10: 89-100, 2002
17) Motoyo O. et al.: Research on indirect moxibustion, Journal of the Japan Society of Acupuncture and Moxibustion 38 (4) : 420-422, 1988
18) Shigekatsu Aizawa: Temperature in the epidermis and dermis as well as the thereby induced tissue changes at sites treated by moxibustion in mice, Educational promotion group of Vocational school, Research Bulletin: 207-218, 1983
19) Yuki Menjo et al.: Ultrastructural Changes of Collagen Fibrils in Mouse Dermal Connective Tissue after Moxibustion Treatment, Acta Anatomica Nipponica 77: 7-15, 2002
20) Shinichi Takeda, Miki Menuma, Kenji Hasegawa, Takahiro Katsumata, Shigekatsu Aizawa: Investigation pertaining to methods of skin temperature measurement at combustion sites, Journal of the Japan Society of Acupuncture and Moxibustion 51(3): 418, 2001
21) Izuru Matsuhata, Koji Hisashita: Regarding the influence of ginger moxibustion on lower extremity blood flow and the deep tissue temperature in the sole of the foot, Journal of the

Japan Society of Acupuncture and Moxibustion 54: 402, 2004

22) Eiji F. et al.: Effects of Moxibustion on the Phagocytic Activity in Mice (report I) TIME COURSE FOR CHAGE IN PHAGOCYTIC ACTIVITY AFTER SINGLE MOXIBUSTION, Journal of the Japan Society of Acupuncture and Moxibustion 31(1): 34-41, 1982
23) Hideharu Sakamoto, Masako O. et al.: Effect of Multiple Moxibustion on Blood Coagulation in Mice, Journal of the Japan Society of Acupuncture and Moxibustion 36(3): 152-157, 1986
24) Masako Okazaki, Mayumi Y. et al.: Effect of Single Moxibustion on Platelet Aggregation and ATP-release in Mice, Journal of the Japan Society of Acupuncture and Moxibustion 38(2): 188-194, 1987
25) Hideaki M. et al.: Anti-inflammatory Effect of Moxibustion on Adjuvant-Induced Arthritis, Journal of Japanese Association of Physical Medicine Balneology and Climatology 68(3): 181-188, 2005
26) Kobayashi K. et al.: The Appearance of Heat-Shock Proteins (hsp) by Moxibustion, The Bulletin of Meiji University of Oriental Medicine 4: 67-71, 1988
27) Kazuko K. et al.: Relationship between Acupuncture and Stress Proteins, Journal of the Japan Society of Acupuncture and Moxibustion 39(3): 338-341, 1989
28) Hideharu Sakamoto: Effects of moxibustion stimulation on ageing phenomena (second report) – Effects relating to recovery from locomotor ataxia (1), Journal of the Japan Society of Acupuncture and Moxibustion, 37(3): 153-158, 1987
29) Hideharu S. et al.: Effect of Moxibustion on Aged Rats (Report 3) Reversal from Movement Disorders of Aged Animals (2), Journal of the Japan Society of Acupuncture and Moxibustion 37(3): 159-163, 1987
30) Hideharu Sakamoto: Effect of Moxibustion on Aged Rats (Report IV): Reversal from Movement Disorders and Recovering the Regular Cyclicity, Journal of the Japan Society of Acupuncture and Moxibustion 38(2): 195-201, 1988
31) Hideharu Sakamoto: Effect of Moxibustion on Aged Rats (Report V) Reversal from Movement Disorders of Aged Animals (3), Journal of the Japan Society of Acupuncture and Moxibustion 38(3): 314-319, 1988
32) Motoyo O. et al.: Effects of Moxa and Moxibustion-products on superoxide, Journal of the Japan Society of Acupuncture and Moxibustion 40(2): 228-231, 1990
33) Motoyo O. et al.: A Study on Radical Scavenging Effects of Moxa, Journal of the Japan Society of Acupuncture and Moxibustion 40(4): 377-379, 1990