2017 International Conference on Medicine Sciences and Bioengineering (ICMSB 2017)
ISBN: 978-1-60595-508-7

Preparation of Acid Bentonite Paste and Its Stimulation to Acupoint

Lan-Xia ZHAO[a] and Teng-You WEI[b,*]

School of Chemistry and Chemical Engineering in Guangxi University, Nanning, China, 530004

[a]zhaolanxia_gxu@163.com, [b]weity@gxu.edu.cn

*Corresponding author

Keywords: Acid bentonite, Paste, Preparation, Acupoint, Stimulation.

Abstract. Prepare the paste with acid bentonite as the main functional ingredient and use it for acupoint stimulation. Adopt single factor experiment and regulate the ratio of disperse liquid composition and acidic bentonite to prepare the paste with good stability and low viscosity; Carry out clinical acupoint stimulation test and investigate the efficiency of using paste by detecting the temperature of acupoint changed before and after stimulation. Experiment results show that the optimum formula of paste is as follows: glycerinum (20.7%), sorbitol solution (41.3%), propylene glycol (20.7%), GMS (0.8%), HEC (0.5%) and acid montmorillonite (16%). At this time, the paste has a relative viscosity of about 2800 cP, which exhibits uniform and fine texture and is easy to be painted without irritation; Moreover, there are also highly significant changes on temperature triggered by stimulating Zusanli, Quchi, Quze, Waiguan and Sanyinjiao. Because of good stability and proper viscosity, acid bentonite paste has good stimulation to the acupoint of human body.

Introduction

Acid bentonite is a kind of modified bentonite [1] obtained after the treatment with inorganic acid [2,3], which is also called active clay in the industry [4,5] due to its acid active center on the surface. Literature [6] reported that this kind of bentonite could be used for autonomic neural regulation, and the dosage of sustained release hydrochloric acid paste agent for external use was also provided. Despite the fact that this paste (referred to as acid bentonite paste in this thesis) was able to enhance the sympathetic nervous system of skin with several kinds of physiological effects, it still had some shortages such as big viscosity, greasiness, poor using comfort and so on. As a peripheral stimulation through acupuncture therapy or moxibustion to acupoint, acupuncture has been accepted by more and more people due to its advantages of no drugs and good safety [7,8]. However, the damage and heating stimulation to acupoint not only result in discomfort feeling such as heat and pain, but also require higher operation of acupuncture therapy [9]. This thesis modifies the formula of acid bentonite paste to increase the comfort of its use and discusses the possibility of acupoint stimulation, so as to lay foundation for the application of acid bentonite paste.

Experiment

Drugs and Reagents

Acid montmorillonite (home-made), glycerol (AR, Guangdong Guanghua Chemical Factory Co., Ltd.), propanediol (AR, Guangdong Guanghua Chemical Factory Co., Ltd.), sorbitol solution (food grade, Shandong Tianli Drug Co., Ltd.), glycerol mono stearate (GMS) (CP, Sinopharm Chemical Reagent Co., Ltd.) and hydroxyethyl cellulose (HEC) (AR, Shanghai Huien International Trading Co., Ltd.).

Experimental Instruments

Heat-collected constant temperature heating magnetic stirrer (DF-101S, Gongyi Yuhua Instrument Co., Ltd.), precision electronic balance (SB5002-BR, Haining Shengbo Weighing Apparatus Co., Ltd.), digital high speed homogenizer (FJ200-S, Fangzhou Tongda Instrument Co., Ltd.), Pincee viscometer (3.5mm, Shanghai Shenyi Glass Product Co., Ltd.), Gran infrared ear temperature gun (EW-2, Dongguan Senpu Industrial Co., Ltd.) and precision thermostat water bath (JB-2, Rex Electric Chemical Xinjing Instrument Co., Ltd.).

Preparation of Acid Bentonite Paste

Paste Formula Design. For paste formulas in the bibliography [10], the formula in Table 1 was selected to optimize the experimental scheme after primary test, and the viscosity and stability were detected for pastes prepared by different schemes.

Table 1. Experimental program of paste formulation.

Raw material name	Dosage[%]
Glycerol:sorbitol solution:propanediol (1:2:1)	Margin
GMS	(0.8) (1)
Acid bentonite	(12) (14) (16) (18)
HEC	(0.25) (0.5)

Preparation of Paste. (1) Took 20 g glycerol, 40 g sorbitol solution and 20 g propanediol into a 100 ml flask, added a certain amount of HEC and GMS, and then stirred it evenly under 70 ℃ to obtain the dispersant.

(2) Mixed the acid bentonite powder and dispersant in different proportions, stirred it evenly, placed it on a thermostat water bath at 70℃ and stirred for 30 min to prepare the acid bentonite paste.

Paste Performance Measurement. (1)Viscosity: Took 10ml fluid to be tested into the dried viscometer by transfer pipette, located the viscometer in 30.0℃ thermostat bath vertically for 5-10 min, and finally measured the time t required from m_1 to m_2 by stopwatch. The formula of relative viscosity of samples to be tested is:

$$\mu_1 = \mu_0 \times \frac{t_1}{t_0} \tag{1}$$

t_1 and t_0 indicate the time of samples to be tested and standard solution; while μ_1 and μ_0 mean the viscosity of samples to be tested and standard solution respectively.

(2) Stability: Took some prepared paste samples in test tube, placed it at room temperature and observed the time for lamination to confirm the stable period.

(3) Comfort: Tried the paste on the hands back and arms of volunteers and recorded their comments on the lubrication level, absorption efficiency, refreshing degree and adverse reaction.

Acupoint Stimulation Test of Acid Bentonite Paste

(1)Volunteer situation: Selected 6 volunteers aged 20-30 (3 men and 3 women) who were willing to accept the use of paste and sign the informed consent of clinical and experimental study.

(2)Test scheme: Selected and correctly found Quchi, Quze, Waiguan, Zusanli and Sanyinjiao according to TCM acupoint determination method, then marked the position of acupoint and took another point beside it for reference. Took appropriate amount of paste with swab and applied it on the acupoint to be measured, massaged circularly until it was basically absorbed, and then measured it by ear thermometer. Measured the acupoints in unequal intervals and recorded the results.

(3)Made the statistic analysis of measurement results via SPSS software.

Results and Analysis

Experimental Efficiency of Acid Bentonite Paste

Influence of Acid Bentonite Content, Thickening Agent and Emulsifying Agent on the Viscosity of Paste. The curve of influence of acid bentonite content (*L*) on the viscosity of paste (μ) under different HEC and GMS is shown in Figure 1.

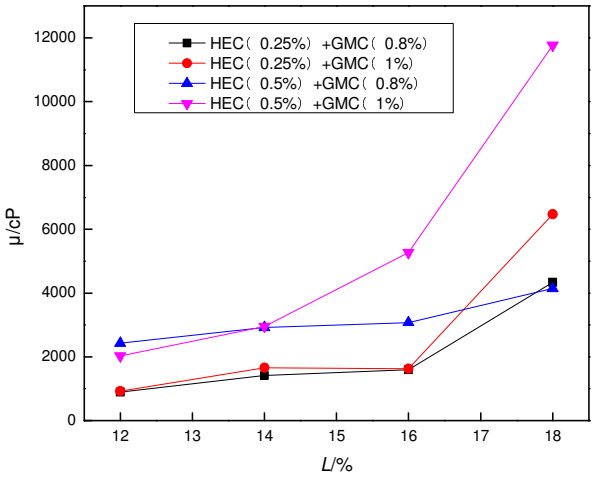

Figure 1. The influence of acid bentonite content on the viscosity.

As shown in Figure 1, under a certain content of HEC and GMS, the more content of acid bentonite was, the bigger relative viscosity of paste was represented. However, too big viscosity not only resulted in sticky and muddy feeling to skin, but also caused poor absorbtion efficiency. Under low content of acid bentonite, the content of drug decrease as well; and when the content of acid bentonite arrived at a certain amount, the viscosity of paste

was increased with the growing content of HEC and GMS. But excessive HEC and GMS will lead to poor fluidity of paste, which shall be determined through stability experiment.

The content of acid bentonite may also affect the using efficiency. Using efficiency of different content of acid bentonite when HEC and GMS were 0.5% and 0.8% is shown in Table 2. Combined with Figure 1 and Table 2, the proper acid bentonite content of paste shall be 16%.

Table 2. Effect of paste.

Acid bentonitecontent[%]	Lubrication level	Absorptionefficiency	Refreshing degree	Adverse reaction
12	++	++	++	+
14	++	++	++	+
16	++	++	+	+
18	+	+	+	+

Note: ① lubrication level: good (++), smooth and comfortable rather than wetting or rough feeling to skin; general (+), general feeling to skin; poor (-), no comfortable,rough and dry feeling to skin;② absorbtion efficiency: good (++), easy to absord; general (+), absorbtion effeciency general; poor (-), basically not absorb ; ③ refreshing degree: good (++), easy to apply evenly to skin and no sticky feeling ; general (+), apply evenly to skin but slightly sticky and muddy feeling ; poor (-), apply unevenly to skin , sticky and muddy feeling to skin ; ④ adverse reaction: good (+), non-red, swollen, painful, itching and other adverse reactions; poor (-), adverse reactions after use.

Influence of Acid Bentonite Content, Thickening Agent and Emulsifying Agent on the Stability of Paste. Figure 2 shows the stability of paste when the content of acid bentonite is 12%, 14%, 16% and 18%.

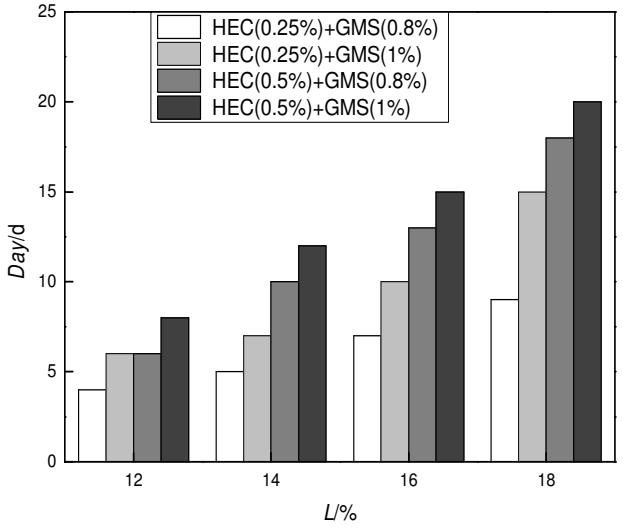

Figure 2. The stability of acid bentonite paste.

As shown in Figure 2, the stability of paste was increased with the growing ratio of acid bentonite, HEC and GMS. When the content of acid bentonite was 16%, the stability period of paste reached 2 weeks when the content of HEC and GMS was above 0.5% and 0.8% respectively, which satisfied the using requirement. Therefore, the formula of preparing acid bentonite paste was determined as follows: acid bentonite (16%), HEC (0.5%) and GMS (0.8%).

Stimulation of Acid Bentonite Paste to Acupoint

Skin temperature changes after stimulating the acupoints of different individuals by paste are shown from Figure 3 to Figure 8, while the significant treatment of temperature change is displayed in Table 3.

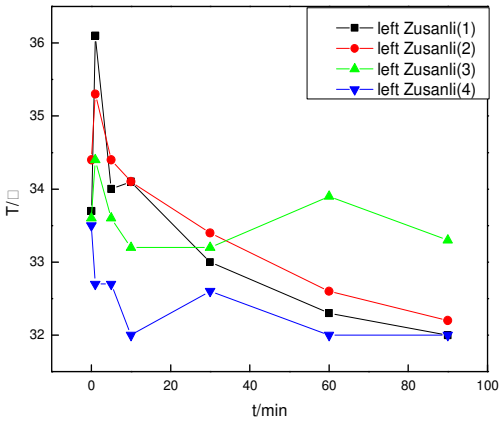

Figure 3. The temperature curve of left Zusanli.

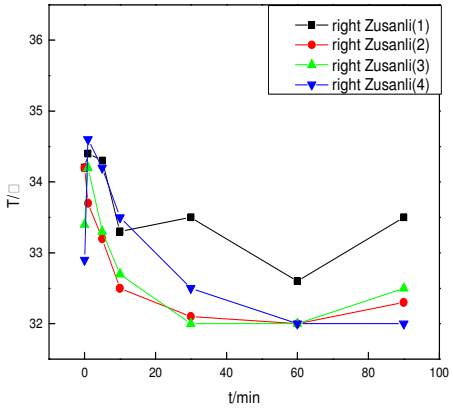

Figure 4. The temperature curve of right Zusanli.

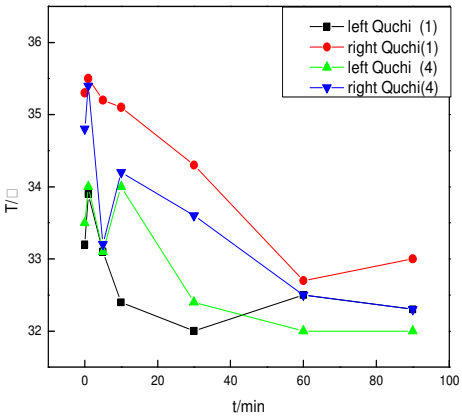

Figure 5. The temperature curve of left/right Quchi.

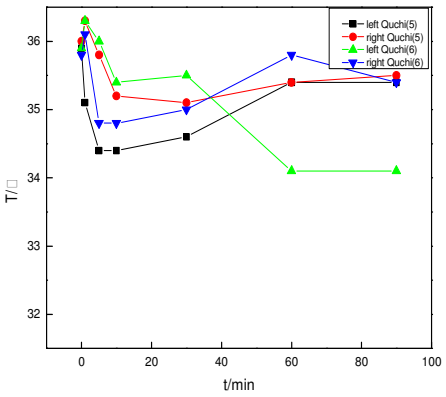

Figure 6. The temperature curve of left/right Quze.

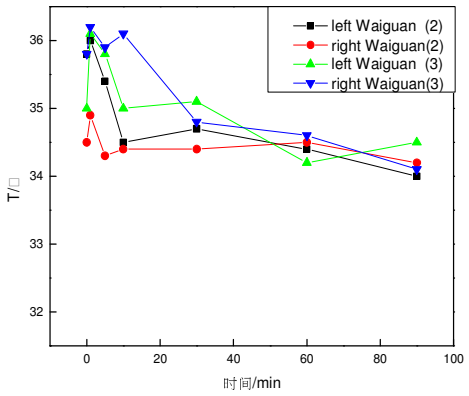

Figure 7. The temperature curve of left/right Waiguan.

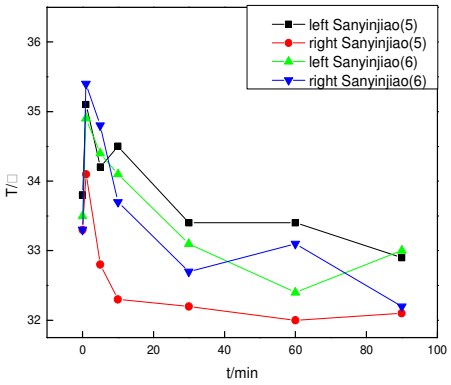

Figure 8. The temperature curve of left/right Sanyinjiao.

Table 3. The temperature statistics of acupoints($\bar{x} \pm s$, Zusanli n=8, other n=4).

T[□]	Zusanli	Quchi	Quze	Waiguan	Sanyinjiao
A[□]	33.7±0.5	34.2±1.0	35.3±0.1	35.9±0.6	33.5±0.2
B[□]	$34.6\pm0.8^{1)**}$	$34.7\pm0.9^{1)}$	$35.8\pm0.6^{1)}$	$36.0\pm0.6^{1)}$	$34.9\pm0.6^{1)**}$
C[□]	$32.3\pm0.4^{2)**}$	$32.3\pm0.3^{2)**}$	$33.9\pm0.4^{2)**}$	$34.6\pm0.5^{2)**}$	$32.4\pm0.4^{2)**}$
D[□]	$32.5\pm0.6^{3)**}$	$32.4\pm0.4^{3)**}$	$34.0\pm0.7^{3)*}$	$35.1\pm0.6^{3)**}$	$32.6\pm0.5^{3)*}$

Note: A- mean temperature at 0 min and standard deviation; B- mean highest temperature and standard deviation; C-mean lowest temperature and standard deviation; the temperature during 90 min; D- mean temperature at 90 min and standard deviation; 1) - mean highest temperature compare to mean temperature at 0 min; 2) - mean lowest temperature compare to mean temperature at 0 min; 3) - mean temperature at 90 min compare to mean temperature at 0 min; *p<0.01; 0.01<**p<0.05.

According to the figures, (1) the temperature of acupoint after stimulating by paste slightly increased at first and then greatly decreased. The increase of temperature on Zusanli and Sanyinjiao was highly significant (p<0.01), but other three acupoints only had small increase of temperature, which was not significant. In fact, the lowest decrease of acupoint was all highly remarkable, and the decrease of temperature on each acupoint 90min later after applying the paste was as follows: Quchi (1.8 ℃), Quze (1.3 ℃), Zusanli (1.3 ℃), Sanyinjiao (0.9 ℃), and Waiguan (0.8 ℃). Other than Quze (which obviously decreased, p<0.05), the decrease of temperature for all other acupoints were highly significant (p<0.01), representing remarkable stimulation efficiency of paste on the tested acupoints. (2) During the experiment, all volunteers had acid bilge and powerlessness feeling that was similar to the feeling of acupuncture.

Literature [11,12] mentioned that human body acupoint had several kinds of sensory receptors, such as nerve endings, nerve bundles, blood vessels, capillary bundles and mast cells, while acupuncture [13] and acupoint massage could increase the excitability of nerve

system and improve local blood circulation. But the literature [6] also pointed that acid bentonite had the function of enhancing sympathetic nerve. Thus, the growing temperature after applying the paste on acupoint showed the reinforcement of nerves, increase of energy metabolism and blood supply on acupoint, so acid bilge feeling and increase of temperature occured at the very beginning. But in the later period, the temperature decreased, which might be caused by the loss of excessive heat brought by the accelerated blood fluidity.

Conclusion

(1) Through adopting single factor test, the formula of paste is determined as follows: glycerinum (20.7%), sorbitol solution (41.3%), propylene glycol (20.7%), GMS (0.8%), HEC (0.5%) and acid montmorillonite (16%). Paste prepared by this formula was very stable with good using efficiency and no adverse reaction.

(2) After stimulating the acupoint by paste, the skin temperature increase at first and then decreased. The time of increasing temperature was very short but the time of decreasing temperature was very remarkable and maintained more than 90 min, which demonstrated that, the acid bentonite paste could be used for acupoint stimulation.

References

[1] Wang Guifang, Lv Xianjun, Qiu Jun et al. Research Status of Using bentonite as a pharmaceutical excipients [J]. Metal mine, 2009(8):174-178.

[2] Lin F H, Lee Y H, Jian C H, et al. A study of purified montmorillonite intercalated with 5-fluorouracil as drug carrier [J]. Biomaterials, 2002, 23(9):1981-1987.

[3] Chen Y, Zhou A, Liu B, et al. Tramadol hydrochloride/montmorillonite composite: Preparation and controlled drug release [J]. Applied Clay Science, 2010, 49 (3):108-112.

[4] Lu Guoqing, High Performance Active Bentonite Preparation Technology and Its Mechanism Research [D]. Guanxi University, 2009.

[5] Gao Xiaowei, Wei Tengyou, Fan Yuanfeng et al. Research on Chemical Modification of Active Bentonite and Its Action Mechanism [J]. Journal of Guangxi University (Natural science), 2010, 35(3):410-414.

[6] Wei Tengyou, Lin Zijun, Chen Lingyu, Zhuge Liuying, Xia Hongwei, Tong Zhangfa, Huang Yilin, Wu Lian, A Combined Drug of Regulating Autonomic Nerve and Its Preparation, Product and Application [P]. Chinese Patent: CN105873595, 2016-8-17.

[7] Liu Jianhua, Ma Wentao, Cui Renfa et al. Acupuncture Mechanism and Meridian Research Status and Expectations [J]. Chinese Basic Science, 2004, 6(4):29-35.

[8] Yang Yongqing, Chen Hanping, Wang Yu, Basic Rules, Characteristics and Advantages of Acupuncture Mechanism [J]. Journal of Chinese Medicine, 2008, 23(6):1-4.

[9] Li Yun, Three Mechanisms and Method of Acupuncture [J]. Journal of Practical Chinese Medicine, 2012(2):77-79.

[10] Wang Ge, Guo Qingsheng, Preparation of Ulcer Clearing Skin Lotion and Clinic Application [J]. Chinese Journal of Hospital pharmacy, 2006, 26(5):626-626.

[11] Xiang Guochu, Gu Zhiyou, Discussions on Acupoint Fixation Method [J]. Chinese Medicine Leader, 2009, 15(12):52-53.

[12] Yu Ansheng, Acupoint Morphology Research Progress [J]. Shanghai Journal of Acupuncture, 1995(3):133-135.

[13] Zhang Dong, Application of Infrared Thermal Imaging Technology in Acupuncture Principle and Meridian Research [J]. Chinese Acupuncture, 2004, 24(1):37-42.