第一页为封面页

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Title： Studies on the skin repair peptide from *American cockroach*

论文题目：美洲大蠊中具有皮肤修复活性的多肽成分研究

摘要：

目前市面上一种用于治疗创伤、烫伤和溃疡的特效药物叫康复新液，其主要成分是美洲大蠊(蟑螂)提取物。尽管临床疗效确切，康复新液的有效成分仍然不清楚。根据文献调研和康复新液的临床应用，我们推测美洲大蠊中可能含有促进皮肤修复的成分。本项目首次运用活性追踪的分离层析方法，从美洲大蠊提取物中分离得到 1 个多肽类化合物；采用波谱分析和氨基酸测序等技术鉴定了该多肽的结构，为一新化合物；运用细胞增殖、细胞迁移和动物皮肤损伤模型，发现该多肽具有明显的促进皮肤修复活性。本项目首次揭示了美洲大蠊（蟑螂）促进皮肤修复的活性成分，该研究成果可应用于药品、化妆品、日化用品等多个领域。

第三页为论文英文摘要（如果是中文论文，此页为英文摘要。否则，留空白。）

Title: Studies on the skin repair peptide from *American cockroach*

Abstract

There is an effective Chinese medicine called Kang Fu Xin Ye in China for the treatment of wounds, burns and ulcers for a long time. This drug is made from the extract of *Periplaneta americana* (American cockroach). Although the clinic effect of Kang Fu Xin Ye is reliable, the bioactive constituents of this Chinese medicine are still unclear. According to the literature research and clinical application of Kang Fu Xin Ye, we believe that there are some compounds having skin repair activity in *Periplaneta americana*. In our present project, a bioactive peptide was isolated from the extract of *Periplaneta americana* using chromatographic separation and activity monitoring methods. The structure was elucidated by spectral analysis and amino acid sequencing, which was confirmed to be a new peptide. Moreover, the results of cell proliferation, cell migration and animal tests indicated this new peptide has significant skin repair activity. This project revealed the skin repair active ingredients form *Periplaneta americana* for the first time. The new active peptide can be used in many fields such as drugs, cosmetics and daily chemicals.

本参赛团队声明所提交的论文是在指导老师下进行的研究工作和取得的研究成果。尽本团队所知，除了文中特别加以标注和致谢中所罗列的内容以外，论文中不包含其他人或本团队已经发表或撰写过的研究成果。若有不实之处，本人愿意承担一切相关责任。

参赛团队签名：

日 期：

此处开始为论文的主体部分……

Title: Studies on the skin repair peptide from *American cockroach*

TEXT:

1. Accidental discovery

One day in last year, I visited my grandmother. When she was cooking dinner for me, I heard “bang” from the kitchen and found that my grandma's foot was burned by the dropping kettle accidentally. My grandfather took out a bottle of Chinese medicine called KangFuXin liquid to her, which was really effective. Then I found the ingredient of the drug turned out to be the extract of *Periplaneta Americana* (American cockroach). How amazing? Why the cockroaches can be used as medicine? I was puzzled, so I began to look for a lot of literature, and design a research programs to explore what’s the active substance in the body of American cockroach to promote skin repair.

2. Research background

Follow my teacher's instructions, I learned that *Periplaneta americana* L. is an insect of genus *Peripalneta*, commonly known as cockroache (Fig. 1), which was widely distributed in China. We often see cockroaches in our daily life and dislike this “pest”. However, cockroach was actually a traditional animal medicine, which had been recorded in the “Shen Nong’s Herbal Classic” and be used as medicine for a long time. It can be used for the treatment of pediatric gangrene, carbuncle swollen and other symptoms. Several clinical drugs such as KangFuXin liquid, Xinmai Long injection, and GanLong capsule (Fig. 2) are made from *Periplaneta americana* as raw materials. KangFuXin liquid is used in the treatment of wounds, burns and ulcers. It’s annual sales is up to two billion yuan.

Pharmacological studies have shown that the extract of *Periplaneta americana* has significant skin repairing activity [2-4]. However, the research on chemical constituents of *Periplaneta americana* is rare. Only several neuropeptides and small molecular compounds such as periplanone A, B, C, D and isocoumarin had been reported [5-7]. Moreover, the active

ingredient of *Periplaneta americana* are still unclear.

Fig. 1 Picture of *Periplaneta americana*

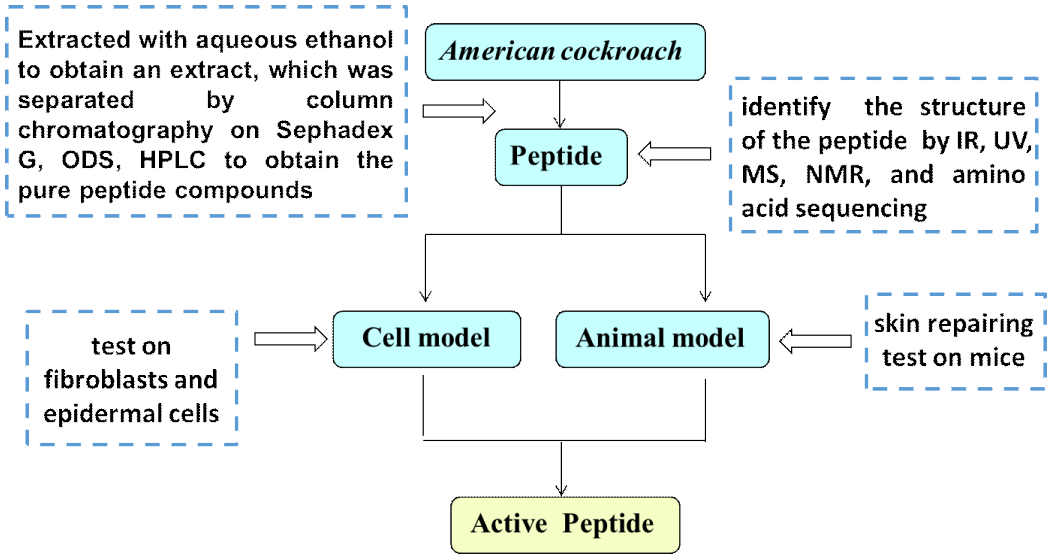
Fig. 2 Drugs made from *Periplaneta americana*

3. Research design

Periplaneta Americana (cockroach) has been survived about 350 million years in the earth. It could resistant to various environmental changes and insecticides and still very active. There must be some special bioactive substances in their body. Follow my teacher's instructions, I had read more literatures and found that the major active ingredients of animal drugs (leech, earthworm, scorpion) are peptides such as hirudin, lumbrokinase and scorpion venom protein. Peptides are short chains of amino acid monomers linked by peptide (amide) bonds, which have multiple biological effects and low toxicity. Therefore, according to the clinical application of *Periplaneta americana*, we proposed that *Periplaneta americana* should contain peptide components which can promote skin repair.

Nowadays, the active peptides from *Periplaneta americana* have not been reported. The research objective was achieved by the following steps. First, the cockroach materials were collected, extracted and concentrated to obtain the total extract. Secondly, the extract was separated under the activity monitoring to yield single peptide. Then, the structure of the isolated peptide was identified. Finally, cell and animal models will be used to evaluate the skin repairing activity of the identified peptide. The active peptide could be used for further development and utilization of *Periplaneta americana*, and can be used in pharmaceuticals, cosmetics, and other fields.

The experimental route of the project:



4. Experimental and Results

4.1. Material

The Qingping medicinal herbs market in Guangzhou is large-scale and famous in China. After investigation in Qingping market, I learned that the professional breeding facility of *Periplaneta americana* have been established in Yunnan and Sichuan Provinces. The medicinal materials of *Periplaneta americana* (Fig. 3) was purchased from Yunnan Chengman Biological Technology. A voucher specimen (No. 2015091501) was deposited in the Institute of Traditional Chinese Medicine & Natural Products, Jinan University, Guangzhou, P. R. China.

Fig. 3 Medicinal materials of *Periplaneta americana*

4.2. Pre-treatment of *Periplaneta americana*

The purchased medicinal materials of *Periplaneta americana* was powdered and then screened with 20 mesh.

4.3. Extraction and concentration

4.3.1 Extraction

The powders of *Periplaneta americana* (3 kg) were extracted with 30 % EtOH (keep the liquid level higher than the surface of medicinal materials to prevent air admission). Firstly, the powders were soaked for one day to make the effective constituents well dissolved in the solvent. Then open the valve and make the soak solution flowing out. Secondly, add 30 % EtOH with the same volume to obtain about 10 L percolate. Thirdly, repeat this operation again. At last, combine the solution (Fig. 4).

Fig. 4 Percolation of *Periplaneta Americana*

4.3.2 Concentration

The extracting solution was refluxed with large rotary evaporators (Fig. 5) to obtain the total extract (131g).

Fig. 5 Reflux with large rotary evaporators

4.4. Bioassay-guided isolation of the active ingredient from the extract of *Periplaneta americana*

The dried extract (120 g) was dissolved in water and subjected to an Amberchrome resin column (10*120 cm) eluting successively with water and different concentration of methanol (30 % MeOH, 50 % MeOH, and 70 % MeOH) (Fig. 6). The fractions containing peptides were detected by HPLC-MS and combined together to yield the total peptide extract (32 g) (Fig. 7).

Fig. 6 Separation with resin column

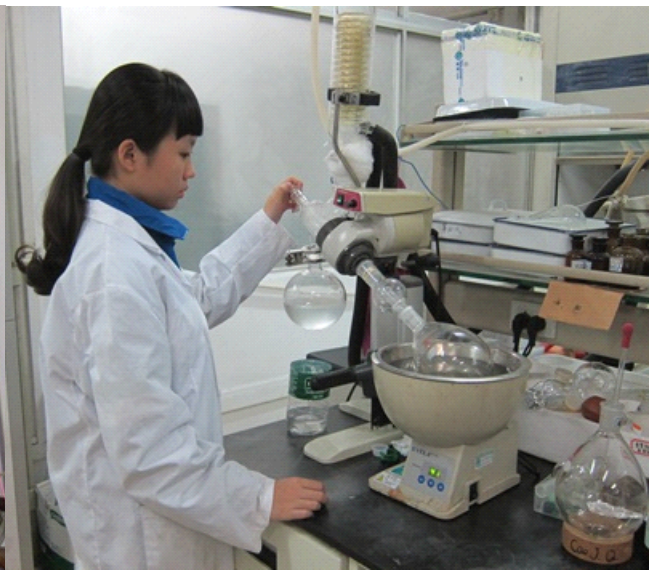


Fig. 7 Concentration with rotary evaporators

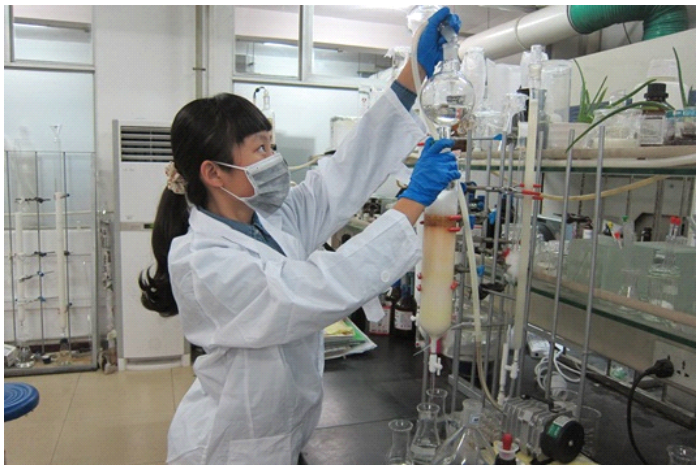


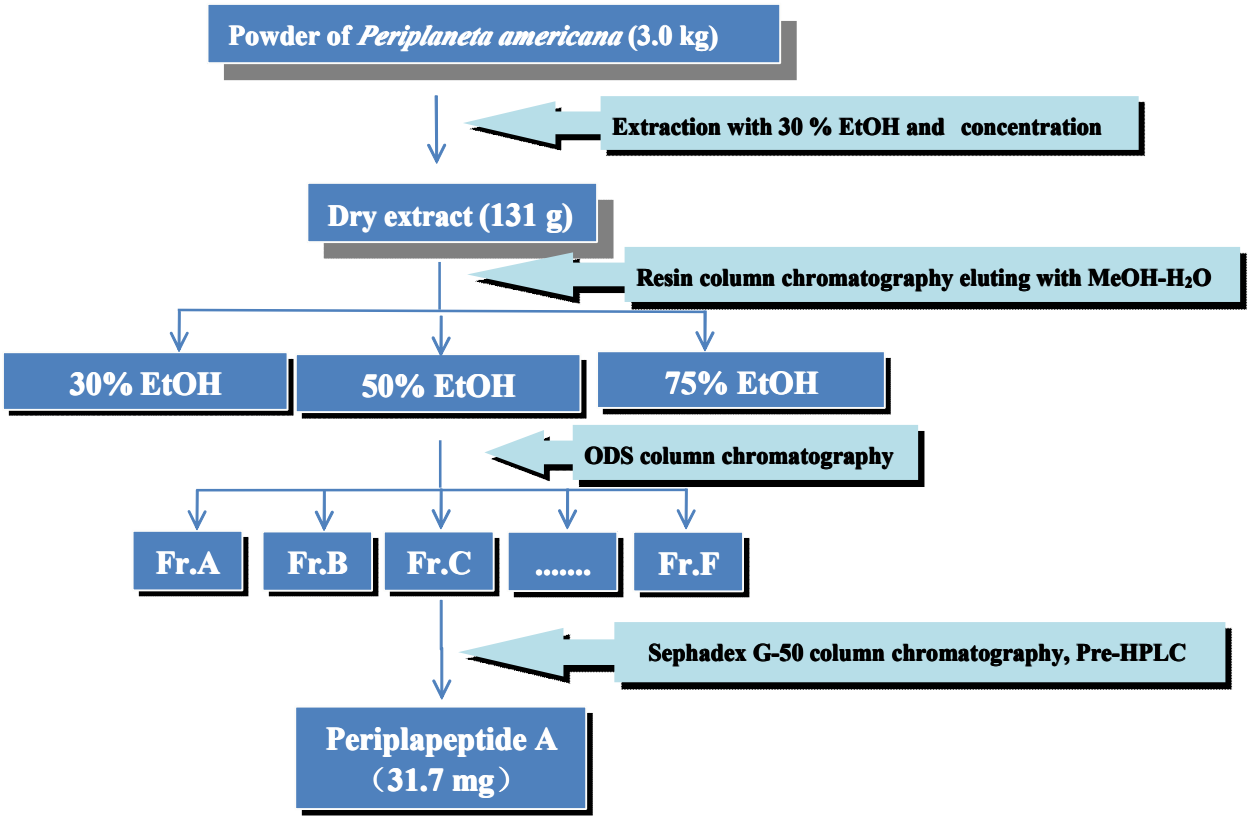
Fig. 8 Separation with ODS column

Next, the total peptide was subjected to ODS column chromatography eluting with MeOH-H_2O gradient system (1:9, 2:8, 3:7, 5:5, 7:3, 9:1, v/v) to produce six fractions (Frs. A-F) (Fig. 8). With the guidance of activity test (see part 6), Fr. C (2.5 g) was chromatographed on Sephadex G-50 eluting with water (0.5 mL/min) to obtain 5 subfractions (Frs. C1-C5) under the guidance of HPLC (Fig. 9). Biological assay (see part 6) showed that only Fr. C4 had obvious activity. Fr. C4 was further purified by semi-preparative HPLC with MeCN-H_2O (40:60, v/v, 3 mL/min) to yield compound **1** (t_R = 30.8 min) and named Periplapeptide A (31.7 mg) (Fig. 10).

Fig. 9 Analysis and purification with HPLC

Fig.10 Sample of pure peptide

The extraction and separation chart:



4.5. Structural elucidation of peptide

The structure of iaolated peptide was identified by UV, IR, MS, NMR and other spectral methods (Fig. 11-14). Wherein the ultraviolet spectrum provides conjugated information of the structural skeleton, the infrared spectrum provides functional group information, the mass spectrum provides molecular information, and the NMR spectrum provides chemical environmental information of the hydrogen and carbon atoms. Based on a comprehensive analysis of the above spectra, the structure of the peptide was identified as follows, which consisted of 14 amino acids and named as Periplapeptide A.

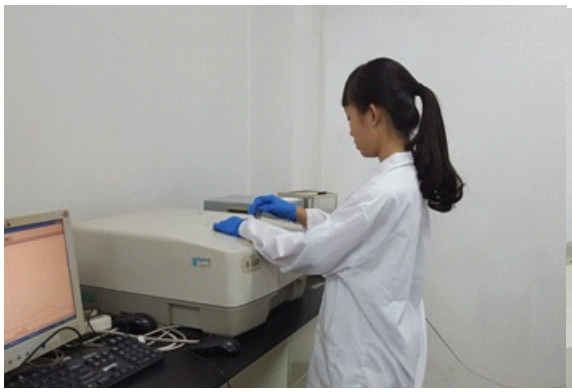


Fig. 11 Ultraviolet spectrum experiment

Fig. 12 Infrared spectrum experiment

Fig. 13 Mass spectrum experiment

Fig. 14 NMR spectra experiment

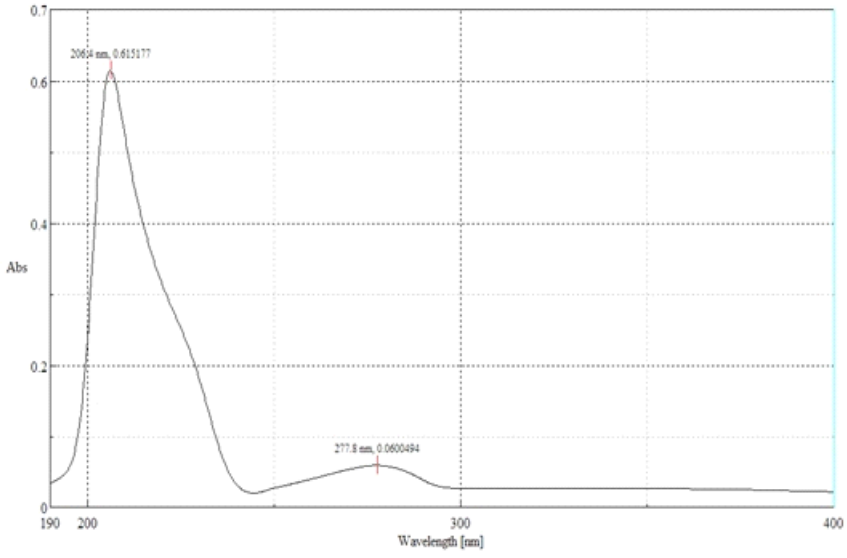


Fig.15 UV spectrum of Periplapeptide A

Periplapeptide A: white powder; positive in ninhydrin reaction. The UV spectrum of **1** displayed absorptions maxima at 206 and 278 nm (Fig. 15). The IR spectrum indicated the presence of hydroxyl group (3400 cm^{-1}), aromatic ring (1592 and 1435 cm^{-1}) and carbonyl

groups (1650 cm^{-1}) (Fig. 16). The molecular formula of **1** was deduced as $C_{72}H_{96}N_{18}O_{17}$ by HR-ESI-MS (*m/z* 1486.7276 $[M+H]^+$; calcd for $C_{72}H_{97}N_{18}O_{17}$: 1485.7234) (Fig. 17).

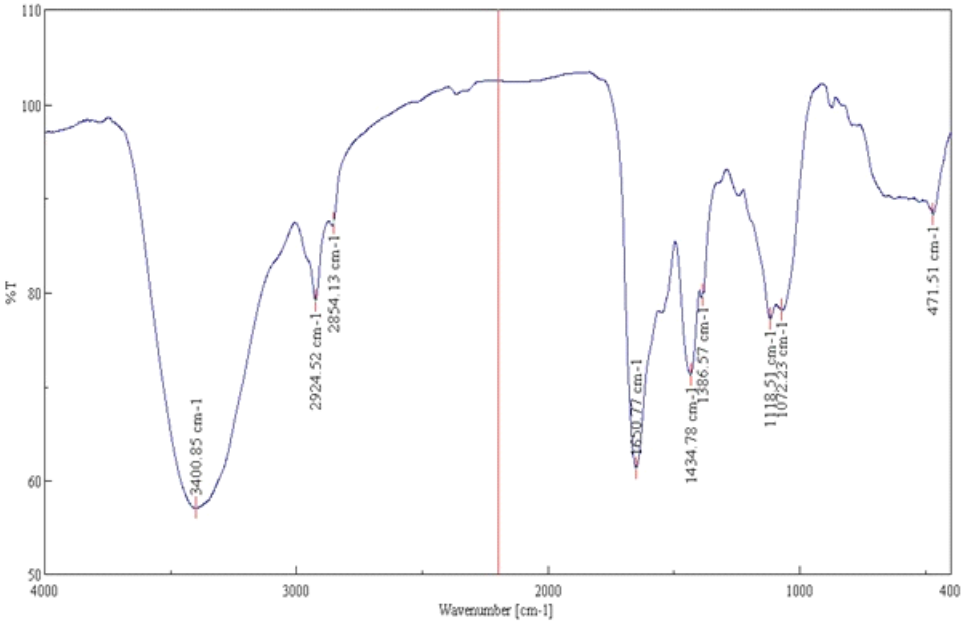


Fig. 16 IR spectrum of Periplapeptide A

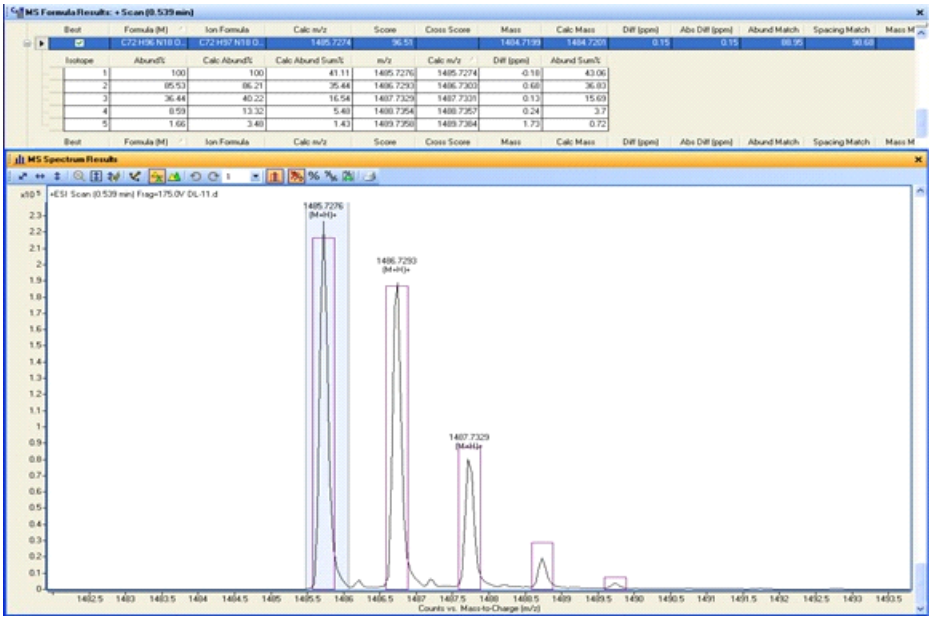


Fig. 17 ESI spectrum of Periplapeptide A

The ^1H NMR spectrum of compound **1** showed signals for fourteen *a* protons of amino acid (δ_H 3.85, 4.15, 4.18, 4.19, 4.21, 4.25, 4.27, 4.34, 4.34, 4.43, 4.49, 4.56, 4.60, 4.65), eight methyl groups (δ_H 0.80, 0.83, 1.15, 1.14, 1.17, 1.19, 1.20, 1.30), two nitrogen-bearing

methylenes (δ_H 3.52, 3.50), and four aromatic protons (δ_H 6.59~6.63, 6.96~6.76), which indicated the presence of valine, alanine, proline and tyrosine.

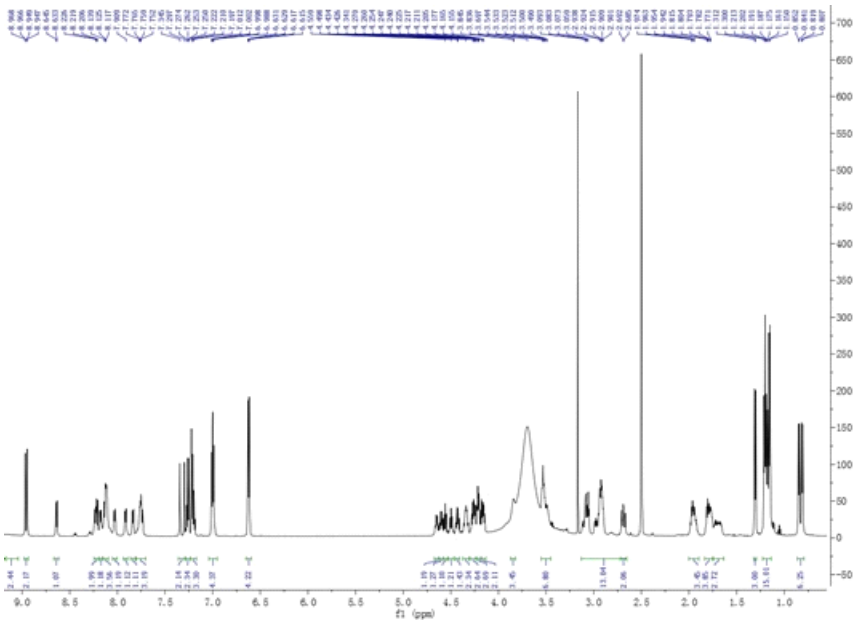


Fig. 18 ^{1}H-NMR spectrum of Periplapeptide A

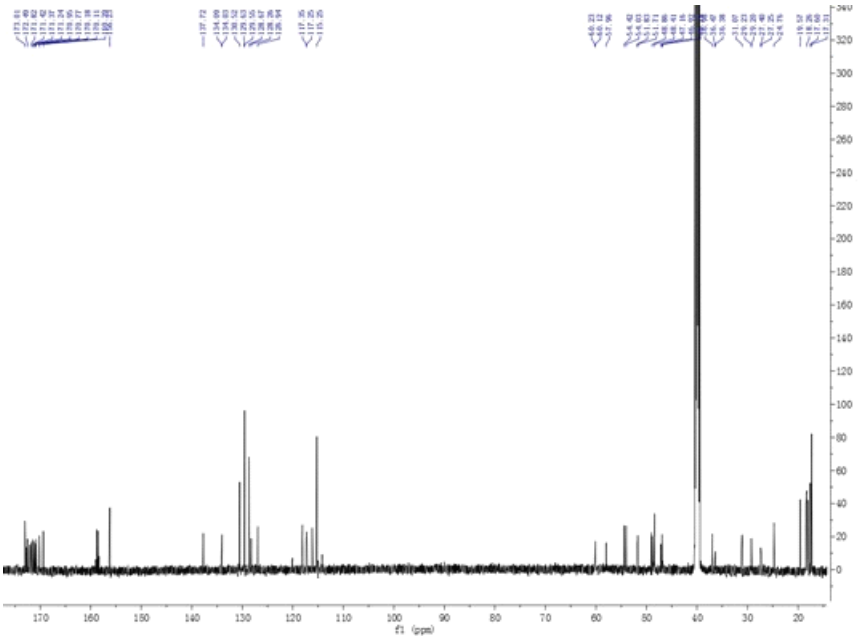
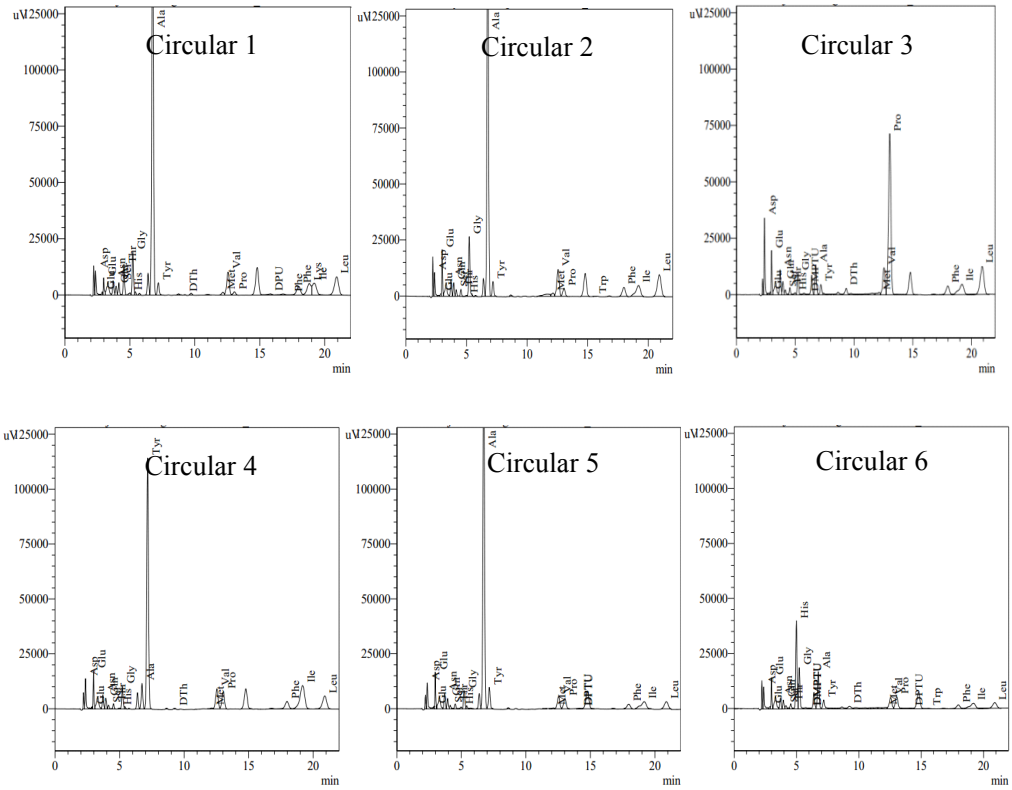


Fig. 19 ^{13}C-NMR spectrum of Periplapeptide A

The ^{13}C NMR and DEPT spectra (Fig. 19) of **1** displayed seventy-two signals, including eight methyls, eleven methylenes, thirty-two methines and twenty-one quaternary carbons. In the lower-filed, fourteen carbonyl groups (δ_C 169.4, 170.1, 170.2, 170.8, 171.0, 171.2, 171.4, 171.5, 171.7, 171.8, 172.1, 172.5, 172.7, 173.0); twelve aromatic carbon signals (δ_C 115.2×2, 128.4×2, 130.5×2, 156.2×2, 128.3×2, 156.2×2) indicated the presence of tyrosine. In addition, eight methyl carbons (δ_C 17.3×2, 17.6, 18.1, 18.2, 18.3, 18.4, 19.6) observed in the high-filed indicated the presence of valine and alanine. Base on the above evidences, the structure of **1** was identified and named as Periplapeptide A, which consisted of 14 amino acids.

With the aid of ^{1}H NMR, ^{13}C NMR, ^{1}H-^{1}H COSY, TOCSY, HSQC and HMBC experiments, the structure of compound **1** was established and the ^{1}H- and ^{13}C-NMR signals of **1** were assigned as shown in Table 1.

In order to further verify the sequence of the peptide, the *N*-terminal sequencing using the Edman degradation method was carried out. The results showed that this peptide contained 14 amino acids: Ala[1], Ala[2], Pro[3], Tyr[4], Ala[5], His[6], Val[7], Ala[8], Ala[9], Pro[10], Tyr[11], Ala[12], His[13] and Phe[14] (Fig. 21), which were in accordance with the NMR analysis.



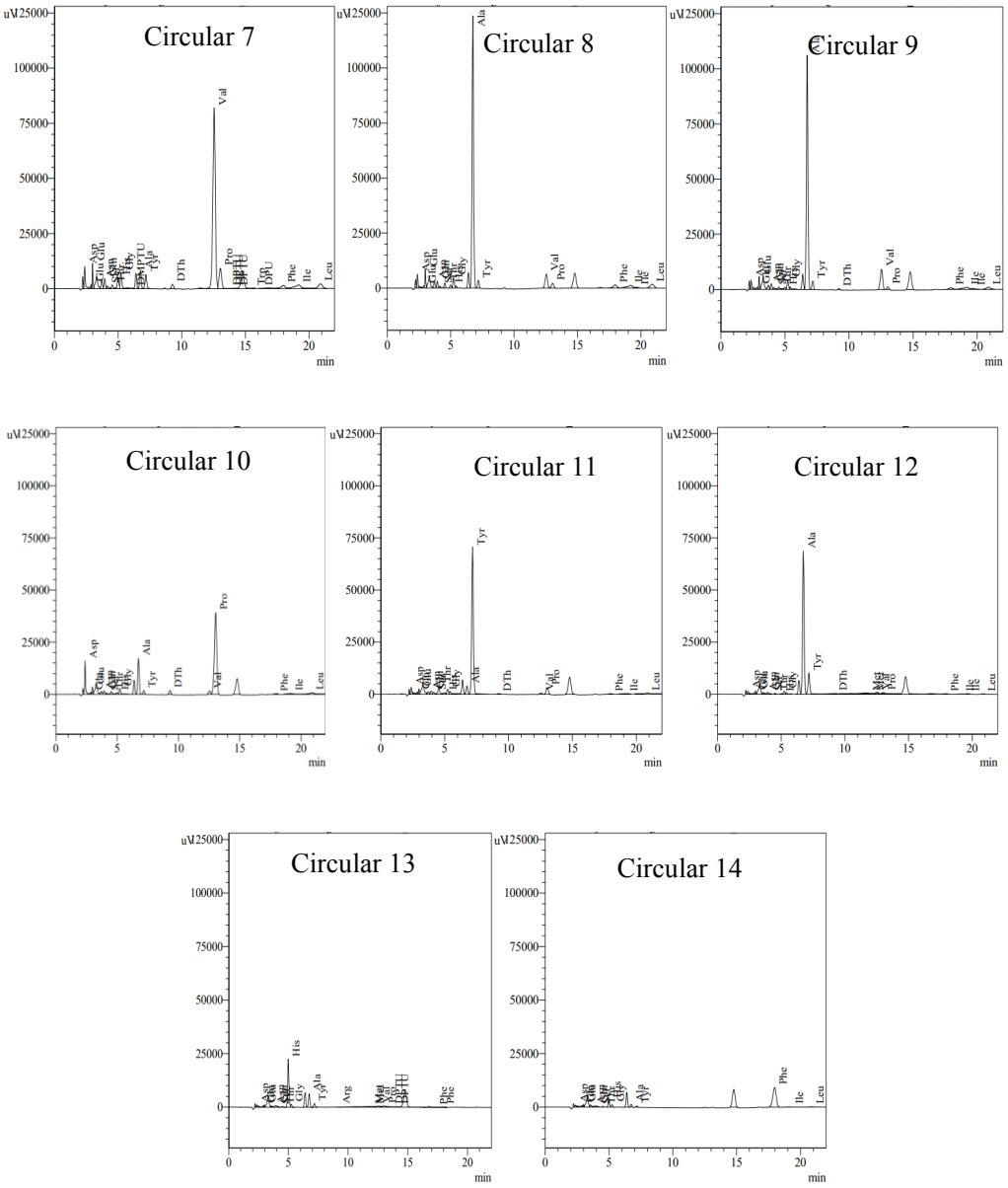


Fig.21 Amino acid sequencing of Periplapeptide A

Base on the above evidences, the structure of compound **1** was established as NH_2-Ala[1]-Ala[2]-Pro[3]-Tyr[4]-Ala[5]-His[6]-Val[7]-Ala[8]-Ala[9]-Pro[10]-Tyr[11]-Ala[12]-His[13]-Phe[14]-COOH and named as Periplapeptide A.

Table 1 ^{1}H and ^{13}C NMR of Periplapeptide A (DMSO-d_6, δ in ppm, J in Hz)

		δ_H	δ_C			δ_H	δ_C
Ala[1]	C=O	—	169.4	Ala[8]	NH	8.02 (d, J= 7.2)	—
	NH	8.10	—		α-CH	4.49 (m)	46.8
	α-CH	3.85 (m)	48.4		β-CH_3	1.14 (d, J= 6.6)	17.3
	β-CH_3	1.30 (d, J= 7.2)	17.6	Ala[9]			
Ala[2]					C=O	—	172.1
	C=O	—	170.8		NH	8.17 (d, J= 4.8)	—
	NH	8.61 (d, J= 7.2)	—		α-CH	4.27	48.5
	α-CH	4.56 (m)	46.9		β-CH_3	1.17 (d, J= 7.2)	18.4
	β-CH_3	1.20(d, J= 6.6)	17.3	Pro[10]			
Pro[3]					C=O	—	171.7
	C=O	—	171.8		NH	—	—
	NH	—	—		α-CH	4.25	60.1
	α-CH	4.19	60.2		β-CH_2	1.68 (m)	29.2
	β-CH_2	1.68 (m)	29.2			1.95 (m)	
		1.95 (m)			γ-CH_2	1.77 (m)	24.8
	γ-CH_2	1.77	24.8		δ-CH_2	3.52 (m)	47.1
	δ-CH_2	3.52	47.2	Tyr[11]			
Tyr[4]					C=O	—	171.4
	C=O	—	171.4		NH	7.74 (d, J= 4.8)	—
	NH	7.72 (d, J= 10.2)	—		α-CH	4.34	54.4
	α-CH	4.34	54.4		β-CH_2	2.68 (dd, J= 9.6, 13.8)	36.5
	β-CH_2	2.68 (m)	36.4			2.91	
		2.91			γ-C	—	128.3
	γ-CH	—	128.2		δ-CH	6.99 (d, J= 8.4)	130.5
	δ-CH	7.00 (d, J= 8.4)	130.5		ε-CH	6.60 (d, J= 8.4)	115.3
	ε-CH	6.63 (d, J= 8.4)	115.3		ζ-C	—	156.2
	ζ-CH	—	156.2	Ala[12]			
Ala[5]					C=O	—	172.5
	C=O		172.7		NH	7.90 (d, J= 6.6)	—
	NH	7.82 (d, J= 6.6)	—		α-CH	4.18	48.9
	α-CH	4.21 (m)	48.8		β-CH_3	1.14 (d, J= 6.6)	18.3
	β-CH_3	1.19 (d, J= 6.6	18.2	His[13]			
His[6]					C=O	—	171.8
	C=O	—	170.1		NH	8.13	—
	NH	8.23 (d, J= 11.2)	—		α-CH	4.60 (dd, J= 8.4, 13.8)	51.7
	α-CH	4.65 (dd, J= 7.8, 13.8)	51.8		β-CH_2	2.96	27.4
	β-CH_2	2.90	27.2			3.06	
		3.06			1'-C	—	129.6
	1'-C	—	129.6		2'-N	—	—
	2'-N	—			3'-CH	7.33 (s)	117.4
	3'-CH	7.29 (s)	117.3		4'-NH	—	—
	4'-NH	—			5'-CH	8.96 (s)	134.1
	5'-CH	8.94 (s)	134.0	Phe[14]			
Val[7]					C=O	—	173.0
	C=O	—	171.2		NH	8.20 (d, J= 7.8)	—
	NH	7.76 (d, J= 20.8)	—		α-CH	4.43	54.0
	α-CH	4.15	58.0		β-CH_2	2.91	37.0
	β-CH	1.94 (m)	31.1			3.04	
	γ-CH_3	0.80 (d, J= 7.2)	18.1		γ-CH	—	137.7
	γ'-CH_3	0.84 (d, J= 7.2)	19.6		δ-CH	7.25	128.7
Ala[8]					ε-CH	7.21	129.5
	C=O	—	171.0		ζ-CH	7.17	126.9

4.6. The bioassay of proliferative and migration effects of the peptide

4.6.1 The proliferative effect on Balb/c 3T3 cells of Periplapeptide A

The Balb/c 3T3 cells (ATCC, USA) were plated into a 96-well plate (3×10^3 per well) and incubated overnight at 37°C and 5% CO_2. The Balb/c 3T3 cells were adhered to the plate and 0.5% FBS were added. Then the serum starved for 24 hours. The peptide sample and Kangfuxin liquid were added to the wells for 48 h incubation. At the end of the incubation, 10 μL of MTT (5 mg/ml) was added to each well and the cells were further incubated for 1~4 h at 37 °C. Absorbance of each well was measured at 450 and 630 nm using a microplate reader. Experiments were repeated independently in triplicate (Fig. 24).

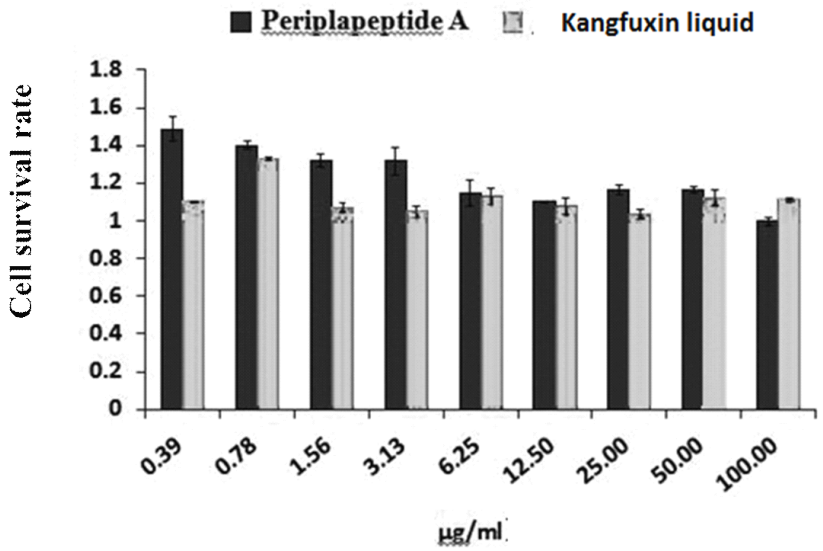


Fig. 22 The proliferative effect on Balb/c 3T3 of Periplapeptide A

The results (Fig. 22) of cell proliferation assay showed that the pure peptide had a significant proliferative effect on fibroblasts at low concentration (0.39~3.13 μg/mL), and its activity was stronger than that of Kangfuxin liquid.

4.6.2 The migration effect on HaCAT cells of Periplapeptide A

HaCAT cells ($1x10^6$/well) were plated into 12-well culture plate, and incubated at 37°C and 5% CO_2, which allowed cells to grow. The cells were wounded with a pipette tip to create a uniform cell-free zone in each well. Cellular debris was removed by PBS washing. Fresh medium supplemented or not with Periplapeptide A (1.56 μg/mL) was added. The migration

of wounded areas was photographed under the microscope every 12 h and the closure of the wounding areas were calculated with the Image Pro Plus 6.0 software. Thirty points were selected at the edge of scratched area, the midline of these points was used to represent scratched margin. Migration rate = [margin width (0 h) - margin width (12~72 h)]/ margin width (0 h).

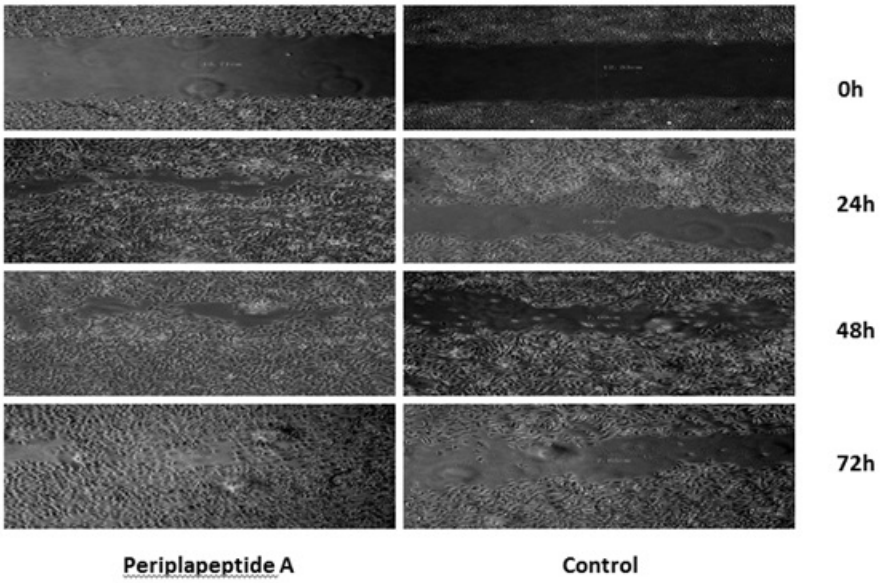


Fig. 23 The migration effect on HaCAT of Periplapeptide A

In the cell migration experiment (Fig. 23), the migration rate of the peptide group was higher (87 %) (72h) than control group (38 %) (72h), which indicated the peptide could promote the migration of epidermal cells.

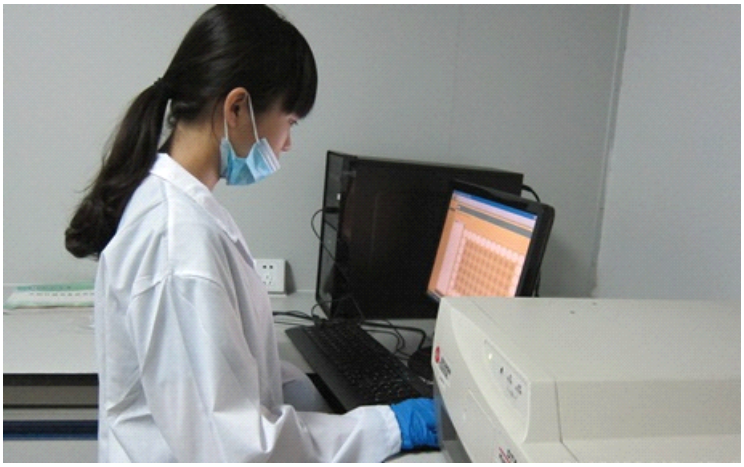


Fig. 24 Bioassay with fluorescence microplate

4.7. The effect of promoting the repair of skin injury

Forty male 8-10 week old Kunming mice (purchased from Guangdong provincial laboratory animal public service center) were caged individual with water and chow given

freely (Fig. 25). Intraperitoneal injection of 0.2 mL nembutal sodium (0.1%, w/w) in mice. Dorsal hairs were removed. Skins were rinsed by using alcohol, and then skin wounds (5 mm in diameter) were created on mice backs. Different concentration of Periplapeptide A, normal saline and Kangfuxin liquid was provided to mice separately. Wound closure was documented on days 3, 5 and 10 post-wounding (Fig. 26). The measurements were calculated by tracing the wound margin on a transparent film, then homogeneous piece of stiff paper was cut off to the same shape of transparent film. The weight of pieces of stiff paper was employed to represent the wound area. Wound closure rate was calculated as follows: Wound closure rate (%)=$[R_{(3\sim10)}-R_{(0)}]\times100$, where $R_{(0)}$ and $R_{(3\sim10)}$ denote the remaining wound area at the same day of operation and postoperative days 3,5, 10, respectively.

Table 2 The statistical result of wound healing in mice

Group		Animal number	healing rate		
			3 days	5 days	10 days
Periplapeptide A	0.1 mg/mL	10	30.21±3.36*	44.01±3.91*	75.15±7.52*
	0.2 mg/mL	10	36.11±3.66*	48.81±4.98*	86.01±8.90*
Kangfuxin fluid		10	26.22±3.38*	38.36±3.79*	69.72±5.80*
normal saline		10	20.23±3.09	31.98±3.56	60.95±5.29

Note: There was significant difference (*P＜0.05) compared to the model group

In animal model, the peptide can effectively promote the repair of skin injury, which has significant differences compared with the control group. Furthermore, the effect of pure peptide is better than Kangfuxin liquid.

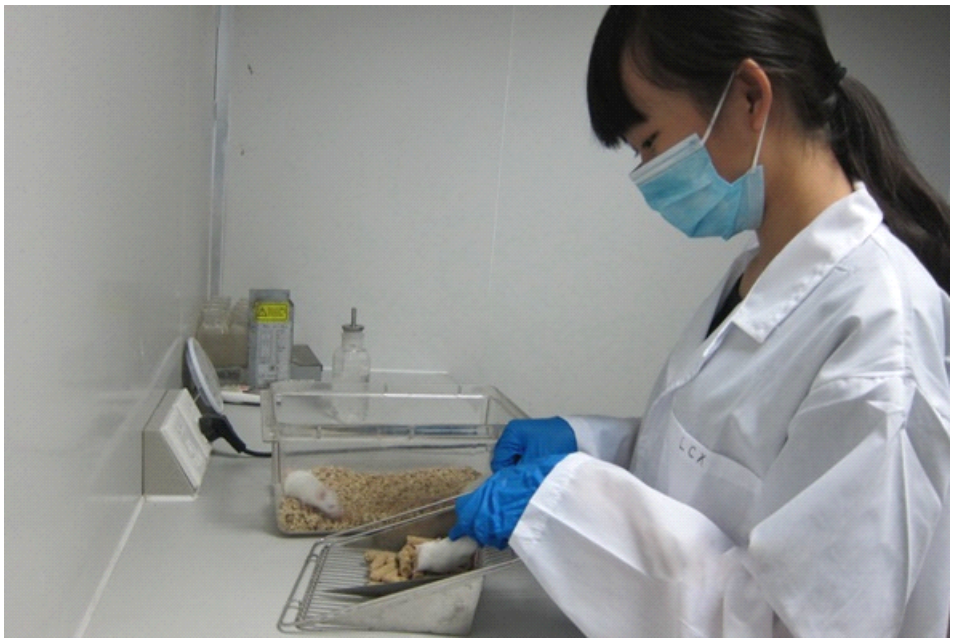


Fig. 25 Intraperitoneal injection of anaesthetized mice

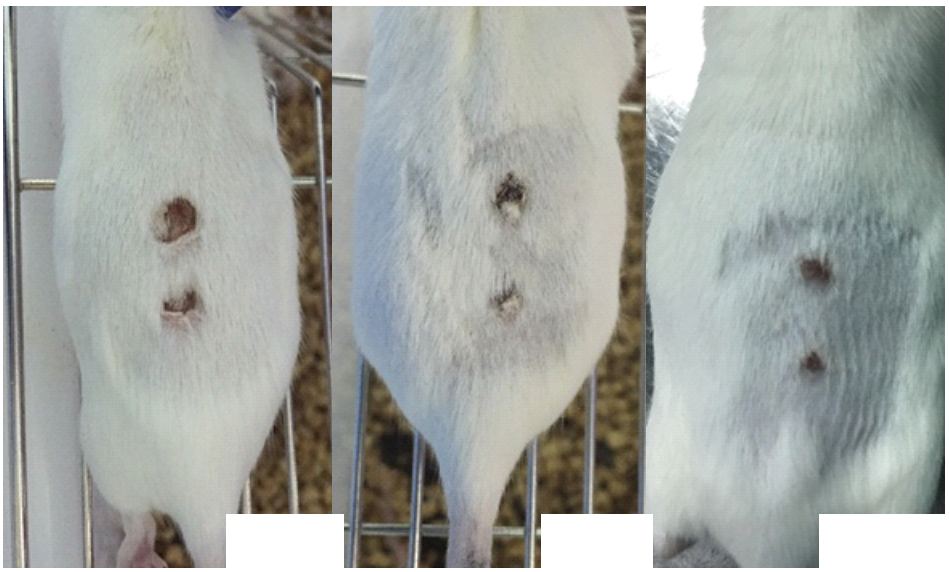


Fig. 26 Observation the wound healing in mice

5. Disccusion

Although Kangfuxin liquid is made from single medicinal material of *American cockroach*, the chemical constituents are very complex. In the experiments, the HPLC chromatograms of many fractions showed complex chromatographic peaks, which brought difficulties to our separation work. Fortunately, our separation was carried out under the guidance of activity tracing, which focus on the active ingredients and make the isolation procedure more effectively.

The total peptide of American cockroach contains so many compounds. This project has

found the main active one. Other peptides in trace amount will be explored in the future.

6. Summary and outlook

In summary, the main innovations of this project are as follows:

Firstly, the active component of *American cockroach* with skin repairing activity was studied for the first time.

Secondly, the isolated peptide was identified as a new peptide with 14 amino acids.

Lastly, the new peptide could promote cell proliferation and migration, and effectively promote the skin repair of mice. It is expected to be developed as a new drug to promote wound healing.

Meanwhile, I plan to explore more active peptides in the future. And whether the active peptide can become new drug deserves more experiments.

7. Gains and experiences

When I was young, I was very interested in medicine since I had read the story of penicillin discovered by Fleming. I dreamed of being a pharmacologist one day. After entering high school, my teacher Mr Xia taught me a lot of knowledge about scientific research and made chance for us to visit laboratories in universities and institutes. From these studies, I had a further understanding of scientific research, especially about chemistry and biochemistry. After seeing Kangfuxin liquid in the first time and puzzling about the cockroaches can be used as medicine, I throw myself into the research project and finally find the activity peptide. This memorable experience presented me with great happiness of science.

Since entered the laboratory, I found everything is novelty. I have a lot of things to learn such as the investigation of literatures and the operation of instruments. The research progress is very hard. Face to the repeated work and some uncertain results, I thought of giving up. But the teachers and graduate students is so meticulous and conscientious, which makes me a deeper understanding of the spirit of scientific research and experience. Their scientific spirit deeply touched me and also encouraged me.

I read a number of books on pharmacy and related disciplines, which expand my vision and let me have a preliminary understanding on natural medicinal chemistry. My chemical and biological basic experimental skills were also improved greatly.

After communication with my teachers, I have learned that traditional Chinese medicine contained complex and numerous chemical constituents. It was great significant to revealing the effective constituents and discovering new compounds. In addition, the natural medicinal chemistry research in our country has reached the world advanced level, and even is leading the world research direction. The research of this project has stimulated my endless passion for the research of natural medicine chemistry.

During nine months experiment, I have found a new peptide which is expected to be a promising candidate drug for skin repair. I realized the difficulty of scientific research and had a deep understanding on the spirit of scientific research, which will be a valuable asset in my life.

Acknowledgments:

Thanks for the help of Mr Tao Xia in the Affiliated High school of South China Normal University. Sincere thanks for the guidance and help of Dr. Lei Wang in the Institute of Traditional Chinese Medicine & Natural Products, Jinan University.

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如果有必要，最后可以列出团队成员和指导老师的简历。

Curriculum Vitae of contestant, Liao Caixing

I am Liao Caixing from senior two Chinese Chemistry Olympiad Specialty Class, the Affiliated High School of South China Normal University. I come from an intellectual family with great passion towards scientific research and I am never satisfied until I get to the bottom of the things. Determination, perseverance and diligence enable me to become a talented person. The love for biology and chemistry is something that runs in my family. It was in the eighth grade when I first started to prepare for a chemistry contest through studying knowledge related to Chinese Chemistry Olympiad competition as well as inorganic chemistry, analysis, physical chemistry and organic chemistry, which is only seen in college textbooks, on my own. Studying in the best school in Guangdong Province, I have formed good study habits, improved my ability to learn, and exceled at striking a balance between schooling and competitions. I not only rank top at school, but also have a great number of awards in national, provincial and municipal competitions. I won the third prize of Chinese Chemistry Olympiad for high school students in Guangdong as a ninth grade student. Later, I won the first second prize in Guangzhou Chemistry Competition and the second prize of Chinese Chemistry Olympiad for high school students in Guangdong during my first year in senior high school. I also won the silver awards of the Hope Cup for many times when I was in high school.

I strive for overall development. During my four-year study in the Affiliated High School of South China Normal University, I was chosen as the merit student and Star of Huafu, and won many awards in recreational and sports activities, such as the champion of badminton match and the third prize in a singing competition.

I contribute my own efforts to social welfare by actively serving as a volunteer and joining different school clubs There was a time when I worked as a volunteer to participate in Guangzhou Metro Volunteer service. Also, I once participated the “Conference on Lebanon-Israel conflicts” as a member of model UN. I spent time taking part in social practice activities every vacation, like Self-challenge Summer Camp in Qingyuan, Ecology

Research Summer Camp in rural areas of northern Guangdong, Scientific Investigation of Qinghai Lake by cycling (also known as Gangcha County Volunteer Actor for Common Good), and I can name but a few. I built up my strength and endurance by tacking all thorny problems and my ten-day cycling trip in Qinghai Lake deserves a mention because I cycled 70km per day and my science investigation report won the second place in the national essay competition and was published on the Yangcheng Evening News.

Over the years, I persisted in doing science and technology innovation practice. Since I entered junior high school, I have already carried out some scientific researches—water purification experiment research in Guangdong University of Technology, Pros and Cons of Waste Incineration Centralized Treatment in Panyu and Polygalacturonase Science Research series activities in the Affiliated High School of South China Normal University. In the course of different excursions, experiments and large project research, my innovative spirit and capacity to conduct scientific research have been honed. I won the first place in Guangdong Scientific and Technological Innovation Contest and the Scientific and Technological Innovation Award at my school with a project named Comparative Analysis about Different Fruits' Sensitivity to Ethene when I was in the eighth grade.

I have done many jobs for scientific research—reading reference, designing project proposals, preparing for experiment materials and writing papers and all of which bring both opportunities and challenges that I have never seen before. Even though it is not that easy to overcome barriers in various experiments and continue doing dull work for repetitive experiments, I stick it out because of my love for science. I enhanced my ability to do scientific research, acquired knowledge and skills which cannot be gained from textbooks and most importantly, I obtained valuable qualities, such as persistence, perseverance and creative spirit. All these successful results strengthen my faith to devote myself to science. I still want to do my best despite obstacles and confusion. Although scientific research is a long and arduous journey with numerous challenges, I will keep going forward with original impetus.

Curriculum Vitae of instructor, Xia Tao

Xia Tao, male, Han Chinese, was born on October, 24th, 1963.

Political affiliation: independent

Job: director of curricula and education, mainly responsible for managing course and teaching with an emphasis on routine teaching, graduating class management along with research study and scientific innovation education management.

Positional title: high school senior teacher

Educational background: master degree

Work experiences:

1 The head teacher of the first round of High school and Primary School Teachers' Studio

2 Employed as the "4+2" program tutor of graduate students majoring in education at South China Normal University

3 Director of Guangzhou High School Biology Teaching and Research Council, director of Guangdong Youth Scientific and Technological Education Associate and tutor of Guangdong Youth Scientific and Technological Tutor Group

4 Personal glory: master biology teacher in Guangdong, "Ten Best" excellent science teacher in China and the Earth Award winner.

Achievements:

I have been teaching biology earnestly and responsibly in the Affiliated High School of South China Normal University for 26 years after my graduation from the school of Life Science, South China Normal University. Great achievements in teaching and research fields were made following my proactive participation and leadership in the reform of teaching and curricula. I have served as the group leader of Senior three leading group at our school to encourage teachers responsible for graduation classes to cooperate and help senior students to prepare for the college entrance exam properly so as to bear satisfactory results. We are very proud that the key universities enrolment ratios of Class of 2014 and Class of 2015 were about 95%!

Meanwhile, along with other teachers in the biology office, I designed and implemented the course and syllabus for our school, developed an optional course named Getting Close to the Nature with a group of excellent young teachers and contributed to exploration in

education innovation through developing research topics, scientific and technological education innovation and taking charge of Green Across the Pacific, a biology summer camp between China and the United States for 16 years with an evident positive outcome.

Curriculum Vitae of instructor Wang Lei

Wang Lei, male, Han Chinese, was born in March, 1982.

Job: mainly engage in teaching and conducting scientific research regarding traditional Chinese medicine and natural medicine

Positional title: deputy researcher

Educational background: master degree and doctorate degree