A review of the use of bromelain in cardiovascular diseases

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Background: In 2004 an estimated 17.1 million people died from cardiovascular diseases (CVDs) worldwide, representing 29% of all global deaths. According to the American Heart Association, heart disease and stroke are the main cause of death and disability among people with type 2 diabetes. Additional safe and effective approaches are needed for the prevention and management of CVDs which may include nutritional supplements.

Objective: To identify the potential of bromelain (a food supplement) on the risk factors associated with CVDs.

Search strategy: An electronic and manual search was conducted during November 2009 to March 2010. The databases searched included: Ovid MEDLINE; All EBM Reviews — Cochrane Database of Systematic Reviews (Cochrane DSR), American College of Physicians (ACP) Journal Club, Database of Abstracts of Reviews of Effects (DARE), Cochrane Central Register of Controlled Trials (CCTR), Cochrane Methodology Register (CMR), Health Technology Assessment (HTA) and National Health Service Economic Evaluation Database (NHS EED); Allied and Complementary Medicine (AMED); British Nursing Index and Archive; EMBASE; Health Management Information Consortium (HMIC); ScienceDirect and Electronic Thesis Online Services (ETHOS). Only papers in the English language were included.

Inclusion criteria: Randomised controlled trials (RCTs), human studies, animal studies and experimental studies related to bromelain for CVDs.

Data extraction and analysis: The quality assessment of all the selected studies was conducted by the authors. Data from 3 animal trials and 3 human trials were included in the review. Data collected included; type of trial, drug dosage, duration, outcome measures, characteristics of bromelain used, significance of results and conclusion.

Results: Out of 223 papers retrieved, 6 papers met the inclusion criteria and could be included in the review. These comprised of 3 animal and 3 human trials, each of which investigated the
use of bromelain for CVDs. Results suggested that bromelain could be used for treating acute thrombophiebitis, as it decreases aggregation of blood platelets, has a cardio-protective effect, ameliorates rejection-induced arterial wall remodelling, prevents thrombin-induced human platelet aggregation as well as reduces thrombus formation.

**Conclusion:** No substantive study of bromelain and clinical CVDs has been carried out in human populations. Only a few studies on bromelain and CVDs were published from 1948 to 2010. This may be an area worthy to be explored in future CVDs research.

**Keywords:** cardiovascular diseases; bromelains; review

Cardiovascular diseases (CVDs) include disorders of the heart and blood vessels, coronary heart disease (heart attacks), cerebrovascular disease (stroke), raised blood pressure (hypertension), peripheral artery disease, rheumatic heart disease, congenital heart disease and heart failure. An estimated 17.1 million people died from CVDs in 2004, representing 29% of all global deaths. Of these deaths, an estimated 7.2 million were due to coronary heart disease and 5.7 million were due to stroke. By 2030, almost 23.6 million people are expected to die from CVDs, mainly from heart disease and stroke. These are projected to remain the single leading causes of death. In the UK, 79 out of every 100,000 people under 75 years old died from heart disease in 2006. According to the American Heart Association (AHA), heart disease and stroke are the main cause of death and disability among people with type 2 diabetes. At least 65% of people with diabetes die from heart disease or stroke.

The AHA recommends treating high blood pressure using angiotensin-converting enzyme inhibitors, diuretics, beta blockers, angiotensin-2 receptor antagonists and calcium channel blockers to control blood pressure in people with diabetes. Treatment is especially important for reducing the risk of heart attack, stroke and other complications such as retinopathy (damage to blood vessels in the retina) and nephropathy (damage to blood vessels in the kidneys). The risk of a recurrence or death from the survivors of a heart attack or stroke can be substantially lowered with a combination of drugs — statins to reduce cholesterol and aspirin to lower antiplatelet activity. Use of these drugs is common despite their adverse effects, for example, the increased risk of gastrointestinal bleeding and hemorrhagic stroke when taking aspirin and rhabdomyolysis when taking statins.

These drugs, despite their adverse effects and the potential for drug interactions for those individuals on multiple medication (prescribed for various comorbidities), remain among the most widely used for treating CVDs. In one study, administration of medication used to control the symptoms of diabetes, hypertension and hypercholesterolemia increased 121% from 1988-1994 to 2001-2006 ($P<0.05$) and was greater for patients with fewer healthy lifestyle habits.

The increased medication use was attributed to a decrease in adherence to healthy lifestyles such as a balanced diet, more exercise, maintaining a healthy body weight, not smoking, and moderate use of alcohol. This demonstrates the need for a safe and effective alternative management of CVDs, specifically among people who have diabetes, while the absence of any cure reinforces the importance of prevention. Prevention and management of CVDs can be partly addressed by nutrition.

Bromelain is a plant proteolytic enzyme (from the family Bromeliacea) that can be derived either from the pineapple fruit or from the stem. In 1957, Heinicke identified high concentrations of bromelain in pineapple stems and it was first introduced as a therapeutic compound that could suppurate wounds, and was used to treat people with extensive third-degree burns or had digested round worms. Many inhabitants in tropical countries use plant proteases, such as fig latex, papaya latex and pineapple juice to digest round worms. Bromelain has been shown to have distinct pharmacological properties. These include interfering with the growth of malignant cells, inhibition of platelet aggregation, fibrinolytic activity, anti-inflammatory action, and skin debridement properties, a protective effect on skeletal muscle during ischemia reperfusion and ameliorating hepatic microcirculation after warm ischemia. Its anti-inflammatory and analgesic properties may provide a safer alternative or adjunctive treatment for osteoarthritis. Currently, bromelain is used for acute inflammation and sports injuries. Bromelain is considered a food supplement and is freely available to the general public in health food stores and pharmacies in the USA and Europe.

Bromelain has been previously described as effective in the treatment of CVDs as an inhibitor of blood platelet aggregation minimizing the risk of arterial thrombosis and embolism. It has been suggested that the therapeutic effect of bromelain might be due to its stimulatory or inhibitory action upon the biosynthesis of endogenous prostaglandins. Bromelain acts on fibrinogen giving products that are similar, at least in effect, to those formed by plasmin. These are small molecular-weight active peptides, which regulate prostaglandin biosynthesis and create conditions existing in the healthy organism.
Bromelain has been used for a variety of clinical applications for more than 35 years[11]. However, only a few human and animal studies on CVDs have been carried out, despite preliminary results indicating that bromelain has useful phytomedical applications. In addition, these results have yet to be amalgamated and critically compared in order to support whether bromelain can gain wider acceptance as a phytomedical supplement[21]. In view of the potential valuable therapeutic properties of bromelain particularly in relation to the CVDs, a systematic review to identify all relevant research on the use of bromelain for CVDs was carried out. This article appraises and summarises the available evidence in the English language on the use of bromelain for CVDs to explore whether bromelain supplementation could reduce any of the risk factors that contribute to the development of CVDs.

1 Materials and methods

1.1 Criteria for considering studies for this review

1.1.1 Types of studies Randomised controlled trials (RCTs), human studies, animal studies and experimental studies were included irrespective of whether they were blinded, placebo-controlled, or controlled in vivo or in vitro. Methods of randomization that included computer-generated random numbers, drawing lots, tossing a coin or rolling a dice were included. The validity of these studies were appraised using a grading system as suggested by the JBI (Joanna Briggs Institute) systematic review criteria[21].

1.1.2 Types of participants Participants irrespective of gender or presence of CVDs or use of bromelain as food supplement were included. The studies were not restricted to humans. Any animal trials using bromelain in relation to CVDs were included.

1.1.3 Types of interventions Studies using bromelain, pineapple enzyme or proteolytic enzyme were included in this review. Bromelain interventions via intraperitoneal injection, intravenous injection or oral ingestion, in capsule, tablet, powder or liquid form were included. There was no limitation on the length of the intervention period.

1.1.4 Types of outcome measures The primary outcome measure was the effects of bromelain on CVDs including stroke and heart disease. Effects included changes in the platelet aggregation, degree of severity of inflammation, heart rate, aortic flow, infarct size, cardiac recovery and thrombus formation.

1.2 Search strategy for identification of studies

Literature searches were performed to explore the use of bromelain in CVDs. The search was conducted in the following databases: Ovid MEDLINE (R) 1948 to 1965; All EBM Reviews: Cochrane Database of Systematic Reviews (Cochrane DSR), American College of Physicians (ACP) Journal Club, Database of Abstracts of Reviews of Effects (DARE), Cochrane Central Register of Controlled Trials (CCRT), Cochrane Methodology Register (CMR), Health Technology Assessment (HTA) and National Health Service Economic Evaluation Database (NHSEED); Allied and Complementary Medicine (AMED) 1985 to March 2010; British Nursing Index and Archive 1985 to March 2010; EMBASE 1980 to March 2010; searches in Health Management Information Consortium (HMIC) from beginning to January 2010; searches in ScienceDirect and Electronic Thesis Online Services (ETHOS) were also conducted from November 2009 to March 2010.

Since Ovid offers the medical, scientific and academic communities customizable solutions of high-quality core and niche content which is fully integrated, a search by clicking on the name of each of the databases above was conducted. All the selected databases were related to the medicine, complementary medicine, health and health care databases. Ovid provides the best technology tools that enhance search precision and speed workflow. As well as Ovid, other databases including ScienceDirect and ETHOS were searched. This ensured increased coverage and maximised the number of studies located for the review. The search did not limit the year of publication to ensure all relevant papers were included.

Free text terms included: “cardiovascular”, “stroke”, “heart disease” and “pineapple enzyme” and each crossed with the term “bromelain”. Titles of all articles and abstracts were read and classified according to the study type: RCTs, human studies, animal studies, reviews, case reports, qualitative research and surveys. The reference list of the full articles was reviewed for further relevant articles which is a known effective means of ensuring that all relevant papers are included in reviews[20]. If an abstract was in English but the full article was in another language then only the abstract was included. Brief conference abstracts and unpublished studies were excluded as they have not been peer-reviewed.

1.3 Data extraction and analysis

Data collected included: type of trial, drug dosage, duration of the intervention, measurement, study outcomes, characteristics of bromelain, significance of results and conclusion. The quality assessments of the selected studies were carried out by three authors (CML, AT, NR).

2 Results

2.1 Characteristics of included studies A total of 220 papers were identified. An additional 5 papers were accepted into the review as a result of reviewing the references. A total of 223 papers
were retrieved for evaluation. Out of these 223 papers, 10 were excluded due to duplication. The majority of the papers were randomised or non-randomised controlled trials, in vivo or in vitro human studies, animal studies, reviews, reports and qualitative research on bromelain relating to treatment for other diseases like tumours, osteoarthritis, knee pain, digestive disorders, skin wounds, sinusitis, hepatic injury, anti-inflammatory, serum fibrinolytic activity and CVDs. After screening the 213 titles and rejecting abstracts not relevant to the selection criteria, the number of papers was reduced to 7. Reasons for exclusion are given in Figure 1. After excluding one paper in German, 6 papers remained comprising of 3 animal trials and 3 human trials using bromelain for CVDs based on the selection criteria (Figure 1).

2.2 Animal studies All 3 animal studies included used experimental rat models. They were randomised, placebo-controlled and in vivo and/or in vitro trials. Three animal studies investigated bromelain on bovine endothelial cells and thrombus formation in rat vessels in vivo; cardio protection against ischemia-reperfusion injury through Akt, forkhead box O (Akt/FOXO) pathway in rat myocardium; and allograft arteriosclerosis in rat aortic model. There was only one in vitro trial which investigated the action of bromelain on human platelet aggregation.

Two animal studies used bromelain containing a protease formulation and a proteolytic enzyme containing rutin, trypsin and bromelain, respectively. The third study by Metzig et al used crude bromelain or bromelain alone. Crude bromelain (0.3 to 0.4 U/mg) used in the study by Metzig et al was sponsored by Dr. J. Houck, Seattle, USA. Commercial bromelain tablets of EC 3. 4. 22. 32. Lot number 1965, and Vital Nutrients, Middletown, CT, at 2 400 to 2 600 gelatine digestive units/gm were used in the study by Juhasz et al. Phlogenzyme, a protease formulation with 2.5 mg trypsin, 4.59 mg bromelain and 5.1 mg rutosid was used in the study by Gacia et al. Bromelain was tested for authenticity, potency (2 400 to 2 600 gelatine digestive units/gm), microbial contamination, residual solvents, heavy metals and aflatoxin in Juhasz et al.’s study. The studies by Metzig et al and Gacia et al did not specify bromelain’s potency or the authenticity test. The non-standard preparations of bromelain used in these studies make it difficult to compare outcomes.

Oral dosages were generally very high when compared to the parenteral ones. The dosages were at 60 mg/kg body weight orally in comparison to 10 mg/kg body weight via intraperitoneal injection and 12 mg/kg via intraperitoneal injection. The dosage duration ranged from two injections per day for 15 consecutive days to 8 weeks of daily intraperitoneal injections.

Studies by Juhasz et al and Gacia et al were controlled trials comparing a placebo group with a bromelain treatment group. Metzig et al did not specify the sample size of the trial.

![Figure 1 Review flow diagram](image-url)
These animal studies measured aortic flow, infarct size, degree of apoptosis and Western blot analysis as indicators for cardio-protective effects, thrombus formation, human platelet aggregation and grafted structural change of aortic transplant.

2.3 Studies involved humans Four clinical trials involved humans[11, 22, 29, 30] were identified but only 3 articles were included for the review as one article was in German[29]. Studies were conducted in the 1970’s in Honolulu (Hawaii, USA) and Germany, respectively. There have been no further human clinical trials. Only one study used a double-blind and placebo-controlled design[30]. It is unclear whether the other two trials were randomised, placebo-controlled and parallel design or double-blind. In addition, most of the trial results lacked adequate statistical evaluation.

All 3 studies recruited patients who were hypertensive, with high platelet aggregation values, with a history of heart attack or stroke and hospitalization for acute thrombophlebitis[12, 22, 30]. Patients were informed of the purpose of the test and possible risks involved, and participated voluntarily in the study.

To determine to what extent increasing dose of bromelain affected the blood pressure and heart rate of humans, 19 patients with hypertension (a mean blood pressure of 189/98 mmHg and mean age at 61.5 years old) were recruited[22]. The study of Seligman[30] evaluated the effectiveness of bromelain as an adjunct in the treatment of acute thrombophlebitis and recruited 73 patients with thrombophlebitis. Patients were divided into two groups. One group of 37 patients (24 women and 13 men, ages 29 to 66) were given an anase “100” tablet and the other group of 36 patients (22 women and 14 men, ages 25 to 70) were provided with a placebo tablet. No sample size calculations were evident for Heinicke et al’s study[31]. Patients with a history of heart attack or stroke or patients with a high aggregation value and healthy subjects were recruited into this study. The high aggregation value was based on their previous study where the platelet aggregation value for “normal” individuals ranged from 8 to 13, therefore those patients with values higher than 13 were grouped as having high aggregation values.

The total number of samples available from the human studies was from 92 male and female patients aged between 25 to 73 years old. This analysis did not include the study on platelet aggregation as there was no information on the sample size required for those patients with high aggregation values[12, 30]. Two of the 3 studies determined the effect of enteric-coated bromelain, orally ingested by volunteers on the sensitivity of patients of platelets to adenosine diphosphate (ADP)-reduced aggregation[12] and as an adjunct in the treatment of acute thrombophlebitis patients[30].

Ananase ‘100’ tablets from William H. Rorer Co., Fort Washington, (2 tablets/160 to 1,000 mg/d) were used for both studies[12, 30]. However, the specific amount of protease activity was not stated. In Gutfreund et al’s study[22], the dosage commenced with 1 capsule or 2 capsules, then increased to 8 capsules maximum to determine to what extent increasing the dose of bromelain affected the blood pressure and heart rate of humans. Each capsule contained 230 mg of bromelain of 1,200 GDU (gelatine digestion units) per gram as the active ingredient.

The duration of the different dosages of bromelain varied among the studies. The range was 2 h to 8 d for two of the studies[12, 30] and one dose a day and at least 24 h before the next dose in the third study[22].

3 Discussion

Bromelain was introduced as a therapeutic compound in 1957[32]. This is the first review on bromelain and CVDs despite the fact that the potential therapeutic effect of bromelain is indicated, both in in vitro and in vivo studies, with possible anti-oedematous, anti-inflammatory, antithrombotic and fibrinolytic activities[33]. The present review included 3 animal studies and 3 human studies on the use of bromelain in relation to CVDs particularly to cardio protection against ischemia-reperfusion, human platelet aggregation, thrombus formation, allograft arteriosclerosis, blood pressure, heart rate and acute thrombophlebitis.

Both animal and human studies were conducted using different methodologies in terms of type of trial, different forms of bromelain, dosage, dose duration and measurement. Most of the animal studies were placebo-controlled trials with various measures such as aortic flow, infarct size, degree of apoptosis, Western blot analysis, platelet thrombus formation, platelet aggregation and grafted structured changes. Conversely, human studies have focused on patients with hypertension, history of stroke or heart attack, high platelet aggregation value (greater than 13) and thrombophlebitis, platelet aggregation patterns and the degree of severity of inflammation, pain, oedema and redness.

Studies on the effect of bromelain on cardiovascular systems in animal experiments have produced a greater degree of significance compared with human trials. The cardio-protective effects were demonstrated in that bromelain treatment showed higher left ventricular functional recovery throughout reperfusion compared with the control (max rate of rise in intraventricular pressure 2,225 vs 1,578 mmHg/s at 2 h reperfusion), an increased aortic flow in bromelain treatment when compared to that in untreated rats (11 vs 1 mL), a reduction of infarct size (34% vs 43%)
and degree of apoptosis (28% vs 37%) compared with the control and an increased phosphorylation of both Akt and FOXO3A in the treatment group compared with the control. These significant results of the animal trials were summarized in Juhasz et al.’s study. These animal studies concluded that bromelain demonstrated a reduction of thrombus formation, prevention of thrombin-induced human platelet aggregation, cardioprotective effect and amelioration of reperfusion-induced arterial wall remodelling. However, animal testing may not be generalised to humans.

The 3 human trials suggested only that bromelain could reduce high platelet aggregation in patients with myocardial infarction. In addition, oral bromelain appeared safe when given orally and alongside usual medication for the treatment of acute thrombophlebitis. These results were demonstrated with less prominence than in the animal trials. However, human studies identified in this review have important clinical implications as they suggested that there were no adverse effects reported. One human trial suggested that there were no side effects when reported along with the usual medication in the treatment of acute thrombophlebitis for 73 patients. Oral bromelain was stated as being safe when the dosage increased up to 8 times of the maximum recommended. Heart rate increased proportionately with the amount administered and blood pressure remained unchanged. In addition, clinical use of bromelain over a period of more than 10 years has suggested that there have been no reports of significant side effects. Nevertheless, it is still premature to consider that these results provide evidence of the effect of bromelain on CVDs. Heinicke et al. have suggested that bromelain seemed to be worthy of testing as a potential for long term maintenance for individuals who have problems with enhanced platelet aggregation rates.

Animal studies have been conducted more recently compared with human studies. Animal models in the laboratory environment are more easily controlled and experiments can be standardized. Human studies were carried out between 1969 and 1978, prior to more rigorous study designs. The Cochrane Collaboration and systematic literature reviewing procedures described in the JBI protocol ensures that blinding, placebo-controlled and parallel or cross-over design and clearly defined primary and secondary endpoints are critical inclusion criteria for trials.

The studies included in this review were conducted in Western countries including two human studies in Honolulu, Hawaii, USA, one human study in Ohio, USA, two animal studies in Germany and one animal study in India, Japan and Hungary. There have been no clinical trials carried out in the UK or Asia.

The human study of Heinicke et al. did not clearly specify the number of subjects but reported that volunteers with high aggregation values and several patients who had myocardial infarction or stroke were included in the trial. There was no information on the ethnic groups studied. Platelet aggregation was reported as being reduced but data were not presented. In addition, the exact value of the protease activity of the bromelain tablet used was not reported. Similarly the oral administration of 160 to 1 000 mg/d did not specify whether it was a dose-dependent administration. There was also inadequate information in Gutfreund et al.’s study. A bromelain dosage of up to 8 times of the tested dose was suggested as the maximum but was not clearly specified. The small sample size of 19 patients is also a limitation of this study. Although the study of Seligman et al. involved a larger sample of 73 subjects and was a double-blind and placebo-controlled trial, there were no inclusion and exclusion criteria for recruitment of subjects. Clear and structured study designs with specified inclusion and exclusion criteria, double blinding and randomisation of placebo controls were not used in any of these human studies.

The small number of animal and human trials identified and appraised in this review demonstrated that these trials were inadequately powered studies. Trials had poor study design and lacked verification of double blinding without inclusion and exclusion criteria and had unclear details of the intervention. In addition, the trials were carried out either in Germany or Hawaii (USA) which may not be representative of those with CVDs. It is important to include populations from different cultural backgrounds in order to investigate the effect of bromelain on CVDs.

This review was conducted on literature published between 1948 and 2010, and suggests that there is a gap in the evidence base on bromelain and CVD as few trials have been conducted. It also demonstrates the decline of research trials on bromelain. Public research does not always meet private needs for the pineapple industry and its development. The therapeutic benefit of bromelain is worthy of further investigation.

4 Limitations of this review

This review has explored only the few human and animal studies which makes it difficult to adequately review and assess the issues around study quality, nor does it allow adequate synthesis of the available information. The animal and human studies included in this review are heterogeneous in their approach in terms of study design, intervention, dosage, duration of treatment, type of control and type of outcome measurement. A meta-analysis was therefore inappropriate as it was difficult to appraise, compare and summarise
the use of bromelain in CVDs, due to the heterogeneous nature of the studies. Only English papers were selected which may bias the review.

5 Conclusion

In conclusion, there are no substantive studies of bromelain and clinical CVDs carried out in human populations and results are inconclusive regarding the effects of bromelain on CVDs. However, it could be a useful avenue to explore the use of bromelain in relation to CVDs since bromelain may decrease aggregation of blood platelets and could be used in the treatment of acute thrombophlebitis, may have a cardio-protective effect, and could ameliorate rejection-induced arterial wall in remodelling. Bromelain may also have other uses such as treating ischemia-reperfusion injury, preventing thrombin-induced human platelet aggregation and reducing thrombus formation.

Therefore, it is important that future trials should be carried out using randomised, placebo-controlled, parallel designs with a standard intervention program which are sufficiently double-blinded and have specified inclusion and exclusion criteria.

6 Acknowledgements

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7 Competing interests

There is no competing interest for this review.

REFERENCES

菠萝蛋白酶治疗心血管疾病的系统综述

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背景: 在2004年，全球估计有1710万人死于心血管疾病。根据美国心脏病协会的数据，心脏病与中风是2型糖尿病患者的首要死因及致残因素。寻找更多适合的、有效的治疗方案对于该疾病预防和治疗十分必要。营养补充品是可行方案之一。

目的: 探讨菠萝蛋白酶（一种食品补充品）对心血管疾病的预防和治疗作用。

检索策略: 2009年9月至2010年3月进行电子与手工检索。检索的数据库包括Ovid MEDLINE；All EBM Reviews—Cochrane Database of Systematic Reviews（Cochrane DSR）、American College of Physicians（ACP）Journal Club, Database of Abstracts of Reviews of Effects（DARE）、Cochrane Central Register of Controlled Trials（CCTR）、Cochrane Methodology Register（CMR）、Health Technology Assessment（HTA）和National Health Service Economic Evaluation Database（NHSEED）；Allied and Complementary Medicine（AMED），British Nursing Index and Archive, EMBASE, Health Management Information Consortium（HMIC）、ScienceDirect和Electronic Thesis Online Services（ETHOS）。检索语言限定为英文。

纳入标准: 有关菠萝蛋白酶用于预防或治疗心血管疾病的随机对照试验、人体研究、动物研究与实验性研究。
资料提取与分析：3位作者分别对检索到的文章进行文献质量评估并提取文献资料。所收集的资料包括实验种类、用药剂量、治疗周期、测量指标、研究结果、菠萝蛋白酶的特征、结果的意义与研究结论。

结果：在检索到的223篇文章中，只有6篇文章符合纳入标准。包括3项动物实验和3项人体试验。菠萝蛋白酶可用来治疗急性血栓性静脉炎，因为它可减少血液中的纤维蛋白原含量，降低血小板聚集度，有保护心脏的作用，并能够改善动脉壁的结构，避免凝血酶所诱发的血小板聚集，减少血栓的形成。

结论：迄今为止，没有菠萝蛋白酶用于心血管疾病治疗的高质量的人体研究。在1948年至2010年间所发表的有关菠萝蛋白酶与心血管疾病的研究的数量极为有限。在未来的心血管疾病研究中这可能是一个值得探索的领域。

关键词：心血管疾病；菠萝蛋白酶类；综述

2011 全国时间生物医学学术会议征文通知

由中国中西医结合学会时间生物医学专业委员会主办，苏州大学承办、山东省医学科学院山东省抗衰老研究中心协办的“2011全国时间生物医学学术会议”将于2011年9月中旬在广东省中山市召开。现将有关会议事宜通知如下。

会议时间 2011年9月15～18日，会期4天。

会议地址 广州温德姆酒店（广州市越秀区环市东路238号）。

会议内容 （1）学术交流：①现代时间生物医学研究方法与技术、生物节律基因控制、时间生理、时间药理、时间毒理、时间治疗、时间护理、时间营养、睡眠、时差及轮班不适应症的防治等相关研究；②中医时间医学与时间针灸，包括脏腑经络气血生理节律、疾病病理节律、疾病时间治疗、时间养生保健、传统时间药理等研究；③国内外时间生物学著名专家作有关时间生物学研究进展学术报告；④时间生物医学专业委员会换届；（4）成立时间生物医学青年委员会。

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