

# 中國預防醫學實況

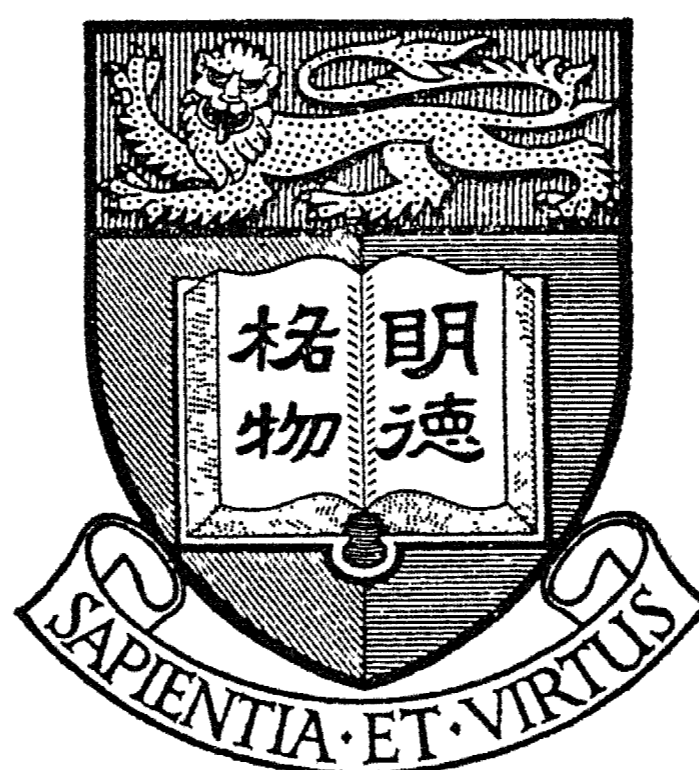


香港大學微生物學系

香港營養學會

一九八七年九月十二日第三屆研討會

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中國預防醫學實況  
**Preventive Medicine in China**  
營養與食物衛生  
**Nutrition and Food Hygiene**



香港大學  
微生物學系  
Department of Microbiology  
University of Hong Kong

一九八七年九月十二日第三屆研討會  
(The Third Symposium, 12th September 1987)

# Foreword

This is the third in a series of Symposia on Preventive Medicine in China. It is especially significant that this Symposium should co-inside with the occasion when we celebrate the Centenary of the Faculty of Medicine of the University of Hong Kong. It is significant, because the symposia serve to remind us of the close and long standing tie between this Faculty and the medical profession in China.

The purpose of the symposia is to review the health care system which has evolved over the period of our association, which because of the different circumstances, is different from the health care system we developed over the years in Hong Kong. The preceding symposia highlighted three major effort in the recent medical history in China, i.e., in combating parasitic diseases, and cancers and in industrial and environmental health programmes. This symposium addresses another important health issue, i.e., nutrition and food hygiene. Together, I believe the symposia have given us an overview of the health care system operating in China today, its achievements and the challenges it faces today. This in turn, I believe, will lead to an even closer tie and collaboration between the health professions in Hong Kong and China.

The conduct of this symposium differs from the previous occasions. Firstly, it is jointly organized between the Hong Kong Nutrition Association and the Department of Microbiology, University of Hong Kong. This I believe is appropriate, for, in doing so, the symposium enjoys the professional input from the appropriate sector of our healthy community. Secondly, the symposium is conducted in English rather than Putonghua as before. This choice of language is, I believe, appropriate for this occasion when there is a large international

gathering for the celebration of the Centenary of the Faculty of Medicine of the University of Hong Kong. Thirdly, the texts of the lectures are published as a monograph in Chinese together with an English translation, both of which being provided by the authors.

## 序

黃煥滔醫生

今年的第三屆中國預防醫學研討會，適逢本校百週年盛會，更顯得有意義和有紀念性。過去我們已經將中國預防醫學科學院轄下的研究所在近三十年來的整體工作情況及所得的成果，原原本本地介紹出來，特別是在寄生蟲病的預防工作，非常成功，很值得世界各國借鏡。去年本會以「癌症及工業衛生」為主題，而今年又以「營養與食物衛生」為主題，作專業性的研討。相信已經達到了原來要介紹中國預防醫學情況的目的。經過三年的相互交流，深信本校與中國預防醫學科學院建立了良好關係。藉此，可促進香港和中國兩地對健康關切的團體，衷誠合作。

今年所選的題目，香港營養學會甚感興趣，與我們不謀而合，願意攜手合作主持這次會議極表歡迎。

本刊自從一九八五年的第一屆至今年已進入第三屆，每年都有些改善。今屆最顯著的不同點是用中英文版本同時刊出。希望能將本刊的珍貴資料更有效的介紹到世界各處，特別是不懂華語的中外社會團體。過往這個研討會是用普通話作為大會語言。一方面便利嘉賓用母語，另一方面使我們同學多學普通話，因為前兩次的研討會都是由我們醫學院的同學主持大會儀式的。今年因為香港營養學會的要求，改用英語。陳春明教授亦同意了。不過本刊所登載的一切內容，皆以中文為主，故在此鄭重聲明。

## Official Opening

Professor J. C. Y. Leong  
Dean, Faculty of Medicine  
Professor M. H. Ng, Professor Chen Chun Ming,  
Colleagues, Ladies and Gentlemen,

This is the third successive combined seminar between the Chinese Academy of Preventive Medicine and the Department of Microbiology, University of Hong Kong. It is standing proof of the success of such academic exchanges, which are blossoming in many other fields as well in the Faculty of Medicine of our University. In this year's seminar, we have the added privilege of the Hong Kong Nutrition Association as a co-organizer.

The theme chosen, on nutrition and food hygiene, promises to be an interesting and refreshing one. All of us are eagerly waiting to hear how a vast country like China, with a population of over 1 billion people tackles such medico-social problems as food safety control. We are well aware that China has taken great strides in modernization, but hand in hand with advances in industry and a surging economy, the nutritional status of its people, both young and old, must also command an important position in her list of priorities.

In Hong Kong, I dare say that attention towards nutrition of the population as a whole has not been overwhelming, although I await to hear what Miss Bateson has to say, and I stand to be corrected if necessary. This sort of seminar may well serve as an impetus for more public and government awareness of the issue. In Hong Kong, in the last several decades, we have seen a gradual change of a conventional Chinese diet

to a mixed western and Chinese diet in most families. In recent years, the lifestyle of the majority of people of Hong Kong, whether workwise or social, is set at a very hectic pace. People enjoy food and, in my opinion, tend to over indulge. These social and nutritional trends are likely to create problems that are quite different from those of China, and will certainly make an interesting study.

Professor Chen and her team of distinguished workers of the Chinese Academy of Preventive Medicine are now well-known in Hong Kong. I myself have had the pleasure of being invited to visit their Academy in 1985, together with Professors R. T. T. Young and M. H. Ng, and obtained first hand knowledge of the excellent work that is being carried out in the Academy. It is a pleasure to meet them again in Hong Kong.

On behalf of the Faculty of Medicine of the University of Hong Kong, may I thank Professor Chen and her co-workers for coming all the way to Hong Kong to participate in this Symposium, and I would like to extend a tremendous welcome to them. It is also most appropriate and meaningful that this Symposium is taking place during the Celebrations of the Centenary of the Faculty of Medicine of our University. May I formally declare this Symposium to be opened.

## 開幕詞

黃煥滔譯

這是第三屆由中國預防醫學科學院及香港大學微生物學系聯合舉辦的研討會。又一次證明成功的學術交流，正如本醫學院其他各學系的學術會議一樣，互相輝映，相得益彰。今年的研討會，特別歡迎香港營養學會成員共同參與工作。

今次以營養和食物衛生為主題，肯定是非常吸引而富有新鮮感。相信大家都很想知道在一個超過十億人口的龐大國家中的醫療社會問題，特別是與國民健康有密切關係的食公的安全措施，究竟是如何去處理的。近年來大家都知道中國已盡力在各方面推行現代化。比較明顯的是在工業上的發展，務求得到經濟上的收益，我們深信，在國內無論男女老幼的營養問題亦會同樣被優先考慮。

今日我相信大部份的香港人都得到充分的營養。或者這個問題需要等待柏遜小姐給我確實的回覆，如果我猜錯了，我願意去更正。其實這類研討會應該廣泛地推行到各市民團體去，同時希望政府亦留意到這些與國民健康有密切關係的問題。本港在過去幾十年間，可以見到一般家庭的飲食習慣，由傳統式的中國飲食，漸漸轉變為中西混合式的飲食習慣。尤其近年來，大部份香港人的生活方式，無論是工作或社交都非常放縱，特別在飲食方面，趨於過量。此等風氣，勢必造成種種的社會和健康問題。這些風氣似乎與中國國內的人有些分別，是一個非常難得研究的問題。

陳教授和她屬下的中國預防醫學科學院的傑出成員，相信早已為香港人所熟識。本人很榮幸曾在一九八五年與楊紫芝教授及吳文翰教授一起被邀請往北京參觀中國預防醫學科學院各研究所，並可直接瞭解他們的工作情況。這次很高興能夠在這裡再見到您們。

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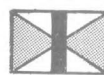
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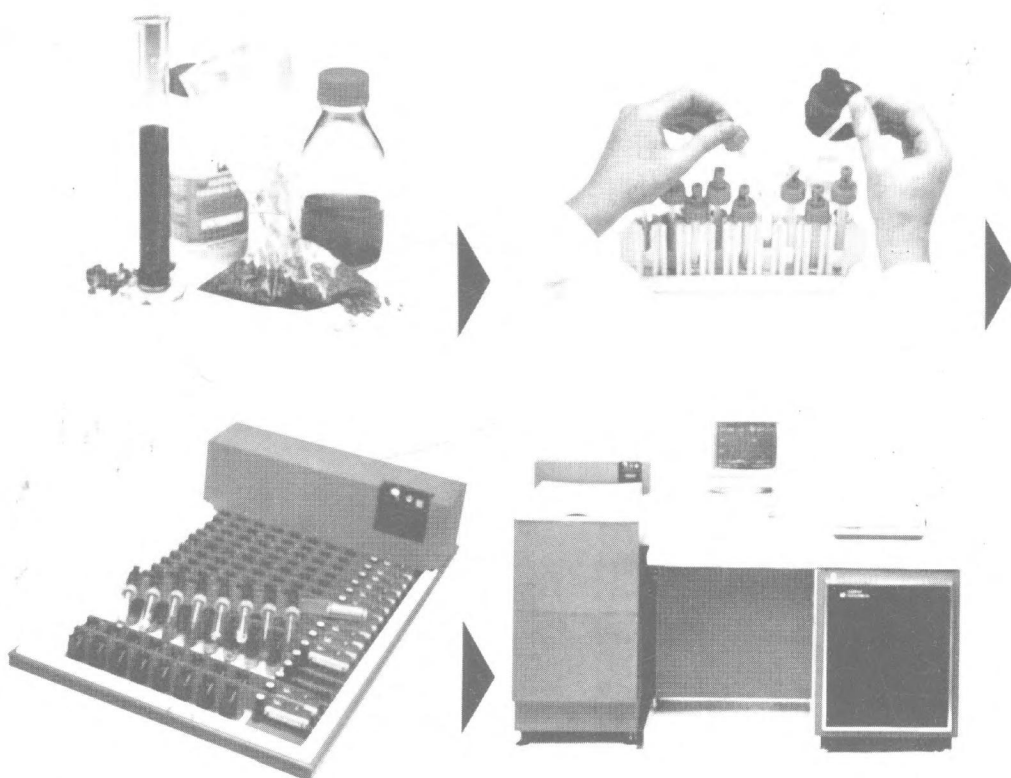
## 自動化分析儀器 不停監察微生物

英國一家公司為食品加工業、水務當局和研究機關設計了一套自動化的微生物分析器，能夠大量減省物料進行微生物滋長的時間，從而節省成本。用一般方法試驗沙門杆菌需時四至七天，但用這套分析器特有的沙門杆菌新式篩濾法可減至十四至三十小時。

它不僅有助於提高製造業的效率，也能降低微生物實驗室在材料和人力兩方面的成本。這系統可同時進行 256 項實驗，它會使到多種試驗程序自動進行而且縮短所需時間，這些試驗包括了沙門杆菌、全生物活動、大腸杆菌、衛生和消毒試驗。

這套電腦基儀器設計到可供廿四小時不停地自動分析。樣本都不需要特別預備，但可以應用不透明液體或懸膠體。由於它採用了模件組合設計，所以一套可處理 32 個樣本的最小型組合可隨着工作量增加而擴大至處理 256 個樣本。

它很容易操作，所有試驗結果都用清楚明確的方法顯示。它的軟件包括了全部常規的實驗室簿記、識別樣本、圖表和數據顯示。它會隨時分析個別或整批的樣本。樣本一旦放在儀器裏面，後者便會自動和不斷地監察生長狀況。在整個試驗期裏，每個樣本的狀況都可以隨時查找。通常任某一個工作天內探查細菌生長的時間會直接關係到微有機體的原密集程度，有機體越多，探查便越快。



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## 香港營養學會代表致詞

陳惠卿 呂秀嫻

本人很高興能代表香港營養學會參加今日的“營養與食物衛生”研討會。本會成立的日子不算太長，但能夠有機會與香港大學微生物學系合辦這個研討會，並邀請到中國預防醫學科學院代表作主講嘉賓，感到非常榮幸。本會更希望將來有機會與其他機構合作，舉辦更多同類型的活動。

本會成立於一九八零年，成員主要為專業營養師和營養學家，他們來自本港各公營和私人機構。本會的宗旨，可分為三方面：

第一、為一般市民提供營養學的教育，務求使市民注意營養及健康。

第二、深入研究並改善本港的醫療飲食常規，及收集有關香港的營養學資料。

第三、提供一個完善的網絡，以加強營養師和營養學家的溝通和聯繫。

本會並致力出版了一系列的營養學小冊子，介紹不同年齡的飲食指引，由嬰兒至老年人都有提及到。最近香港電台電視部製作了一輯健康飲食指南，由本會擔任顧問。

香港的營養問題，主要為進食過量，特別是脂肪及鹽，這與不少疾病有關，包括肥胖、糖尿、高血壓、冠心病等。我們相信只要香港人注意食物營養及衛生，即使保留原有飲食習慣，仍然可以得到更健康的飲食。

今天我們能藉這個機會與中國預防醫學科學院專業人士交流知識，是難得的經驗。在此我僅代表香港營養學會多謝各位光臨，並感謝香港大學邀請我們一起參與舉辦這個研討會，希望能提高大家瞭解營養與食物衛生對身體健康的重要性。

## Introductory Remarks

Ms. Deborah Bateson  
Hong Kong Nutrition Association  
Professor M. H. Ng, Professor J. C. Y. Leong, Professor  
Chen Chun Ming,  
Colleagues, Ladies and Gentlemen.

I am very happy to be representing the Hong Kong Nutrition Association at today's seminar on the theme of Nutrition and Food Hygiene. As our Association is still quite young, we are especially pleased to have this opportunity to forge links with both the Department of Microbiology at the University of Hong Kong as co-organisers of the seminar, and with our guests from the Chinese Academy of Preventive Medicine. We of course look forward to many more collaborative activities in the future.

The Hong Kong Nutrition Association was formally established in 1980 and its membership is drawn from professional dietitians and nutritionists working in both the public and private sectors. Our aims can be divided into three broad categories: firstly, to promote a better understanding of sound nutrition amongst the Hong Kong public; secondly, to study and improve therapeutic dietetics and collect information relating to nutrition in Hong Kong; and thirdly, to provide a network system for the exchange of professional knowledge and expertise between dietitians and nutritionists.

We are involved in publishing a wide range of booklets containing locally appropriate guidelines for all stages of life from infant feeding through to nutrition for the elderly, and have recently completed a role as advisors to RTHK's series of 17 television broadcasts on the theme of 'Food and Health'. As the Association grows in size and experience, so our success at reaching the Hong Kong public increases.

Hong Kong's nutrition problems are of course mainly those of over-consumption, especially of fats and salts which are associated with conditions and diseases such as obesity, hypertension, diabetes, coronary heart disease and others. We feel confident however, that Hong Kong people can make the transition to a healthier diet yet still maintain a traditional enjoyment of social eating.

We are very privileged today in having this chance to learn about the very different experiences of fellow professionals working in the areas of nutrition and food hygiene in China. I am certain that a lively discussion will ensue after presentation of the papers, and I will close my introduction by thanking our guests once more on behalf of the Hong Kong Nutrition Association for joining us here in Hong Kong, and the University of Hong Kong for inviting us to act as co-organisers of today's seminar which acknowledges the increasingly important role played by nutrition and food hygiene in the promotion of a healthy lifestyle.

## 鳴謝

黃煥滔醫生

適逢本校百週年校慶紀念，本研討會倍添光彩。今年得到百週年紀念大會主席莫志強教授的鼓勵及該會的經濟支持，本會才能繼續舉行。這次很榮幸請到本校醫學院院長梁智仁教授光臨本會主持開幕典禮，使本會增添不少莊嚴的氣氛。

更值得高興的是今年請到中國預防醫學科學院院長陳春明教授及幾位營養專家蒞臨本校，參加這次以‘營養和食物衛生’為主題的研討會。本人僅代表大會同寅表示極之歡迎及萬二分感謝。陳院長是第一次來港，過去兩次都因事不克。這次能撥冗光臨，一定使大會生色不少。

今年的研討會，一如過往，有賴校方及各界人士鼎力支持，得以順利進行。本會同寅謹向各位支持致萬分謝忱。最後對承印公司的馮志和先生幾年來之衷誠合作，每次都能在非常短暫的時間內，完成一切印刷及訂裝事宜，使本刊能如期出版，故特此致謝。

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## Acknowledgement

Dr. W. T. Wong

The organizing committee is grateful to the delegation of distinguished nutritionists and food hygienists from the Chinese Academy of Preventive Medicine. The delegation is led by the current President of the Academy, who is the foremost nutritionist in China today.

The committee wishes also to thank the Dean of the Faculty of Medicine, University of Hong Kong, Prof. J. C. Y. Leong, for presiding on the symposium.

It gratefully acknowledges the support of the Chairman of the Centennial Celebration Committee, Prof. C. K. Mok and the financial contributions to this symposium from various donors.

We wish to thank our publisher, Mr. Louis Fung for his co-operation in the publication of this and preceding monographs.

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# 我國人民的營養狀況

陳春明教授  
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新中國成立以後，政府對促進人民營養的工作給予了重視，在五十年代就開始了食物營養成份研究，出版了《食物成份表》，它包括我國各類食物的營養成份的含量，如蛋白質、脂肪、礦物質、維生素、氨基酸、膽固醇等，成爲我國使用最廣泛的一本營養學工具書。建國初期，根據糧食政策的需要，我們開展了糧食碾磨精度的研究，提出了米的碾軋程度爲 92%，麥面粉爲 80%，在當時的條件下，既節約了糧食，又保證人民的營養需要。以後在實驗室研究的基礎上，開展人群營養工作，如對建築工人、高溫作業工人、有害作業工人、礦山工人等的營養狀況進行了研究，並就改善他們的營養狀況及補充其特殊營養需要提出了建議。我們在嬰幼兒營養研究有較長的歷史，系統地研究了一種豆代乳粉（5410 配方），通過動物試驗，嬰兒代謝試驗及 50 對雙生嬰兒喂養對比試驗，證明以這種配方喂養嬰兒，其生長發育效果可以與喂牛乳者媲美。六十年代後期，我們開始了克山病的研究，證實了微量元素硒與克山病的發病有關，並採用大規模補充實驗說明用硒可以預防急性克山病，對該病的控制做出了較大貢獻。與此同時，我們對人體硒中毒也進行了研究，這些工作博得了國際營養學家的高度評價。

以上是我國營養研究工作的歷史簡明概括，本文只就我國人民膳食特點，營養狀況及改善措施作介紹。

## 一、我國人民膳食的特點

中國是一個人口最多但食物資源並不豐富的國家，我國政府十分關懷人民的溫飽，我們曾經開展過兩次全國營養調查。第一次在 1959 年，適逢三年嚴

表一、 城鄉居民平均攝入量（克/人/日/）

（1982年全國調查）

	城市居民	農村居民	平均
谷類	456	554	512
根莖類	62	230	160
豆類及其製品	15	14	15
蔬菜	352	338	309
	12	14	13
水果	69	24	27
牛乳	10	7	8
蛋類	15	4	9
肉禽類	63	23	39
魚蝦類	21	6	11
動物油脂	5	6	6
植物油	21	9	11
鹽	11	17	13

表二、 城鄉居民各類營養素  
平均每人每日攝入量

	城市居民	農村居民	平均
熱能（千卡）	2446	2615	2485
蛋白質（克）	67	69	67
脂肪（克）	68	41	49
鈣（毫克）	561	557	540
鐵（毫克）	34	51	43
維生素A（視黃醇當量）	538	784	656
硫胺素（毫克）	2.2	2.5	2.3
核黃素（毫克）	0.8	0.8	0.8
尼克酸（毫克）	17.9	18.3	17.8
維生素C（毫克）	109	104	122

重自然災害的第一年，糧食產量大大減少，全國以每人每日平均計熱量攝入 2060 千卡，蛋白質 57 克。1978 年以來，我國經濟體制改革首先在農業生產上取得了偉大的成績，糧食產量持續增長，人民生活水平明顯提高。糧食產量在 1978-1982 年間增長了 16%。農民人均收入增加一倍。我們於 1982 年進行了第二次全國營養調查。

第二次營養調查包括 27 個省、市、自治區，對 240000 人進行了膳食調查，與第一次調查一樣，我們採用了詢問稱重法，它較各國現在普遍採用的三天或 24 小時回顧調查更爲準確可靠。從表一，表二可見熱能攝入，平均每人每日爲 2485 卡，如以當年全國人口調查中各年齡組人口比例計算日推薦供給量標準 (RDA)，則此攝入量已達標準的 102%；蛋白質攝入量每人每日平均爲 67 克，爲標準的 92%。這說明我國人民生活已經達到了基本溫飽。

從表三可以看出，我國人民膳食中來自動物性食物的熱量爲 8%，城市居民爲 12.4%，農村居民爲 4.2%；來自糧食的熱量爲 71.2%；熱量來源分配，蛋白質佔 10.8%，脂肪佔 18.5%，碳水化合物 70.8%。來自動物性食物的蛋白質爲 11.2%，其中城市居民膳食中動物蛋白質爲 16.9%，農村居民爲 6.3%。我國人民膳食的模式與發達國家比，其特點是動物性食物少，脂肪攝入低，植物性食物比例大。從表三中可見美國膳食中熱量來源穀物僅佔四份之一，動物性食物佔四份之一，食糖佔 10%；美國人膳食中蛋白質來源者爲 17%，脂肪 41%，碳水化合物 43%。由於糧食攝入過少，食糖過多（佔總熱量 12-15%），而纖維素過少，脂肪過高，與一些疾病如糖尿病、腫瘤、高血壓，肥胖病等有關。美國的營養學家建議美國人的膳食中將碳水化合物來源的熱量提高到 60%，脂肪來源的熱量由 40%降低到 30%。世界衛生組織針對發達國家膳食模式的缺點，提出了推薦膳食目標（見表三）。與上述情況相比，我國人民的膳食模式，略加改善，如適量加動物性蛋白質，不失爲一種符合健康的膳食模式。

表三 膳食中熱量分配比較

	中國 (1982年調查)	美國	WHO推荐膳食目標
(1)以食物品種計			
肉禽、魚	7.9%	25%	
糧食、薯類	77.5%	24%	
油脂	7.7%	11%	
糖	<2%	12-15%	
(2)以營養素計			
蛋白質	10.8%	17%	12%
脂肪	18.4%	41%	30%
碳水化合物	70.8%	43%	58%

當然，我們的膳食還存在一些問題。由於我國人民膳食中以植物性食物為主，牛奶攝入量很少，每人每日平均僅 8 克，因此鈣及核黃素攝入不足，僅及日供給量標準 71% 及 60%。膳食中蛋白質數量雖已達到供給量標準的 92%，但其中動物性蛋白質僅及 11.2%，加上豆類蛋白質，也僅 21.2%。因此適當增加動物性食物，尤其是增加牛奶，是我們的努力目標。

為了保證人民健康的需要，從我國人民膳食現狀及農業生產發展的可能出發，我們向農業部門提出了食物供應標準作為發展食物生產的根據（見表四），如能實現，則 1990 年及 2000 年蛋白質的量可增至佔熱能來源 12%，脂肪所佔熱能可達 21 及 26%，碳水化合物所佔熱能逐漸降到 62%，從表四中可見牛乳需量頗大，每人每年 24 公斤，是現在的近 10 倍，需要作出很大努力才能實現。

表四 推荐1986-1990及1991-2000年

	我國膳食組成 (公斤/人/年)	
	1986-1990	1991-2000
谷類	170	132
薯類	36	36
乾豆類	12	18
蔬菜類	144	120
水果	10	20
肉禽類	18	24
乳	24	25
蛋	6	10
魚蝦	6	9
植物油	3	6

二、我國人民營養狀況

生長發育 在 1982 年營養調查中的體格檢查中，未發現嚴重的營養缺乏症，青少年的生長發育是我國人民營養改善的標誌。1975 年我國在 9 省進行了 27 萬 0-17 歲人群的體格測量，1979 年又進行了十六省中 25 萬 7-15 歲人群的體格測量二者相比較，其體重及身高均在增長（見表五）。僅以 1975 年嬰兒出生體重及一歲時體重看，其水平居於亞洲與歐洲之間（表六）。

表五 8-17歲兒童、少年體重及身高增長 (1975與1979比較)

性別	年齡	8歲	11歲	14歲	17歲
男	身高增長(cm)	0.4	0.7	1.8	1.9
	體重增長(kg)	0.1	0.4	2.1	1.7
女	身高增長(cm)	0.4	0.6	1.1	0.7
	體重增長(kg)	0.1	0.5	1.2	0.6

表六 中國嬰兒出生體重及1歲時體型與歐洲及亞洲比較

	中國嬰兒*		歐洲嬰兒	亞洲嬰兒
	城市	城郊		
出生體重(kg)				
男	3.27±0.36	3.22±0.38	3.39-3.57	3.07-3.21
女	3.17±0.16	3.15±0.37	3.32-3.45	2.94-3.10
1歲嬰兒體重(kg)				
男	9.66±1.08	8.97±1.15	9.7-10.63	8.0-10.5
女	9.04±1.02	8.43±0.98	9.0-10.0	7.5-10.0

\*均值±標準差

## 地方病

地方性甲狀腺腫在我國 28 個省、市、自治區都有不同程度的流行，累計查出病人大約有三千餘萬，我國政府對此十分關注，各部門通力合作制訂了防治規則，應用碘鹽、碘酒防治，經過多年努力，取得了很大成績。1984 年病區食用碘鹽人口已達二億八千萬，佔其人口的 89.6%，從而在這些地區控制了新病人的發生。全國共治愈二千一百萬病人，佔病人總數的 60%。到 1985 年，已有 14 個省、市、自治區相繼達到了基本控制地方性甲狀腺腫的標準，他們達到標準所需要時間一般為 5-6 年，短的僅用了三年，在短短的時間內將延續了幾千年的古老的地方病控制住確是偉大的成就。以陝西、黑龍江兩省分別與國外人口相近的芬蘭及波蘭相比，陝西省僅用了五分之一的時間，黑龍江省僅用了八分之一的時間。

另一個地方——克山病的預防在近十年來有很大進展，將由我的同行聞芝梅醫生作詳細介紹。

## 佝僂病

由於我國未採用嬰幼兒食品中強化維生素 D 的措施，而北方各地季節長，嬰兒戶外活動少；南方一些地區也由於長期形成了嬰兒時期少出戶的習慣，佝僂病目前還是一個未完全解決的問題。1977-1983 年調查中可見在北方地區三歲以下嬰幼兒中，患有不同程度的佝僂病者可達 40%，南方也有近 25%，但以輕度、中度患者居多。這幾年我國婦幼保健部門就預防佝僂病進行了全國防治，該病已在大幅度減少，如河北省 4 年內已使佝僂病患病率降到了 18%。

## 缺鐵性貧血

缺鐵性貧血是一個世界性的營養問題，我國七歲以下兒童中，患缺鐵性貧血者約為 30%，6 月至一歲嬰兒中患病率最高，可達 80%，孕婦由於特殊生理需要，患病率可達 35% 左右。這種缺乏病的發生原因尚未澄清，可能主要由於我國膳食以植物性食物為主，鐵的利用率很低，機體從膳食中所得鐵大部份並不能為機體所用，嬰兒時期補助食品不足等等。

## 過度營養

過度營養在一些發達國家是相當嚴重的問題，對於我國來說，目前還不是一個全國性普遍問題，但在大城市中已經看到脂肪攝入量增加的趨勢，如北京市城區居民每人每日脂肪攝入量平均已達 73.3 克，佔熱量來源的 27%，近兩年來又增至 31%，北京市區內成人體重超過標準的佔三份之一，學齡前兒童體重超標準的也有 3%。

隨着國民經濟的發展，人民生活的提高，人們的膳食結構發生變化，因此對人民進行合理營養的指導，從各個方面採取措施保持我國膳食模式的優點，是一個關係民族健康的大事。

## 三、我國改善營養的措施

1. 解決營養問題的根本途徑是增加食物生產以及合理分配食物。中國這樣一個佔世界五份之一人口的國家，能够在新中國成立三十餘年初步解決吃飽問

題，是一個偉大的成就；除了農業生產在 1978 年以後的持續增長外，採取了許多政策以保證基本需要的糧食供應，同樣是首位重要因素。

但是隨着經濟發展，人們對食物的需求及習慣也會發生變化，從而改變膳食的結構，這是各國歷史證明了的，如日本戰後膳食構成的西方化——脂肪攝入量增加，動物性食品大幅度增多，隨之而來的與營養有關的疾病日漸增多。因此我國營養學家在幫助政府制訂符合健康需要的食物生產供應規劃的同時，對人民群眾給以營養指導。通過電視、報紙進行教育，以增強人們自我保健的能力。

對於農村居民來說，他們的收入增加以後，如何改善營養，存在營養知識貧乏的問題，我們的做法是將營養知識交給基層衛生保健人員。自 1984 年以來，我們已經與五個省合作進行這樣的培訓工作，已經培訓了從省至鄉各級衛生人員八千餘人，通過他們去指導家庭食物生產和嬰兒喂養。持續推動這一工作，將會對增強人民體質，保證健康發揮很重要的作用。

2. 就特殊的營養問題制定防治規劃。如地方性甲狀腺腫、克山病、小範圍的腦型腳氣病等均取得了成功。我國的營養研究與防治缺乏病工作密切聯繫，有許多成功例子。1959 年第一次全國營養調查中，我們發現新疆南部一些地區由於膳食單調，以玉米為主，出現了癩皮病。春天時，成人中發病率可達 40%，我們研究了防治措施，並向當地政府建議，由政府支持開展了全面的防治工作，採用補充維生素，指導群眾烹調玉米時加適量的碱，增加蔬菜及豆類生產，引種高賴氨酸、色氨酸玉米，該病逐年減少，七十年代時發病率已減到 4%，1980 年為 0.9%，1982 年第二次全國營養調查時，僅有 0.3% 的成人有此病的某些症狀或潛在的尼克酸缺乏。

3. 發展營養補充食品。在我國未制訂食品強化政策的情況下，針對某些營養缺乏病，研究生產一些價格低廉的營養補充食品，人們可以根據自己的經濟條件選購，以改善營養，如針對缺鐵性貧血，我們應用一種含維生素 C 豐富的沙棘果，加鐵制劑制成固體飲料；針對我國兒童鋅不足，研究生產了補充鋅的固體飲料；受到社會的歡迎。近期内發展老年人用的營養補充品。不少地區根據條件已在發展學校加餐食品，由家長支付低廉的費用，改善小學生的營養，從而有助於提高他們的學習能力。

資料來源：

(1) 一九八二年全國營養調查總結 中國預防醫學中心衛生研究所，1985

(2) 中國地方病防治經驗 實用地方病雜誌編輯部出版 1986

(3) Nutrition monitoring in the United States USDHHS & USDA, US Government Printing Office, 1986

# NUTRITION IN CHINA

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Since the founding of new China, two nation wide nutrition survey have been conducted. The first was in 1959, it was the first year of successive three – year natural calamity, the average caloric intake per capita per day was 2060 kcal, and protein intake 57gm. Since 1978, the Chinese government has been putting most efforts on agricultural production by implementing Joint Household Contract System which makes great achievement, the grain production increased 16 % and the income of the rural population doubled from 1978 to 1982. The second survey was carried out in 1982, which covered 27 provinces ( or municipalities, autonomous regions ), the total number of people surveyed was 240,000. In this survey, food intake was the actual amount by weighing and inquiry.

## The Characteristics of Chinese diet

Data from the 1982 survey in Table 1 and 2 showed the energy intake in average was 2485 kcal, meeting the RDA set by the Chinese Nutrition society at 102%; protein intake was 67 gm, and 92% of RDA. Table 3 showed the dietary calorie intake from animal food was 8%, for urban area 12.4% and rural 4.2% ; energy intake from grains was 71%. The calorie distribution was : protein 10.8%, fat 18.4%, carbohydrates 70.8%. Animal protein consisted 11.2% of the total protein intake while for urban residents 16.9% and rural residents 6.3%. Being compared with the American diet, the Chinese dietary pattern is characterized with low animal food and low fat intake. the food sources of energy intake of American diet in 1977 – 1978 were : one fourth from grains, one fourth from animal food, and sugar contribution was about 10%; the nutrient sources of energy were : protein 17%, fat 41% and carbohydrates 43% of the food energy. Since the American dietary pattern is considered to be associated with several chronic diseases such as diabetes, cancer, obesity etc., nutritionists in the United States set up the nutrition goal for American people : increase calorie from 40% to 30% of the total energy intake the goal is very close to the WHO guideline for the developed countries.

In conclusion, the dietary pattern of the Chinese people may be one of the most healthy patterns in the world if minor changes can be made by increasing suitable amount of animal or legume protein and vegetable oils. Milk intake was only 8 gm per day in average which caused low calcium and riboflavin intake ( 71% and 60% of the RDA ), and animal protein only amounted to 11.2% of the total intake, and 21.2% if legume protein added. So, more milk and soybean production will be the future goal of the agriculture plan.

To fulfill the needs of the people's good nutrition and health, the nutrition consideration of agricultural production is so important that the nutritionists makes

the recommendations on future production plan for people's food. Based on the data from the 1982 survey, the expected food consumption of Chinese people showed in Table 4. It proposed that the calorie intake from protein, fat and carbohydrates will be 12, 26 and 62% accordingly by the year of 2000; The milk consumption will be 24kg per capita per year for the whole population, being 10 times of the current intake, it will be a great challenge to the agriculture sector.

## The Nutrition Status of Chinese People

**GROWTH** The first large scale anthropometry was carried out in 1975, nine provinces were selected and 270,000 subjects from new born to 17 years of age were measured ; and another measurement was made in 1979 which covered 16 provinces and 250,000 students aged 7–25; Table 5 showed the increase of the weight and height of male and female students within 4 years.

**ENDEMIC DISEASES** Endemic goiter has been prevalent in 28 provinces with thirty million patients accumulated, by the great concern of the central and provincial government, a prevention and treatment program was formulated under the coordinated poly-sectoral efforts. Iodized salt and iodized oil are producing and distributing properly to the endemic areas. Till 1984 the population eating iodized salt has reached 280 million which is 89.6% of the population in the endemic area and no new cases reported ; 21 million patients, 60% of the total, have been cured. By 1985, 14 provinces have met the criteria of the " Standard of endemic goiter control " within 5–6 years, some of the provinces took only 3 years making such a good achievement. As examples, Shaanxi and Heilongjiang took only one fifth and one eighth of the time to control endemic goiter as countries like Finland and Poland of the same population size did.

**RICKETS** In north China, long winter keeps infants indoor, and people do not take infants for sunshine very often even in south China, and nutrient fortification policy has not yet been taken, so rickets is still a problem among children below 3 years old. The investigation during 1973–1983 showed the prevalence among children below 3 in the north was 40% and 25% even in the south. The Maternal and Child Health Care Centers at all levels have been working very hard on the prevention of rickets; it reduced to 18% within 4 years in Hebei province was an example.

**NUTRITIONAL ANEMIA** Iron deficiency anemia is a worldwide deficiency disease, the prevalence is 30% among children under 7, and as high as 80% for 6–12 month infants. For pregnant women, it is 35%. Poor iron bioavailability and insufficiency of supplementary food for infants might be the causes.

**OVERNUTRITION** Even overnutrition is not yet a serious problem in China, tendency of having too much fat intake appears in several big cities, the average fat

intake of urban residents in Beijing is now going up to 73.2gm ( 24% of the total calorie intake ) in 1982, and is continueing increasing to 31% of the total energy intake in recent years. In result of such change, one third of the adults and 3% of the preschool children in the urban area got overweighted.

## MEASURES TAKEN FOR PROMOTION OF NUTRITION STATUS

( 1 ) Boosting food production and rationally distributing food have been the fundamental approaches for solving nutrition problems. It is really a great success that a big country with one fifth of the world population like China makes people well nourished within 30 years, besides keeping agricultural production increasing, implementation of those policies ensuring food needs of the whole population has been proved to be the most important factor.

It has been proved that dietary pattern and food needs will be changed along with economic development. It happened in Japan that the diet has been gradually westernized with increasing fat intake and animal foods which was unusual according to the traditional Japanese diet. To pace the economic progress, the Chinese nutritionists are giving advices to the Government on developing food production plan with nutrition consideration, and initiating nutrition education to the public in the urban area as well as in the rural area.

Since the farmers are getting better-off, efforts are taken to integrate nutrition into Primary Health Care System by teaching nutrition knowledge to the health workers at the grassroot level. A nutrition education program covering five provinces started in 1984, and over 8000 health professionals from the provincial to township levels have been trained. Subsequently nutrition service has been delivered to the rural families since then and the vegetables and bean production in the family gardens got better planned and the infant feeding practice improved in the programmed area.

( 2 ) Undertaking nutrition programs for specific nutritional deficiencies is always a major way to go. Prevention of endemic goiter and Keshan disease have been very successful. Another outstanding example of close link of research achievements to the practical work of prevention was the pellegra prevention program we have had in Xingjian Uygur Autonomous Region. Pellegra had existed for decades in the south part of the Region where the diet was monotonous and maize was the staple food. The disease was identified by the scientists during the first nation wide nutrition survey in 1959 and reported to the governmental officials. In 1960 the morbidity was 40% among the adults in the spring. Since then research has been stressed on the feasible approaches for solving the problem, then the accomplishment of the recommandated action was carried out by the local governmental officials, including adding alkaline during cooking of maize, growing vegetables and soybean on the land, breeding new species of corn with high tryptophane content and distributing nicotinamide pills to the patients etc. Then, the morbidity greatly reduced : 4% in 1970's, 0.9% in 1980 and 0.3% in 1982, the cases found in recent years were all mild or subclinical.

( 3 ) Developing nutrition supplementary foods for specific groups. Research and production of low cost-high nutrition foods is very much welcome by the society, such as the iron and vitamin C soft drink solids and zinc fortified fruit juice powder are available in the market, and a kind of nutrition supplementary food for old people is an ongoing research project.

### DATA SOURCE :

- ( 1 ) Nutrition Survey, 1982, Institute of Nutrition and Food Hygiene ( 1985 )
- ( 2 ) Experiences in Prevention and Treatment of Endemic Diseases, Published by the Editorial office of Journal of Endemic Diseases, ( 1986 )
- ( 3 ) Nutrition Monitoring in the United States, USDHHS & USDA, US Government Printing Office, 1986

**Table 1 Average Food Intake of Rural and Urban Residents  
( 1982 Nationwide Nutrition Survey )  
( gm per capita peraday )**

	urban	rural	Whole nation
Cereals	456	554	512
Tubers	62	230	160
Legumes and products	15	14	15
Vegetables	353	338	309
Pickles	12	14	13
Fruit	69	24	27
Milk	10	7	8
Eggs	15	4	9
Meat & poultry	63	23	39
Fish & shrimps	21	6	11
Animal fats	5	6	6
Vegetable oils	21	9	11
Salt	11	17	13

**Table 2 Average Nutrients Intake of Rural and Urban Residents ( 1982 Nationwide Survey ) ( per capita per day )**

	Urban	Rural	Whole nation
Energy ( kcal )	2446	2615	2485
Protein ( gm )	67	69	67
Fat ( gm )	68	41	49
Calcium ( mg )	561	557	540
Iron ( mg )	34	51	.
Retinol ( ug equivalent )	538	784	656
Thiamin ( mg )	2.2	2.5	2.3
Riboflavin ( mg )	0.8	0.8	0.8
Niacin ( mg )	17.9	18.3	17.8
Ascorbic acid ( mg )	109	144	122

**Table 3 Energy Distribution in Diet**

	China	United States	WHO Guideline
( 1 ) Food sources			
Meat, poultry, fish	7.9%	25%	
Grains, tubers	77.5%	24%	
Fat, oils	7.7%	11%	
Sugar	2 %	12-15%	
( 2 ) Nutrients sources			
Protein	10.8%	17%	12%
Fat	18.4%	41%	30%
Carbohydrates	70.8%	43%	58%

**Table 4 Recommended Food Production for 1986-1990 and 1991-2000 ( Kg per capita per year )**

	1986-1990	1991-2000
Grains	170	132
Potatoes	36	36
Legumes, dry	12	12
Vegetables	144	120
Fruits	10	20
Meat, poultry	18	24
Milk	24	25
Eggs	6	10
Fish, shrimps	6	9
Vegetable oils	3	6

**Table 5 Weight and Height Increment of Children and Adolescent ( 1975 to 1979 )**

Age ( yr )	8	11	14	17
Male				
Height increment ( cm )	0.4	0.7	1.8	1.9
Weight increment ( kg )	0.1	0.4	2.1	1.7
Female				
Height increment ( cm )	0.4	0.6	1.1	0.7
Weight increment ( kg )	0.1	0.5	1.2	0.6

**Table 6 Weight and Height Comparison of Chinese Children with Asian and European ( at birth and 1 yr )**

	Chinese		European	Asian
	Urban	Rural		
At birth ( kg )				
Male	3.27 ± 0.36	3.22 ± 0.38	3.39 - 3.57	3.07 - 3.21
Female	3.17 ± 0.16	3.15 ± 0.37	3.32 - 3.45	2.94 - 3.10
1 yr old ( kg )				
Male	9.66 ± 1.08	8.97 ± 1.15	9.7 - 10.63	8.0 - 10.5
Female	9.04 ± 1/02	8.43 ± 0.98	9.0 - 10.0	7.5 - 10.0

# 酵米麵及變質銀耳中毒

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酵米麵是我國東北地區一種傳統的民間食品。用小米、玉米或高粱米，放在水內浸泡10~30天左右，

然後用水磨漿，經紗布過濾，待沉澱後，涼晒成粉，稱做酵米麵(fermented corn flour)。用玉米製成的酵米麵為最常見。利用此粉，可加工成麵條，餃子等食品，偶而由於食用酵米麵而發生食物中毒，稱之曰酵米面中毒(Fermented Corn Flour Food Poisoning) (1) (2) 其病死率極高達40~100%。

1974年衛生部責成我所參與這項工作，與東北三省衛生防疫站等單位，組成酵米麵中毒病因研究協作組，經過全體成員的共同努力。在1979年找到了病原菌及其毒素，並對該菌做了初步鑒定。1981~85 (3) (4) 相繼純化和精製和精製毒素，並建了化學、微生物學監測毒素的檢驗方法，找出了影響該菌的因素，初步地探索其雜菌及去毒方法，為今後防治本病，提供了可靠的科學依據。

一、 酵米麵中毒及變質銀耳中毒的流行病學。

酵米麵中毒，在解放前沒有記載。1953年黑龍江省首次報告了吃酵米麵而引起的中毒。其後1956與1959年分別在吉林和遼寧兩省相繼報告。到1975年，根據不完全統計，僅東北三省就發生了266起酵米麵

表1 酵米麵和變質銀耳中毒的流行情況

地 區	年 度	中毒食品	起數	中毒人數	死亡人數	病死率(%)
黑龍江省	1953~1964	酵米麵	75	568	247	43.5
	1973~1974	酵米麵	11	97	41	42.3
吉林省	1956~1975	酵米麵	132	199.1	373	37.6
	1977~1981	酵米麵	11	68	44	64.7
遼寧省	1959~1965	酵米麵	8	186	42	22.6
廣西藏族 自治區	1966~1980	(一起是由於鏈球菌小米飯引起) 糝巴	15	150	98	65.3
山西省	1982	霉變小米粉	1	7	4	57.1
河北省	1982	酵米麵	1	3	3	100.0
	1983	酵米麵	6	6	4	66.7
內蒙古自治區	1982	格格豆	1	12	7	58.3
四川省		湯丸	2	21	13	61.9
山東省	1984	變質銀耳	1	105	8	7.6
河南省	1984	變質銀耳	1	5	1	20.0
河南省	1985	變質銀耳	5	29	11	37.9
共 計	1953~1985		270	2248	896	39.8



中毒，1842例病人死亡703人平均病死率高達38.1%，個別起病死率高達100%(5)。1979年後由於病因已明，引起各省區有關部門的注意，先後在廣西(6)、山西(7)、河北(8)、內蒙(9)、四川(10)九個省區，相繼發現了這種中毒。1985年又發現了一種新的食物中毒—變質銀耳中毒，是由於食用了變質的新鮮銀耳引起的，在山東(11)、河南(12)兩省發生，臨床表現與酵米麵中毒完全一致，只是病狀較輕，病死率較低。經過調查，証明也是由於同一種細菌毒素所引起，現一併列入表1。據不完統計，酵米麵中毒共263起，中毒人數2109人，死亡人數876人，病死率41.54%。變質銀耳中毒共7起，中毒人數139人，死亡20人，病死率較低14.4%。

酵米麵中毒發生的月份，最早是5月，最晚到10月，一般多集中於6~8月。原因食品，絕大部份是酵米麵，有一起是鏈孢霉小米飯而引起的。各年今組和性別在發病方面，無明顯差別。

潛伏期：各起中毒的潛伏期有些不同。根據13起中毒，130人患者的統計，短者一小時，長者可超過48小時。一般在1~10小時為最多，佔70.4%，變質銀耳中毒以12小時為多。

食用量與發病的關係：從91例資料分析，進食量與中毒症狀的輕重，有密切關係，進食少者發病輕，進食多者則發病重。食半斤者，發病率為60%；二斤以上者為96%，病比率為25%；三斤以上者發病率為100%，病比率為40~100%。見表2

表2 91例患者的進食量與發病率

攝食量 (g)	人數	發病人數	發病率(%)	死亡人數	病死率(%)
25	5	3			
50	10	9	60.0	3	23.3
100	25	24	96.0	6	25.0
150	10	10	100.0	4	40.0
200~250	22	22	100.0	14	63.7
300~350	9	9	100.0	8	88.9
400~450	10	10	100.0	10	100.0

變質銀耳中毒，主要由於鮮銀耳腐爛變質(菌片喪失正常的光澤和彈性，顏色呈棕黃色，發黏不成形，)有異臭味)而引起。多發於6-7月和11月。潛伏

期為3~15小時。這種中毒，其食用方法與發病有密切關係。見表3

表3 變質銀耳食用方法與發病的關係

食用方法	食用人數	發病人數	發病率(%)	住院人數	死亡人數	病死率(%)
1.水洗開水燙加 涼拌	177	77	43.5	27	7	9.1
2.涼水沖洗炒食	52	22	42.3	7	1	4.6
3.水洗煮沸去湯水洗加 涼拌	57	6	10.5	0	0	0
計	286	105	36.7	34	8	7.6

## 二、酵米麵中毒和變質銀耳中毒的臨床表現

進食後，開始患者感到上腹部不適，全身無力等症狀。少數患者出現腹瀉，但症狀輕微。吐物多為咖啡色，嚴重者出現黃疸、昏迷、譫語、四肢抽搐、少尿、尿閉、便血和尿滯留。有的發病很急，呈現中毒休克而死亡。一般體溫不高，少數重症患者有中等度發燒，肝腫大，肝功有明顯改變，血較氨酶有明顯增

加，觸膜皮膚黃染。心律較快，有時出現心律不齊。肺部在病後期，可出現濕性囉音。有皮膚出血。重症患者出現血壓下降，陳施呼吸，呼吸麻痹而死亡。紅細胞和血色素一般在正常範圍，少數病例白細胞增加。見表4

變質銀耳中毒的表現，一般較酵米麵中毒為輕。見表5

表4 58例酵米麵中毒的臨床表現

症狀	發熱	頭痛	頭暈	昏睡	痙攣	譫妄	全身無力	惡心	嘔吐
人數	12	23	24	27	22	13	23	37	31
%	20.7	39.7	41.4	46.6	37.9	22.4	39.7	63.9	53.4
症狀	嘔吐物呈咖啡色	心窩不適	腹痛	腹泄		血尿	腹水	腦水腫	頸部強直
人數	11	21	17	14	5	10	6	6	10
%	18.9	36.2	29.3	24.1	8.6	17.2	13.2	13.2	17.2
症狀	對光反射消失	瞳孔散大	黃疸	心律不齊	肝炎	肺部囉音	血壓下降		
人數	11	7	12	17	9	16	12		
%	18.6	12.1	20.7	29.3	15.5	27.6	20.7		

三、屍驗所見

在23起酵米麵中毒事件中，共進行了三例屍檢，經肉眼及病理組織學觀察，結果見表6

四、病原微生物的檢驗及鑒定

1. 酵米麵中毒病因的探討

按中華人民共和國食品衛生檢驗方法微生物學部份及

化學部份進行採樣本檢驗。結果未發現常見的化學毒物及農葯等，也未發現常見的致病菌，只是在真菌培養用土豆葡萄糖瓊脂培養基(PDA)平板上，發現一種少見的有黃色素的小菌落。經過純化從32起中毒樣品中，分離到40株產毒菌株，通過產毒試驗、動物試驗、病理組織觀察，結果証實了這種有黃色素。

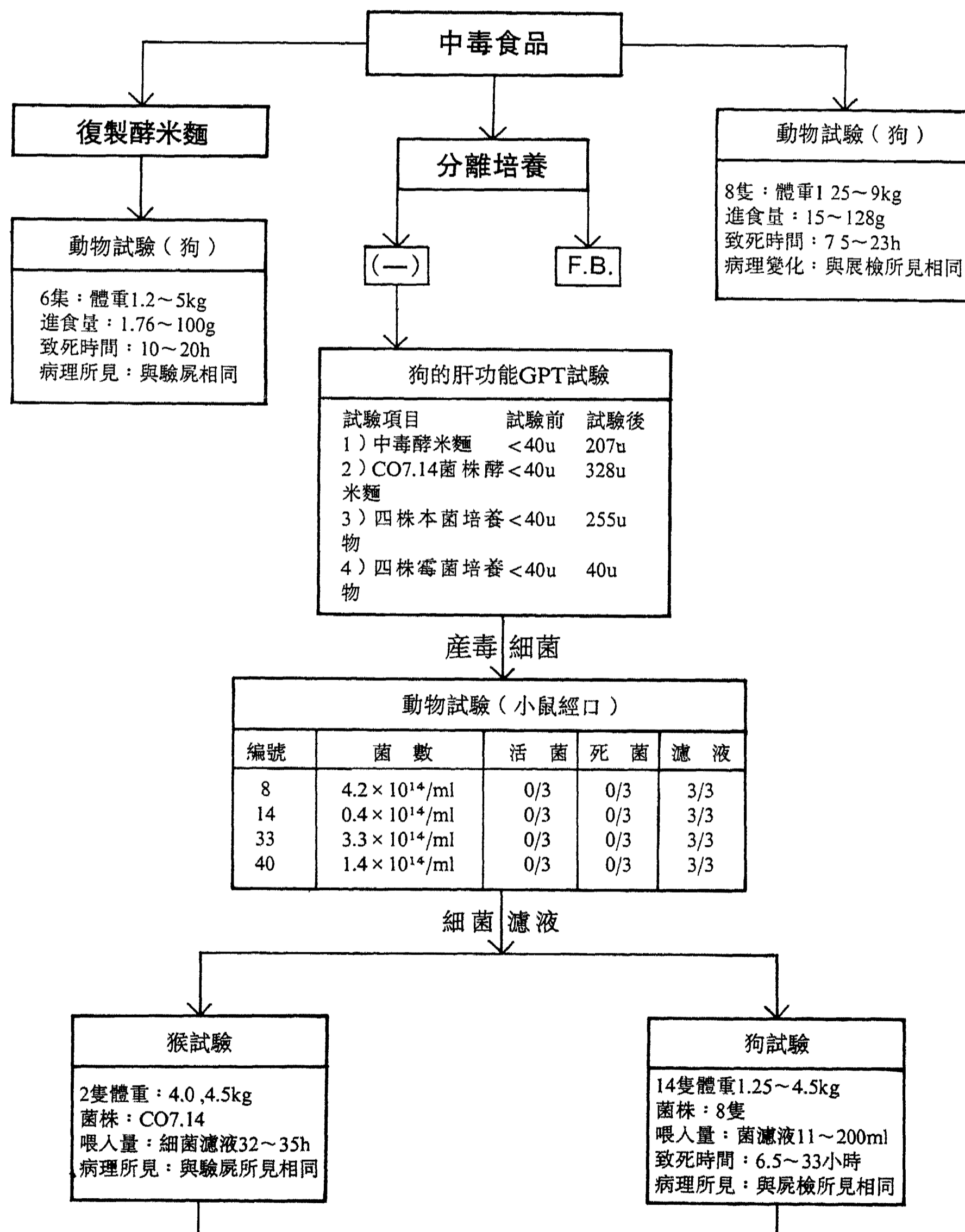


表5 105例變質銀耳中毒的臨床表現

症狀	發熱	頭痛	頭暈	惡心	嘔吐	嘔血	腹痛	腹泄	腹脹
人數	2	57	65	48	40	8	35	24	8
%	1.90	54.28	61.90	45.71	38.10	7.62	33.33	22.86	7.62
症狀	煩燥	痙攣	昏迷	瞳孔散大	皮下出血	肝腫大	黃疸	血尿	
人數	12	17	9	17	27	17	19	1	
%	11.43	16.19	8.57	16.19	25.71	11.43	18.10	0.95	

表6 三例屍檢的肉眼所見及病理組織切片所見

臟器種類	肝	腎	腦	心	肺	胃腸	脾
肉眼所見	質軟、暗紅色、無光澤、表面有不均等出血、呈紅黃相間的斑紋狀。	腎皮質腫大髓質充血、包膜不易剝離。	中毒性腦水腫，腦癰、軟腦膜及蛛網膜充血、水腫。	心肌軟濁腫、心內外膜出血。	肺水腫，切面可見大量粉紅色泡沫及液體流出，肺不脹。	胃內有咖啡物，十二指腸，空腸黏膜點出血，腸系膜淋巴節腫大。	瘀血較常大一倍
病理切片所見	急性中毒性肺壞死，細胞變性壞死以肝小葉中心帶及中間帶為主。	中毒性腎病，近側曲管上皮細胞變性，壞死崩解，脂肪變性，這曲變壞死，並有顆粒及管明管形成。	中毒性腦病，水腫，神經細胞退變，壞死。	心肌濁腫變性，局部心肌纖維斷裂，心內外膜斑狀及點狀出血。	肺水腫瘀血肺泡擴張，內充血球，在大量白細胞的細胞漿中，含有中毒顆粒。	胃點狀出血，細胞漿胞斑狀及點狀出血，黏膜下肌層漿膜腫脹瘀血。	瘀血

2. 產毒菌株來源：

遼寧省13株、黑龍江省19株、吉林省6株、廣西壯族自治區2株共40株。其詳細情況見表7

表7 40株菌來源一覽表

統一編號	菌株來源	中毒情況			分離日期
		就餐人數	中毒人數	死亡人數	
協1	遼寧遼平縣中毒小米飯	47	47	7	1961.7
協2	遼寧遼平縣中毒高糧飯	47	47	7	1961.7
協3	黑龍江木蘭縣中毒醇米麵	7	7	4	1961.10
協4	遼寧、瀋陽中毒地瓜麵	7	7	6	1962
協5	遼寧、本溪中毒醇米麵	14.3	14.3	8	1962.8
協6	遼寧、開原中毒醇米麵	不詳	不詳	不詳	1962
協7	遼寧、凌源中毒醇米麵	8	7	5	1976.7
協8	遼寧、清源中毒醇米麵	3	3	2	1978.7
協9	同上	3	3	2	1978.7
協10	吉林醇米麵	不詳	不詳	不詳	1964.8
協11	同上	不詳	不詳	不詳	1964.8
協12	同上	不詳	不詳	不詳	1964.8
協13	同上	不詳	不詳	不詳	1964.8
協14	黑龍江通河中毒醇米麵	4	4	4	1977.8
協15	黑龍江通河縣中毒醇米麵	3	3	2	1977.11
協16	黑龍江通河縣	3	3	2	1977.11
協17	黑龍江巴彥	8	8	2	1977.8
協18	黑龍江依蘭	4	4	3	1978.7
協19	黑龍江依蘭	4	4	3	1978.7
協20	黑龍江雞西市	4	4	3	1977.11
	(嬰兒人)				
協21	縣份不清	4	4	3	1977.11
協22	黑龍江方正縣	5	4	1	78.12
協23	黑龍江五常省	4	4	3	79.2
協24	黑龍江龍江縣	4	4	3	79.3
協25	黑龍江克山縣	4	4	3	79.2
協26	黑龍江安遠縣	4	4	3	79.2
協27	黑龍江安遠縣	7	7	2	79.2
協28	黑龍江湯源	6	6	4	79.3
協29	黑龍江綏化	16	16	10	79.1
協30	黑龍江木蘭縣	7	7	4	79.1
協31	黑龍江延壽縣	4	4	2	79.2
協32	黑龍江依蘭縣	5	4	1	78.12
協33	吉林雙陽縣	9	8	2	75.9
協34	吉林雙陽縣	10	10	6	76.7
協35	吉林雙陽縣	10	10	6	76.7
協36	吉林雙陽縣	10	10	6	76.7
協37	吉林雙陽縣	10	10	6	76.7
協38	吉林德惠縣	8	8	2	77.7
協39	廣西靖西	8	8	6	79.9
協40	廣西靖西	8	8	6	79.6

3. 產毒菌株的生物學性狀

(1) 形態特徵：本菌為革蘭氏陰性桿菌大小為0.5×1.0~3.0微米。呈杆狀或稍彎曲，兩端鈍圓，有的兩端呈濃染顆粒，無芽胞，有動力。在光學顯微鏡及電子顯微鏡下，可見到有極生、亞極生及側生鞭毛。細胞壁外面有一層較厚的黏液層。透射電鏡下，

可以看出胞漿內均含有異染顆粒和脂質顆粒，有的菌株呈現複雜的內膜系統和環形板層樣結構。

(2) 培養性狀：將40株試驗菌接種在九種分離用培養基上37°C 24小時進行培養，觀察其生長情況見表8

表8 在各種培養基上菌落形態特徵 (37°C 24)

培養基	菌落形態
馬鈴薯葡萄糖瓊脂平板	菌為灰白或乳白色光滑濕潤，生長較快，菌落直徑1~2mm有黃綠色色素，擴散到基質內在紫外燈下觀察(波長365um)菌落呈黃色。
沙保弱瓊脂平板	菌落圓形略扁平有的呈鈕扣狀，表面光滑，但較乾燥(有的濕潤)肉眼觀察菌落呈檸檬色，直徑1~1.5mm在菌落背面有一乳白色沉淀帶(三天後)。
卵黃瓊脂平板	菌落表面光滑濕潤，48小時後，在菌周圍形成乳白色混濁環，在環外周，有一特殊的虹彩環。
察氏瓊脂平板	菌落圓形乳白色或黃綠色，光滑生長緩慢，直徑0.5~1.0mm(26°C 78小時)。
普通瓊脂平板	菌落為圓形光滑濕潤，邊緣整齊，灰白色或無色半透明，有的菌株48小時後產生黃色色素，菌落直徑為1mm左右，生長緩慢。
血瓊脂平板(兔血)	菌落灰白或乳白色，光滑濕潤圓形邊緣整齊，直徑0.5~1.0mm左右，不溶血或甲型溶血。
ENB瓊脂平板	菌落圓形光滑濕潤粉色扁平直徑0.5~1.0mm
SS瓊脂平板	不生長或生長微弱
MCK瓊脂平板	菌落圓形淡黃色或無色透明，光滑濕潤，直徑0.5~1.0mm，基質有淡黃色色素。

選有代表性菌株Co14、33、8菌株，接種在PPA平板上，26°C培養10天，結果見表9

表9 不同菌株的菌落形態

項目	Co 14	Co 33	Co 8
大小(mm)	60	70	40
形狀	草帽狀	扁平狀	低凸狀
表面	光滑	放射狀	光滑
邊緣	整齊	葉狀	整齊
顏色	黃褐	褐黃	乳黃
透明鏡	半透明	半透明	混濁
乾濕	濕潤發粘	乾燥	濕潤
色素	卍	卍	卍

(3) 色素產生：在四種培養基上，接種試驗菌株放37°C、26°C培養48小時，結果在26°C以King A、King B、沙保弱瓊脂平板產生色素最好，在紫外燈下觀察熒光，以37°C為宜。

(4) 生理生化特性試驗

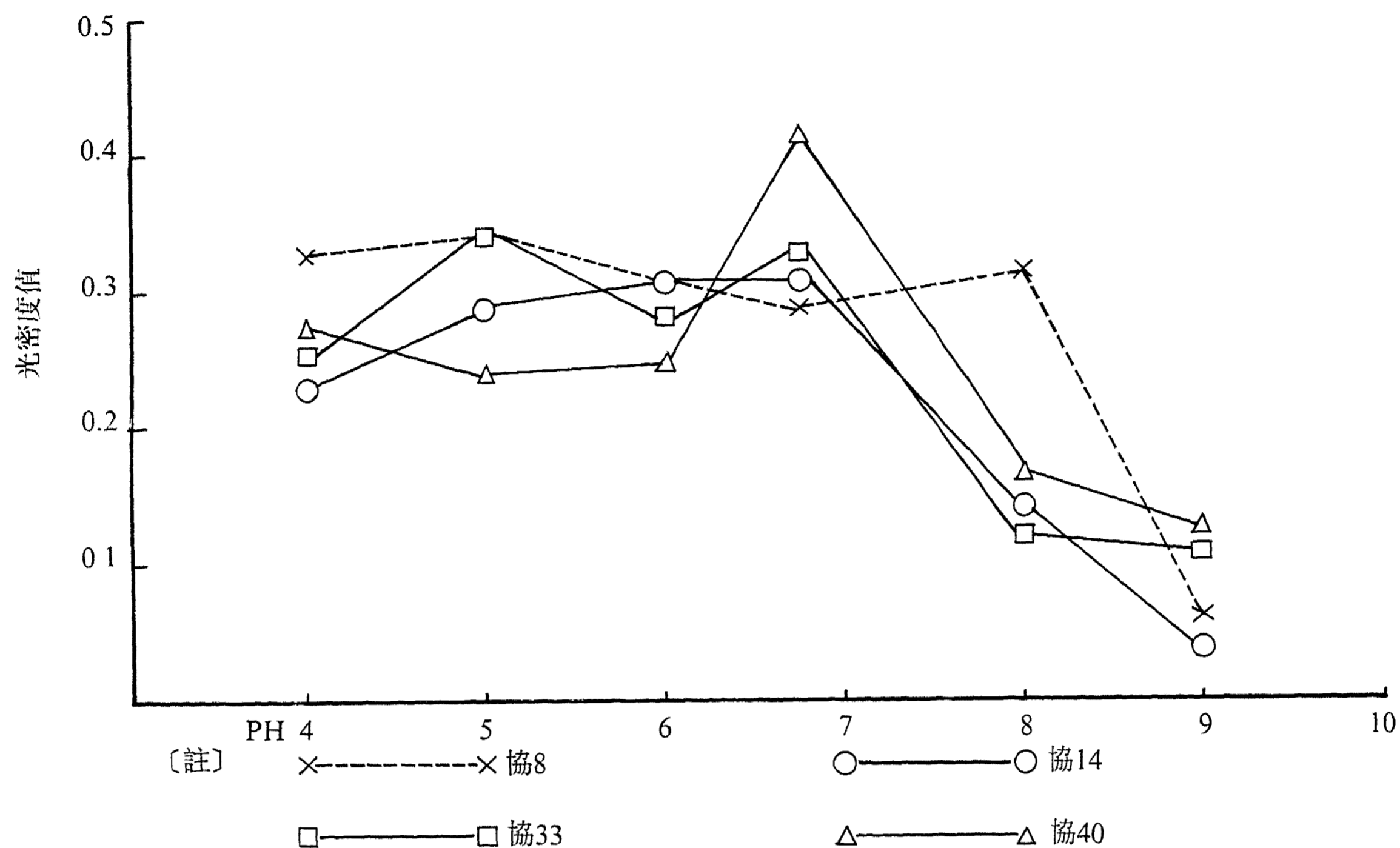
1. 最適生長溫度試驗：我們選用了三個代表菌株(協8、14、33)接種在葡萄糖臙水中，26°C、30°C、37°C三種溫度培養24小時，用72分光光度計測其光密度，結果以37°C生長最好，菌的濃度最高。見表10

表10 不同溫度對試驗菌生長的影响

菌株編號	不同溫度光密度值		
	26°C	30°C	37°C
協 8	0.24	0.48	0.62
協14	0.295	0.54	0.74
協33	0.21	0.54	0.67

2 最適PH生長試驗：用4個代表菌株（協8、14、33、40）接種在PH4、5、6、7、8、9六種葡萄糖腫水中，37°C24小時觀察結果。見圖

四個菌株在不同PH培養基中生長情況



3,其他生化試驗：將40株試驗菌株接種在各種生化管內，於26°C進行培養，觀察15天，結果在38項試驗中，有26項是一致的，有12項是有不同。詳見表11，此菌對各種糖類分解比腸道菌慢，一般必須2~4天，有些菌株對乳糖遲緩分解呈弱陽性反應，快者3至4天遲者可達10~15天才出現陽性。用液體培養基則不易判斷其產酸情況。

表11 40株試驗菌生理生化性狀

試驗項目	1.動力	13.硝酸鹽還元	1.氧化酶	1.乳糖	9+/31 <sup>-</sup>
	2.過氧化氫酶	14.尿素	2.甲基紅	2.麥芽糖	9+/31 <sup>-</sup>
	3.O/F試驗氧化型	15.精氨酸	3.淀粉	3.蔗糖	2+/38 <sup>-</sup>
	4.葡萄糖	16.卵磷脂酶	4.靛基質	4.鼠李糖	10+/30 <sup>-</sup>
	5.甘露醇	17.石蕊牛乳	5.H <sub>2</sub> S	5.葷糖	26+/12 <sup>-</sup> /2d
	6.阿拉伯糖	18.明膠液化	6.苯丙氨酸	6.纖維糖	17+/23 <sup>-</sup>
	7.木糖	19.檸檬酸鹽利用	7.含碳化合物利用	7.山梨醇	25+/15 <sup>-</sup>
	8.果糖			8.水楊素	8+/32 <sup>-</sup>
	9.肌醇			9.糊精	3+/37 <sup>-</sup>
	10.側金盞花醇			10.棉子糖	4+/36 <sup>-</sup>
	11.半乳糖			11.V-P	2+/38 <sup>-</sup>
	12.節茅醇			12.七葉靈	23+/16/1d
反應結果	+		-	不定	

d:表示可疑

4.產毒菌株的G-C克分子比值測定：

蔡良婉等以測定DNA融點（T<sub>m</sub>）值法，測定了具有地區代表的產毒菌株，並以小牛胸腺、大腸杆菌和銅綠假單胞菌為對照，測得的結果見表12

表12 不同來源菌株的DNA T<sub>m</sub>值與G-C克分

DNA來源	子百分比值			
	T <sub>m</sub> 值		G-C克分子比值	
	本 文	文 獻	本 文	文 獻
小牛胸腺（水溶液）	86°C	87.5°C	40.73	42
大腸杆菌（在SSC溶液中）	89°C	90.5°C	48.05	50
本菌（在SSC溶液中）				
不同來源的菌株				
Co.14	91°C		52.92	
Co.8	90°C		50.49	
Co.40	92°C		55.37	
Co.33	92°C		55.37	
銅綠假單胞菌 （在SSC溶液中）	97°C	97°C	67.56	67
腦膜炎敗血黃杆菌				36.4

5.血清學試驗 白竟玉等按常規方法，取代表菌株10株，制備。抗元（煮沸2小時），做成100億菌/ml菌體懸液免疫家兔，取其免疫血清，進行試管凝集測定滴度，結果這10個菌株的免疫血清，分別對此10個菌株，都發生凝集，滴度從1:40~1:1280，說明這些菌株間有共同抗元；但對其他常見致病菌，除對付溶血性弧菌和大腸埃希菌，呈現低滴度（1:40~1:80）的凝集外對乙型付傷寒菌，鼠傷寒沙門氏菌、腸炎沙門氏菌、變形杆菌、豬霍亂沙門氏菌、銅綠假單胞菌、熒光假單胞菌、臭味假單胞菌等均呈陰性。從以上結果，可以初步說明其菌間的親疏關係。見表13

表13本菌的抗血清與其他菌屬的凝集情況

菌株名稱	抗o血清編號		
	Co.7	Co.8	CO.14
甲型付傷寒沙門氏菌		40	40
乙型付傷寒沙門氏菌			
鼠傷寒沙門氏菌			
腸炎沙門氏菌			
豬霍亂沙門氏菌			
變形杆菌16			
變形杆菌17			
大腸埃希氏菌	40	80	80
付血性弧菌	40	80	80
556A		80	
417.7A	80	80	80
746A	80	80	80
臭		80	80
412.1A			40
F143.3B			
銅綠假單胞菌			
熒光假單胞菌			
臭味假單胞菌			

從上表可以清楚地看出，本產毒菌的抗O血清與部份致病菌有低滴度的交叉反應，經吸收試驗後的因子血清，則完全消除這種現象。

經過吸收試驗後，發現本菌共有五個因子，O-I因子為40個菌株所共有；O-II因子為部份菌株間所共有；O-III，O-IV，O-V因子，經過吸收試驗，可制備出單個因子血清並進行了分型，結果見表14

表14 40株產毒的血清分型

血清型	遼 寧		吉 林		黑龍江		廣 西		合 計	
	菌株數°	菌株數°	菌株數°	菌株數°	菌株數°	菌株數°	菌株數°	菌株數°	菌株數°	菌株數°
O-III	5	62.5	5	50.0	2	10.0			12	30.0
O-IV	1	12.5	1	10.0	18	90.0	2	100	22	55.0
O-V	2	25.0	3	30.0	0				5	12.5
未分型			1	10.0					1	2.5
計	8		10		20		2		40	100.0

綜合以上的試驗結果，從形態、培養特性、生理生化特性、DNA的G-C克分子比值%及抗O血清的特性，根據Bergey's細菌鑑定手冊第8版（1974年），其DNA的G-C克分子百分比值，與做單胞菌屬不同，恰介於黃杆菌屬低組（30~47）與高組（63~70）之間，因此暫定名為酵米麵黃杆菌〔*Flavobacterium farinifermentans* nov. sp. (Meng, Z. & Wong, D)〕

五 酵米麵黃杆菌毒素的提純及鑒定

1984年孟洪德等及胡文娟等先後對酵米麵黃杆菌，進行毒素，進行純化與鑒定。

菌株鑑定

形態	培養特性	生理生化特性	DNA的G-C克分子比值%	抗血清的特性
光學顯微鏡			50.49	
透射電鏡			52.92	
			55.37	53.54
			55.307	

根據Bergey's細菌鑑定手冊第8版(1974)G-C克分子比值%介於黃杆菌屬中低組(30-47)與高組(63-70)間

暫定名 醇米麵黃杆菌 *Flavobacterium fa-ri-nofermentans* nov. sp. (M 問eng. EH & Wong, D.S.)

圖1 醇米麵黃杆菌的命名

1. 毒素的制備:

係將醇米麵黃杆菌，接種在蓋以滅菌玻璃紙的PDA半固體瓊脂平板上面，於26°C，培養5天，用無菌手續，問取掉帶菌的玻璃紙，將平板放100°C滅菌30分鐘。待問冷卻後，放低溫冰箱中凍結。翌日取出後，在高溫內化凍，問則融出含有毒素的淺黃色液體，經加熱或減壓濃縮，等發到問原體積的 $\frac{1}{3}$ ，放冰箱內備用。

2. 有毒物質的提取

按圖2程序進行提取，並以動物試驗為指標進行毒物篩選，結果在A.B.兩部分有毒性，經無水乙醇處理，則其問濾液無毒性，而沉澱有較強的毒性。

3. 有毒部份純化

胡文娟等利用酸性甲醇水及2%碳酸氫鈉溶液提取，再問用石油酸提取，則可得結晶狀純品稱之為醇米麵黃杆菌毒素問A(Flavotoxin A)。一般用此法的提取率在問70%。

4. 黃杆菌毒素A的儀器鑑定

1. 紫外光譜鑑定用甲醇作溶劑時，黃杆菌A有兩個最大吸收峰波長，即236nm( =34100)與267問nm( =40600)。另有一最小吸收峰波長為247問nm( =28800)。

2. 質譜鑑定在質譜上黃杆菌毒素A的基峰為m/e1問69.0892(符合C<sub>10</sub>H<sub>9</sub>O<sub>3</sub>計算值169.08問65)。甲酯化黃杆菌毒素A的分子離子峰為m/e528問，基峰為m/e183，碎片離子峰有m/e151和m/問119等，此外尚有一些雜質峰。

3. 核磁共振氫譜測定所得核磁共振氫譜見圖4。

根據以上黃杆菌毒素a的核磁共振氫譜(圖13)，除問3個雜質峰(見圖1打×記號)以外，其餘的峰形與化學位問移均與文獻資料，所報道的Bongkrekic酸的相一問致，此外黃杆菌毒素A的紫外光譜、克分子消光系數( )問及質譜鑑定結果也均與文獻資料所報道的Bongkrek問ie酸相一致。

根據1973年De Bruijn等[8]報道的Bo問ngkrekic酸的分子式為C<sub>23</sub>H<sub>33</sub>O<sub>7</sub>，分子結構式為3-羯甲基-17-甲氧基-6,18,21,-三問甲基廿二碳-2,4,8,12,14,18,20-問七爐二酸。其結構式如下：峻峻稀稀稀

5. 黃杆菌毒素A的動物性試驗

小鼠一次口服黃杆菌毒素A的LD<sub>50</sub>為3.16毫克問/公斤(95%可信限為1.63-6.15毫克/公斤)問。小鼠中毒症狀與醇米麵中毒樣品和粗毒素所引起的小鼠中毒症狀<sup>[1]</sup>一致。

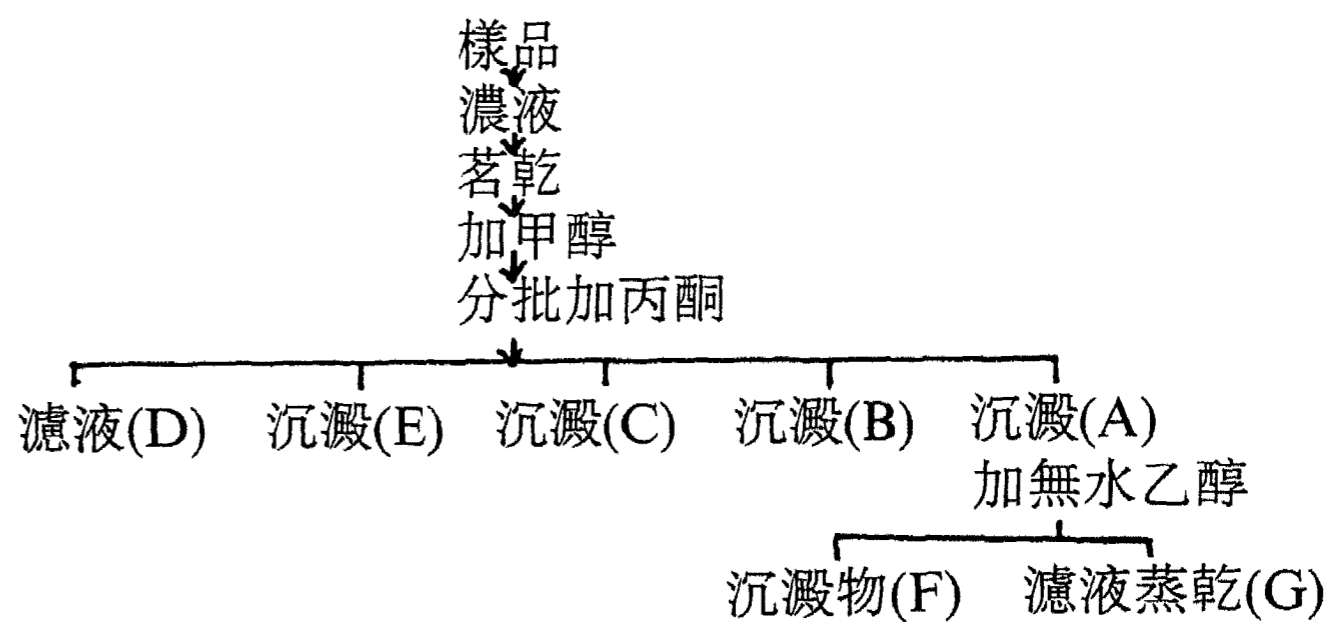


圖2 有毒物質的提取程序

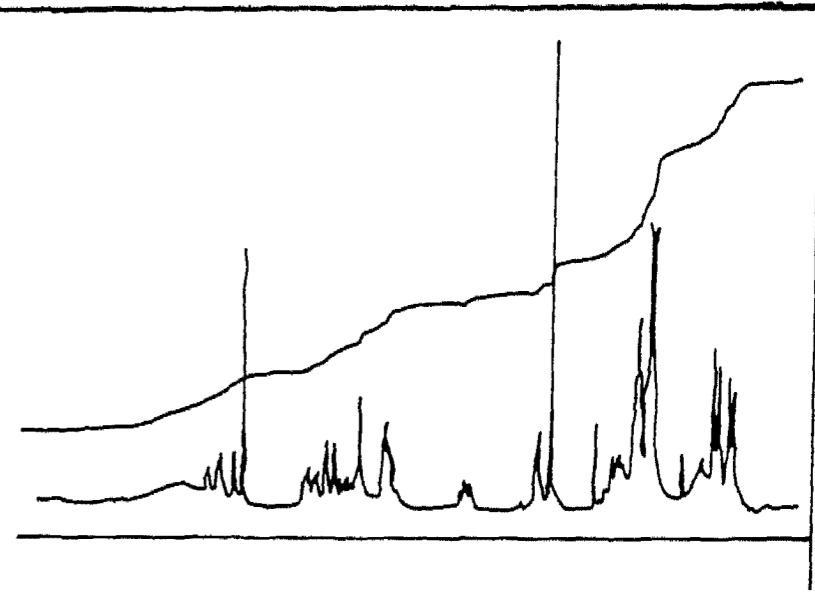


圖3 黃杆菌毒素A的核磁共振氫譜(90MHZ)

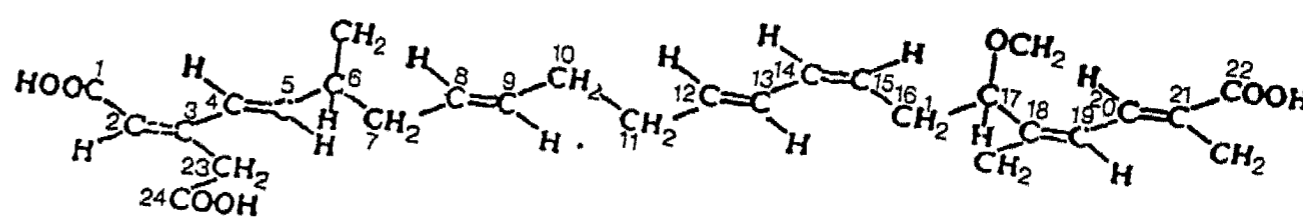


圖4

據報道<sup>[9]</sup>Bongkrekic酸是在印度尼西亞問一帶從中毒的椰子發酵食品中分離出的一種由Pseudo問monas cocovenenans產生的代謝產物。問國外學者<sup>[4-10]</sup>對Bongkrekic酸於Bon問gkrekic酸的LD<sub>50</sub>表明黃杆菌毒素A的急性毒性問極強，屬劇毒物質，小鼠中毒表現與過去用中青樣品和粗毒問素的試驗結果相一致，同時用現場中毒的醇米麵的主要有毒問物質。為今後醇米麵中毒的防治提供了依據。

六、 醇米麵黃杆菌毒素A的測定方法

1986年胡文娟等建立了醇米麵、銀耳、玉米中醇米問麵黃杆菌毒素A的簿層及高壓液相色譜測定法。同年王夏等問建立了該毒素的紫外分光光度法及微生物學測定方法，現將問四種方法加以對比，以利於推廣應用。見表15

表15 四種方法監測酵米麵黃杆菌毒素A的比較

		方法名稱			
特點	薄層層折法	高壓液譜	紫外分光光度法	微生物化	
原理	在短紫外綫下，於GF254硅膠薄層色譜上顯示黑色吸光點	C <sub>18</sub> 柱分離後，用紫外檢測器(波長267nm)檢測根據峯面積定量	利用流毒素對特定波長有強烈的吸水作用，如在甲醇中用267nm波長測定	利用該毒素有抑毒作用利用其抑光圈大小測毒素是	
需要設備和儀器	1) GF254薄層板 2) 短波紫外燈 3) 層折槽 4) 展開劑氣紡：甲醇冰醋酸94：5：1	1) 高壓液相色譜儀 2) 紫外綫檢測器 3) C <sub>18</sub> 反相應柱 4) 洗脫劑	Pu8800可見光—紫外分光光度計	1) 篩選敏感的真菌杆株(黑曲霉) 2) 配成10億/ml菌液 3) 蔡氏平板 4) 標準毒素液 5) 溫箱	
提取法及回收率	加該毒素0.2~1ppm於不同食品中利用酸鹼分配提取法來測定回收率 玉米87~97% 乾銀耳88~97% 鮮銀耳80~97%	102~104% 90~97% 73~93%	77%	利用加鹽法提取培養液	
最低檢出率	0.25ppm	0.1~0.25ppm	0.5ppm	0.38mg	
	一般實驗室都不應用	有條件實驗室應用	有條件實驗室應用	一般實驗室都不應用	

六、影响酵米麵黃杆菌產毒因素

1. 不同因素對產毒的影响

王夏等採用正交設計法，用三個菌株(CO.8,14,33)，以半固體做為基礎培養基，含土豆粉(0.5g,2.5g)、及鮮土豆，在三個不同水平的溫度(15~18、26°C、37°C、HP(6,7,8,)值、培養時間(5,7,10日)的條件下，做平行培養。用加鹽法提取，紫外分光光度法測定結果，影响產毒大小順序為：菌株>溫度>培養基>HP值>時間。見表16，第二次試驗結果見表17

表16 產毒條件正交試驗(I)

水平	因素			
	A.菌株	B.溫度	C.培養基	D.時間
1	165.7	144.7	69.5	139.1
2	200.2	256.7	152.5	208.7
3	108.2	69.2	252.5	126.8
極差	91.2	187.7	183.0	81.9

表17 產毒條件正交試驗(II)

水平	A.菌株	B.溫度	C.時間	D.PH值
1	31.7	170.4	43.2	130.4
2	299.7	139.1	168.3	55.1
3	29.9	51.6	149.8	175.8
	69.8	118.8	125.1	120.8

[註]溫度1)26型PH子6,18,31,,20~2間3°C

2,40個菌株產毒性能和測定：將菌接種在PDA半固體平板上面的滅菌玻璃紙上，26°C培養7天，除去玻璃紙及其上面的菌苔，將半固體平格在100°C滅菌30分鐘，待冷，調PH至8~9，於水盒中冷凍一夜，按加鹽法提取後，用紫外分光光度法及微生物法測毒，結果見圖。

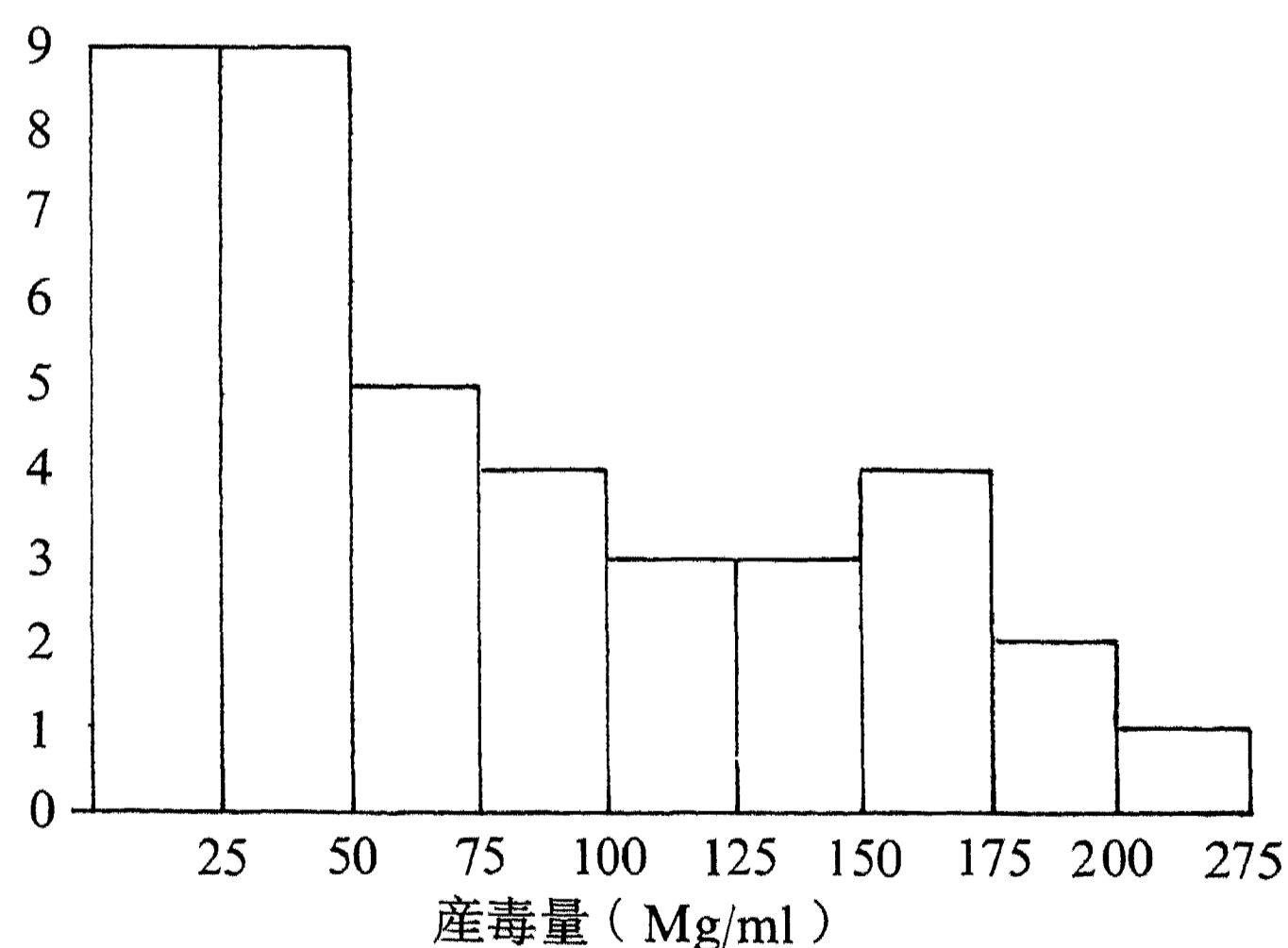


圖 40株酵米麵黃杆菌產毒分佈情況。

3. 不同培養基對產毒的影响

用三個菌株(CO.8,14,33)按種在11種培養基上，除pda和YDA培養基產毒較多外，其他培養基產毒量都較少。見表18



表18在不同培养基上产毒量比较

培养基名称	实验次数	平均产毒量 (mg/m)
1. 土豆葡萄糖琼脂培养基 (pda)	1	14.5
2. 酵母葡萄糖琼脂培养基 (YDA)	1	12.4
3. 沙氏培养基	2	1.6
4. 营养琼脂	1	1.7
5. 察氏培养基	1	1.2
6. 玉米培养基	2	1.6
7. 甘蔗培养基	2	2.0
8. 土豆粉培养基		
(含2.5%土豆粉)	1	3.0
(含2.0%土豆粉)	1	1.7
(含1.0%土豆粉)	1	1.3
(含0.5%土豆粉)	1	1.2

4. 在自然基质中产毒情况

选用市售不同粮食及可能产毒食品，粉碎后过40目筛网，制成5%的半固体培养基（银耳粉2.5%，不加琼脂），网接种CO14,8,33,26℃培养7天，用微生物法及网动物试验（小鼠灌喂）测毒结果见表19

从上表清楚地看出CO14菌株除鸡蛋粉、乳儿粉、肉网粉中不能产毒外，在其余粮食和食品中，均可产毒，并使小鼠致死。

七、酵母菌对物理化学因素的抵抗力

著者等选用了四个代表菌株（CO8,14,33,4网0）、不同温度（56℃、80℃、100℃）、常用消毒网剂（来苏儿、石炭酸、新法而灭和酒精等）进行了杀菌试验，网结果4个菌株，在56℃可存活一分钟，三分钟网灭。来苏儿网0.5的浓度下，可存活5分钟，10分钟网

表20利用微生物学测毒方法筛选去毒剂的效果

试剂	浓度 (%)	1	2	3	4	5	(1-5)
次氯酸钙	5:1	40	0	14	14	0	40
次氯酸钠	5:1	45	45	20	44	26	19
高锰酸钾	0.5:0.1	40	0	0	30	30	10
过氧乙酸	10:2	44	15	20	34	0	44
氢碘酸	10:2	42	16	25	38	32	14
硫酸	10:2	40	0	0	32	20	20
乙酸	10:2	40	0	15	37	28	12
亚硫酸钠	5:1	40	0	0	33	30	10

注：对照组

1. 毒素稀释2倍
2. 低浓度去毒剂
3. 网高浓度的去毒剂
4. 试验组毒素+低浓度去毒剂
5. 网毒素+高浓度的去毒剂

表中数值是抑菌的直径 (mm)，其差值表示去毒效果网。

以上表可以清楚地看出次氯酸钙是最理想的去毒

表19酵母菌在不同粮食和食品中产毒情况

基质	Co 8		Co 14		Co 33	
	阳性率	产毒量	阳性率	产毒量	阳性率	产毒量
玉米	0/3	0	5/5	22.6	0/3	0
小米		9.5	5/5	15.6	1/3	0
高糯米	0/3	0	5/5	11.4	0/3	0
大米	0/3	0	1/5	8.6	0/3	0
大豆粉	0/3	0	5/5	64.2	0/3	0
豆腐粉	0/3	0	2/5	20.4	0/3	0
牛奶粉	0/3	0	5/5	21.2	0/3	7
肉粉	1/3	0	0/4	0	0/2	8
甜蛋白粉	0/2	0	0/4	0	0/2	0
乳儿粉	0/2	0	0/4	0	0/2	0
银耳粉(I)	0/2	9.3	3/3	118.0	1/3	0
银耳粉(II)	0/3	41.2	2/3	40.8	2/3	0
PDA	2/3	60.1	4/4	155.2	3/3	28.4
YDA	2/2	26.0	2/2	93.5	2/2	12.7

网。1%石炭酸网5分钟存活，十分钟网灭。1%新结而网灭一分钟即可网灭网。0.5%亚硫酸钠，在常温下，作用前三网菌株，15分网均可网灭。

各种抗生素及磺胺药物对本菌的抑菌作用，按常规方法网对四个菌株进行试验，结果金霉素、土霉素、四环素最有效网（16~24mm）。庆大霉素、磺胺药物及卡那霉素对部网份菌株稍有抑制作用；而钍喃妥因、红霉素、青霉素、合霉素、氯霉素、新霉素、痢特灵均光效。

八、酵母菌毒素A的去毒试验

1. 去毒剂的筛选及应用效果

王夏等利用酵母菌糖菌毒素A对真菌有抑菌效果的特网点，用抑菌试验的方法，进行药物去毒的筛选，取得了较好网的效果见表20

表21 不同浓度次氯酸钙去毒效果（20℃12小时网）

次氯酸钙浓度 (%)	实验动物数	动物死亡数
5	10	0
2.5	10	0
1.25	10	0
1.0	10	0
0.625	10	0
0.5	10	7
毒素 (liz) (对照)	10	10
2.5%次氯酸钙 (对照)	8	0

剂。在网5:1%浓度下，均可达到去毒菌的。为了摸清其最低去毒网浓度，又进一步进行了试验，结果见表21

以上表可清楚地看出0.625%的次氯酸钙，可使全网部实验动物得到保护。0.5%的次氯酸钙，基本上则不能网保护毒素的致死作用。

为了作切了解去毒剂的去毒效果，又进行了作用时间与网去毒效果的观察，结果见表22

表22 不同濃度不同作用時間的次氯酸鈣去毒效果（同20℃）

濃度（%）	時間（分）	實驗動物數	動物死亡數
2.5	60	5	0
2.5	30	5	0
2.5	5	5	0
1.0	5	5	0
1.0	即刻	35	0
0.75	即刻	40	0
0.毒素（x2）	30	10	7
1%次氯酸鈣	—	10	10
	—	5	0

利用薄層掃描，2%次氯酸鈣溶液5,3,2.5,1同ul均能使mg的黃杆菌毒素A色點完全消失。2.日光的同去毒效果：除曉明等利用紫外綫數剪成小塊的銀耳用日光進同行照射，結果見表23

表23 日晒對有毒銀耳的去毒作用  
黃杆菌毒素A含量（ppm）

編號	種類	取樣量（g）	日晒天數	晒前	晒後	去毒效果（%）
1	鮮銀耳	1.5	2	178	5.9	96.7
2	鮮銀耳	1.5	2	178	5.9	96.7
3	鮮銀耳	2.0	2	960	23.3	97.6
4	鮮銀耳	2.0	2	768	21.3	97.2
5	鮮銀耳	4.0	2	316	8.9	97.2
6	鮮銀耳	4.0	2	285.2	8.0	97.2
7	鮮銀耳	4.0	1	426.7	20.0	95.3
8	鮮銀耳	4.0	2	420.7	11.1	97.3
9	乾銀耳	0.5	2	2255.7	962.1	57.3
10	乾銀耳	0.5	2	2255.7	842.1	62.7
11	乾銀耳	0.5	8	2255.7	130.6	94.2
12	乾銀耳	0.5	8	2255.7	126.9	94.4

鮮銀耳日晒兩天，可使95.3~97.6%的毒素被同破壞，而乾銀耳經日晒只可破壞62.7%，曝晒8天方可同達到94.2~94.4%的毒素去毒。

#### 九、小結和展望

以上概括地介紹了一種新型的食物中毒——酵米麵及變同質銀耳中毒。通過流行病學、臨床症狀、屍驗的病理所見、同病原菌分離、生理生化試驗、血清學試驗、DNA的G-C同克分子百分比值測定等。按Bergey's細菌鑑定手冊同等八版（1974）所載，本菌的DNA G-C克分子百同比估，恰介乎黃杆菌屬低組和高組之間，故暫定名為酵米麵同黃杆菌（*Flavobacterium farinofementans* nov. Sp.

Meng, Z & Wang, D. )。通過分離、純化、精別毒素，經鑑定命名為酵米麵黃杆菌毒素A（Flavo-ToxinA—即米酵菌酸（Bongkrekic acid），並建立了薄層色譜、液相色譜、熒光分光光度法及微生物法四種監測方法，為今後防病滅提供了可靠地科學數據。

除此之外，我們還進行了各種食品對本菌產毒的影響、酵米麵黃杆菌的消毒方法、酵米麵黃杆菌毒素的去毒方法及黃杆體分要等。由於這種菌的研究，時間尚短，對其生態學、血清學、中毒機理、以及在各種食品中的分離情況，和地區性疾病間的關係等等尚需進一步研究。

# Food poisoning caused by fermented corn flour and deteriorated tremella

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A new type of severe food poisoning outbreak has been reported from different parts of the People's Republic of China. Liver, Kidney, heart and brain were main target organs, the overall fatality was 38.2%. Evidence obtained from epidemiological studies and animal tests showed that the food poisoning is caused by the consumption of fermented corn flour products.

Fermented Corn Flour ( FCF ) is a traditional food in Northeastern areas of mainland China. It is prepared by soaking the corn in water for 2 - 4 weeks followed by washing with fresh water, and grinding into a wet flour which is then used for the preparation of steamed corn bread, noodles and dumplings. Consump-

tion of foods prepared by this process has resulted in severe food poisoning outbreaks (1).

During 1953 to 1983, 263 outbreaks of FCF food poisoning were reported, 876 persons died among 2109 patients, the fatality of cases was 41.54 per cent. Recently in 1984 - 1985, 7 outbreaks of deteriorated tremella food poisoning were reported. Twenty persons died among 139 patients with a cases fatality of 14.38 per cent ( Table 1,2 ).

The causal pathogens isolated during these 2 types of food poisoning were proved to be the same and a new name, *Flavobacterium farinofermentans* was suggested by Meng, ZH, et al (2).

**Table 1. Fermented Corn Flour Poisoning occurred in China**

Areass	Years	No. of outbreaks	No. of patients	No. of deaths	Fatality (%)
Heilongjiang	1953-1964	75	568	247	43.5
	1973-1974	11	97	41	42.3
Jilin	1956-1975	132	991	373	37.6
	1977-1981	11	68	44	64.7
Liaonin'	1959	8	186	42	22.6
Guangxi	1966-1980	15	150	98	65.3
Shanxi	1982	1	7	4	57.1
Hebei	1982-1983	7	9	7	77.8
Neimengo	1982	1	12	7	58.3
Sichuan	1982	2	21	13	61.9
Total		263	2109	867	41.5

**Table 2. Deteriorated tremella occurred in the Northern China**

Areas	Years	No. of outbreaks	No. of aptients	No. of deaths	Fatality (%)
Shandong	1984	1	105	8	7.6
Henan	1984	1	5	1	20.0
Henan	1985	5	29	11	37.9
Total		7	139	20	14.4

**Table 3. the relationship between the amount of FCF and morbidity and fatality**

Amount of FCF ( g )	No. of persons	Morbidity No. %	Fatality No. %
25	5	3	
50	10	9 60.0	3 33.3
100	25	24 96.0	6 25.0
150	10	10 100.0	4 40.0
200-250	22	22 100.0	14 63.7
300-350	9	9 100.0	8 88.9
400-450	10	10 100.0	10 100.0

The epidemiology, clinical manifestations and pathological changes associated with 32 outbreaks of FCF food poisoning as confirmed by similar microbiological findings are presented as follows.

Thirty-two of the total FCF poisoning outbreaks occurred during 1961 to 1972 have been investigated. Six of these occurred in Liaoning, 7 in Jilin, 18 in Heilongjiang and 1 in Guangxi. Three hundred and fourteen food poisoning cases were reported among 327 persons who have eaten the FCF products. The case fatality was approximately 32 per cent. The outbreaks usually occurred between July and September. the fatality appears to be related to the amounts of the flour consumed and there were no sex or and differences ( Table 3 ).

## 2. Clinical Manifestation and Pathology

The earliest symptoms included upper abdominal discomfort and lethargy. Slight diarrhea and vomiting were observed in a few cases. Patients in more serious cases experienced icterus, coma, delirium, oliguria, urodialysis, rigidity of extremities, hematochezia and urinary retention. Some victims developed a toxic shock and rapid death followed. A moderate increase in body temperature was observed in some serious cases. Yellowish of sclera and skin was observed. Palpitations and sometimes and arrhythmia appeared. In the later period, there was a drop down of blood pressure, Cheyne-Stokes respiration and respiration and respiration paralysis prior to death. Generally, red cell counts and hemoglobin contents were within normal range. White-cell counts increased slightly. ( Table 4 ).

Three autopsies were conducted and the pathological changes were acute hepatic cell degeneration and necrosis at centre and intermediate zone of hepatic lobules, toxic necrosis of nerve cell ( Table 5 )

No chemical and known pathogenic bacteria were found from suspected foods. All of the left-over foods collected from the outbreak were toxic to mice by oral administration. In order to further demonstration the association between the FCF products and food poisoning, eight dogs were fed with contaminated foods. Approximately 2 to 3 hours after feeding, the dogs became restless, vomiting hindleg paralysis, latered decubitus, chronic spasms, coma and death associated with heart failure. The pathological changes just same to human being. ( Fig 1 )

## 3. Microbiological findings

( 1 ) The origins of 40 strains studied ( Table 6 )

( 2 ) Morphology of strains : forty strains of bacteria producing yellow pigment were isolated from 32 samples collected During FCF food poisoning. The organisms were rods measuring  $0.5 \times 1.0 - 3.0 \mu$ . They are slightly curved with round ends, and motile with polar, subpolar or peritrichous flagella. All strains were Gram - negative and nonsporulating. S thick mucoid capsular material around the cells was observed under electronmicroscopy. colonies grown on potato dextrose agar were 1 - 2 mm in diameter and glistening white and grayish white in color. Colonies produced a yellow - green pigment which diffused into the media ( Table 7 )

( 3 ) Biochemical characteristics : The strains showed positive reactions in the following 19 tests : ie motile, glucose, arabinose, fructose, urea, dulcitol, lecithinase, nitrate, peroxidase, mannitol, xylose, inositol, galactose, arginine, adonitol, litmus milk, gelatin liquefaction, citrate utilization, O/F test, The results were negative in the following six tests : methyl red, indol, starch,  $H_2S$ , oxidase, and phenylalanine, In other tests including V - P test, trehalose, sorbitol maltose, and esculin the results are variable.

( 4 ) Toxicity of culture : Live cells and / heated (  $100^\circ C$ , 20 Minutes ) cells from PDA semisolid culture were non-toxic to animals, but the filtrates were toxic and caused severe symptoms in mouse, dog, rabbit or monkey after oral administration and the pathological changes were similar to those found in human. It is the exotoxin produced by these bacteria that causes poisoning. ( Fig 2 )

( 5 ) Serology : Eight antisera were made by rabbits and agglutinated with different genus of species of organisms, the results were listed in Table 9. Three antigenic types were found in 49 isolated strains, they are named 0-III, 0-IV and 0-V. The 0-I and 0-II antigen are common to all or most strains tested. The distribution of antigenic types in strains isolated at different areas are listed in Table 10.

( 6 ) Determination of DNA G-C mole percentage : Four strains were tested for DNA G-C mole percentage and the results were 50.49, 52.92, 55.37 and 55.37 respectively. ( Table 11 )

( 7 ) Hybridization : DNA were isolated from 3 strains ( including *Pseudomonas cocovenenans*, isolated strain Co.14 and *Flavobacterium devorans* ) and labelled by <sup>32</sup>p and hybridized with 4 strains, the results are listed in Table 12.

( 8 ) Toxin purification and identification :

A " crude toxin was prepared from PDA semisolid culture of Co. 14 strain with an mral lethal dose 0.7mg per mouse ( 15mg b. w. ) . The "crude toxin" was further purified with liquid - liquid extraction procedure by petroleum ether from an acid solution and subjected to further purification. A pure substances by the name

of Flavotoxin A was obtained with the following characteristics :

a) The methanoic solution shows absorption shows absorption maxima at 236 mu ( =34100 ) and 267 mu ( = 4-600 ) and minimum at 247 mu ( =-8800 ) ;

b) The NMR spectra in CdCl<sub>3</sub> shows a molecular structure which is the same as the previously reported Bongkreki acid, ( De Bruijn 1973 ) being 3 - carboxymethyl - 17 methoxy - 6, 18, 21-trimethyl - 1-docosa-2, 4, 8, 12, 14, 18, 20-heptaenedioic acid.

The oral LD 50 of Flavotoxin A in mice was 3.16 mg/kg.

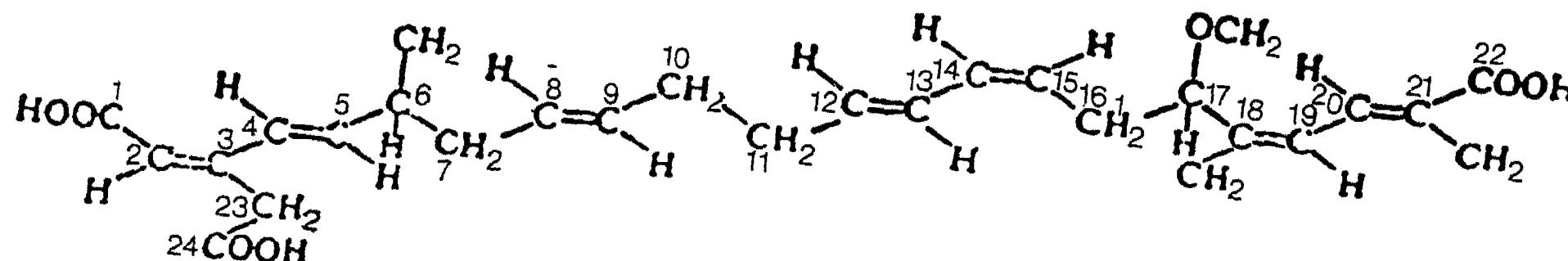


Fig 3 The chemical structure of Bongkreki acid

( 9 ) Analytic methods and detoxication : Four methods including TLC, HPLC, UV, and Microbiological methods were used to detect the toxin ( Table 13 ) The toxigenicity of this organisms in different grains, foods and tremella is deteriorated fresh tremella and 57.3 to 94.9% on dried tremella ( Table 15 )

#### 4. Discussion and conclusion

( 1 ) Fermented Corn Flour Poisoning and Deteriorated Tremella Food Poisoning are new types of microbial food poisoning occurred in China caused by the same pathogen.

( 2 ) Microbiological studies indicate that the pathgen is a Gram negative bacterium with O type reaction in O/F test. It's morphological, biochemical and serological characteristics as well as the hybridization of DNA and ability of producing the highly toxic exotoxin-Bongkreki acid are all the same as the strain of *Pseudomonas cocovenenans* ( NCTB 9450 ). According to Bergey 's manual of systematic Bacteriology vol.1 ( Krieg, NR. & Holt, JG. 1984 ) described.

"To our knowledge, no description of this species is available and the first time this name was proposed ( van Damme et al. 1960 ) was conjunction with the description of toxoflavin, the yellow poisonous compound produced by this organism. Even though the most appropriate position in such a situation is the adopted in the eighth edition of the manual, where the species is placed among the species incertae sedis, the name is mentioned here for the potential interest of the organism whose type strain is available from collection ( NCTB 9450 )".

Therefore, we concluded that the *Flavobacterium farinifermentans* isolated from FCF and deteriorated tremella food poisoning in China is the same strain named *Pseudomonas cocovenenans* isolated from fermented coconut in Indonesia. According to the bacterial nomenclature and considering the distribution and adonitol test are different from *Pseudomonas cocovenenans* therefore we named *Pseudomonas subsp. farinifermentans* ( Meng, ZH. & Wang, DS. ).

Table 4. the clinical symptoms of FCF poisoning ( 54 cases )

Symptoms	No.of patients	%	Symptoms	No.of patients	%
Nausea	37	62.9	Delirium	13	22.4
Headache	23	38.7	Spasms	22	37.9
Dizzy	24	41.4	Bloody stool	5	8.6
Feel weak'	23	39.7	Hematuria	10	17.2
Cardia malaise	21	36.2	Encephaledema	6	13.2
Vomiting	31	53.4	Neck rigidity	10	17.2
Coffee color of vomit	11	18.9	ascutes	6	13.2
Abdomen pain	17	29.3	Loss light reflex	11	18.6
Abdominal distention	14	24.7	Icterus	12	20.7
Diarrhea	7	12.1	Hepatitis	9	15.5
Coma	27	46.6	Arrhythmia	17	29.3
			Pulmonary bubble	16	27.6
			Lower blood pressure	12	20.7

**Table 5. Pathological findings of FCF poisoning ( 3. autopsies )**

Liver : acute hepatic cell degeneration and necrosis at centre and intermediate zone of hepatic lobules  
 Kidney : toxic nephrosis, biliary nephrosis  
 Brain : encephalopathy, encephaledema and necrosis of nerve cells  
 Significant : changes in lung, heart, stomach and intestine were also found.

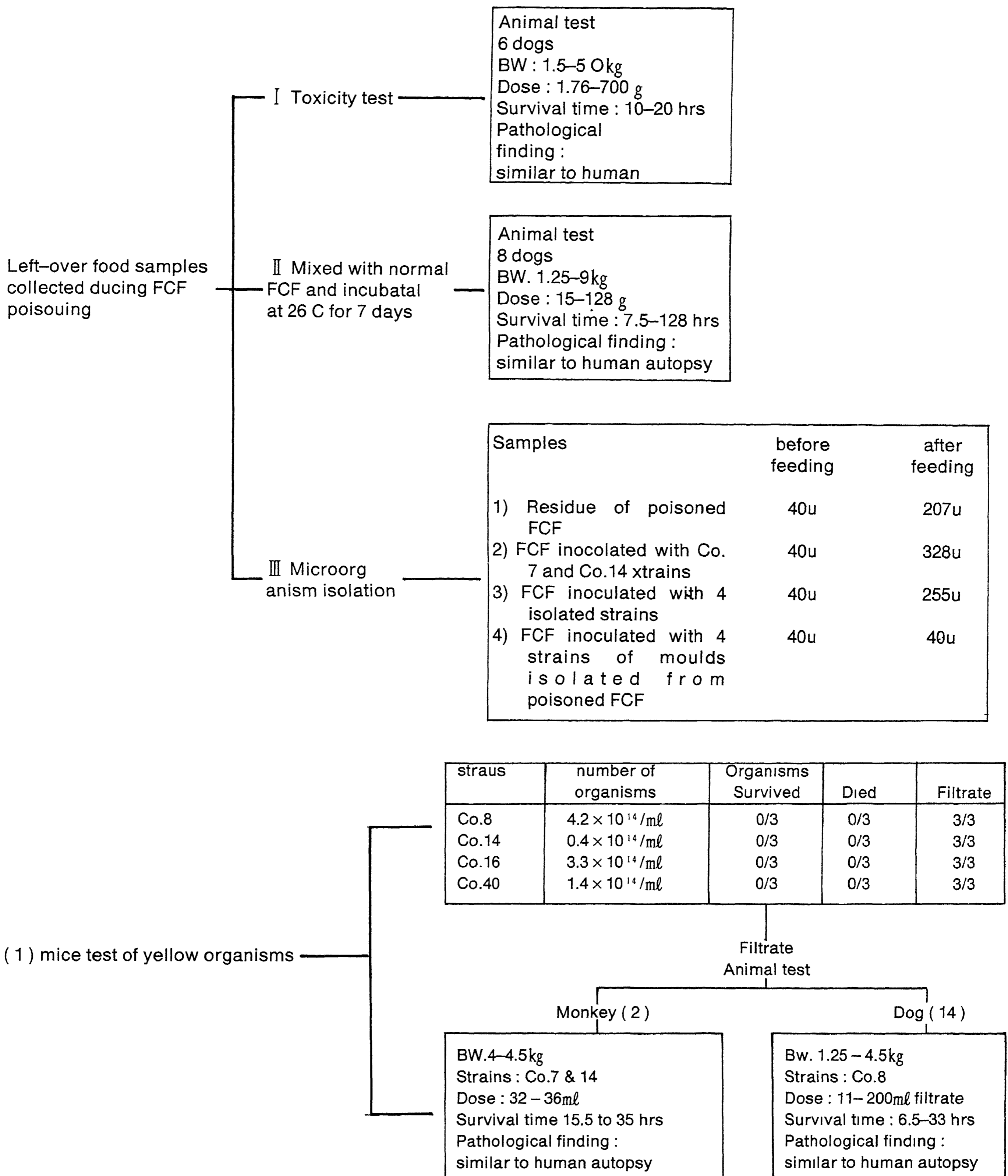


Fig 2 protocol of toxicity tests

**Table 6 The origins of 40 strains**

No of strains sources	Persons of intake	Persons of poisoning	No of death	Date of isolation
Co 1 Jianping, Liaoning millet	47	47	7	July, 1961
Co 2 Jianping	47	47	7	
Co 3 Mulan, Heilongjiang fermented corn flour	7	7	4	Oct 1961
Co 4 Shenyang Liaoning sweet potato flour	7	7	6	1962
Co 5 Benxi, Liaoning fermented corn flour	143	143	8	Aug 1962
Co 6 Kaiyuan Liaoning fermented corn flour	no detail	no detail	no detail	
Co 7 Lingyuan, Liaoning fermented corn flour	8	7	5	July, 1976
Co 8 Qingyuan, Liaoning fermented corn flour	3	3	2	July, 1976
Co 9 Qiggyuan,	3	3	2	
Co 10 Jilin fermented corn flour No 1	no detail	no detail	no detail	Mer 1964
Co 11 No 2	no detail	no detail	no detail	
Co 12 No 3	no detail	no detail	no detail	
Co 13 No 4	no detail	no detail	no detail	
Co 14 Tonghe Heilongjiang fermented corn flour	4	4	4	Aug 1977
Co 15 Tonghe	3	3	2	Dec 1977
Co 16 Tonghe	3	3	2	
Co 17 Bayan, heilongjiang	8	8	2	Aug 1977
Co 18 Yilan, Heilongjiang	4	4	3	July, 1977
Co 19 Yilan Heilongjiang	4	4	3	Nov 1977
Co 20 Heilongjiang	4	4	3	
Co 21 Heilongjiang	no detail	4		Nov 1977
Co 22 Fangzheng, Heilongjiang	5	4	1	Dec 1978
Co 23 Wuchang Heilongjiang	4	4	3	Feb 1979
Co 24 Longjiang, Heilongjiang				Mar 1979
Co 25 Keshan, Heilongjiang				
Co 26 Anda, Heilongjiang				Feb 1979
Co 27 Anda, Heilongjiang	7	4	2	Feb 1979
Co 28 Tangyuan, Heilongjiang	6	7	4	Mar 1979
Co 29 Suihua, Heilongjiang	16	6	10	Jan 1979
Co 30 Mulan, Heilongjiang	7	16	4	Jan 1979
Co 31 Yanshou, Heilongjiang	4	7	2	Jan 1979
Co 32 Yilan, Heilongjiang	5	4	1	Dec 1979
Co 33 Shuangyang, Jilin				
Co 34 Shuangyang				
Co 35 Shuangyang				
Co 36 Shuangyang				
Co 37 Shuangyang				
Co 38 Dehui, Jilin	8	10	2	July 1977
Co 39 Jingxi, Guangxi	8	8	6	June 1979
Co 40 Jingxi				

**Table 7 The characteristics of isolated strains on different media**

Media	Morphology of colonies
PDA	White grey, milk white glisten in moisture, 1-2mm diameter of colonies, yellow green and diffused in media, yellow colour under ultraviolet light
Sabouraud's	Round, slight flat, smooth and moist of surface, but slight grey, colour: lemon yellow, 1-1.5mm diameter
Egg yolk agar	Smooth, moist, milk-white turbid around the colonies and iris ring developed under sunlight
Czapek's	Milk-white or yellow green, smooth, grow slow, 0.5-1.0mm diameter (26°C for 48 hours).
Nutrient agar	Round, smooth, moist, tidy edge, white grey colour less semitransparent, yellow pigment produced by some strains after 48 hours, 1mm diameter grow slowly.
Blood agar (rabbit)	White grey, and milk-white, smooth, moist, round, tidy edge, 0.5-1.0mm diameter, no hemolysis or hemolysis.
EMB agar	Round, smooth, moist, pink colour, 0.5-1.0mm diameter
S.S agar	No growth or poor growth
MCK agar	Round, slight yellow colour or transparent, smooth, moist, 0.5-1.0mm diameter, slight yellow in substrate.

**Table 8 Biological characteristics of the 40 isolated strains**

Tests	Code name of testing strains*							
	1	2	3	4	5	6	7	8
1 Motile	+	+	-	+	+	+	+	40+/0-
2 O/Ftest	0	F	0	0	0	0	0	40(0)/0(F)
3 Oxidase	+	+	-	-	-	-	-	0+/40-
4. Catalase	+	+	+	+	+	+	+	40+/0-
5 Lecithinase	-	-	-	+	+	+	+	40+/0-
6 Tween 80	+	-	-	+	+	+	+	3+/0-
7. ONPG	-	+	+	+	+	+w	+	1+/2w
8 Indol	-	+	-	-	-	-	+w	0+/40-
9 V-P test	-	-	-	-	-	-	-	0+/40-
10 MR test	-	-	-	-	-	-	-	0+/40-
11 H.S test	-	-	-	-	-	-	-	0+/40-
12. Citrate test	+	-	-	+	+	+	-	40+/0-
13 Malate	+	-	+	+	-	+	+	2+/1-
14 Tartaric acid	-	-	-	+	+	+	+	3+/0-
15 Citrate	+	-	-	+	+	+	+	40+/0-
16 Alginate acid	-	+	+	+	+	+	+	3+/0-
17 Nitrate	-	-	-	+	+	+	+	40+/0-
18. Pectin	+	-	-	+	+	+	+	3+/0-
19. Urea	-	-	-	+w	+	+	+	40+/0-
20. Gelatin	+	+	-	+	+	+	+	40+/0-
21. Glucose	+	+	+	+	+	+	+	40+/0-
22. Lactose	-	+	+	-	-	-	-	9+/31-
23. Maltose	-	+	+	-	-	-	-	9+/31-
24. Galactose	+	-	+	+	+	+	+	40+/0-
25 Sucrose	-	-	+	-	-	-	-	9+/31-
26 Xylose	+	-	+	+	+	+	+	40+/0-
27 Rhamnose	-	-	-	-	-	-	-	0+/40-
28 Fructose	+	+	+	+	+	+	+	40+/0-
29 Cellbiose	-	-	+	-	-	-	-	17+/23-
30 Salicin	-	-	+	-	-	-	-	8+/32-
31 Inulin	-	-	-	-	-	-	-	0+/3-
32 Arabinose	+	-	+	+	+	+	+	40+/0-
33 Trehalose	-	+	+	+	+	+	+	26+/12- /2+
34 Mannitol	+	+	+	+	+	+	+	3+/0-
35 Raffinose	-	-	+	-	-	-	-	4+/36-
36 Mannitol	+	+	-	+	+	+	+	40+/0-
37 Erytyritol	-	-	-	-	-	-	-	0+/3-
38 Inositol	-	-	-	+	+	+	+	40+/0-
39. Sorbitol	-	-	-	+	+	+	+	40+/0-
40. Adonitol	-	-	-	-	+	+	+	40+/0-
41 Dulcitol	+	+	-	+	+	+	+	40+/0-
42 Arginine	+	+	+	+	+	+	+	40+/0-
43. Ornithine	+	-	-	+	+	+	+	22+/1-
44. Lysine	+	+	+	+	+	+	-	2+/1-
45. Phenylalanine	-	+	-	-	-	-	-	0+/3-
46. Esculin	+	+	+	+	+	+	+	40+/0-
47. Starch	-	-	-	-	-	-	-	0+/40-
48. Litmus milk	k**	Ax*p*	-	k.p	k.p	K.P	k.p	40+/0-
49. 5°C growth	-	-	-	-	-	-	-	0+/3-
50. 37°C growth	+	+	+	+	+	+	+	3+/0-
51. 41°C growth	-	-	-	-	-	-	-	0+/3-



\*Strains No.1 *Pseudomonas aeruginosa*  
 No.2 *Pseudomonas cepacia*  
 No.3 *Flavobacterium devorans*  
 No.4 *Pseudomonas cocovenenans*  
 No.5,6,7, isolated strains Co.7 Co.14, Co.33  
 No.8 : 40 isolated strains  
 \*\*K\* : alkali, Ac\* : acid, P\* : peptonization

**Table 9 Agglutination test of isolated strains antisera ( O ) to other genus or Species bacteria**

Species	O antiserum		
	7	8	14
<i>Salmonella paratyphi A</i>	-	40	40
<i>S paratyphi B</i>	-	-	-
<i>S typhi murium</i>	-	-	-
<i>S enteritidis</i>	-	-	-
<i>E coli</i>	40	80	40
<i>Proteus 16</i>	-	-	-
<i>Proteus 17</i>	-	-	-
<i>S choleraesuis</i>	-	-	-
<i>V parahaemolytica</i> ( 556 )	40	80	80
( 417/7A )	-	80	-
( 746 )	80	80	80
( Wu )	80	80	80
( 822A )	-	-	80
( 410/1A )	80	80	80
( F143/3B )	80	-	40
( 478/3B )	80	80	80
( 527/2A )	80	160	160
( F78 )	80	80	80
( 450/3B )	40	40	80
<i>Pseudomonas aeruginosa</i>	-	-	-
<i>P fluorescens</i>	-	-	-
<i>P stutzeri</i>	-	-	-
<i>P putida</i>	-	-	-
<i>P cocovenenans</i>	320	80	640

**Table 10 Serological typing for 40 testing strains by areas**

Types	Liaoning		Jilin		Heilongjiang		Guangxi		Total	
	No	%	No	%	No	%	NO	%	No	%
	5	62.5	5	50.0	2	10.0	12	30.0		
	1	12.5	1	10.0	18	90.0	22	55.0		
	2	25.0	3	30.0	0		5	12.5		
			1	10.0			1	2.5		
	8		10		20		40	100.0		

**Table 11 DNA G - c mole percentage of isolated strains**

Sources of DNA	Tm value		G + C mole %	
	Cai Lw	Ref	Cai Lw	Rcf
Thymus of calf ( water solution )	86°C	87.5°C	40.73	42
<i>E coli</i> ( in SSC solution )	89°C	90.5°C	48.05	50
Isolated strains				
Co 8	90°C		50.49	
Co 14	91°C		52.92	
Co 33	92°C		55.37	
Co 44	92°C		55.37	
<i>P aeruginosa</i>	97°C	97°C	67.56	67
<i>Flavobacterium meningosepticum</i>				36.4

**Table 12 The hybridization of isolated strain to *P. cocovenenans* and *F. devorans***

Organisms	32p-DNA		
	<i>P. cocov.</i>	Co. 14	<i>F. devorans</i>
<i>P cocov</i>	100%	61-64%	41%
Co 14	72%	100%	33.9%
<i>F devorans</i>	35%	23-33%	100.0%
<i>E coli</i>	10%	12-22%	10%

**Table 13 The comparison of 4 assaying methods for toxin**

	Methods			
	TLC	HPLC	UV	Microb.
Extract method &	Put the toxin ( 0.1 - 1 ppm ) in to foods and extracted by acid - alkali distributing method		The toxin was extracted by acidalkali distributing method after NaCl addition	
Recover rate			77%	
Corn Corn	87-97%			
Dried tremella	88-97%			
Fresh tremella	80-9%			
Sensitivity 0.25ppm	0.1-0.25ppm		0.5ppm	0.38ug
Application	laboratory		laboratory	routine

**Table 14 Toxicogenicity of isolated strains in grains and foods**

Substrates	Strains					
	Co.8		Co 14		Cp 33	
	D/T*	AT**	D/T	AT	D/T	AT
Corn	0/3	0	5/5	22.6	0/3	0
Millet	1/3	9.5	5/5	15.6	0/3	0
Sorghum	0/3	0	5/5	11.4	0/3	0
Rice	0/3	0	1/5	8.6	0/3	0
Soybean	0/3	0	5/5	64.2	0/3	0
Tofu	0/3	0	2/5	20.4	0/3	0
Milkpowder	0/3	0	5/5	21.2	1/3	7.8
Meat powder	0/2	0	0/4	0	0/2	0
Egg albumin Powder	0/2	0	0/4	0	0/2	0
Baby powder	0/2	0	0/4	0	0/2	0
Tremella powder 1	1/3	9.3	3/3	118.0	0/3	0
Tremella powder 11	2/2	41.2	2/3	40.0	0/3	0
PDA	3/3	60.1	4/4	155.2	2/3	28.4
YDA	2/2	26.0	2/2	93.5	2/3	12.7

\* D : died number of mice T : Total number of mice AT : amount of toxin (ug/ml)

**Table 15 The detoxication of toxic tremella by sun light**

No	Species	Sampling (g)	Sun light (days)	toxin (ppm) before	after	Detoxication (%)
1	Fresh tremella	1.5	2	178	5.9	96.7
2	Fresh tremella	1.5	2	178	5.9	96.7
3	Fresh tremella	2.0	2	960	23.3	97.6
4	Fresh tremella	2.0	2	768	21.3	97.2
5	Fresh tremella	4.0	2	316	8.9	97.2
6	Fresh tremella	4.0	2	285.2	8.0	97.2
7	Fresh tremella	4.0	2	426.7	20.0	95.3
8	Fresh tremella	4.0	2	420.7	11.1	97.3
9	Dried tremella	0.5	2	2255.7	962.1	57.3
10	Dried tremella	0.5	2	2255.7	842.1	62.7
11	Dried tremella	0.5	8	2255.7	130.6	94.2
12	Dried tremella	0.5	8	2255.7	126.9	94.4

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## 一、前言：

克山病是以急、慢性心功能不全為特徵的地方性心肌病。發生在我國 15 個省、自治區的某些山區、丘陵地帶的農村，以 10 歲以下兒童和生育期婦女的發病率最高。本病在我國流行已有數百年，1935 年在東北地區暴發流行，當時就以發生本病較重的地區——黑龍江省克山縣命名，稱為克山病。急型重症克山病的病死率極高，在 85% 以上，即使在發病的當年沒有死亡，以後大部份死於慢性充血性心力衰竭。解放後，我國醫務人員對本病的防治做了大量研究工作。1974 年以來，用亞硒酸鈉預防克山病取得明顯效果，並證明病區內外環境中硒低，說明地方性硒缺乏可能與克山病的發病有關。

## 二、克山病的臨床及病理特點：

1. 臨床表現、分型及處理：克山病病人的臨床表現主要為急、慢性心功能不全；根據病程的快慢和病情的嚴重程度可以分為急型（急克）、亞急型（亞急克）、慢型（慢克）和潛在型（潛克）。

急克的常見臨床表現為心源性休克，有的病例還有急性肺水腫或出現阿—斯氏綜合徵。心源性休克的病人表現為心慌，出冷汗，面色蒼白，四肢厥冷，脈搏微弱，血壓下降，心律失常。急克的心電圖常常表現為急性心肌缺血，甚至出現單向曲綫，有的表現為各類束枝傳導阻滯或房室傳導阻滯。但也有急克患者已有明顯症狀而心電圖未見異常。自從發現用大劑量抗壞血酸靜脈推注治療克山病的心源性休克以後，病死率和轉慢克率大大降低。成人劑量為每次 5-10 克（用 12.5% 抗壞血酸制劑）加入 25% 葡萄糖液 40 毫升由靜脈推注，間隔 2-3 小時可以重覆使用，日注射量不超過 30 克，兒童劑量每次 3-5 克。

亞急克的起病較慢，在 2-4 週內逐漸加重並發展到充血性心力衰竭，病人的心臟中度擴大，常常可以聽到奔馬律。心電圖可能表現各式傳導障礙，ST 段及 T 波改變和室性早搏。心功能一般為 III-IV 級。

慢克病人可能由急克或亞急克轉變而來，也可能沒有急性發作史，稱為自然慢克。慢克的心臟重度擴大，伴有嚴重的心功能不全。亞急克和慢克的治療原則以控制心力衰竭為主，與其他心臟病心力衰竭的治療原則類似。

潛克病人的心功能代償正常，主觀病症不明顯，多因為在體檢時有心臟輕度擴大，心電圖有某些變化而被發現，這些現象常被人們忽略。潛克病人一般不需特殊治療。

2. 心肌的病理改變：克山病的病變主要在心肌，少數病例的膈肌也有較輕的病變。其他組織和臟器的病變，如肝瘀血和肝的脂肪變，可能是繼發於急、慢性心功能不全。

由於心肌受損，克山病的心臟均有不同程度擴大，以心室擴張為主，心室壁的增厚不顯著，X 光檢查時心臟擴大變成近乎球形，搏動減弱。尸檢時室壁肌肉，鬆軟、在心肌的切面上肉眼可見多數散在的灰黃色小斑塊。在顯微鏡下同一視野內可見壞死灶纖維增生，同時還可見正常的心肌細胞夾染其間。壞死灶大致可以分為凝固性壞死和肌溶解壞死兩種基本類型。凝固性壞死灶中可見不規則的條紋或顆粒，為心肌細胞收縮成分的凝聚和崩解，主要見於急克。肌溶解壞死灶中可見大小不等的空泡和液化現象，為綫粒體高度腫脹的結果，多見於亞急克。壞死通常不累及間質，不引起急性炎症反應。壞死灶周圍的浸潤細胞多為淋巴細胞及巨噬細胞。修復過程主要通過網狀纖維膠原化而形成癍痕。心肌細胞的壞死成批發生，新臨病灶並存。

## 三、克山病的流行特點：

1. 地區分佈，克山病主要分散發生在山區、丘陵地帶，由東北至西南呈一寬長帶，波及 15 個省和自治區，而病帶內的衝積平原或湖區發病少，病情又較輕。對病區的地理環境分析表明，病區土壤多半受到淋溶，而非病區多屬於沉積地帶。

2. 時間分佈：克山病的發病特點為年度多發和季節高發性，即急克與亞急克的高發年與低發年相間，呈波浪式，不同地區的高峰年度並不相同。不同地區和高發季節也不相同，東北地區急克的高發季節在冬季的12-2月；而西南地區兒童以亞急克為多，高發季節則是在夏季的4-8月。從近十多年的觀察，各地病情是逐年下降的趨勢。

3. 人群分佈：此方病區生育期婦女（20-50歲）的發病率為同年齡男子的1.5-4.8倍。近年來雖然總的發病率有所下降，但兒童患者所佔的比例較前增加。南方病區的患者主要為2-7歲的兒童。患者多半來自靠農業生產收入的家庭，飲食比較單調。農村的職工戶得少發病，城鎮居民幾乎不發生此病。

四、微量元素硒在克山病防治中的作用：

1. 防治家畜白肌病的啟示：在克山病流行區也有犏牛和羔羊白肌病流行，當地獸醫用亞硒酸鈉防治白肌病有一定效果。因患白肌病的家畜除了骨骼肌有變化外，也有心肌壞死，心肌的病變在形態上也與克山病類似。1969年中國醫學科學院克山病防治科研小分隊

（下稱小分隊）將亞硒酸鈉試用於人的克山病防治。

2. 口服亞硒酸鈉干預試驗：我們首先用動物實驗確定了亞硒酸鈉的安全劑量，並在試點區的觀察中看出了一些備頭(1)。由於觀察面小，發病率低，未能對防治效果作出肯定結論。

1974及1975年小分隊在四川省克山病重病區進行了大面積的有嚴格對照的口服亞硒酸鈉干預試驗(2)。1974年在3個公社119個生產隊及1975年在4個公社179個生產隊的全部1-9歲兒童中以生產隊為單位隨機安排半數生產隊服亞硒酸鈉片，另半數生產隊服對照片，兩年觀察期間服硒片或服對照片的隊不變。由專人分別發放，每週發藥一次，每次劑量為1-5歲0.5mg，6-10歲1.0mg。負責診斷和治療克山病患者的醫生對亞硒酸鈉的投放情況一元所知，病例統計由負責干預試驗區的醫生作最後分析。1974及1975年未服硒組的3985及5445名兒童的發病率分別為千分之13.5及9.5，而服硒組4510及6767名兒童的發病率分別為千分之3.2及1.0，經統計分析，有非常顯著的差別，由此得出了硒預防克山病的急性發作有效的結論。

表1. 試點區服硒及未服硒組克山病的發病及轉歸情況

組別	年度	觀察人數	發病人數	發病率 (%)	存活人數			合計	死亡人數
					轉慢	好轉	轉潛		
未服硒	1974	3985	54	13.5	2	9	16	27	27
	1975	5445	52	9.5	3	10	13	26	26
服硒	1974	4510	10	3.2	1	0	9	10	0
	1975	6767	7	1.0	0	0	6	6	1

於1977年底對以上病例隨訪，未服硒組半數病例死亡，約5%病例仍有明顯的心功能不全。而服硒組的17例患者中僅有1人死亡，病死率為6%，其他患者均無明顯的臨床症狀，表明服硒組的預後也比未服硒組好。

1976-1980年，這四個公社的全部兒童服硒片，按總人口計，五年間新發病例佔千分之0.12，而相鄰的三個未服硒公社佔千分之3.75，經統計處理也有顯著差別(3)。

表2 1976~80年寬寧縣服硒公社與未服硒公社在克山病發病率的比較

年份	服 公社(4)*			未服 公社(3)*		
	總人口	新發病例	發病率(%)	總人口	新發病例	發病率(%)
1976	41,181	4	.009	5,999	33	.550
1977	41,758	3	.007	6,243	12	.192
1978	41,533	5	.012	6,310	32	.507
1979	41,248	8	.019	6,411	23	.359
1980	41,384	4	.010	6,463	18	.279
總計	207,104	21	0.12	31,426	118	3.75

其後，在全國十個省，自治區的69個病區縣擴大了硒預防試驗，服硒人數達142萬多人，都取得了較好效果。截至1984年底，在北方重病區已有407萬人堅持服硒預防克山病，至此，把亞硒酸鈉作為羣體性的預防措施已大面積地應用於人類。

聞芝梅等(4)於1984年對補充硒已十年的克山病病區中3—10歲兒童進行體格檢查，心電圖檢查和心肌X光拍片檢查，結果補充硒片的194名兒童中檢出潛克4例，服硒鹽的211人中檢出潛克5例，未服硒的218人中檢出亞急克1例和潛克13例。

### 不同人群發硒含量、X光及心電圖的變化

發硒含量 ppm  X±SE	受檢人數	X光及心電圖變化					
		心胸比0.53-0.60		心胸比0.51-0.55		心胸比<0.05	
		異常ECG	··正常ECG	異常ECG	··正常ECG	異常ECG	··正常ECG
硒片 (I組) 0.107±0.008 (27)	194	0	0	0	3	1	190
硒鹽 (II組) 0.155±0.007 (16)	211	0	0	0	3	2	206
未服硒 (III組) 0.050±0.007 (20)	218	1	1	3	4	5	204
服硒片前 (IV組) 0.072±0.004 (20)	183	0	2	3	2	1	175

- ( ) 括號內為檢查樣品數
- · 包括一些輕度心電圖改變

以上結果表明補充硒還不能完全防止潛克發生，但服硒兒童的潛克發病率低於未服硒者。

關於亞硒酸鈉的治療作用，與分隊曾試用於治療亞急克，但未得到治療效果。

#### 五、硒與克山病關係的研究：

1. 硒在營養上的作用：硒是一種微量元素，它被發現的歷史並不長，以前一直被認為是有毒的，在1957年施瓦茨 (Schwarz)(5) 證明能防止大白鼠肝壞死的第三因子就是硒，這才認識了硒的營養作用。後來發現硒對幾種動物的不同疾病，如犢牛和羔羊的白肌病，雞的滲出性素質等也有預防作用。Rotruck(6) 證明硒是穀胱甘錫過氧化物酶 (GSHpx) 的基本成分，GSHpx 能使在代謝過程中所生成的脂質過氧化物 (ROOH) 還原為相應的較不活潑的醇 (ROH)，防止脂質過氧化物對細胞膜及細胞生物功能的損害作用。硒還可以節約維生素E(VE)，在體內與VE起協同抗氧化作用。

2. 克山病病人區人群硒的營養水平：克山病在地區分佈上的特點使人聯想到它可能與水土中某些因素有關係。當在現場中用亞硒酸鈉預防克山病得到初步效果時，使我們想到進一步分析克山病病區人群內外環境中的硒與發病的關係，把現場和實驗室研究有機地

結合起來。小分隊在11個省77個病點和在20個省110個非病點採樣，分析了血液、頭髮、尿和糧食中的硒含量，以及血中的GSHpx活力水平。

(1) 血硒：人群的血硒水平能較好地反映人體的硒營養狀態。楊光圻等測定病區及非病區人群的血硒含量分別為0.021及0.095ppm，兩者差異顯著(7)。他們認為個體血硒水平在0.02ppm以下者應認為是機體處於貧硒狀態。徐光祿等(8)測定陝西病區兒童血硒含量平均為0.018而非病區為0.036ug/ml，與以上結果一致，病區人群血硒水平均顯著低於非病區者。與世界上其他低硒地區人群血硒水平的均值相比，芬蘭的兒童為0.060ug/ml (kg)，新西蘭的兒童為0.042-0.06ug/ml (10)，均高於我國克山病病區居住的兒童的硒營養狀態。

小分隊曾對200份相應的血硒及發硒值的對數作相關分析，結果呈顯著的直綫相關。由於現場採集人群血樣比較困難，在大規模的現場調查中均採用發硒值代表當地居民的硒營養背景。

(2) 發硒：通常自枕部取距髮根1cm以內的頭髮作樣品。分析的結果表明病區居民的發硒含量均低於0.12ppm，非病區者高於0.20ppm，鄰近病區的非病區者則介於0.12-0.20ppm之間(7)。但是在同一病區中，病人和健康人的發硒均值沒有顯著差別。發硒的波動與季節高發沒有關係，同一農戶成人的發硒水平平均比兒童高。

(3) 尿硒：尿硒排出量隨膳食中硒的進食量而變動。楊光圻 (8) 等測定12小時夜尿中的硒排出量，病點兒童為 0.69 $\mu$ g，北京市郊者為 1.5 $\mu$ g，而北京市區者為11.9 $\mu$ g。徐光祿等 (8) 測定24小時尿硒排出量，病區兒童為40 $\mu$ g，非病區者為 7.1 $\mu$ g。病區兒童尿硒排出量顯著低於非病區兒童。

(4) 血中的穀胱甘錳過氧化物酶 (GSHpx)：GSHpx 是已知的人體中唯一的含錳酶。朱蓮珍等 (12) (13) 測定了人群全血中的 GSHpx 活力，病區高於非病區，職工高於農業戶。補充亞錳酸鈉後，血錳、發錳和全血中 GSHpx 活力均增加。因此，血中的 GSHpx 活力也可以作為評價機體錳營養狀況的指標之一。

3. 克山病的地區分佈與糧食中的錳：研究發病率不同地區人群的錳攝入量是研究錳與克山病關係的另一重要方法。

錳作為一種微量元素進入人體的途徑不外乎空氣、水和食物。空氣和水中的錳含量極微，肉類，海產品和豆類中含錳較多，穀類食物次之，克山病患者多半是農業戶居民，其食物的主要來源為當地自產的穀物，因而穀物中的錳含量可以大致反映當地的錳營養背景。小麥、稻米和玉米為我國的三種主要穀物，雖不同穀物種類間錳含量有差異，但遠不如地區間的差異明顯，黃豆中的錳含量雖較多，但它在食物中所佔的比例不大，因而對病區人群錳攝入量的影響較少。許多分析結果表明病區糧食中的錳含量低於非病區 (表3)。

表3 病區與非病區主要糧食中的錳含量 (ppm)

	病區				非病區			
	小麥	稻米	玉米	黃豆	小麥	稻米	玉米	黃豆
楊光圻(11)		0.0148	0.005	0.082		0.048	0.028	0.137
徐光祿(8)	0.026	0.021	0.021	0.032	0.044	0.031	0.047	0.083
譚見安(14)	0.019	0.017	0.014		>0.036	>0.039	>0.024	
程之鸞(15)	0.021	0.018	0.014	0.031	0.045	0.045	0.045	0.045

據楊光圻等調查，病區成年人每日錳攝入量多在 10  $\mu$ g 以下，而非病區至少在 17  $\mu$ g 以上。

表4 某些地區居民的錳攝入量及血錳含量

地區	攝入量 $\mu$ g/天	血含量 $\mu$ g/ml
中國克山病病區	11	0.008
中國非克山病區 (病區附近)	17-30	0.027
中國非克山病區 (遠離病區)	66.4	0.146
新西蘭 (Tapanui)	28	0.06
芬蘭 (Lappeenranta)	30	0.056
美國 (南達科他州)	216	0.265
中國錳中毒地區	4990	3.18

遠遠低於我國的非病區及世界上其他已知的低錳地區如新西蘭及芬蘭等。

六 錳預防克山病的可能機制：根據克山病的流行特點及臨床、病理特點推理，克山病可能由於水土中的某些致病因子通過食物鏈而致病，許多人用病區糧喂養的動物作為研究克山病病因和發病機理的主要動物模型。用錳作為干預因子可以更好地研究錳在克山病的發病機制中的作用。

1. 病區糧飼養動物的錳代謝：陳君石 (21) 康保安 (22) 等將  $Na^{275}SeO_3$  或  $L-^{75}Se$ -蛋氨酸經灌胃或經腹腔注入以病區糧飼養的大鼠體內，發現  $^{75}Se$  在其體內各組織中的貯留量比對照動物多，而由尿、糞中排出得少。無機錳或有機錳在體內的代謝相似 (參見表5)。

表5 克山病區與非病區飼料組大鼠注入L-57Sc-硒蛋氨酸2日後組織中硒吸收量(劑量%/g)2日

	鼠數	血	心	肝	腎	脾
病區組	6	0.7669 ±0.2019	0.9740 ±0.1768	4.0197 ±0.4987	3.6181 ±0.5988	1.4539 ±0.3287
非病區組	6	0.6259 ±0.1321	0.6646 ±0.1761	2.8519 ±0.4308	2.8356 ±0.5755	1.0685 ±0.2854
P		0.2 > P > 0.1	< 0.01	< 0.002	0.1 > P > 0.05	< 0.058

李廣元等(19)進一步證明病區糧飼養大鼠心肌的蛋白質、總脂、RNA、DNA中sE的摻入量也較對照組高。表明病區糧飼養的動物確實處於貧硒狀態。

3 缺硒對心肌細胞氧化代謝的影響：楊同書等(20)用氧電極法測定心肌琥珀酸脫氫酶(SDH)和細胞色素氧化酶(CCO)活力及心肌綫粒體氧化磷酸化作用。(參見表6)。

表6 心肌呼吸酶活性

組別(例數)	硒活性(▲mmHgPO/分/mg心肌蛋白)	
	SDH	CCO
對照組(6)	27.6±4.8	55.5±7.7
病區組(6)	21.4±5.6	45.0±6.9
病區+Se組(5)	22.9±3.5	50.4±13.3

心肌綫粒體氧化磷酸化機能

組別(例數)	QO <sub>2</sub>		RCR	P/O
	State 3	State 4		
對照組(6)	133.2±8.6	19.7±5.3	7.1±1.7	2.85±0.26
病區組(6)	110.3±19.5	13.1±6.3	10.7±4.8	3.01±0.30
病區+Se組(5)QO	128.8±27.9	10.8±5.4	16.0±10.8	3.10±0.60

結果表明病區糧組動物心肌的SDH和CCO活性均明顯低於對照組(P<0.05)，補充硒對SDH及CCO有改善，但仍未達到對照組水平。病區糧組心肌綫粒體的状态了呼吸連率低於對照組(P<0.05)，補充硒後有所回升。P/O比值各組間元統計上的差別。以上實驗說明病區糧所引起的動物心肌供能代謝障礙是以氧化代謝過程受損為主，偶聯過程變化不大。補硒可能有益於心肌細胞的供能代謝。

4. 硒缺乏對心肌的脂肪代謝：李廣元等(20)還發現病區糧飼養的大白鼠及仔豬心肌及血清中游離脂肪酸(FFA)及總脂含量明顯高於對照組，與心肌中的Se含量呈相反關係。(參見表7)

表7 大白鼠心肌及血清中脂質含量比較表

組別	例數	血清 FFA L肌	L肌		
			FFAuM mg ±11	PPM	脂質 mg 100mg L肌
病區組	10	301.05 +36.15	281.16 33.86	0.053 ±0.005	3.81 ±0.33(23)
加Se組	6	181.83 +26.84	182.88 ±15.77	0.422 ±0.012	1.59 ±0.15(20)
西女組	10	171.28 +23.78	200.68 +17.78	0.497 ±0.020	1.59 +1.32(24)

●P<0.01(與其他兩組比較)

心肌組織氧化脂肪酸的速率，病區組低於對照組(參見表8)。提示在低硒情況下心肌組織對其主要能源物質(脂肪酸)的氧化能力降低，

表8 大白鼠心肌氧化丁酸鈉攝氧量

組別	例數	10分	20分	30分	40分
病區組	6	10.89 +1.77	16.46 +1.63	19.76 ±1.56	23.56 ±1.50
加Se組	6	20.54 1.66	34.1+1.51 29.77	51.82 +7.33	68.85 ±10.45
西女組	6	22.27 3.67	+3.36	48.65 6.89	67.05 +5.35

●P<0.01

▲O ul/40mg L肌/分

導致病區糧組動物心肌中的脂肪堆積，補硒後有明顯的改善。

5. 硒與免疫功能：微量元素硒在生物學上的作用尚未完全弄清楚，硒對免疫功能的影響早已引起人們重視。缺硒的啤酒酵母飼料中補充非中毒劑量的硒可以增進小鼠抗綿羊紅細胞的Igm及IgG抗體的滴度，過量的硒反使免疫功能降低。克山病患兒的PHA皮試反應低下，周圍血淋細胞的玫瑰花結所佔的比例低於正常，經補充適量的亞硒酸鈉後有所改進(16)。

白錦等用能致小鼠心肌壞死的柯薩奇B<sub>4</sub>病毒作為牽累因子感染以病區糧或人工合成低硒飼料喂養的子代乳鼠，結果證明這些低硒仔鼠心肌病變的檢出率和病變嚴重程度均高於對照組。加Se對心肌有一定保護作用。病變程度與血Se水平呈相反關係(表9)。

## 感染病毒乳鼠的心肌壞死及血硒

	檢例數	陽性例數	陽性%	病變積累 (格)	血硒(ppm)
常備組	72	8	11	468	0.321
四川組	44	17	38	2525	0.033
川硒組	58	8	14	297	0.070
合成組	74	23	31	1984	0.023
合硒組	70	16	22	767	0.088

最近，我們用病區糧飼養小鼠(23)，其脾淋巴細胞對  $Co_{12}A$  刺激的轉化率稍降低，免疫空斑形成細胞數減少，免疫特異性玫瑰花形成細胞（抗原結合細胞所佔的百分比降低，淋巴細胞介導的體外綿羊紅細胞溶血反應也較低，與用非病區糧飼養的動物相比有非常顯著的差異，說明病區糧中確實存在抑制機體免疫功能的因素，補充硒後能部份改善其免疫功能狀態。

七、結語：大量現場和實驗室的研究結果證明：

1. 用亞硒酸鈉預防急型和亞急型克山病的發病有明顯效果。
2. 病區糧食中的硒含量較低，病區人群體內貧硒。
3. 補硒對用病區糧模擬病區環境所產生的心肌壞死有一定保護作用。
4. 補充硒對用病區糧飼養的動物的心肌細胞氧化代謝及脂肪代謝有一定調節作用。
5. 克山病患兒的免疫功能降低，用病區糧飼養的動物的免疫功能比對照動物低，補充硒有部份改善作用。

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以上結果表明克山病的發病很可能與環境中的硒有密切關係。證明了微量元素硒在保障人體健康，預防人類疾病方面有作用，這項研究得到了專門從事微量元素與人體健康研究的國際學術組織的關注。於 1985 年 6 月 1 日在我國首都北京召開的第三屆“硒在醫學生物學中的作用”專題國際討論會上，我國科學工作者獲得了以美國著名微量元素專家克勞斯·施瓦茨 (Klaus Schwarz) 教授命名的“施瓦茨獎”證書和獎章。

克山病的病因是複雜的，我們對克山病的病因、發病因素及流行規律的本質還未完全掌握，許多現象還不能用缺硒來解釋，例如：低硒地區並不一定都發生克山病，病區患者與病區“健康人”的發硒水平無差別，用亞硒酸鈉和維生素 E 治療亞急型克山病病人的效果不明顯等，但用亞硒酸鈉預防急型和亞急型克山病的效果是肯定的。

近年來，我國克山病病情呈持續穩定下降，已有 15 年沒有暴發流行。到 1984 年底的統計資料表明，發病率及病死率均降至歷史最低水平，全國全年分別只有 374 人和 92 人，不及多年來平均數的 1/20。克山病的發病率在全國範圍內一致下降這一事實的原因是多方面的，除補充硒的效果外，病區農民的生活水平提高，如農作物品種多樣化，家畜家禽飼養增多，居住及衛生條件改善等均有很大關係。

目前對於硒預防克山病是屬於病因防治還是阻斷發病過程中某一環節，尚待繼續觀察和研究。硒在克山病發病中的地位已引起我國地方病學、營養學、生物化學、地球化學和生物物理學各方面科學家的興趣，他們所取得的成果均引起了國內外學者的重視。硒缺乏很可能不是克山病的唯一病因，但研究克山病關係的研究為克山病的防治和硒的營養功能開闢了新的領域。



# Endemic Selenium Deficiency and Keshan Disease

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### I . Introduction :

Keshan Disease is an endemic cardiomyopathy characterized by acute or chronic insufficiency of heart function. The disease is prevalent generally in hilly and mountainous areas in 15 provinces. Many patients are from farming families. The most susceptible population are women of child-bearing age and 2-7 year-old children. Because Keshan Disease was rampant in 1953 in Keshan county. Heilongjiang province in northeastern China, the disease was named after the place. The mortality rate of Keshan Disease used to be more than 80%. A large proportion of the survivors would die in the consequence of chronic heart failure later. A lot of research works have been done on prevention and treatment of Keshan Disease after the Liberation. It is demonstrated that sodium selenite is effective in reduction of the incidence of Keshan Disease

and selenium is deficient in the internal and external environment of population in Keshan Disease endemic areas. The results suggested that endemic selenium deficiency may be related to the occurrence of Keshan Disease.

### II . Characteristic feature of Keshan Disease patients :

1. Clinical types and treatment of Keshan Disease :  
The predominant signs and symptoms of Keshan Disease are the result of acute or chronic insufficiency of heart function. Keshan Disease can be subtyped into acute, subacute, chronic and latent type on the bases of acute or chronic occurrence, severe or mild signs and the degree of heart enlargement.

(1) Acute type : The acute type of Keshan Disease is usually sudden onset in otherwise apparently healthy children without history of cardiac disorders.

The most common sign of acute Keshan Disease is cardiogenic shock. Acute pneumoedema and Adams-Stocks syndrome are not seldom seen. The features of cardiogenic shock are dizziness, malaise, nausea, palpitation, cold sweating, pallor, cold extremities, weak pulse, hypotension, arrhythmia, etc. The ECG showed that ST segments elevated above the isoelectric line and the T waves inverted and even formed monophasic curves, atrioventricular conduction time and Q-T intervals prolonged and bundle branch blocks are formed.

The death rate and the proportion of patients transformed to chronic Keshan Disease decreased sharply since the using of megar dosage of ascorbic acid for the treatment of cardiogenic shock in 1960's. Five to ten grams of ascorbic acid ( in a 12.5% solution ) was added to 40ml of 25% glucose solution for intravenous injection. It can be repeated after 2 or 3 hours. The total amount of ascorbic acid should not be over 30 grams per day. The dosage for children is about 3 to 5 grams for each injection.

(2) Subacute type : In subacute Keshan Disease, obvious congestive heart failure occurred in 2 to 4 weeks after the onset. The degree of dilation of heart is in the median range. Gallop rhythm can often be heard. Block of the conductive system of heart, ST-T segment change and ventricular extrasystole appeared on ECG. The function insufficiency of heart is in the III to VI grade.

(3) Chronic type : The chronic type of Keshan Disease can be transformed from acute or subacute type, or occurred spontaneously. The treatment of subacute and chronic Keshan Disease is similar to that of other congestive heart failure by cardiotonics and diuretics.

(4) Latent type : The heart function of latent type of Keshan Disease is in the compensated condition with no obvious cardiogenic symptoms. The mild enlargement condition with no obvious cardiogenic symptoms. The mild enlargement of heart and slight abnormal ECG changes are always neglected by themselves but discovered in physical examination for other reasons.

2. Pathology of Keshan Disease ; Myocardium is the major target tissue of Keshan Disease. Skeleton muscle such as the diaphragm may or may not have mild changes. Lesions in other organs are mostly secondary to acute or chronic heart function insufficiency.

On gross observation the heart showed highly expanded with all chambers dilated in chronic cases of Keshan Disease, but it may show no enlargement or only moderate myocardial hypertrophy in acute cases. Yellowish gray lesions scattered on the surface of heart muscle, especially on left ventricular walls in acute or subacute types. Histopathologically, multifocal necrosis and fibrotic replacement with some relatively intact myocardium located in the same field under microscope. The necrosis are distinguished into two types, contraction band necrosis and myocytolysis. Contraction band necrosis appeared in a irregular fibril disorganization, which may be the contraction and breakdown of myofibril in acute attack of Keshan Disease. Myocytolysis is regarded as the representative change of Keshan Disease especially of subacute type, characterized by progressing vacuolation and liquefaction. Ultrastructural observation showed that mitochondrial change appeared to be the most commonly and conspicuous change including mitochondria

swelling, cristae broken and lost later. Mitochondria may lose all their contents and appeared as balloons outlined by the remaining outer membrane. Usually the interstitial tissue is not involved. Lymphocytes and macrophages are commonly found in and / or around the necrotic foci.

### III. Epidemiological characteristics of Keshan Disease :

1. Endemic distribution of Keshan Disease : The disease is prevalent in certain hilly and mountainous areas in a wide belt extending from northeast to southwest of China. In alluvial plains or in lakesides within the wide belt, the number of patients are less or the situation of patients are milder. The geographic features of endemic areas are " eroded " , however that of non-endemic areas are " precipitated " .

2. Annual and seasonal variation : The prevalence of Keshan Disease are intermittent and the peak years are not the same in different areas. The peak season in Northeast is in cold winter from December to February, but that in Southwest is in hot summer from April to August.

3. Population susceptibility : The incidence rate among women of child-bearing age was 1.5 to 4.8 times higher than that among men of the same age. Although the total incidence rate has decreased in recent years, the proportion of children to adults increased. In the South, children of two to seven year-old were the main victims. They are from farming families living on relatively monotonous foods.

### VI. Selenium and its preventive effect on Keshan Disease :

1. The clue from the prevention and treatment of white muscle disease in livestock : The areas which are prevalent of Keshan Disease are also prevalent of white muscle disease in young ruminants. The local veterinarians have been using sodium selenite for the treatment of white muscle disease and got good results. Because of the similarities of myocardial lesions between white muscle disease animals and Keshan Disease human, the idea of using sodium selenite for the prevention and treatment of Keshan Disease was appeared, and a research programme was developed by our Keshan Disease Research Group. The Chinese Academy of Medical Sciences in 1969.

2. Intervention study with sodium selenite tablets : After a series of toxicological studies on animals, the safe dosage of sodium selenite was established, pilot human studies were conducted in the field. The preliminary results were encouraging. No conclusion was obtained by 1973 because of the lower incidence rate and the relatively limited subjects investigated.

In 1974 and 1975, our research group conducted a double-blinded intervention study in all 1-9 year-old children of 119 production teams in 3 communes and of 179 teams in 4 communes respectively in Sichuan. The selenium supplemented or placebo groups are arranged randomly, and not changed in these two years. The tablets were delivered by the trained personnel chosen from each production team. Sodium selenite tablets were given on 0.5 mg for 1-5 year-old

children and 1.0 mg for 6-9 year-old children once a week. Doctors who were in charge of the diagnosis and treatment of patients did not know anything about the assignment of groups. The case analysis was performed by other doctors who were in charge of investigation and following up patients. The incidence rate of Keshan Disease were 13.5 ( 27/3985 ) and 9.5 (26/5445 ) per thousand children in control group and 3.2 ( 10/4510 ) and 1.0 ( 7/6767 ) per thousand children in supplemented group in 1974 and 1975 respectively. The difference was highly significant between these two groups. No side effect were seen due to selenium supplementation except for a few cases of nausea which could be avoided by consuming the tablet postprandially. The conclusion of the efficacy of selenium supplementation on the prevention of Keshan Disease was drawn then.

All cases in these groups were followed up for four years. By the end of 1977, 50% ( 53/106 ) of patients in control groups died and 4.7% ( 5/106 ) remained in insufficiency of heart functions. On the contrary only one of 17 patient died in selenium-supplemented group. The results showed that selenium reduced but not eliminated the number of patients and the prognosis of Keshan Disease is better in selenium supplemented group. ( table, 1 )

Because of the received selenium tablets from 1976 to 1980. The incidence rate of Keshan Disease was decreased further. ( Table,2 )

In order to follow up the long-term effect of selenium on prevention of Keshan Disease, another survey ( ) was conducted in children from 3 to 10 year-old who were born and living in areas supplemented with selenium tablets or selenium enriched table salt for ten years. Physical examination, ECG and X-ray were taken for diagnosis. The result showed that there were 4 latent type cases in 194 selenium tablet treated subjects, 5 latent type cases in 211 selenium salt treated subjects. In contrast to this, there were one subacute Keshan Disease patient and 13 latent type cases in 218 untreated subjects. Thus, it is likely that selenium might retard the effect of pathogenic factors. ( Table, 3 )

#### V. The relationship between selenium and Keshan Disease:

1. The role of selenium in nutrition : The history of selenium, a trace element, is less than one hundred years. It has been known only as a toxic agent until the discovery by Schwarz in 1957 that the " third factor " which could prevent rats from liver necrosis was selenium. The effect of selenium on prevention of white muscle disease in livestock and exudative diathesis in chicken was proved in later years.

It is known that selenium is an integral part of glutathione peroxidase which distorys lipid peroxides forming in the metabolism of unsaturated fatty acids and thus selenium prevents cell membrane and cell function from damage caused by lipid peroxide. Selenium is synergistic to vitamin E on antioxidation and can save vitamin E in the body.



2. Selenium status of residents in Keshan Disease endemic areas :

The prevalence of Keshan Disease in certain particular areas made this disease in connection with the local environmental factors. The preliminary result of prevention study prompted us to analyze the selenium status in the internal and external environment of local people. Samples from 77 endemic sites in 11 provinces and 110 nonendemic sites in 20 provinces were collected. The selenium content of blood, hair, urine and grains were analyzed and the activity of GSHpx in blood were measured.

(1) Blood selenium : The selenium content in blood is known to be the better parameter for representing nutritional selenium status in the body. The average blood selenium level is 0.021 and 0.095 ppm in endemic and non-endemic population respectively, and the difference is highly significant. The blood selenium content in Shanxi province is 0.018 ug/ml in endemic and 0.076ug/ml in non-endemic population. Thus blood selenium content less than 0.2 ppm is considered as selenium deficiency. ( Table, 5 )

The blood selenium content of population in Keshan Disease endemic area is the lowest in comparison with those in Finland ( 0.060ug/ml ) and in New Zealand ( 0.042-0.060ug.ml ) identified, as the lower selenium areas on the earth. Because of the disadvantage of collecting blood samples and good linear on-log correlation of blood selenium content with that of hair selenium ( observed from 200 pairs of samples by our laboratory ), hair samples were selected to indicate the background of selenium nutrition status of population for extensive field studies.

(2) Hair selenium : Hair samples were collected within 1cm from occipital scalp. The result showed that hair selenium content of population in endemic areas were less than 0.12ppm while those in non-endemic population were greater than 0.2ppm, and those regions nearby the endemic areas ranged from 0.12 to 0.20 ppm. The hair selenium content of adults is higher than children in the same family.

(3) Selenium excretion in urine : The selenium excretion in urine follows the selenium intake from food. The average selenium excretion in 12 night hours from urine of children was 0.69 ug in endemic site, 1.5 ug in the suburb of Beijing ( non-endemic region ) ( yang et al ). In Shanxi, the selenium excretion in 24 hours from urine of children was 4.0 ug in endemic areas and 7.1 ug in non-endemic areas. The difference are highly significant.

(4) The glutathione peroxidase ( GSHpx ) activity in blood : Glutathione peroxidase ( GSHpx ) is known as the only enzyme containing selenium in human. The GSHpx activity of population in non-endemic area is higher than that in endemic area, and that in professional families is higher than that in peasant's families. The activity of blood GSHpx increased along with blood selenium content after selenium supplementation.

(5) Selenium in grains : One of the methods for studying the relationship between selenium and Keshan Disease is to study the selenium intake and selenium content in human body. Selenium is rich in meat, seafood and relatively poor in grains. The selenium contents in air and water are scarce and can be neglected.

Because most of patients are from peasant's families living on local grains, the selenium content of grains can represent the selenium background of local people. Wheat, rice and corn are the three major staple foods in our country.

The selenium content of grains analyzed by different laboratories are shown in table 4. There are highly significant difference between endemic and non-endemic areas.

The total dietary intake of selenium is less than 10 ug per day in endemic areas and that is at least 17 ug in non-endemic areas.

V]. Experimental studies on etiopathogenesis of Keshan Disease : In view of the epidemiological patterns, clinical appearance and pathological characteristics, the etiology of Keshan Disease was considered as the result of certain pathogenic factors in water, soil and food from endemic regions passing through the food cascade to human. Animals fed with grains produced in endemic areas have been used as the model for the research of etiology and pathogenesis of Keshan Disease.

1. Selenium metabolism in animals fed grains from endemic areas : Rats fed with grains grown in endemic areas ( experimental group ) and non-endemic areas ( control group ) were injected with  $\text{Na}_2^{75}\text{SeO}_3$  or L- $^{75}\text{Se}$ -methionine. The content of Selenium retained in tissues of experimental group was greater than that of control group. The metabolism of inorganic or organic selenium is the same in the body. The amount of Se incorporated into protein, lipids, RNA and DNA of tissue in rats is higher in the experimental group. It shows that animals of experimental group are in deficient selenium status. ( Table, 6 )

2. The effect of selenium deficiency on the oxidation of myocardium : Oxygen electrodes were used for the measuring of the activity of succinic acid dehydrogenase ( SDH ) and cytochromoxydase ( CCO ) and the oxidative phosphorylation in myocardium. The activity of SDH and CCO in myocardium of experimental group is low and the activity increased after selenium supplementation, but it is still lower than that of the control group. The respiratory rate of state 3 in the mitochondria of myocardium of experimental group is slower than that of control group. The P/O ratio is not different between groups. These results suggest that the block of energy metabolism may exist in the oxidative process. The phosphorylation is unchanged. The supplementation of selenium may be beneficial for the energy metabolism of myocardiocyte. ( Table, 7, 8, )

3. The fat metabolism of myocardium in selenium deficiency : The amount of free fatty acids and total lipids of plasma and heart muscle is greater in experimental group and the amount of selenium is in reverse relations with blood lipids ( Li et al ). The rate of oxidation of fatty acids is also slower in experiment group. It suggested that the oxidation of energetic substances, fatty acids, of myocardium in experimental group is decreased, the accumulation of fat in heart muscle thus occurred. The situation was improved after selenium supplementation. ( Table, 9, 10 )

4. Selenium and immunity : The role of selenium in biology was not clear. The effect of selenium on immu-

nity has attracted many people's attention. Several investigators have demonstrated that optimum selenium supplemented to Se- deficient torula yeast-based diet resulted in enhancement of the production of anti-SRBC IgM and IgG antibodies in mice. Over consumption of selenium may depress the humoral immunity. The skin test of delayed-type hypersensitivity with PHA was depressed and the rate of rosette forming cell in peripheral lymphocyte was decreased in subacute type Keshan Disease. Adequate supplementation of selenium can improve above parameters.

Bai et al reported that multifocal necrosis have been produced in suckling mice by injection of Coxsackie B virus. The incidence and degree of necrosis are higher in experimental mice ( born from Se-deficient dams either fed grains grown in endemic area or low selenium synthetic diets ) than that in control mice. The change of myocardial tissue can partially be protected by selenium supplementation. The degree of damage in the heart and the concentration of selenium in blood is in reverse relations.

Recently, groups of mice were fed grains grown in an endemic area and immune function tests were conducted in our laboratory. In these affected mice, the response of lymphocyte transformation to Con A decreased, the number of plaque forming cell reduced, the ratio of rosette forming cell decreased and the response of lymphocyte mediated hemolysis also decreased. Partial improvement of the tests could be observed by selenium supplementation.

VII. **Conclusion** : Many facts in field studies and in experimental animal studies demonstrated that :

1. The efficacy of selenium supplementation of prevention of acute and subacute type of Keshan Disease is obvious.
2. People living in endemic areas are in poor selenium status. The selenium content in grains grown in endemic areas are much less than that in non-endemic areas.
3. Selenium supplementation is helpful to a certain degree on protection of animal from imitated myocardial necrosis induced by endemic grains.
4. In a certain sense, the changes of oxidation metabolism and fat metabolism induced by endemic grains is regulated by selenium supplementation.
5. The immune function of Keshan Disease children was decreased. The immune response of animals fed endemic grains was lower than controls. Selenium supplementation can improve the response to some extent but not reach the control level.

These facts showed that the occurrence of Keshan Disease is related to the environment low in selenium. The results of our work proved that trace element selenium is related to human health and is effective in protection of human from the attack of Keshan Disease. To our knowledge, Keshan Disease is the first human disease discovered to be associated with selenium deficiency. This project was attracted attention by many scientists and scientific organizations in the world who were engaged in the research on trace element and human health. On June 1 1984 in the Third International Symposium on Selenium in Biology and Medicine holding in Beijing, Capital of China, our scientists were rewarded " Schwarz " certificate and medal ( in honour of the famous trace element scientist Dr. Klaus Schwarz ).

The cause of Keshan Disease is very complicated. Although we did not grasp the essence of etiology of Keshan Disease do not occur in every area poor in selenium, the hair selenium content is not different between patients and " healthy " people in the same endemic area, the efficacy of selenium supplementation on prevention of acute and subacute type of Keshan Disease is doubtless.

The incidence rate of Keshan Disease is decreasing constantly in recent years. There has been no outbreak of Keshan Disease for 15 years. The incidence rate and death rate has come down to the lowest level in the history with only 374 and 92 cases respectively in the whole country, which was reported in 1984, not reaching one twentieth of the average number of cases per one year.

According to the fact cited above, selenium supplementation may be only one of the reasons for the lower incidence rate of Keshan Disease. In addition,

the raising of living standard in farmers, such as variety of crops, more animal meats, proper arrangement of diet, improving of living and sanitation conditions also play important roles.

The role of selenium supplementation on prevention of Keshan disease, whether selenium supplementation resolved the problems from etiological point or broke one of the cycles of the occurrence, needs further studying. The role of selenium in the occurrence of Keshan Disease has aroused big interest among physicians, nutritionists, biochemists, biophysicist and geograph-chemists in our country. Their achievement attracted attentions nationally and internationally. Selenium deficiency may not be the only cause of Keshan Disease but the research work on the relationship between selenium and Keshan Disease has thrown a new light for searching the etiology Keshan Disease.

**Table 1. Incidence and prognosis of Keshan Disease in selenium-treated and non-treated group**

Group	Year	Total subjects	No. of patients	Incidence rate %	No. of survivor				No. of dead
					worse	improve	latent		
Se-treated	1974	3985	54	13.5	2	9	16	27	
	1975	5445	52	9.5	3	10	13	26	
No-treated	1974	4510	10	3.2	1	0	9	10	
	1975	6767	7	1.0	0	0	6	6	

Year	Se-treated			No-treated		
	Total populatio	No of patie	Incidece rate %	Total populatio	No of patie	Incidece rate %
1976	41,181	4	0.09	5,999	33	5.50
1977	41,758	3	0.07	6,243	12	1.92
1978	41,533	5	0.12	6,310	32	5.07
1979	41,248	8	0.19	6,411	23	3.5
1980	41,384	4	0.10	6,463	18	2.79
Total	207,104	24	0.12	31,426	118	3.75

**Table 3. Hair Selenium content and changes of ECG and heart roentgenography in Se-treated and non-treated children.**

Group	Hair Se (ppm + SE)	No of subject	Heart roentgenography and ECG changes					
			H · C < 0.50		H · C = 0.51-0.55		H · C = 0.56-0.60	
			NorECG	Ab0ECG	NorECG	Ab0ECG	NorECG	Ab0ECG
Se tablet treated(1)	0.107 + 0.008 (27)	194	190	1	3	0	0	0
Se salt treated(2)	0.155 + 0.007 (16)	211	206	2	3	0	0	0
No-treated(3)	0.059 + 0.008 (20)	218	204	5	4	3	1	1
Before treatme0t(4)	0.072 + 0.002 (20)	183	175	1	2	3	2	0

a H · C, Heart : Chest ratio.

b Nor, Normal, Ab0, Ab0ormal.

c Numbers in parentheses are number of samples.

**Table 4. Selenium contents in grains in endemic and non-endemic regions.**

	Endemic regions				Non-endemic regions		
	wheat	rice	corn	soybean	wheat	rice	corn
Yang	0.008	0.008	0.006	0.014	0.038	0.043	0.029
Xiu	0.026	0.021	0.021	0.032	0.044	0.031	0.047
Tan	0.019	0.017	0.014		0.036	0.039	0.024
Cheng	0.021	0.018	0.014	0.031	0.045	0.045	0.045

**Table 5. Selenium intake and blood selenium content.**

Regions	Se intake ug/ml	blood Se ug/ml
Keshan Disease endemic areas China	11	0.008
Keshan Disease non-endemic areas (nearby endemic areas)	17-30	0.027
Keshan Disease non-endemic areas (far from endemic areas)	66.4	0.146
Tapanni, New Zealand	28	0.06
Lappeenranta Finland	30	0.056
North Dakota, USA	216	0.265
Selenosis area, China	4990	3.18

**Table 6. Absorption of <sup>75</sup>Se in 2 days after injection of L-<sup>75</sup>Se-methionine in rats fed with grains growing in endemic and non-endemic areas (retained percentage of dose/gm tissue)**

Group	No of rats	blood	heart	liver	kidney	spleen
Endemic	6	0.77	0.97	4.02	3.62	1.45
non-endemic	6	0.62	0.66	2.85	2.84	1.07
p		0.1	0.01	0.002	0.05	0.05

**Table 7. The activity of respiratory enzyme in myocardium.**

Group	Activity of enzyme mmHg PO <sub>2</sub> /mg heart protein		
	No of subjects	SDH	CCo
Control	6	27.6 ± 4.8	55.7 ± 7.7
Endemic	6	21.4 ± 5.6	45.0 ± 6.9
Endemic + Se	5	22.9 ± 3.5	50.4 ± 13.3

**Table 8. The oxidative phosphorylation of mitochondria in myocardium.**

Group	No. of subjects	QO <sub>2</sub>		RCR	P/O
		State 3	State 4		
Control	6	133.2 ± 8.6	19.7 ± 5.3	7.1 ± 1.7	2.85 ± 0.26
Endemic	6	110.3 ± 19.5	13.1 ± 6.3	10.7 ± 4.8	3.01 ± 0.30
Endemic + Se	5	128.8 ± 27.9	10.8 ± 5.4	16.0 ± 1.08	3.10 ± 0.60

**Table 9. Serum and myocardium lipid in rats.**

Group	No. of subjects	Serium FFA u Eq/L	Muocardium		
			FFA uM/mg pro.	Se ppb	Total lipeds mg/100mg heart
Endemic	10	301 ± 36	281 ± 34	83 ± 5	3.81 ± 0.33
Endemic + Se	6	182 ± 27	183 ± 16	422 ± 12	1.59 ± 0.15
Non-endemic	10	171 ± 24	201 ± 18	497 ± 20	1.59 ± 1.32

**Table 10. Oxidation of butyrate in myocardium of rats. (oxygen uptake Oul/40mg heart/min.)**

Group	No. of subjects	10	20	30	40
Endemic	6	10.89 ± 1.77	16.46 ± 1.63	19.76 ± 1.56	23.56 ± 1.50
Endemic + Se	6	20.84 ± 1.66	34.18 ± 1.51	51.82 ± 7.33	68.88 ± 10.45
Non-endemic	6	22.27 ± 3.67	20.77 ± 3.36	48.68 ± 6.89	67.05 ± 8.35

# 我國食品衛生工作進展

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我很榮幸有機會到香港來向香港地區的同事們和朋友們介紹我國的食品衛生工作的進展。

建國三十多年以來，我國衛生工作在黨的領導下，取得了很大成績。而由於預防醫學的重要性以及黨和政府的重視，最近又組建了中國預防醫學科學院，這予示着我國衛生工作將以更快的步伐發展。將為人民衛生事業作出更大的貢獻。食品衛生工作和其他衛生工作一樣，三十多年來也得了相當顯著的成績，尤其近十幾年，發展更為迅速，現就我國建國以來，尤其是近十年的食品衛生工作進展，簡要介紹如下：

一、建立了食品衛生監督、檢驗、研究系統，初步形成了全國性的食品衛生監督網。

解放前，我國僅少數幾個大城市有一些食品衛生管理工作。就全國範圍而言，沒有全國性統一的食物衛生監督，新中國成立後，黨和政府十分重視衛生防病工作，於1953年在全國範圍內，建立了縣及縣以上的各級衛生防疫站，開展了食品衛生監督工作。自成立衛生防疫站到1966年以前的一段時間內，衛生部頒發或與其他部共同頒發了若干有關食品衛生管理方面的辦法，規程和條例。例如，建國初期，由於冷飲引起腸胃道疾患較多，1953年衛生部頒發了“清涼飲食物品管理暫行辦法”，有力地改變了冷飲質量不良的問題。五十年代末期，發現我國食品行業應用色素比較混亂，經過衛生部組織有專業人員參加的調查後，1960年由國務院轉發了“食用合成染料管理辦法”，指定專廠生產食用色素，從而杜絕了濫用色素以及因此而造成中毒死亡的情況。所有這些對加強當時食品衛生監督檢驗，保證人民健康都起到了良好作用。但由於當時人力物力和客觀情況的限制，食品衛生工作並未得到很大發展。十年動亂期間，食品衛生工作除涉及外貿者外幾乎全部停頓。

七十年代以來，由於外貿工作的需要，以及黃菌毒素等毒物污染食品引起的國際性的關注，我國情況究竟如何，是中央領導和廣大群眾都十分關心的問題，在此形勢下，我國食品衛生工作也相應獲得了迅速發展。從此，真正開始了我國食品衛生工作體系的建立和形成。

1973年衛生部召開了“食品衛生學習班”，由醫科院衛生研究所具體負責，制定了“1973年—1975年全國食品衛生標準科研協作計劃”，並以衛生防疫站為主體，組成了14個科研協作組，發展全國力量，開展食品衛生的制標科研工作。當時據到會各省有關專業人員共同估計，全國從事食品衛生的專職兼職人員僅300人左右，以此力量來進行全國規模的制標工作，顯然是很困難的。於是積極召回和增添人員，重新組織力量，進行了大量檢測和試驗，獲得第一批有關我國食品污染的數據。據此，1974年衛生部將全國食品污染情況報告計委，計委報告國務院，國務院隨即以（74）82號文批轉計委“關於防止食品污染問題的報告”，報告中提出要大力加強食品衛生工作，成立食品衛生領導小組和食品衛生監督檢驗機構，加強了監督檢驗和研究的手段和技術力量，逐步建立起食品衛生監督檢驗研究系統，到1981年，全國衛生系統中，

衛生防疫站，醫學院校以及研究機構內從事食品衛生工作的專業人員已增加到約5000人。其後，由於黨中央的決策，決定大力發展食品工業，也由於食品衛生法的頒佈，各級領導都積極支持和要加強食品衛生工作，到1983年全國18個省市自治區的統計，衛生系統已有食品衛生專業人員10709人，估計全國約為13000人，到1986年統計全國已達26000人其中主任醫師級（副教授及其以上技術人員約佔1%，主管醫師（講師級）約佔10%醫師級（助教級）約佔40%。目前，就全國範圍而言，各省市、區衛生防疫站內均設有食品衛生監督檢驗所或專業科室，相當數量的市縣級衛生防疫站內有食品衛生科，所有縣以上衛生防疫站均有食品衛生專職人員，從事食品衛生工作。在衛生部食品衛生監督檢驗和各省市區衛生防疫站的指導下，全國現有31個口岸食品衛生檢驗所，負責對進口食品進行監督和檢驗，全國現有22個大專醫學院設立營養及食品衛生教研室（或組）所有這些機構，在衛生部及預防醫學科學院的統一領導下，承担着食品衛生監督檢驗所，省市區一級衛生防疫站（或相應的食品衛生監督檢驗機構），口岸食品衛生檢驗所到市縣一級衛生防疫站食品衛生科（組或專職人員），組成的比較權威性的食品衛生監督檢驗研究體系業已初具規模。

此外，我國鐵道交通部系統以及有關部門所屬大型（場）礦也都設有衛生防疫站，從事本部門範圍內的食物衛生監督管理工作又輕工、商業、外貿、化工等食品生產經營或與此有關的部門，為了保證其食品或產品衛生質量，也都在近十年內，建立或加強了本系統的食物衛生監督、檢驗和研究工作，如原糧食部在部內成立了衛生檢驗外，並建立了縣以上糧庫的衛生檢驗系統，以保證其出庫糧食的衛生質量。這些部的食物衛生監督工作，與衛生系統有經常性的聯系。這樣，全國食物衛生監督工作（包括檢驗和研究）在以衛生部為主，其他各部系統為輔，就形成了全國性的食物衛生監督網，為保障消費者身體健康起到了重大作用。例如，不少大城市的糧庫業已做到糧食衛生質量（如黃曲霉毒素等）不符合要求不准出庫。很多冷飲廠業已做到產品檢驗不合格不出廠等。

雖然如此，我國食物衛生監督網與美日相比，不論在人員、設備或管理水平方面都還有相當大的差距，有待進一步改善和充實。

二、逐步建立了食品衛生法制體系，取得了相當成績。

食品供應的豐富與否以及食品衛生質量好壞與否，反映了一個國家民族富強和精神道德文明程度。而是否能迅速立法並真正執行則是一個國家從人治走向法制的具體體現。從我國自身發展而言或與舊中國相比，應該說，我國食物衛生立法是比較快的。是黨和政府決心迅速使國家法制化的具體體現之一。

當然，食品衛生法的頒佈也和我國廣大食品衛生工作者多年的辛勤勞動力分不開的。五十年代我國頒佈了21個法規，六十年代頒佈了13項法規，這對當時的食物衛生管理工作是十分必要的。但這些都是單項法規，而且不是在有系統有組織地對食品衛生工作進行研究的基礎上制訂的。

七十年代由於國際國內形勢的發展以及我國食品污染情況比較嚴重，在全國範圍內開始大規模的試驗研究工作。在大量數據的基礎上，制定頒發了68個法規標準。與五十年代六十年代相比，不但有了量的增加而且有了質的區別，即依靠科學數據來制訂法規和標準。八十年代的步伐更快，僅在三四年間，就頒佈了110項法規和標準。並在多年廣泛研究的基礎上，迅速制訂出我國第一部食品衛生大法——中華人民共和國食品衛生法（試行），這是我國食品衛生工作的里程碑，也是我國衛生系統的一件大事。

近幾年來，在食品衛生法及其他有關法規的推動下，使得全國食品衛生工作有法可依，在各方面取得了相當的成績：

1. 食品合格率有了一定程度的提高。

根據18個省市區的統計，食品衛生法未正式試行前，1982年檢驗各種食品合格率，平均值約為56%，而1983年食品衛生法正式試行後的合格率平均約為66%，增加了10%左右。當然，各地的發展是不平衡的，雖然這些合格率與技術先進國家相比，還遠遠不能令人滿意，但畢竟是起步了、前進了。而十年動亂期間不少大中型廠的那種根本不檢驗或不合格的食品也照樣投放市場的局面業已根本扭轉了。

2. 廣泛宣傳，大力培訓，提高了專職人員的認識和加強了群眾性衛生監督。

1983年1~6月間，為準備正式試行食品衛生法，全國及118個省市區共舉辦了有關學習班5681個，受訓人數達七十二萬三千餘人，其中包括衛生行政幹部，食品衛生監督員，生產經營部門領導，食品行業從業人員等。中央及各省級衛生部門和其他部門協作還採用電視、廣播、戲劇、幻燈、手冊、街頭宣傳等多種形式向群眾進行極其廣泛的宣傳教育，有些地方，如北京、天津等地為了發動群眾監督，還將市及各區縣衛生防疫站電話號碼公佈在地方報紙上，使群眾發現問題隨時可以打電話告訴防疫站進行監督，得到了很好的效果。

為了貫徹執行食品衛生法，不少省市區還廣泛開展了食品衛生法宣傳月活動，如北京市20個市區縣衛生防疫站和醫療衛生部門出動了一萬五千多人次，利用多種形式向六十多萬群眾進行了宣傳。並向一百五十萬戶居民散發了題為“大家都來注意和監督食品衛生”的公開信，出了五十萬份專刊和小報，並且邀請了在北京有關技術人員和中央電視台共同舉辦了“食品與健康”的電視講座。

經過以上的宣傳和培訓，專職人員認識到責任的重大，認識到保護消費者健康的重要意義同時也使群眾受到了教育和鼓勵，敢於起來和食品不衛生的現象作鬥爭。

3. 頒佈了各種“辦法”“細則”或“手冊”，使食品衛生法具體化，便於執行。

各地在食品衛生法正式試行前後，又制定了許多“辦法”“細則”“手冊”等，如“衛生許可證發放試行辦法”，食品衛生索證管理試行辦法”“食品從業人員健康檢查管理暫行辦法”“食品商販和城鄉集市貿易食品衛生管理暫行辦法”“違反食品衛生法行政處罰細則”“食品衛生監督員暫行管理辦法”“食品衛生監督員手冊”等，這樣就進一步使食品衛生法具體化，便於執行。

4. 隊伍擴大，管理落實

前面業已提到，81年食品衛生學術議期間統計全國食衛專職人員約5000人，83年已達萬餘人，86年為

2.6萬人。這一發展各地也是不平衡的。有的步伐比較快，管理就比較好一些。例如天津市執法前，從事監督的僅97人，為了做好監督和執法，又選拔了約200名專業人員參加監督員行列，同時還從衛生院選錄了三百餘人，擔任“食品衛生檢查員”，協助監督員工作，這六百餘人的監督隊伍，使天津市食品衛生監督工作落到了實處，確實在很大程度上保證了食品衛生法的認真執行，也從而保護了消費者的身體健康。顯然，沒有一支數量質量都合格的執法隊伍和輔助人員也就不能真正貫徹執行好食品衛生法。

最後得強調的是，經過食品衛生法的宣傳學習，以及各級領導的重視，很多食品企業的自身管理加強了，表現在企業內的衛生監督員的增加和食品合格率的上升。這為消費者的健康提供了最有力的保證。

三、制訂了一套比較系統的食品衛生標準、管理辦法和檢驗辦法。

如前所述，我國五十年代已制訂了一些單項法規、標準和辦法，1963年在國內頒發了食品衛生檢驗方法即細菌學部分和理化學部分，共兩本書，對當時起到了一定推動作用，七十年代初期，醫科院衛研所開始建立黃曲霉毒素測定方法並對進口糧食衛生標準進行研究，組成了協作組。其後由於國內外，食品貿易的要求，於是在1973年，衛生部委托醫科院衛研所正式開始大規模地組織全國性大協作，對我國食品衛生的各類問題如黃曲霉毒素，有機氯農藥殘毒，“三廢”污染，食品添加劑，食物中毒，細菌，理化檢驗方法，毒理學評價程序以及各類食品衛生標準，由全國廿六個協作組進行了相當廣泛的調查研究。自1973年開始後，不到十年間，由於大批技術人員歸隊，同時補充了人員設備，終於積累了五十萬個數據，制定了一套比較完整的食品衛生標準和管理辦法，目前已約有一千種食品 and 食品添加劑等有了衛生標準。這一計劃的規模之大，範圍之廣，在我國食品衛生史上是空前的，在國際上也是少有的。例如，制定黃曲霉毒素衛生標準，全國用簿層層折法測定了三萬餘份樣品，而制定有機氯農藥殘留量標準時，我國廣泛應用了氣相色譜法測定一萬餘份食物，這兩項測定方法在國際考核中均得到了承認，說明我國的測定數據是可靠的。此外，還進行了大量的動物試驗，以及流行病學調查，在此基礎上制定出來的衛生標準自然是比較切實可行的。

此外，為了制訂好衛生標準，我國還對細菌、理化以及放射性物質測定方法進行了系統研究，並於最近進行了修訂。又如，為了保護食品的安全性，了解其潛在危害，近年來，很多國家都提出，對應用於食品中的化學物質需要進行毒理學研究。為此，經過國內進行試驗研究、專家評議及會議多次討論，提出了我國“食品安全性毒理學評價程序”，並於1983年由衛生部頒發試行。這是我國毒理學立法的開始，從此使我國食品中有關化學物質的安全性評評有了法律依據和比較嚴格的要求，結束了完全依靠國外資料對國內產品進行評價的時代。

四、大力開展食品衛生科學研究，為食品衛生監督奠定了基礎

食品衛生工作的第一線是食品監督，監督是應用自然科學成果解決社會科學中出現的問題，因此，監督本身就是自然科學和社會科學的結合，是技術和政治的統一，也是食品衛生工作中最難的工作。但監督要以檢驗為後盾，而檢驗又必須以研究為基礎，沒有研究，就沒有檢驗，也就無法搞好監督，反之，檢驗



不為監督服務，食品衛生的研究有檢驗和監督的目的，那末研究檢驗就丟失了方向，只能文獻來文獻去，或者從實際中來到文獻中去，就沒有生命力，就不能產生社會效益和經濟效益，是無效勞動。三者的關係是相輔相成的，想搞好食品衛生工作，就必須使三者密切結合，不能偏廢。研究的重點，一方面是為實驗室提供手段，另一方面則為監督和檢驗提供科學數據。正是在這一正確思想指導下，我國在進行監督和檢驗的同時，大力開展了研究工作，並且取得了一批比較好的成果，現簡略介紹一下：

1.細菌性食物中毒—自五十年代開始至今，我國曾對沙門氏菌、葡萄球菌、鏈球菌、致病性大腸菌、蠟樣芽孢菌、耶爾森氏菌、彎曲菌、付溶血性弧菌、肉毒菌等分別進行了研究，首先建立了多種檢驗方法，同時對其引起食物中毒的條件和規律作了探索。如付溶血性弧菌的研究，由於1960年前後，沿海地區經常發生螃蟹等水產品的食物中毒，經研究發現系該菌引起。於是對其診斷、治療、預防等進行了一系列研究，得到了一定成果，尤其是噬菌體分型和血清學分型方面，超過了當時日本的水平。最近又發現以乳兔進行經口毒性測試，十分敏感，比較特異，可以鑒別付溶血性弧菌和溶藻弧菌。

在研究肉毒菌中毒方面發現我國主要不是由罐頭引起的，而是以家庭自制發酵豆制品為主，同時發現少量多次攝入的肉毒毒素中毒症狀、潛伏期、治療效果等與國外很不相同，是一種亞慢性中毒，有其固有的特點，這是國外從未報導過的。

至於幾十年來迄今未獲解決死亡率可高達100%的臭米麵中毒，自全國第一次食品衛生學術會議後，經過我國科研人員進行了大量研究後，證明由酵米麵黃干菌的外毒素所引起，並且確定了其結構式，肯定了該毒素和在印尼發現的米醇酸（Bengkrekic acid）是同一物質。

這些研究成果對食品衛生監督檢驗的促進作用是不言而喻的。

2.霉菌及霉菌毒素—從七十年代初開始，由衛生部門牽頭，組織了廿多個省市區的有關技術人員共同協作，對黃曲霉毒素進行了食品中含毒量測定，慢性毒性試驗，防霉去毒方法等多方面的廣泛研究，這是我國近年來規模最大的研究協作課題，其主要結果：

（1）全國測定了三萬餘份食品，鑒定了一千餘株菌株的產毒情況，結果說明我國長江流域及其以南的廣大高溫高濕地區的食品，有黃曲霉毒素的污染，污染的主要食品為玉米、花生、及花生油，個別地區的污染率可達40-60%，而東北、西北及華北地區的污染較少，或未見污染。

（2）食品污染率，產毒菌株比率和肝癌死亡率之間均呈正相關。（3）根據食品中測定結果，國內外慢性毒性試驗以及我國實際情況制訂了各類食品中黃曲霉毒素允許量標準，管理辦法和檢驗辦法。

（4）糧油食品中污染黃曲霉毒素可以預防和去毒。在我國現場兩年的試驗研究證明最易污染黃曲霉毒素的玉米、花生，只要能及時挑除霉糧，盡快乾燥就可有效地使玉米、花生中含毒量符合國家標準或不含毒。而含毒玉米、大米、花生米、花生等也可以利用挑選、淘洗、紫外綫照射，中草藥處理。機械分離後漂洗等方法，有效地去除黃曲霉毒素，例如含毒量為670PPB的玉米，經處理後所制的玉米米粉檢不出黃曲霉毒素，結果是比較理想的。這些辦法，都具有我國的特色，國外至今研究很少或尚無報導。

又最近幾年各地先後發生了多起霉甘蔗中毒，兒童食後，死亡率很高，經過幾年的努力，現業已証實是由節菱孢霉所引起，所產生的毒素為3硝基丙酸（3-Nitro Pr Pionic acid）目前正在着手對其進行深入研究。

此外，國內還建立了食品中雜色曲霉毒素、棕曲霉毒素-A的測定方法，對赤霉病麥、黃粒米等也進行了相當規模的試驗研究，並取得了一些進展。

3.有毒動植物中毒—我國曾經對河豚魚、木薯、山黑豆、四季豆、蜂蜜、棉籽油、織紋螺、毒蕈中毒等進行了研究，現簡略介紹如下：

發現2%碳酸鈉可破壞河豚魚卵巢的毒性，為利用河豚魚內臟提供了可能性。

經過化學測定，動物試驗，人體試驗提出了木薯去毒去氫氰酸殘留標準，及防止急性中毒的氫氰允許限量。

研究了浙江沿海一帶發生的織紋螺中毒，發現其毒力隨地區而異且和當地海域中有毒藻類有關，証實其與國外報導的麻痹性貝中毒相符。

開展了毒蕈中生物碱及毒甙的測定研究，繪制出常見毒蕈彩色圖譜，為防止誤采食毒蕈提供了手段。

4.農藥—七十年代，在國家科委，化工部等大力支持下，衛生部組織力量對我國使用的近百種主要農藥進行了廣泛的毒理學研究對農藥的主要研究結果為：

有機氯農藥—我國直到八十年代初期農藥生產使用主要六六六但由於其理化特性，易於蓄積於機體內，很多國家業已禁用工業品六六六，只允許生產使用林丹。我國是否也要將工業品六六六轉產為林丹？這涉及我國主要農藥生產的前途問題，據此，自1973年組織了有廿七個省市區參加的協作組，對六六六進行了研究，其主要結果有：

（1）在十多個省市區共採樣品一萬餘份，氣相色譜測定結果說明我國食品普遍有六六六，DDT的污染，在此基礎上結合我國的有關毒性試驗，制定了多類食品的殘留量標準。

（2）我國不同單位進行的亞慢性、慢性、致癌試驗證明工業品六六六主要侵犯肝臟，而林丹主要侵犯腎臟，飼料中含林丹僅1ppm時即可引起雄性大鼠腎臟的病理改變。同時病變與腎臟中六六六含量密切相關。國外迄今未見類似報導，據此，生產部門決定不發展林丹的生產。

（3）在國內外首先發現證明中有機氯農藥含量與人體脂肪中含量呈十分顯著的正相關。因此，可以用訂吟代替脂肪來檢測有機氯農藥對人體的污染，從而為研究其與人體腫瘤關係提供了切實可用的生物材料。此外，在我國的試驗中還發現WHO規定的以脂肪計算表示肉類中有機氯含量有一定的局限性，並提出了我們的修改意見。

有機磷農藥—我國使用這類農藥業已多年，但迄今未制訂其殘留標準，也無測定方法，因此，也無法進行監督，食品衛生法頒佈後，此問題更為突出，為此，近幾年迅速建立了多種主要有機磷農藥殘留量測定方法，並結合國內外毒性資料和測定結果提出了有關標準。使多年來的問題獲得了解決。

其他—

我國在研究菌核利時發現它能引起動物發生白內障，敵枯雙具有強致畸作用，而工業品敵草隆的致突變作用很強，從而都及時地作出相應決策，避免了經濟損失，保障了人民健康。而對川化018，和雙氰胺

的毒性研究，說明這些品種比較安全，可以發展，從而為化工部門提供了生產的科學依據。

#### 5. 食品添加劑：

食品添加劑的種類、品種繁多，全世界約有萬餘種，食品工業生產者已提出“食品添加劑是食品工業的靈魂，沒有食品添加劑就沒有現代食品工業”的說法。這一說法不一定全面，但由此可見其在食品工業中的重要地位。有鑒於此，衛生系自1973年以來，成立了協作組，對此進行了系統調查和研究，根據國際資料，國內測定結果和毒性試驗，逐個進行了評價，確定了允許使用的品種和範圍並提出有關衛生標準和管理辦法，從而制止了各大城市濫用的現象。在增稠劑的田菁膠的研究中證明我國生產的田菁膠，用於食品中是安全的可以代替進口的古爾膠，這將為國家節約大量外匯，又我國的研究還證明我國氨法生產的焦糖色並無致畸作用和致驚厥作用，而進口香料二甲基嘧喃酮進行的研究表明，它可引起某些致突變試驗獲得陽性結果，這些都是國外未曾報導過或與國外報導不一致的，顯然，上述結果對這些產品的生產或進口會產生影響。

#### 6. “三廢”污染

從七十年代開始，我國即對汞、砷、鉍、石油廢水等污染食品問題進行了大規模的研究工作。

汞：根據16省市自治區4905份食物樣品的分析結果以及我國進行的動物試驗和人體中毒調查，制定了我國食品中總汞的容許限量標準。在研究中還發現飼料中含汞為0.1PPm時，一年後動物腎臟中均有汞的明顯蓄積。而人體服入含汞量為0.2~0.3PPm的大米，數月後出現症狀，尿汞也有所增加，國際尚未見有類似報告。

鉍：我國普查了6500份樣品，結合1981年以來我國進行毒性試驗和人群流行病調查，提出了鉍在食品中的容許限量標準建議並且提出了人體容許攝入量應為100~150r/人/日。

近幾年還對甲基汞、氟、無機砷等在食品中的污染，測定了一萬餘份食品。同時根據國內毒性資料參考國外數據，制定了相應標準。

#### 7. 食物放射本底

在六十年代初即提出了這一課題。可惜一直未能開展這項基礎研究，七十年代開始建立統一測定方法，並對全國各類食品作了測定共分析了糧、菜、蛋、奶、肉、海產、茶葉等各類食品中的總r、總B放射性，銥-90、銻-137、鐳-226天然鈾等結果表明，我國主要食品的放射性均在限制濃度以下。

#### 8. 輻照食品

我國五十年代即對此問題進行了研究，與國際相比起步不晚，但進展不快，七十年代在國家科委的領導和組織下，衛生系統開始大規模的動物毒性試驗。1982年，由國家科委及衛生部負責組織，又對有關衛生標準和人體試驗制定了詳細研究計劃，到目前為止，業已結束了大米、土豆、香腸、花生仁、磨菇的單項輻照食品和多項輻照食品人體試驗和必要的理化學指標驗證工作，結果表明食用一定劑量照射的輻照食品對所測各種指標均無顯著變化，可以安全食用。經過上述研究後，最近已提出大米、土豆、香腸、花生米、磨菇、洋蔥、大芋等七項輻照食品衛生標準的建議，並已由衛生部批准頒佈。

除以上科研項目外，我國食品衛生方法學的研究也獲得了很大進展。近年來，特別是在近二三年來，

全面對“食品衛生檢驗方法”的理化學部分和微生物學部分在廣泛研究基礎上進行了大量修改和驗證使之更適合我國國情。又在1983年，由衛生部頒佈了“食品安全性毒理學評價程序”（試行），從而使我國在農葯、添加劑、包裝材料新食物資源等安全評價方面有了法定程序。此程序在1985年衛生部又予以修定。此外，七十年代裏我國還制定了放射性物質的測定方法。

從以上簡要介紹不難看出，建國三十多年來，尤其是近十多年來我國食品衛生工作的發展是十分迅速的。全國食品衛生面貌有了很大改變。可以毫無誇張的說，我國食品衛生工作確實成績很大。但另一方面，以我國現在的工作和我國目前迅猛發展的食品工業對食品衛生的要求相比，和美、日、歐發達國家相比，差距還是相當大的，例如美國食品衛生的合格率能保證在95%以上，美國食品局敢於宣佈美國的食品是相當安全的，相形之下，我國合格率尚不足70%。因此其安全性也只能是60~70%了。而欲提高我國食品的安全性，還有許多工作要做！

#### 五、存在問題

1. 執行食品衛生法尚有阻力。食品衛生法是國家法律，應該有其權威性和嚴肅性，經中央一再強調“法律面前，人人平等”“有法必依，執法必嚴、違法必究”以後，近年來，人治的局面已有很大改變，但在某些地方某些問題上，權大於法的現象仍然十分嚴重，這主要是某些領導無視法律的結果，也是黨紀國法民心所不允許的。

#### 2. 隊伍設備亟待加強更新

如前所述，我國現有食品衛生專業人員約2.6萬人，這與一些發達國家相比差距很大，如日本人口1.2億，食品衛生監督員有6000人，每2萬人即配備一名。美國情況也相類似。至於儀器設備與美國相比更是瞠乎其後，僅以美國食品藥物管理局下屬的國立毒理學研究中心而論，就有800餘人，氣質聯機數台，氣相色譜儀已成常規儀器。我國相應機械的人力設備和其相比差距很大。故亟待加強和更新。

#### 3. 國際交流有待改善

雖然我國食品衛生工作近十多年來有了相當的發展，但國際交往實在太少了。

通過有限的交往我們了解到美、日、歐很多國家的專業同道們對中國在食品衛生方面進行的工作了解很少，或根本不了解，而我們對國外的情況雖有一定了解，但也了解不深，食品在國際貿易中佔有相當比重，各國之間的食物貿易交往也十分頻繁，為了各國自身的利益和實現CAC國際食品法典委員會的宗旨，促進國際貿易，消除食品貿易壁壘，統一國際標準，維護消費者健康，有必要加強各國之間的信息交流和人員來往。

最近，我國趙紫陽總理在“七五”規劃的衛生保健事業中，明確提出要在我國“建立健全葯品、食品國家監督的保證體系，”這說明我國已將建立食品監督體系列為國家決策，相信在這一規劃的指引下，我國食品衛生將獲得更好更快的發展。

香港現在已是一個國際著名的城市，也是國際信息的集散中心之一，這次應邀前來和同道們進行學術交流，很希望能得到更多食品衛生監督檢驗研究方面的信息，更希望能獲得國際間的交流和協作。我們也歡迎香港的同事們到北京或其他省市進行學術交流，相信這樣的交流對香港和內地都是有益的。

謝謝大家！

# Advances in Food hygiene in People's Republic of China

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It is my great honour to have this opportunity to introduce the advances in food hygiene in China to my colleagues and friends in Hong Kong.

After over than 30 years of founding of New China, under the leadership of Government and Party the hygiene in China has got great success. Because of the importance of the preventive medicine and the concern of Government and Party CAMP ( Chinese Academy for Preventive Medicine ) was established three year ago. This is to show the hygiene in China will be developed more quickly, and then it will make more contribution to the people's health. Similar to the other hygienes food hygiene has also got considerable successes in this 30 years. Especially in recent over ten years, the development of food hygiene is more quickly. Now I'll give you a short introduction of the advances in food hygiene in China after liberation, espically in recent ten years.

( 1 ) Set up nation-wide system of food safety control, inspection and research, and the food safety control network in nation-wide was preliminary formed.

Before liberation in China only very few big cities had food hygiene control in limited extent but after the founding of new China under the direction of Government the Sanitary and Antiepidemic Stations in different levels were established all over this country, and in the mean time the food hygiene control works were proceeded. After the setting up sanitary and antiepidemic stations to the end of 1966, the Ministry of Public Health itself or with other Ministries promulgated a certain number of regulations and rules concerning the food hygienc. For example, in the early stage of the founding of New China, there were many cases of GI disorders caused by cold drinks then in 1953 the Ministry of Public Health issued " The Provisional Regulation of cold drinks ". This regulation improved the quality of cold drinks effectively at that time. Another example was that in the late of 1950's, we found the use of food colors was thrown into confusion. After a survey organized by the ministry of Public Health in 1960 The State Council promulgated " The Regulation of synthetic food colors ", and assigned one chemical plant to produce food colors. The adoption of these above measurements ended the poisoning even death due to the indiscriminated uses of food colors. All of these played an important role to strengthen food hygienic inspection and to guarantee the people's health. But due to the limitation of manpower, facilities and the situation at that time the food hygiene work could not be developed more quickly than others. During the " Culture revotution " except the international food trade almost all food ahgiene works in China had been stopped.

After 1970 due to the requirements of foreign food trade and the international concern of aflatoxin contam-

ination of food stuffs and people wanted to know the situation of aflatoxin contamination in China The Ministry of Public Health made a big decision to develop the food hygiene works more quickly. Since then the real establishment of food safety control and inspection system was started.

In 1973 the Ministry of Public Health convened a training course of food hygiene, At this course under the organization of Institute of Health, the Chinese Academy of Medical Sciences ( now it is Chinese Academy of Preventive Medicine ), a nation-wide collaborative research programme of food hygiene standards was formulated. Taking the Sanitary and Antiepidemic Stations as main force 14 research collaborative groups were organized, and started researches concerning food hygienic standards. At that time according to the estimation from the participants in the training course there were around 300 staffs in charge of food hygiene in China. In this case it was obviously very difficult to finish this programme. Then we recalled and increased the manpower and fcilities, and carried out a large scale of detections and experiments. In 1974 we got the first batch of scientific data about the food contaminations. Based on these data Ministry of Public Health submitted a report to the State Planning Commission, and then from there to the State Council, then The State Council issued the ( 74 ) 82 Instruction, in which " The report for prevention of food contamination " by State Planning Commission was attached. In this Instruction it presented following measures to strengthen the food hygiene in China.

- 1.To set up a leading group of food hygiene and Institutes of Food Safety Control and Inspection in different levels.
- 2.To strengthen the facilitiles, approaches and technology in food safety control, inspection and research.
3. To establish a nation-wide system of food safety control, inspection and research step by step.

By the end of 1981 the number of staffs engaged in food hygiene were rapidly increased to about 5000 all over the China.

From then on because of the big decision of Central Committee of Party, i.e. the decision to develop the food industry, and the promulgation of Provisional Law of People's Republic of China on Food Hygiene the leaders in different levels supported the food hygiene works, so until 1983 according to the statistic data from 18 provinces or autonomous regions the number of staffs engaged in the field of food hygiene were 10709, the estimation of the total number in China, except Tawan and Hong-Kong, was 13000. In 1986, the statistic total number was 26000. It consisted of 1% of

full or associate professors, 10% of lecturers and 40% of assistants. At present each Sanitary and Anti-epidemic Station in provincial or autonomous region levels has possessed of Institutes of Food Safety Control and Inspection or independent division of food hygiene. Considerable number of Stations in District level have divisions of food hygiene and in all counties there are personnels in charge of food hygiene works. In some provinces the Institutes of Food Safety Control and Inspection are separated from Sanitary and Anti-epidemic Stations. Under the direction of the Institute of Food Safety Control and Inspection, Ministry of Public Health, and Sanitary and Antiepidemic Station in provincial levels there are 31 Institutes of Food safety Inspection at ports which are responsible for monitoring the imported foods.

In addition 22 divisions of Nutrition and Food Hygiene in Medical Colleges are also organized by the Ministry of Public Health and Chinese Academy for Preventive Medicine to conduct researches concerning food safety control and inspection. From these above mentioned it is obvious that a preliminary authoritative system all over this country was formed. It consists of Institutes of Food Safety Control and Inspection in national, provincial, district and county levels, most of the counterparts in Medical Colleges, and Institutions of Food Safety Inspection at ports.

In addition Ministry of Rail Way, Ministry of Communication and big plants and mines under related departments have their own sanitary and Antiepidemic stations engaged in monitoring and administrative work on food hygiene. For guarantee the food quality the manufacture sectors under the Ministries of Light Industry, Commerce, Foreign Trade and Chemical Industry, set up or strengthen their own food hygiene control, inspection and research works in recent 10 years. For example, the late Ministry of Cereal ( now it is Ministry of Commerce ) had a division of sanitary monitoring and set up hygienic monitoring system of cereal in and above county level. This is for improving and monitoring the cereal quality. All of these above mentioned sectors regularly contact with their counterparts under Ministry of Public Health. Thus the Ministry of Public Health ( the Chief Sector in Food safety control in whole country ) other ministries, ( the auxiliary bodies ) and their institutions in different levels ( National, Provincial and County levels ) formed a food safety control network all over the country. This network plays an important role to ensure the consumers health. For example, in big cities the grain depots do not permit to sale any amount of grain if it does not meet the standards ( e.g. aflatoxin etc ) , and many plants producing cold drinks have already carried out the rule, i.e. non-pass against non-compliance.

However comparing inspection system in China with which in Japan or America, either in number of staffs and facilities or the quality of administration there is still big room for improving.

( 2 ) Built up a legal system of food hygiene and got considerable achievements.

The food supply is plentiful or not and food quality is good or not are the reflection of the degree of prosperous and strong, culture, ethics and the spirit of a country or a nationality and the rapid legislation and real implementation of the Laws, Rules and Regulations

is a big step adopted from changing " rule by man " into " rule by Law ".

Comparing with the past of ourselves or with old China we should say that the legislation in food hygiene in China is rapid. This is to show the determination of the government to go to the " rule the country by Law ".

Obviously, the promulgation of the provisional Law of the People's Republic of China on Food Hygiene could not be separated from the hard works of our vast working personnel on food hygiene. In 1950's and 1960's China issued 21 and 13 rules and regulations respectively. This was very important for the food safety control at that time. But these rules and regulations were not mainly and systematically formulated upon our own research data.

In 1970's the domestic and international situation in food trade and the severity of food contamination in China impelled us to start a research programme concerning the establishment of food hygiene standards and rules in large scale. Based on a great number of scientific data 68 standards and rules were formulated and promulgated in 1970's. It means that not only the quantity of the standards and rules was increased but the quality of them was also quite different from which in 1950's or 1960's, i.e. to set up standards or rules by scientific data. The step in 1980's is more rapid than before. Only in 3-4 years 110 standards and rules were promulgated. And based on large amount of research data collected for many years the Provisional Law of The People's Republic of China on Food Hygiene was formulated and issued. This is the first Law on Food Hygiene, a mile stone and a big event in this field of China.

In recent years we have got considerable success in this respect.

1. Rate of compliance increased to certain extent.

In terms of data from 18 provinces, municipalities and autonomous regions, in 1982, i.e. before the implementation of Provisional Law on Food Hygiene, the rate of compliance of various foods to the hygienic standards was about 56% ( average value ) , and in 1983, that was after the enforcement of the Provisional Law, the average rate of compliance was increased to 66%, i.e. 10% more than before. It goes without saying that the situation in different places was not the same. The rate of compliance of 66% could not be compared with developed countries, and was not satisfactory, even so it was a start for further progress. And the situation of providing foods without quality control or even providing foods with non-compliance in quite a number of big and medium size food plants was brought about radical change.

2. Through extensive propaganda and training the knowledge of professionals was increased and the safety control from public was strengthened.

During January to June, 1983, for preparing the promulgation of Provisional Law on Food Hygiene, 5681 training courses which covered about 720 thousand people were conducted in national or provincial levels. Participants included hygienic administration cadre, food hygiene inspectors, leaders from sectors producing or processing foods and food handlers. In addition to these, TV, broadcast, drama, sled show,

booklet, and street propaganda etc. were utilized to educate the residents. In some big cities e.g. Beijing and Tianjin in the telephone No. of Sanitary and Anti-epidemic Stations were published in newspapers. Once anyone who found something concerned is going wrong could call the Station to inspect. This measure got positive results.

3. Various kinds of " Regulations " " Detailed Rules " and " Manuals " were promulgated to facilitate the enforce of the Provisional Law on Food Hygiene. For example, " Provisional Regulation for issuing the certificate on food hygiene ", " Provisional Regulation of asking for certificate", " Provisional Regulation regarding health examination of food handlers", " The detailed Rules of administrative penalty for violation of the Provisional Law on Food Hygiene ", and " the Manual for Food Hygiene Inspectors " etc.

4. The No. of Inspectors is increased and the food safety control is put into practice.

As mentioned above in 1981 the total number of staffs was around 5000, in 1983, it's 13000, and in 1986 there were around 26000 staffs working in this field. Up to now the estimation is around 30000 staffs engaged in the work of food hygiene.

It is worth emphasize that after the enforcement of the Provisional Law most of the food manufacturers, food plants and food enterprises strengthened their own food hygienic quality assurance. This was reflected in the increased number of administrators in these premises and the increased rate of compliance.

( 3 ) Formulation of a systematic hygienic standards, regulations and analytical methods for foods.

As mentioned above, in 1985's some individual regulations, hygienic standards and analytical methods for foods had been formulated in China. Methods of food hygienic analysis, both microbiological section and physico - chemical section have been published in 1963. At that time it promoted the work in this respect. In the early stage of 1973's Institute of Health, Chinese Academy of Medical Sciences, organized collaborated research groups and established the analytical methods for aflatoxin, and studied the hygienic standards for imported cereal grains. Later on, due to the demands of domestic and foreign markets of food trade, the Ministry of Public Health entrusted Institute of Health to organize nation - wide scale cooperation. In total there were 26 collaborative research groups which were responsible for the studies of general survey on aflatoxin, organochlorinated pesticide residues, pollutants ( including Hg, Cd, As, F, Cr, B (a) P, etc ), food additives, food poisoning, detection methods of bacteria and physico - chemical methods, toxicological evaluation as well as hygienic standards for foods etc. From 1973, a number of technical personnels returned to the profession one was trained for within 10 years. The staffs and facilities were also replenished. Finally we collected 500,000 figures, and formulated a more comprehensive food hygienic standards and regulations. Up to now, our food hygienic standards covering about 1,000 varieties of foods and food additives have been promulgated. The scale of the program were so large and so extensive, it is unprecedented in history of food hygiene of China. It is also seldom in foreign countries. For example, the tolerance of aflatoxin in foods was established on the basis of more than 30,

000 analyzed data by using TLC method. And the tolerance of organochlorinated pesticide residues in foods was set up on the basis of more than 10,000 food sample determinations by using gas - chromatography method. Both TLC for aflatoxin and GC for organochlorinated pesticides were recognized by the international collaborative studies. It shows that our data are reliable. In addition, a large number of animal toxicity tests as well as epidemiological surveys were carried out. The hygienic standards of foods formulated on the basis of these data should be practical and feasible.

In order to formulate hygienic standards of foods successfully, the published analytical methods of microbiology, chemistry as well as radio - active materials have been also studied systematically, and revised recently in China. In recent years, many countries made suggestions that the toxicological studies of the chemical substances added in foods should be investigated in order to understand the potential harmful effects and then to guarantee the safety of foods. For this reason, after experimental studies and thorough discussion by the experts, " The procedure of toxicological evaluation for food safety " was presented. It was issued by the Ministry of Public Health for trial implementation in 1983. This is the beginning of the legislation of toxicology in China. From now on, the evaluation of chemical substances in foods have the legal basis and more strict requirements. The times that the evaluation of domestic foods entirely relied on foreign countries information was over.

( 4 ) To carry out extensively the researches on the science of food hygiene and then to lay the foundation of food safety control.

Food safety control is the front in food hygiene, and it utilizes the achievements of nature science to solve the problems occurred in social science. So food safety control itself is the combination of natural and social sciences and is also the most difficult work in food hygiene.

Food safety control is based on the work of food safety inspection ( laboratory work ), and the later is supported by the data from food safety researches. Without researches there is no inspection at all, and no inspection one can do nothing about food safety control. On the other hand if the inspection does not serve the control and if the researches are not directed at the inspection and control, they will lose the right way. In our point of view if anyone engaged in research works performs his job from literature to literature or from practice to literature, there will be no social and economic benefit. And this kind of work is non-sense. So food safety control, inspection and research, all these three kinds of work must be combined closely. On one hand the focus of research shall be to provide the approaches to the laboratory, on the other hand to provide the scientific data to the food safety control and inspection.

Now I would like to introduce briefly as follows :

#### 4.1. Bacterial food poisoning.

From 1950's up to now we carried out a lot of investigation programs on bacterial food poisoning, such as salmonella, staphylococcus, streptococcus, pathogenic E. coli, Bacillus cereus, Yersinia enterocolitica,

Campylobacter jejenum, vibrio parahemolyticus and C. botulinum etc. First of all, various detection methods had been established, then the conditions and rules which give rise to food poisoning had been subjected to study. Taking vibrio parahemolyticus for example, during 1960's there a lot of food poisoning was caused by sea foods. e.g. crabs etc, at the coastal regions. Finally it was identified that was caused by vibrio parahemolyticus. We had investigated its diagnose, treatment and prevention etc. and got some success, especially in the classification by antiserum and phage. At that time this technique was better than Japan. In recent years it was found the infant rabbit could be used as an animal for toxicity test in oral rout. This kind of rabbit is very sensitive and specific. Vibrio parahemolyticus and vibrio - alginolyticus can be differentiated by the infant rabbit test.

Some severe food poisoning have been put into high priority in investigation and control. For example, it was found that most botulisms occurred in China were not caused by canned foods, but by home-made fermented bean products. And the poisoning usually occurred after the consumption of bean products for multiple times and the clinical process was slowly progressing in a subchronic type. These characteristics ( i.e. casual foods, latent period, symptoms and treatment etc. ) are different from those reported from the western countries.

A fermented maize product which is quite popular in some areas of northern China, has been known to cause food poisoning with a mortality rate of nearly 100% in some cases. It was taken seven years to identify what referred to as " Bengkrelic acid " as the likely cause.

#### 4.2. Mycotoxins

The Institute of Health ( now it is the Institute of Food Safety Control and Inspection ) under the Chinese Academy of Preventive Medicine was assigned by the Ministry of Public Health to organize a collaborative research program on mycotoxins and related toxins which comprised Sanitary and Antiepidemic Stations and Medical Colleges in more than 20 provinces of the country. The program included aflatoxin content in foods, chronic toxicity test, the detoxification, elimination and prevention of aflatoxin contamination of food stuffs. The main results are as follows :

a. Over 30 thousands of food samples had been collected and detected all over the country. More than 1000 strains were analysed for their producing ability of aflatoxin. As a result, the food crops grown in the high temperature and high humidity areas along Yangtzu River and its southern areas in China were very often contaminated by aflatoxin. It was found that maize, peanut and peanut oil was contaminated heavily by aflatoxin. The rate of contamination of these was about 40-60% at individual area. But there are less or no contamination in North East, North West and Hua Bei areas.

b. The rate of contamination of foods, the rate of toxic strains and the rate of liver cancer is positively correlated.

c. Based on the nation-wide program for the detection of aflatoxin in foods and the chronic and carcinogenicity tests conducted in China the food hygienic standards, regulations and laboratory methods

for aflatoxin in foods had been promulgated.

d. The contamination of aflatoxin in foods and oils could be prevented and eliminated.

From our field experiments for two years it showed the easily contaminated maize and peanut could meet the standards if the drying process and picking out the mouldy ears of corn were carried out in time. And the aflatoxin in the contaminated maize, rice, peanut and peanut oil could be eliminated effectively by the use of following methods such as chosing, washing, ultraviolet irradiation, chinese herbs and washing after mechanical separation etc. For example, contaminated maize containing 670 ppb aflatoxin was treated by one of above. mentioned methods and finally we could not found the aflatoxin in the corn flour. There methods are different from those reported by other countries.

In recent years we payed more attention to the research of the etiology of food poisoning with unknown causes. The example is mouldy and deteriorated sugar cane poisoning which has an average mortality of 9.25% and usually end up with severe CNS sequelae. After thorough investigation now we found this kind of poisoning was caused by an variety of fungi, Anthrinium. Now we are conducting the further studies on this poisoning.

Otherwisw, we also pay more attention to set up the methods of sterigmatocystin and ochratoxin A. We also got some progress in the studies of scabby wheat and yellowed rice.

#### 4.3. The study on toxic plants and animals

In this subject it includes ball fish, cassava, legume, cotton seed oil, honey, mushroom etc. The following are examples :

Ball fish : It was found that the toxin of ovary of ball fish could be detoxified by 2% sodium carbonate. It is thus possible to utilize the internal organs of ball fish nonharmfully.

Cassava : Through detection of cassava samples, animal toxicity test, and human trial the standard of HCN residue of detoxified cassava and tolearance had been presented.

Mushroom : For preventing the mushroom poisoning an atalas of toxic and edible mushrooms in China was published.

#### 4.4. Pesticides

In terms of the entrustment of the National Science and Technology Commission and the Ministry of Chemical Industry in the late of 1970's Ministry of Public Health organized a collaborative research program to conduct the toxicity studies, and safety evaluations on about 100 pesticides.

Organochlorinated insecticides : Up to 1980's organochlorinated insecticides such as BHC etc. were the main insecticides used in China. Due to the physical and chemical properties they can be easily accumulated in the body. The technical BHC has already been banned in many countries and only r-BHC can be used. Should we follow them to use the r-BHC instead of the technical BHC ? This was concerned with the technical policy of insecticides production in China, so a nation-wide collaborative research program was organized in 1973 which including 27 provinces, Muunicipalities and Autonomous Regions. The main results are as follows :

a. More than 10,000 food samples collected from more than 10 provinces had been detected by GC method and the results showed that many kinds of foods were contaminated by BHC and DDT. Based on these data and the toxicity tests conducted in our country the standards of the BHC and DDT residues in foods had been formulated.

b. Organochlorinated insecticides had been studied extensively during these years. In Chronic toxicity test, 1 year and 2 years feeding trials showed that r-BHC containing diet could induce the histopathological change in male rat kidneys, even the content of r-BHC in the diet was as low as 1 ppm. The severity of this pathological change is parallel to the content of r-BHC in the kidney. As we know there is no such report in literature.

c. The scientists in China also found that the content of r-BHC in human ear-wax is very significantly correlated to the content of organochlorinated insecticides in adipose tissue, so the ear-wax can be used as biological material instead of adipose tissue for the investigation of relationship between insecticides and cancer incidence.

d. Based on our data we found that the analytical method for detecting organochlorinated insecticide residues in rabbit meat in fat-base is unreasonable. The suggestion to revise the method was submitted to the CCPR, and CCPR has already made some revision of this method.

Organophosphorus insecticides : These kinds of insecticides has been used for a long time, but the standards of residues and analytical methods is still not available. So it is difficult to monitor and inspect. Since the Provisional Law of the People's Republic of China on Food Hygiene was promulgated, we paid more attention to set up a series of standards of residues and the detection methods on organophosphorus insecticides in foods. This project is on going now.

Other pesticides : When we found that the dichlorzoline could induce cataract in rats, the N, N'-methylenebis was teratogenic to various species of animal, and Duiwon possesses strong mutagenic effect we made corresponding decisions to stop developing these agri-chemicals. therefore the economic loss was avoided and the physical health of the people was guaranteed. Contrary, it was evidenced that some other pesticides were safety in use in according to toxicological studies. Then we provided the scientific information to the department of chemistry for manufacturing these pesticides.

#### 4.5. Food additives

There are so many kinds of food additives, let's say more than 10,000, in the world. As the saying by food industry's managers " food additives is the soul of the food industry, if there is no food additives there is no food industry. " This idea, of course, is not integral, but it can be seen the important position of food additive in food industry. In view of the above status, a collaborative group has been established since 1973 to conduct systematic investigation and research and evaluate food additives one by one according to our own results of chemical analysis and toxicological tests and the data from foreign countries and international organization and then stipulating the variety of food additives

permitted to use and the scope of application, setting up the corresponding hygienic standards and regulations by which the abuse of the food additives in big cities were prevented. It was found by toxicological tests that certain thickening agent produced in China is safely used in foods, and it can be used instead of Guar gum. This means a great number of foreign currency can be saved. In addition the carmel color manufactured by ammonia method in China has no teratogenic and convulsion effects, and certain imported flavouring is mutagenicity positive. All these results mentioned above have not been reported or is inconsistent with the results in the literature. Obviously these results would have some influence on the manufacture and importation of these products.

4.6. Contamination of waste water ( sewage ), waste gas and waste solid, so-called " three wastes " in China.

Since 1970's the foods contaminated by mercury, cadmium, fluorine, arsenic, chromium, sewage from petroleum production etc. have been investigated in large scale.

Mercury : According the analytical results of 4905 samples collected from 16 provinces and autonomous regions, experimental animal tests and human poisoning the permissible levels of mercury in foods was set up. Meanwhile, it was found that animals after feeding 0.1 ppm mercury in diet for one year the mercury was accumulated in the kidneys significantly, and human consuming rice containing 0.2-0.3 ppm of mercury for several months had got some toxication symptoms, and the urinary level of mercury of these subjects was also increased. As we know there is no such data in literature.

Cadmium : General investigation of 6500 Food samples were carried out in China. Combining with the results of study on toxicity of Cd and human epidemiological survey, a recommendation of permissible level of Cd in foods was set up. It means the daily acceptable intake is 100-150r/person.

In recent years, we also analysed more than ten thousand food samples for their methyl mercury, fluorine, inorganic arsenic contaminant, and combining with the toxicological data from home and abroad we laid down the corresponding standards.

#### 4.7. Background figure of radionucleotides

This project was passed at the beginning of 1960's unfortunately the basic research of this project was not carried out until 1970's. Since then the unified analytical methods were established, by which the total r, and radioactivity, Sr-90, Cs-137, Ra-226 etc, were determined in various nation-wide distributed foods, e.g. cereals, vegetables, eggs, milk, meats, sea-foods, tea etc.

4.8. Irradiated foods. Studies on irradiated foods began since 1950's. Although it was not lag comparing with the foreign countries, it developed slowly. In 1970's under the leadership and organization of State Scientific and Technological Commission, a large scale of animal experiments were carried out in the sectors under Ministry of Public Health. In 1982, a detailed research programme of hygienic standards and human trials on irradiated foods was raised. It was led and organized by State Scientific and Technological Commission and Ministry of Public Health. Up to now, human

trials on irradiated individual food such as rice, potato, sausage, peanut, mushroom and irradiated multi-foods and verification of physical, chemical and medical parameters have been completed. It showed that ingestion of foods irradiated with limited dose was no effects on all parameters selected. This means irradiated foods under certain condition are safe. Verification of "Analytical Methods in Food Hygiene Inspection" (physical and chemical analysis, seven standards for irradiated foods, i.e. rice, potato, pork sausage, peanut, mushroom, onion and garlic, have been formulated and promulgated by the Ministry of Public Health.

In addition to the programme mentioned above, the methodology in food hygiene has great development. In recent years, especially in last 2-3 years, comprehensive and great revision and verification of "Analytical Methods in Food Hygiene Inspection" (physical and chemical methods, and microbiological methods) on the basis of extensive study in order to fit for the Chinese status.

From the brief introduction above, it can be seen that the Chinese food hygiene develops rapidly after 30 years of the foundation of the People's Republic of China, especially in recent 10 years, the features of Chinese food hygiene has made great changes. Seeking without exaggeration, great success has been made in Chinese food hygiene, but on the other hand, comparing with the demand to food hygiene work by the rapid development of food industry, and with the developed countries, such as the United States, Japan, West Europe, there is still a long way to go, for example, the rate of compliance of food hygiene in U.S. can be kept above 95%. The FDA of U.S. dare to declare that the American foods are quite safe. In contrast with China the compliance rate is less than 70%. In this case the safety of the food, therefore, is just only 60%-70%. So great effort should be made for raising the safety of our foods.

#### (5) Existing problems

##### 5.1. Obstruction in implementing the Provisional Law.

The Provisional Law is a national Law. It should have its own authoritativeness and solemnity. After strengthening again and again that "equal rights for every one in front of Law", "Law must be obeyed, enforcing the Law must be strict, and violating the Law must be found out", the situation of "rule by man" has been changed greatly, but in some cases and in some locations, the phenomenon of "power over Law" is still present. This is mainly due to some leaders disregard the Law, it is, of course, not permitted by the Party's discipline, national Law and the common aspiration of the people.

##### 5.2. Personnel and equipments should be reinforced and renewed.

As early mentioned now there are about 30,000 staffs in charge of food hygiene, there is still a great gap, comparing with developed countries. For example, in Japan, the population is 120 million, but the number of food inspector is 6,000, i.e. 1/20,000. The similar ratio is in the U.S. As to the instruments and equipments it is lag far behind the U.S. Taking the NCTR as an example, there are 800 staffs, several sets of GC-MS, and the GC has been an routine instrument. Comparing with them, the manpower and equipments of co-

operparts in China is far less. So it is emergent to strengthen and renew.

##### 5.3 International exchange should be improved.

In recent 10 years, Chinese food hygiene has made great success, but international exchange is not enough.

Even by limited exchange, we realized that the fellow workers in food hygiene of the U.S., Japan, West Germany etc. understand very few about Chinese food hygiene, and in our aspect, we understand the situation of foreign countries to some extent, but it is far unsatisfactory.

Food occupies a considerable proportion in international trade. For the profit of export and import countries and realizing the goal of the CAC, i.e. promoting the international food trade, eliminating the trade barrier, unifying international standards and protecting the consumer's health, it is necessary to strengthen the communication of information and personnel exchange.

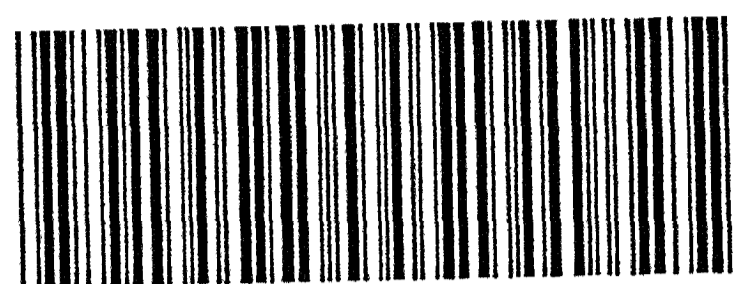
Recently, Chinese Premier Zhao definitely pointed out in the section of "health care" in the report of The Seventh Five Year National Plan that "a control and guarantee system in medicine and food should be established and perfected" in China. It means that to establish food control and guarantee system has been considered as a national strategic decision. We certainly believe that under the direction of this plan, Chinese food hygiene can make more rapid and much better development.

Hong-Kong is a famous international city and is also one of the information exchange centers. This time we are invited to here to make academic exchange with our colleagues. We do hope to get much more information on food hygiene control and inspection from here. Furthermore, we wish to make much more exchange and collaborations. Of course, we sincerely hope you come to Beijing and other provinces to make academic exchange. We are confident that such kinds of exchange will benefit to both Hong-Kong and mainland.

Thank you



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中國預防醫學實況：營養與食物衛生

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CENTENNIAL SYMPOSIUM  
**PREVENTIVE MEDICINE IN CHINA**  
*NUTRITION AND FOOD HYGIENE*

Room M7, Main Building,  
University Main Estate,  
Pokfulam Road,  
Hong Kong.

Saturday, September 12, 1987

<i>TIME</i>	<i>LECTURE</i>	<i>SPEAKER</i>
Afternoon 2:00 - 2:15	Official opening 開幕詞	Professor J.C.Y. Leong <i>Dean</i> <i>Faculty of Medicine</i>
2:15 - 2:25	Introductory remarks 香港營養學會代表致詞	Ms. D. Bateson <i>Hong Kong Nutrition Association</i>
2:25 - 3:05	The Nutrition Survey in China 我國人民的營養狀況	Professor Chen Chun Ming <i>President</i> <i>Chinese Academy of Preventive Medicine</i>
3:05 - 3:45	Studies on a Food Poisoning Caused by Deteriorated Tremella 醇米麩及變質銀耳中毒	Professor Meng Zhao He <i>Institute of Nutrition and Food Hygiene</i> <i>Chinese Academy of Preventive Medicine</i>
3:45 - 4:00	Tea break	
4:00 - 4:40	The Role of Selenium in the Etiology of Keshan Disease 地方性硒缺乏與克山病	Professor Wen Zhi Mei <i>Institute of Nutrition and Food Hygiene</i> <i>Chinese Academy of Preventive Medicine</i>
4:40 - 5:20	Food Safety Control in China 我國食品衛生工作進展	Professor Dai Yin <i>Director</i> <i>Institute of Food Safety Inspection and Control</i> <i>Chinese Academy of Preventive Medicine</i>
5:20 - 5:40	Summary & Discussion	Professor Chen Chun Ming

*Organized by Hong Kong Nutrition Association and Department of Microbiology, University of Hong Kong.*

ALL INTERESTED ARE WELCOME

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