PAN-ASIA PACIFIC CONFERENCE ON FLUORIDE AND ARSENIC RESEARCH

PROGRAM AND ABSTRACT BOOK

AUGUST 16-20, 1999

SHENYANG, CHINA

SPONSORED BY FLUORIDE AND ARSENIC SOCIETY OF CHINA (FASC)

PAN-ASIA PACIFIC CONFERENCE ON FLUORIDE AND ARSENIC RESEARCH

(Sponsored by FASC)

****

INTERNATIONAL ADVISORY COMMITTEE

Dr. Dipankar Chakraborti (INDIA)
Dr. Willard Chappell (USA)
Dr. Gourisankar Ghosh (UNICEF)
Dr. Koichi Kono (JAPAN)
Dr. A. K. Susheela (INDIA)
Dr. Hiroshi Yamauchi (JAPAN)
Dr. Takahiko Yoshida (JAPAN)
Dr. N. B. K. Yoshitake (JAPAN)
Dr. Ming-Ho Yu (USA)

CONFERENCE ORGANIZING COMMITTEE

Prof. Shouren Cao Chairman
Prof. Guifan Sun General Secretary
Dr. Xianyi Chen
Dr. Shufen Gao
Dr. Zhizhong Guan
Dr. Yang Hao
Prof. Chaoke Liang
Prof. Hengzhi Ma
Prof. Yufu Sun
Dr. Zhanyi Wang

PROGRAM COMMITTEE

SCIENTIFIC PROGRAM

Prof. Guojun Dai
Prof. Rongdi Ji
Dr. Taiyi Jin
Dr. Zhendong Luo
Dr. Cong Qian
Prof. Mingcai Qiu
Prof. Guoquan Wang
Prof. Zandao Wei
Prof. Zhenrong Wu
Prof. Baoshan Zheng

SOCIAL PROGRAM

Lijun Dong
Wen Yu
Xuemei Zhang
Quanmei Zheng
Bing Li

****

ACKNOWLEDGEMENT

The Organizing Committee is grateful to the following organization for their support:

Health Ministry of China
Environmental Protection Agency (EPA), USA
World Health Organization (WHO)
Tokai University, JAPAN
St. Marianna University, School of Medicine, JAPAN
The Scientific and Technology Committee of Shenyang, China

****

GREETINGS

On the occasion of the solemn opening of Pan-Asia-Pacific Conference on Fluoride and Arsenic Research, on behalf of the Organizing Committee of the Conference and Fluoride and Arsenic Society of China, we cordially welcome you, the specialists and delegates from various countries of the world and the various provinces, cities, and autonomous regions of China and wholeheartedly thank the leaders of Ministry of Health of China, Liaoning Provincial Government and Shenyang Municipality for your presence.

In China the chronic endemic fluorosis and arsenism attack wide areas and an extremely large population. Up to now in mainland of China there are at least 100 million people living in the regions naturally exposed to high fluoride in well water, coal-burning, or tea and about 2 million exposed to high arsenic environment. And most of arsenic-exposed regions are concurrently attacked by high fluoride. This grave situation has seriously harmed the mental and physical health, the study and work, and familys happiness of the sufferers. The Chinese government has paid close attention to fluorosis and arsenism, list them into the eight major endemic diseases in China. Since 1970s our government has organized a large number of scientists as well as put up large funds for the deepgoing researches on the two diseases. And in 1996 supported by our government, Fluoride and Arsenic Society of China (FASC) was founded.

In order to make the further international exchanges and collaborations in the research fields and to study and share the advanced experience from various countries in the prevention and treatment of the two diseases, FASC decided to hold the Conference two years ago. It is very gratifying that since the preparation of the conference began we have got great supports and helps from various levels of Chinese government and the organizations or groups interesting in the field researches in the world. The great supports and helps make the international conference an exceptionally grand occasion with about 200 participants from Australia, Bangladesh, Chile, India, Japan, Korea, Mexico, Thailand, the United States, Vietnam, China mainland and Taiwan region. WHO, UNICEF, and EPA of the United States sent their officials and specialists to attend the meeting. The Chinese officials on various government levels in charge of the control and prevention of endemic diseases also attend the meeting.

In the Conference there will be 64 platform presentations and 95 posters which concern with the health effects, epidemiology, geochemistry, toxicology, metabolism, prevention and treatment of fluorosis and arsenism. A seminar on the global information exchange related to fluoride and arsenic research will be also held by WHO. I hope that the Conference will play a role in investigating the research of fluoride and arsenic deeply and improve the health condition of the people all over the world.

This month is just the time of Shenyang International Friendship Activities. With the help of Shenyang Municipality we arrange several social activities including for ladies for strengthening our friendship. We wish you have a nice stay in Shenyang.

Thanks again for your presence at the meeting.

Wish you success in your presentation in the Conference.

Shouren Cao, Chairman
Guifan Sun, General Secretary
Organizing Committee

CONFERENCE PROGRAM SCHEDULE

Monday, August 16, 1999
8:00 a.m.- 6:00 p.m. Registration (1st floor hall of Traders Hotel)
6:30 p.m.- 9:00 p.m. Opening Ceremony & Welcome Reception * (Grand Ballroom)

Tuesday, August 17, 1999
8:30 a.m.-11:50 a.m. Platform Session 1 : Health Effects on Human and Epidemiology
11:50 a.m.- 1:30 p.m. Lunch (Weadle Stars Mansion)
1:30 p.m.- 5:05 p.m. Platform Session 1 (continued)
5:05 p.m.- 6:05 p.m. Poster Session 1
9:00 a.m.- 5:00 p.m. Tour **

Wednesday, August 18, 1999
8:30 a.m.-11:35 a.m. Platform Session 2 : Geochemistry , Toxicology and Metabolism
11:35 a.m.-12:15 p.m. Lunch
12:15 a.m.-1:30 p.m. WHO lunch-time meeting
2:00 p.m.-6:00 p.m. Sightseeing of the Imperial Palace of Qing Dynasty *
9:00 a.m.-12:00 a.m. Shopping **

Thursday, August 19, 1999
8:30 a.m.-11:35 a.m. Platform Session 2 (continued)
11:35 a.m.-12:20 p.m. Platform Session 3 : Prevention and Treatment
12:20 p.m.-1:20 p.m. Lunch
1:20 p.m.-5:10 p.m. Platform Session 3 (continued)
5:10 p.m.-6:10 p.m. Poster Session 2
6:30 p.m.-8:30 p.m. Banquet at Dragon Sea Restaurant *
9:00 a.m.-5:00 p.m. Tour **

Friday, August 20, 1999
9:00 a.m.- 5:00 p.m. One-day tour in Shenyang *

* Participants/Delegates and Guests
** Non- Participating Guests only

Tuesday, 17 August, 1999

Platform Session 1: Health effects on Human and Epidemiology

Chairpersons: W. Chappell and N. B. K. Yoshitake

8:30-8:45

01. Arsenic and Fluoride in Drinking Water; WHO's recent endeavours
S.T. Yamamura

8:45-9:00

02. WHO Strategic Plan for Arsenic Mitigation in the South-East Asia Region
D. Caussy

9:00-9:15

03. Epidemiological Study of Arsenic-related Skin Cancer Cases
Z.D. Luo, Y.M.Zhang, G.Y. Zhang, Q.Dai, X.F.Liang, X.Y. Ren, M.Y.Zhang, C.X.Xue, S.B.Tucker, L.S.Loo, R.Wilson, S.H.Lamm

9:15-9:30

04. Health Effects of Indoor Fluoride Pollution by Coal Burning
M. Ando, M. Tadano, X.Q. Chen, S. Asanuma, S.Matsushima, K. Tamura, T. Watanabe, T. Kondo, S. Sakurai, R.D. Ji, C.K. Liang, S.R. Cao

Chairpersons: M. H. Yu and G. S. Li

9:30-9:45

05. Blood Biochemistry and Electrolyte Effect of Exposure to Fluoride from Burning Coal on Population
C.K. Liang, S.L. Zhang, W.H. Li , F. Ma , Y.P. Wu,Y. Li, B.P.Katz, E.J. Brizendine, G.K. Storkey

9:45-10:00

06. Skeletal Fluorosis Caused by Coal Burned Indoors in Southwestern Chinese Villages
T. Watanabe, T. Kondo, S.Asanuma, M.Ando, K.Tamura, S.Skuragi, R.D.Ji, C.K. Liang

----------Coffee Break----------

10:20-10:35

07. The Levels of Lipid Peroxidation and Antioxidation of Patientswith Endemic Fluorosis and the Influence of Interference
G.J. Dai, Z.Y. Zhang, C. Zhai, B.L. Chen, G.F. Sun, G.X. Sun, H.X. Gao, X.X.Zhang, J.Y. Wei, H.P. Lu, F.J. Meng, H.M. Li

10:35-10:50

08. The Health Effects of Ingested Fluoride
D.C. Kennedy

Chairperson: C. K. Liang and D. C. Kennedy

10:50-11:05

09. A Study On the Correlative Relation Between Fluoride Concentration in Drinking Water and Endemic Fluorosis
X.C. Wang

11:05-11:20

10. Fluorosis Mitigation Programme in India
K. Susheela

11:20-11:35

11. Effects of Sodium Fluoride and Arsenic Trioxide on Liver, Gastrocnemius Muscle of Mice and Their Reversal by Vitamin C

N.J. Chinoy

11:35-11:50

12. A Study on Fluoride in Sediments of River Yamuna at Agra, India

M. Agarwal, S. Taneja, K. Rai, R. Shrivastav, S. Dass

Chairpersons: J. R. Chen and T. Yoshida

13:30-13:45

13. Study of Arsenic Metabolism in the Acute Arsenic Poisoning by Arsenic Trioxide Intake

H.Yamauchi, J.Kinoshita, N.Nagai, K.Shimazaki, M.Kasamatsu, M. Aminaka, S.Saito, Y.Nito, K.Yoshida

13:45-14:00

14. Arsenic Exposure, Genetic Polymorphism of Gstm1, T1, P1 and P53, and Risk of Carotid Atherosclerosis

H.Y.Chiou, I.H.Wang, C.C.Wu, C.H.Tseng, H.Y.Mei, C.J.Chen

14:00-14:15

15. Arsenic Poisoning Caused by Residential Coal Combustion in Guizhou Province, China

R.B. Finkelman, H.E. Belkin, B. S. Zheng, J. A. Centeno

14:15-14:30

16. Cancer and Cardiovascular Mortality among Residents in the rseniasis-endemic area in Southwestern Taiwan A 12-year Follow-up Study

L.I. Hsu, M.J.Lin, C.J.Chen

Chairpersons: H. Yamauchi and H. Z. Ma

14:30-14:45

17. Characteristics of Arsenic Poisoning in China

T.Yoshida, H.Aikawa, K.Sakabe, H.Yamauchi, F.Kayama, W.Fujimoto, L.Nakai, G. F.Sun, G.J.Dai, H.X.Gao

14:45-15:00

18. A Retrospecive Cohort Study on the Relationship Between High-Arsenic Exposure through Drinking Water and Lung Cancer

X. F. Liang, Q.Dai, G.Y. Zhang, Z.R. Zhou, Y.M. Zhang, M.Y. Zhang, X. Y. Ren, Z.D.Luo

----------**Coffee Break**----------

15:20-15:35

19. Arsenic Problem in Drinking Water in Bangladesh Context

B. A. Hoque, S. Yamamura, H.A. Heijnen, G. Morshed, F. Khan

15:35-15:50

20. Association Between Chronic Arsenic Exposure and Childrens Intelligence in Thailand

U.Siripitayakunkit, P.Visudhiphan, M.Pradipasen,T.Vorapongsathron

Chairpersons: G. Ghosh and H. Y. Chiou

15:50-16:05

21. Long-Term Arsenic Exposure and Incidence of Non-Insulin-Dependent Diabetes Mellitus: A Cohort Study in Arseniasis-Hyperendemic Villages in aiwan

C.H.Tseng, T.Y.Tai, C.K.Chong, C.P.Tseng, M.S.Lai, B.J. Lin, H.Y.Chiou,Y.M. Hsueh, C.J.Chen

16:05-16:20

22. The Evaluation of Arsenic Consumption and Adverse Skin Effects
Z.D.Luo, Z.R.Zhou, G.Y.Zhang, Y.M.Zhang, Q.Dai, X.Y.Ren, X.F. Liang, M.Y.Zhang, Q.J.Sun, C.Z.Zhang, S.B.Tucker,LS.Loo

16:20-16:35

23. The Cell-Type Specificity of Cancer Associated with Arsenic Ingestion
H.R.Guo

16:35-16:50

24. Environmental Risk Assessment of Hazardous Materials in Water System of Sapporo City, Japan
Y. Sato,M. Aoki, A. Tabata, T. Kamei, Y. Magara

16:50-17:05

25. Arsenic Groundwater Contamination and Sufferings of People in Bangladesh and West Bengal-India
U.K. Chowdhury, B.K. Biswas, T.R. Chowdhury, B.K. Mandal, G.Samanta, G.K.Basu, C.R. Chanda, S.Roy, B. Ahmed, Q. Quamruzzaman, D. Chakraborti

17:05-17:25

The Present Arsenism Situation in China(Video Show)

Poster Session 1: 17:25-18:25

****

Wednesday, 18 August 1999

Platform Session 2: Geochemistry , Toxicology and Metabolism

Chairpersons: A. K. Susheela and G.J.Dai

8:30-8:45

26. Hepatocyte and Neurone Apoptosis Induced by Chronic Fluorosls in Rats
G.S. Li, X.H. Lu, L. Jing

8:45-9:00

27. Modification Of Membrane Lipids In Rat Brain, Liver And Kidney With Chronic Fluorosis
Z.Z. Guan, K.Q. Xiao, Y.A.Wang, J.L. Liu, G. Allner

9:00-9:15

28. Effects of Fluoride on the Cell Cycle and Apoptosis in Vitro Organ Culture of bone
K.T. Liu, G.Q. Wang, S.Z. Wang, J.Y. Wu, B.Y. Xiao

9:15-9:30

29. Inhibition of Growth and A -Amylase Activity in Germinating Mung Bean Seeds by Arsenic , Cadmium , Copper , Mercury , And Zinc
M. H. Yu, C. Keeney, M. Logan, C. Bellona, L. Dier-Ackley

Chairpersons: M. Judy and L. F. Wang and M.E. Gutierrez-Ruiz

9:30-9:45

30. Decreased Serum Levels of Nitric Oxide Metabolites Among Residents in An Endemic Area of Chronic Arsenic Poisoning in Inner Mogolia, China
J.B.Pi, Y.Kumagai, G.F.Sun, H.Yamauchi, T.Yoshida, A.Endo, L.Y.Yu, K. Yuki, T.Miyauchi, N.Shimojo

9:45-10:00

31. Cytogenetic Alterations Induced by Inorganic Arsenic in Human Cells
T.C.Lee, L.H.Yih, S.C.Huang

----------Coffee Break----------

10:20-10:35

32. Biomarkers of Effects Caused by Arsenic
J.C. Ng, L.X.Qi, C.Garnett, S.Kratzmann, B.Chiswell, M.R. Moore

10:35-10:50

33. Study of Arsenic Carcinogenicity Using the *In-Vitro* and *In-Vivo* Systems
J.C. Ng, LX. Qi, J.P.Wang , X.L.Xiao , M.Shahin, A.S. Prakash

10:50-11:05

34. Histological Assessment of Arsenic Induced Lesions: The Development of the International Tissue and Tumor Repository for Chronic Arsenosis in Humans
J.A.Centeno, L.Martinez, N.P.Page, F.G.Mullick, R.B.Finkelman, H.Gibb, D.Longfellow, Y.P.Liu, C.Thompson

11:05-11:20

35. Effect of Arsenite on Gap Junctional Intercellular Communication Between Human Skin Fibroblast Cells
F.R. Deng, X.B. Guo

11:20-11:35

36. Red Blood Cell Membrane Damaged and Mechanism of Endemic Arsenism
H.Z. Ma, Y.J. Xia, K.G. Wu, G.J. Yu, Y.H. Li, S.F. Hou, L.S. Yang

****

Thursday, 19 August 1999

Chairpersons: J. C. Ng and J. A. Centeno

8:30-8:45

37. Experimental Studies on Fluoride-Arsenic Joint Action
J.Y. Wu, K.T. Liu, W. Lian, J.H. Dai, P. Jiang, Y. Gong

8:45-9:00

38. Low Arsenic Methylation Capability, Low Serum Carotene Level and Arsenic-induced Peripheral Vascular Disease
Y.M.Hsueh, C.H.Tseng, Y.L.Huang, H.Y.Chiou, W.L.Wu, L.Y.Shih,Y. F. Ko, M.H.Yang, C. C. Huang, C.J.Chen.

9:00-9:15

39. The Immunological Effects of As_2O_3 in Mice
J. Cheng, S.F. Zhu

9:15-9:30

40. Histological Study on the Skin Lesion of Patients with Endemic Arsenism
Y.Wu, D.S. Wu, F.S. Liu

9:30-9:45

41. Purified Thioredoxin Reductase from Mouse Liver Is Inhibited by Methylarsenicals and Arsinothiols
S.Lin, W.R. Cullen, D.J.Thomas

Chairpersons: M. Ando and D. Caussy and Z .Z. Guan

9:45-10:00

42. The Major Ingestion Pathways of Arsenic in Endemic Arsenosis Areas in Guizhou Province, China
B.S. Zheng, Z.H. Ding, J.M. Zhu, J. Zhang, J.P. Long, D.X. Zhou, Y.S. Zhou, C. Zhou, D.N. Liu

10:00-10:15

43. Fluoride Sorption Studies on A Chemically Amended Silty Clay Sediment (Illite)

M. Agarwal, K. Rai, R. Shrivastav , S. Dass

----------Coffee Break----------

10:35-10:50

44. Speciation and Dispersion of Arsenic in a Tailings Dam and Surrounding Soils

M. E. Guti開rez-Ruiz, P. Fern◊ndez-Lomel韓, I. Sommer Cervantes, J. Busch, A. Torrens

10:50-11:05

45. Geochemistry of Fluorine-Rich Coal Related to Endemic Fluorosis in Guizhou Province, China.

H.E.Belkin, R.B.Finkelman, B.S.Zheng

11:05-11:20

46. Effects of Aluminium (Al3+), Calcium (Ca2+) and Iron (Fe2+) on Diffusive Mobility of Fluoride in Soil

K. Rai, M. Agarwal, S. Dass, R. Shriivastav

11:20-11:35

47. A Study on the Diffusive Mobility of Fluoride

K. Rai, M. Agarwal, S. Dass, R. Shrivastav

Platform Session 3: Prevention and Treatment

Chairpersons: B. S. Zheng and R.B.Finkelman

11:35-11:50

48. Investigation of Prevention and Cure of Endemic Fluorosis and Arsenism

S.Z. Sun, Y.Y. Chen, X.M. Chen, G.F. Sun

11:50-12:05

49. Surgical Treatment of Spinal Cord Injure Resulting from Fluorosis

L.Z. Li, R.Tian

12:05-12:20

50. Project for Improvement of Drinking Water in Rural Area of Baicheng Prefecture

T. Sakaguchi

Chairpersons: B. A. Hoque and M. Agarwal

13:20-13:35

51. Effect of -Carotene and SOD on Lipid Peroxidation Induced by Fluoride

L.Y. Qiu, G. F. Sun

13:35-13:50

52. Study on Hyperthermy Regeneration of Bone-salt Reagent for Defluoridation

L.F. Wang, L. Zhang, S. L. Wang, Y. Yang

13:50-14:05

53.The Effects of GSH taken orally on Lipid Peroxidation Induced by Fluoride

G. Liang, X. M. Zhang, H.Zhao, J.C. Tang, Y.Y.Li, F.J.Li, G.F.Sun

14:05-14:20

54. Fluoride Concentration of Korean Beverage Measured by F-Ion Selective Electrode and Ion Chromatography.

H.W. Ahn

14:20-14:35

55. Combined Toxicity of Fluoride and Arsenic Trioxide in Ovary and Uterus of Mice and Its Amelioration by Ascorbic Acid

N. J. Chinoy

Chairpersons: T. Sakaguchi and A. M. Sancha

14:35-14:50

56. Arsenic Metabolism in Humans and Its Modulation by Selenium

K.H.Hsu, H.Y.Chiou, C.J.Chen

----------**Coffee Break**----------

15:10-15:25

57. Effects of Organ-selenium on Cell Membrane Structure and Function of Endemic Arsenism

Y.J. Xia, S.F. Hou, K.G. Wu, L.S. Yang, S.M.Tian, W.Y.Wang, H.Z. Ma

15:25-15:40

58. Environmental Arsenic Levels and Human Health

R. E. Grissom

15:40-15:55

59. Arsenic Contamination of Drinking Water: an Alternative Viable Concept of Mitigation

M.Rahman, Q.Q.Zaman, A.H. Milton, S. Roy, D.Chakrabarty, B.Biswas, U.Choudhury, G.Samanta

Chairpersons: R. E. Grissom and S. Z. Sun

15:55-16:10

60. Preliminary Results of a Study on Safe Water Supply Options in Rural Bangladesh.

B.A. Hoque, K. Firoz, M.R. Munshi, G. Morshed, M. A. Mahmud

16:10-16:25

61. Treatment of Arsenic Related Skin Cancer With Recombinant Interferon Alfa-2b

X.F.Liang, G.Y.Zhang, Y.M.Zhang, Z.R.Zhou, Q.Dai, M.Y.Zhang, X.Y. Ren, Q.J.Sun, Z.D.Luo, S.B.Tucker,LS.Loo

16:25-16:40

62. Evaluation on New Arsenic Removing Materials

Y. Zhang, H. Yan, M. Yang, X. Huang

16:40-16:55

63. Removing Arsenic from Drinking Water. a Brief Critical Review of Some Key Issues

A.M. Sancha

16:55-17:10

64. Study on the Material and Device of Eliminating Arsenic

Q.X. Zhang, F.H. Bai, Z.Q. Wang

Poster Session 2: 17:10-18:10

01. Arsenic and Fluoride in Drinking Water; WHO's Recent Endeavours

S.T. Yamamura

Sanitary Engineer, Water, Sanitation and Health Programme, Department of Protection of the Human Environment, World Health Organization

Arsenic in drinking water has recently been drawing a great deal of attention. Cases of arsenic in drinking water have been reported from countries such as Argentina, Bangladesh, China, Chile, Ghana, Hungary, India, Mexico, Thailand and the United States of America. Arsenic contamination is regarded as a world-wide problem.

One of the chief endeavours of WHO is the determination of norms, and the WHO Guidelines for Drinking-water Quality are intended for use as a basis for the development of national standards in context of local or national environmental, social, economic and cultural conditions. The last edition of the Guidelines (1993) established 0.01mg/L as a provisional guideline value for arsenic, with a view to reducing the concentration of carcinogenic contaminants in drinking water. Many countries have kept 0.05mg/L either as the national standard or as an interim target before aiding populations exposed to lower but still significant concentrations in the 0.01-0.05 range, reflecting that an earlier edition of the Guidelines established this as the guideline value.

In January 1999, within the new organization of WHO headquarters, a cross-departmental initiative in the Sustainable Development and Healthy Environments cluster was launched. Its first joint action is the production of a technical monograph on the control of health hazards from arsenic in drinking-water. Country level activities, covering drinking-water, toxicity and poison control, nutritional interactions, crop contamination, poverty alleviation and relief for chronic emergencies are to be jointly planned and implemented by the various departments and units, together with the regional and country offices concerned. Prior to this movement, the task force in charge of overseeing the current revision of the WHO Guidelines for Drinking-Water Quality has given priority to the monograph. WHO's task is to now combine the coordinated action of the various UN agencies.

Similar efforts are now being planned for fluoride in drinking water. My presentation will introduce WHO's recent efforts on arsenic and fluoride and call for the collaboration of researchers with a global perspective.

02. WHO Strategic Plan for Arsenic Mitigation in the South-East Asia Region

D. Caussy

Environmental Epidemiologist, WHO-SEARO, New Delhi

It has been estimated that in India and Bangladesh, over 20 million people have ingested water containing arsenic concentration exceeding the WHO maximum permissible level of 0.05mg/L. In India alone 220,000 out of 1,500,000 subjects are showing dermatitis due to chronic arsenic exposure. Recognizing the gravity of situation, WHO organized a bilateral consultation of experts and donors in 1997 followed by a series of consultations. Assistance has also been provided for training and development of test kit. From epidemiologic point of view, WHO has three main goals: Validation of test Kit for field testing of arsenic; estimate of the true prevalence of arsenic contamination determining the risk factors for dermal lesions including cluster sampling and case control ones and the monitoring of arsenic removal technologies. Appropriate epidemiolgic studies are being designed for implementation and the details will be presented.

03. Epidemiological Study of Arsenic-related Skin Cancer Cases

Z.D. Luo[1], Y.M. Zhang[1], G.Y. Zhang[1], Q. Dai[1], X.F. Liang[1], X.Y. Ren[1], M.Y. Zhang[1], C. X. Xue[2], S.B. Tucker[3], L.S. Loo[3], R. Wilson[4], S.H. Lamm[5]

1.Hohhot Anti-epidemic and Sanitation Station, Inner Mongolia, PRC 2.Academy of Preventive Medical Sciences of China 3.Medical College of Texas University, USA 4.Harvard University, USA 5.CEOH, USA

Objective This study first concentrates of the relationship between three factors relating to arsenicism: arsenic concentration, doses and effective time. Second the study focuses on the course and results of cancer. Third, based of available data from the study, a predication has been made on a new prevalence rate of skin cancer till 2012.

Methods The study was conducted in two villages named Tie Men Geng and Black River respectively. Subjects in the test case drank from two wells of high arsenic content, in comparison with those who drank from other wells of lower content. On both groups, individual case studies and cohort studies were carried out simultaneously in 1992. As a result, clinic and epidemiological data are now available, including the utilization history and arsenic content of all the examined wells, size of exposed population and severity of skin lesions.

Results 1.With arsenic concentration being 0.598-0.615 mg/L and a continuous exposure over 3-4 years, skin cancer was diagnosed about 30 years later. The accumulated prevalence rate was found to be 39-73%. 2.With a concentration of 0.153-0.212 mg/L and a continuous exposure time of over 39-72 years, no cases of skin cancer were discovered after periodical or retrospective or perspective studies. There no effective concentration could be identified as far as the subjects were concerned. In other words, arsenic-caused skin cancer seems closely associated with exposure intensity, but not so much with time length. Cancer focuses are often foune in patients which continuously develop until their death. When the toxicity of arsenic is accumulated in the body enough to cause cancer, it will result in irreversible damage to health. Thus, provision of new water sources or migration will not help those who are already affected. 3.Skin cancer is ususlly discovered on the unexposed body parts such as waists and buttocks. Keratoses on the palms and excipuliform hyperplasia on the trunk are distinctive symptoms of chronic arenicism. 4.Regarsing the comparision between skin and lung cancers, the exposed have proved to display similar tendency in getting affected by the two in terms of age and time of incidence, probably due to their interralation.

This project is funded by the National Fund for the Research Project The Study of the Epidemic Arsenic-related Cancers and Trace Elements in Drinking Water in the Area of Hohhot, Inner Mongolia, 39460070

04. Health Effects of Indoor Fluoride Pollution by Coal Burning

M. Ando[1], M. Tadano[1], X.Q. Chen[1], S. Asanuma[2], S. Matsushima[1], K. Tamura[3], T. Watanabe[4], T. Kondo[5], S. Sakurai[6], R.D. Ji[7], C.K. Liang[7], S.R. Cao[7]

1.National Institute for Environmental Studies, Tsukuba, Ibaraki, Japan
2.Japan Institute of Rural Medicine, Usuda, Nagano, Japan
3.National Institute for Minamata Disease, Minamata, Kumamoto, Japan
4.Saku Central Hospital, Usuda, Nagano, Japan
5.Matsumoto Dental College, Matsumoto, Nagano, Japan
6.Otsuma Women's University, Tama, Tokyo, Japan
7.Institute of Environmental Health and Engineering, Beijing, China

In some areas in China, coal and surrounding soil are highly contaminated by fluoride. Therefore serious fluoride pollution has been observed in indoor air of coal burning families in these areas. Farmers use the contaminated coal produced by local mines and the main energy sources of cooking, heating and drying are coal burning. For human health, fluoride in indoor air is directly inhaled by residents and absorbed in stored food, such as corn, chilli and potato. In fluorosis area in China, concentrations of urinary fluoride in the residents have been extremely higher than in non-fluorosis area in China and in rural area in Japan. Since the personal exposure to fluoride was very serious, the incidence of fluorosis was extremely high. Deoxypyridinoline in urine is one of the significant biochemical marker of bone resorption. In rural residents in China, urinary deoxypyridinoline was extremely higher than in rural residents in Japan. In this study, it is suggested that bone resorption was extremely stimulated in the residents in rural residents in China. Since indoor fluoride by combustion of coal is easily absorbed in stored food and food contamination is a main source of fluoride exposure, it is necessary to reduce airborne fluoride and food contamination for the prevention of serious fluorosis in China.

05. Blood Biochemistry and Electrolyte Effect of Exposure to Fluoride from Burning Coal on Population

C.K. Liang[1], S.L. Zhang[2], W.H. Li[1], F. Ma[1], Y.P. Wu[1], Y. Li[3], B.P. Katz[4], E.J. Brizendine[3], G.K. Storkey[4]

1.Institute of Environmental Health and Engineering, Chinese Academy of Preventive Medicine. Beijing 100050, China 2.Center for Disease Control in Tianjin, China 3 Indiana University School of Dentistry, USA 4.Indiana University School of entistry,USA

There is no more information of blood biochemistry and electrolyte available regarding possible effects of long-term exposure to excessive fluoride from burning coal on population. The purpose of this investigation was to determine the various levels of blood biochemistry and electrolyte in human with burning coal fluorosis. Four groups of Chinese with different fluoride exposure from burning coal were selected from four rural villages. Study participants were healthy male and female adults except fluorosis with 35 to 60 ages, 119 to 122 local residents in each group.

Fluoride exposure of each study population was determined by analysis of fluoride in food, drinking water and indoor air using a combination fluoride-specific electrode. Dental fluorosis was determined using Dean's index as well as the Total Surface Index of Fluorosis. Singh and Jolly diagnosed Skeletal fluorosis on the basis of clinical evidence and radiological examination using the criteria. A blood sample from each subject was analyzed for sodium, potassium and chloride using an EPX Antomatic Analyzer. Additional chemical parameters (urea nitrogen, creatinine, calcium, phosphorus, uric acid, total protein, albumin, total biliribin, alkaline phosphatase, glutamic-oxaloacetic transaminase, cholestrol and creatinine kinase) were analyzed using the National 7150 Automatic Analyzer.

The survey results indicate that total daily intake fluoride 6.57 and 8.54 mg/person.day, dental fluororis prevalence rate 92. 86% and 99.02%, skeletal fluorosis rate by x-ray 44. 44% and 95.00% for two burning coal fluorosis groups respectively, as well as daily total intake fluoride 2.42 and 2.48 mg/person day, dental fluorosis prevalence rate 14.81% and 14.13%, skeletal fluorosis for two control groups respectively. There were same distributions of age, sex, height and body weight for four groups. It got good results of 1 6 indexes of blood biochemistry and electrolyte also.A two-way analysis of variance (ANOVA) model was used to examine these data. When a significant effect was detected, a Fisher's least-significant-difference test was used to determine Pairwise significance difference among these groups. A significance level of 0.05 was used to test all hypotheses.

While several blood biochemistry parameters were found to be influenced by fluoride exposure from indoor air pollution, such as the increased alkaline phosphatase activity and potassium, their effects do not appear to be clinically significance because all monitored values were within normal range. Based on data from the present investigation, it can be concluded that while chronic fluoride exposure from burning high-fluoride coal increase the risk of dental and skeletal fluorosis, it does not induce adverse extraskeletal in humans.

06. Skeletal Fluorosis Caused by Coal Burned Indoors in Southwestern Chinese Villages

T. Watanabe[1], T. Kondo[2], S. Asanuma[3], M. Ando[4], K. Tamura[5], S. Skuragi[6], R.D. Ji[7], C.K. Liang[7]

1.Saku Central Hospital
2.Matsumoto Dental College
3.Japan Institute of Rural Medicine
4.National Insutitute for Environmental Studies
5.National Insutitute for Minamata Disease
6.Otsuma Womens University
7.Chinese Academy of Preventive Medicine

The endemic fluorosis is normally caused by fluoridecontaining drinking water. In southwestern Chinese villages, fluorosis which is caused by coal burned indoors for cooking. Heating and grain drying is taken up as a serious issue. We probed into this situation with the collaboration of Chinese researchers. We performed surveys in Xaochang, Sichuan Province, Which was counted as one of the most severely polluted area, In 1995; in Shucai, Jianxi province, as the control in 1996; and in Minzhu, Guizhou province, considered moderately polluted, in 1997. We x-rayed the right forearm and the lower leg (frontal), Whereas in polluted communities. The bony pelvis (frontal) and the lumbar vertebrae were radiographed as far as possible.

In Xaochang, the subjects consisted of 33 males and 18 females. According to Singh & Jolly classification of skeletal fluorosis, three subjects came in Stage I(no finding), 3 in Stage II(minor) and 43 (88%) in Stag III (severe). As the findings were checked against the data of Kondo, 39 of 41 subjects in Stage III were in Grade 3 or 4 of Deans classification of dental fluorosis. In Minzhu, we covered 29 males and 20 females in our survey. Twenty-one of them in Stage I skeletal fluorosis, 3 in Stage II and 25 (52%) in Stage III. In this village, incidentally, the rate of cases with skeletal fluorosis in Stage III but dental fluorosis in Grade 0-2 stood at 12/17.

07. The Levels of Lipid Peroxidation and Antioxidation of Patients with Endemic Fluorosis and the Influence of Interference

G.J. Dai, Z.Y. Zhang, C. Zhai, B.L. Chen, G.F. Sun,
G.X. Sun, H.X. Gao, X.X. Zhang, J.Y. Wei,
H.P. Lu, F.J. Meng, H.M. Li

Department of Epidemiology, College of Public Health, China Medical University, 92# Beier Road, Shenyang, China, 110001

Objective To explore the levels of lipid peroxidation and antioxidation of patients with endemic fluorosis and the effect of the low fluoride concentration in improved drinking water on them.

Method Cross sectional study was used. 48 patients of fluorosis, aged 35-55 years, were selected from the endemic fluorisis areas where the mean fluoride concentration in drinking water was 5.403mg/L, the drinking water improved to preserve the fluoride concentration at 1.0mg/L for 23 years and one year. 16 normal persons in nonendemic fluorosis area were selected as negative control group.

Results The mean fluoride concentration in urine in 23 years group of improved water was significantly lower than that in the positive control group, but was not difference from that in the negative control group. The mean fluoride concentration in urine in one year group of improved water was markedly lower that in the positive control group, but still higher than that in the negative control group. The levels of GSH and GSH-Px in 23 years group of improved water were significantly higher than those in the positive control group and one year group of improved water, but were not difference from that in negative control group. The levels of GSH and GSH-Px showed significantly difference between one year group of improved water and the positive control group. There were no differences concerning levels of SOD and LPO in serum, PC, PE, SM and the total phosphalipid in RBC membrane, the total cholesterol of RBC, SM/PC and cholesterol / phosphalipid among the groups.

Conclusion Our study has indicated that drinking water containing high fluoride concentration for a long time would reduced the levels of GSH and GSH-Px. However, drinking water with low fluoride concentration for over a year would return them to the normal.

08. The Health Effects of Ingested Fluoride

D.C. Kennedy

3243 Madrid Street San Diego, California, 92110 U. S. A.

I) Fluoride in water increases tooth decay and fluorosis?
II) Cumulative adverse health effects?
III) Interactions between fluoride and other minerals or substances.
IV) Environmental impact to endangered species from waste water run off.
V) Credibility of reported positive benefits from ingested fluoride.
VI) Credibility of cancer studies which support negative finding of cancer.
VII) Manipulation of data in order to produce a predetermined outcome.
VIII) Impact of chronic fluoride ingestion.
IX) Water fluoridation descriminates against minorities.
X) Conclusions

Fluoride is an aggressive element which inhibits enzymes and forms strong complexes with calcium and magnesium. The tissues in the body that are most visibly affected by exposure to fluoride are teeth and bones. Childhood exposure to excess fluoride will produce visible mottling of the teeth enamel. Bones accumulates fluoride and become weak, bent, brittle and porous. Premature calcification of the pineal gland causes an early onset of puberty.

Personal habits and physical ailments can accelerate the adverse health effects. Laborers drink more water than sedentary workers. Consequently, where fluoride is found in drinking water, people who drink more water receive a proportionately larger dose of fluoride. The kidney is responsible for clearing fluoride from the blood stream and if kidney function is diminished fluoride exposure becomes much more serious.

The severity of damage to humans is increased where dietary intake of protein, calcium, magnesium and vitamin C are low. Fluoride will cross the placental membrane, however, only minimal fluoride is found in breast milk. Both prenatal and post natal exposure to fluoride can have a profound neurological impact.

Epidemiological studies have linked fluoride in drinking water and increased hip fractures, behavioral problems, bone levels of fluoride, dental fluorosis, bone cancer, oral cancer, and early onset of puberty.

09. A Study On the Correlative Relation Between Fluoride Concentration in Drinking Water and Endemic Fluorosis

X.C. Wang

Xi'an University of Architecture and Technology, Xi'an, 710055, China

The influence of extra intake of fluoride from drinking water on endemic fluorosis was studied in Togtoh County, Inner Mongolia Autonomous Region, China. As a result of water quality analysis for villages in three districts of the county, the fluoride concentration was higher than the drinking water quality standard, the fluoride concentration of 75% of the well water supply, and the highest value was 8.0 mg/L. This has caused a high morbidity of fluorosis, 53% for moderate and severe dental fluorosis and 13% for skeletal fluorosis. An analysis of the regional distribution of fluoride concentration of drinking water and the morbidity of fluorosis showed an approximately linear relationship. High occurrence of fluorosis was definitely accompanied by a high fluoride concentration. In addition to the general survey, two villages were selected for case studies. In Village A where water supply depends on a common well of 5~6 mg/L in fluoride concentration, the morbidity of moderate and severe dental fluorosis is as high as 98% among people of 10 years old and above. The symptoms of skeletal fluorosis appear for almost all people older than 40, many of them showing apparent deformity of joint regions, limbs or backbones, and shrinkage of muscles. The importance of water quality improvement is shown by the example of Village B where a deep well was drilled and fresh water with a fluoride concentration of 1.3 mg/L had became water resource since 1976. The occurrences of dental fluorosis by age groups show a declining tendency. In contrast with a high morbidity of 53% to 80% for the thirties and older, that for the younger groups is much lower - 20% for the twenties and 15% for the tenth, with almost no occurrence of dental fluorosis for school children below 12. Changing water resource has apparently improved the health condition of the younger generation.

10. Fluorosis Mitigation Programme in India

A.K. Susheela

Fluorosis Research and Rural Development Foundation C-13, Qutub Institutional Area (Building of the Nutrition Foundation of India). New Delhi 110016,India

India is one among the 23 nations around the globe, where serious health problems occur due to consuming fluoride contaminated water. An estimated 62 million people in India in 16 states of the 32 are affected with Dental, Skeletal and/or Non-skeletal Fluorosis. The extent of contamination of water with fluoride in India varies from 1.0~48.0 mg/L.

An innovative approach developed for Fluorosis mitigation is reported. Netwo king between Public Health Engineering and Health sector personnel, well defined objectives for provision of safe/de-fluoridated water, improvement of the health status or the community through nutritional intervention are the highlights of the programme. Modules for use of Clinicians in their Out-patient departments for early and correct diagnosis of Fluorosis has been developed. The need for teaching of Fluorosis in medical colleges is emphasized. Early detection of the disease is the crux of the problem.

In the Fluorosis Management Programme, the major thrust is on (1) awareness generation (2) developing information, education, communi-cation packages, for the community (3) opting the technology for fluoride removal/other approaches for providing safe water on a sustainable basis and (4) importance of consuming calcium, vitamin C and other antioxidant rich diet for minimizing the adverse effects of fluoride. The communication throws light on the inappropriateness of use of fluoride for prevention of Dental decay.

11. Effects of Sodium Fluoride and Arsenic Trioxide on Liver, Gastrocnemius Muscle of Mice and Their Reversal by Vitamin C

N.J. Chinoy

Reproductive Endocrinology and Toxicology Unit Zoology Department,
School of Sciences Gujarat University Ahmedabad 380009 India

The effects of oral feeding of sodium fluoride and arsenic trioxide together to albino mice (Mus musculus) for 30 days were investigated on liver and gastrocnemius muscle. The recovery of these tissues by withdrawing the treatment and feeding ascorbie acid during this period were also investigated.

The data revealed that both the low dose and high doses of arsenic (0.1mg and 0.5mg per kg body weight) along with 5mg NaF/kg body weight treatment resulted in similar effects on protein and glycogen levels, activities of phosphorylase and succinate dehydrogenase in liver and muscle. However, on the whole the effects by high dose were more severe than the low dose and the muscle was more severely affected than the liver.

Zonal necrosis, vacuolization and pycnosis of nuclei were prominent changes in histology of liver. The protein levels in liver and muscle were significantly decreased after the treatment, which would affect their enzymes and overall metabolism.

The changes in carbohydrate metabolism included accumulation of glycogen due to inhibition of phosphorylase.

The oxidative metabolism of muscle was also affected due to decrease in succinate dehydrogenase. Hence a metabolic block would exist in krebs cycle.

All the parameters studied were recovered by withdrawing the treatment fur 30 days. The recovery was more significant by feeding vitamin C at a dose of 15mg/kg body weight per day for 30 days. This is attributed to the antioxidant property of the vitamin.

The results elucidate that combined effects of NaF and arsenic trioxide are transient and reversible and ascorbic acid manifests beneficial effects. To the best of our knowledge this is the first report of its kind.

12. A Study on Fluoride in Sediments of River Yamuna at Agra, India

M. Agarwal, S. Taneja, K. Rai, R. Shrivastav, S. Dass

Department of Chemistry, Faculty of Science, Dayalbagh Educational Institute, Dayalbagh, Agra 282 005 (INDIA)

The present study was undertaken in sediments of river Yamuna at Agra, India to explore a relationship, if existing, between high levels of fluoride (F) in groundwater (out of 4, 000 samples 61% were above 1ppm, highest being 22ppm) and low level of fluoride in river water (0.5 0.8ppm).

Water soluble F, KCL extractable (0.1M) F, and sorption studies (10 ppm) of F on sediments were made on 54 samples collected from two representative sites (i.e entry and exit) of river Yamuna at Agra as a function of a) river banks: north, middle, and south, and b) depths: 1, 2, and 3 feet, at 1 hr contact with required solutions and sediment amount (100 g / L). To quantify the role of metal-F complexes, total ionic strength adjusting buffers containing tri-sodium citrate and trans 1, 2-diamino cyclohexane NNNN, tetra-acetic acid (CDTA) were used. Studied sediments showed low levels of F ranging from nil-7.3 ppm (water soluble) and nil-3.9ppm (Kc1 extractable). Overall values of water soluble F appeared to be nearly similar for both entry (Runkuta) and exit (Tajganj) points. High F concentrations in southern bank of Runkuta (84% samples above 1.0ppm, maximum being 7.3ppm) and northern bank of Tajganj (33% samples above 2.2ppm, maximum being 6.6ppm) can be attributed to anthropogenic activities. F distribution as a function of depth yielded no sequential pattern. Sediments demonstrate insignificant sorption for F (1-8%). Increased metal-F complexes at southern bank of Runkuta and northern bank of Tajganj were also evident.

13. Study of Arsenic Metabolism in the Acute Arsenic Poisoning by Arsenic Trioxide Intake

H. Yamauchi[1], J. Kinoshita[2], N. Nagai[2], K. Shimazaki[2], M. Kasamatsu[2], M. Aminaka[1], S. Saito[1], Y. Nito[1], K. Yoshida[1]

1. Department of Preventive Medicine, St. Marianna University School of Medicine, Kawasaki, Japan. 2.Wakayama City Public Health Center, Wakayama, Japan

The studies were results of toxicology area by mass acute arsenic poisoning in the Wakayama City on July 25, 1998. In the outbreak of this incident, it is a causation to have contaminated the arsenic trioxide with food from which one crime person is offered in the summer festival. For the acute arsenic poisoning patients, the total was 67 people in 32 men and 35 women. The age was from 1 to 67 years old. The arsenic trioxide was contaminating with the roux of curry. The onsets were caused as the acute arsenic poisoning ate several items the roux of curry with the teaspoon. However, the intake dose of roux of the curry had individual variation. Four people died in this incident around half a day after intake of the arsenic trioxide. The vomit was appreciated from the first stage (about ten minutes) as a symptom by many of acute arsenic poisoning patients. The appearance of an early symptom thought that it was a causation to have taken the arsenic trioxide, which was able to solve. The persons of the serious illness observed the onset of peripheral neuritis. Arsenic trioxide intake dose in 63 acute arsenic poisoning patients was presumed to be 20-140mg.

The mean of the urinary arsenic (inorganic arsenic; iAs + methylated arsenic; MA + dimethylated arsenic; DMA) levels after intake of the arsenic trioxide at 1,10 and 30 days, 9029, 1148 and 160 μ g As/g creatine, respectively. The recovery was identified to normal value (50 μ g As/g. creatine) as for the urinary arsenic levels when later of 2-3 months. In the arsenic ratio in the urine after intake of the arsenic trioxide during a day, iAs 86%, MA 90% and DMA 3%, respectively. On the other hand, the arsenic ratio in the urine after intake of the arsenic trioxide after 10 days, iAs9%, MA 80%, and DMA 83%, respectively. The age difference was appreciated as a finding to the arsenic trioxide concerning the methylation by the 2-nd methylation (DMA/MA). A special alteration did not indicate to 1-st methylation (MA/iAs). It was suggest to methylation capacity that a young person be strong compared with people with high age. On the other hand, the sex difference was not indicated. The inorganic arsenic levels in the hair in the acute arsenic poisoning patient increase rapidly after intake of the arsenic trioxide. The highest value was 2.1 μ g/g. The recovery was identified to the value of normal as for concentration of inorganic arsenic in hair when later of about six months.

The material (8-hydroxy-2deoxyguanosine; 8-HOdG) of DNA damage in urine was determined to adult acute arsenic poisoning patients. DNA damage in the body was caused by arsenic trioxide intake, and 8-HOdG levels in urine increase remarkably. And, the continuance of DNA damage was observed as for the condition that arsenic is almost excreted in the body. However, the levels of the material of DNA damage in urine were recovered normal when later of six months. The determination of 8HodG levels in urine was effective to the evaluation of DNA damage by the arsenic exposure.

14. Arsenic Exposure, Genetic Polymorphism of Gstm1, T1, P1 and P53, and Risk of Carotid Atherosclerosis

H.Y. Chiou[1], I.H. Wang[1], C.C. Wu[1], C.H. Tseng[2], H.Y. Mei[3], C.J. Chen[4]

1.School of Public Health, Taipei Medical College, Taipei, Taiwan
2.Department of Internal Medicine, National Taiwan University Hospital, Taipei, Taiwan
3.Department of Public Health, School of Medicine, Taipei Medical College, Taipei, Taiwan
4.Graduate Institute of Epidemiology, College of Public Health, National Taiwan University, Taipei, Taiwan

In order to evaulate the association between arsenic exposure, genetic polymorphism of GSTM1, T1, P1 and p53, and risk of carotid atherosclerosis, a total of 450 residents of Lanyang Basin including 236 carotid atherosclerosis patients and 214 community control were recruited in this study. Each study subject was interviewed by well-trained interviewer using structure question-naire to collect the sociodemographic characteristics, history of drinking well water, habit of cigarette smoking and alcohol drinking, and disease of hypertension, diabetes mellitus. Doppler ultrasonography was used to examined carotid atherosclerosis. Genomic DNA was extracted from oral mucosas cell by Viogen Kit. Polymerase chain reaction (PCR) was used to amplify DNA for GSTM1 and T1. Genetic polymorphism (exon5:Ile^{105}Ile, Ile^{105}Val, Val^{105}Val) of GSTP1 and (codon72, exon4: Arg-Arg, Arg-Pro, Pro-Pro) of p53 was examined by PCR-RFLP using restriction enzyme***Bsm*** AI and ***Bst*** UI, respectively. Hydride-generation atomic absorption spectrometry (HGAAS) was used to determine the content of arsenic in well water. The cumulative arsenic exposure was derived from arsenic concentration in well water and duration of consuming the well water. Age- and sex-adjusted odds ratios and their 95% confidence intervals (CI) were derived from multiple logistic regression models. Logistic regression analysis were also used to estimate the multivariate-adjusted odds ratios and their 95%CIs. Significantly higher risk of carotid atherosclerosis with odd ratios of 2.4 and 4.3 for the age group of 60-69 and 70+, respectively, compared with age 40-49 as the referent group. Men had significantly higher risk of carotid atherosclerosis than women with odds ratio of 1.9. Dose-response relationship between arsenic exposure and risk of carotid atherosclerosis were observed in this study. Our study also found a significantly association between genetic polymorphism of GSTP1 and p53, and risk of carotid atherosclerosis, showing odds ratios of 2.3 and 2.1, respectively, for mutant-type of these markers compared with wild-type of them. Interaction between arsenic exposure and genetic polymorphism on risk of carotid atherosclerosis will be reported in the conference.

15. Arsenic Poisoning Caused by Residential Coal Combustion in Guizhou Province, China

R.B. Finkelman[1], H.E. Belkin[1], B. S. Zheng[2], J. A. Centeno[3]

1.U.S. Geological Survey, Reston, VA
2.Institute of Geochemistry, Guiyang, P. R. China
3.Armed Forces Institute of Pathology, Washington, DC.

Severe arsenic poisoning affects several thousand people in Guizhou Province, southwest China. Exposure to the arsenic is a consequence of the complex interactions of geology, climate, energy needs, food preferences, and cultural practices. The primary source of the arsenic is the mineralized coals used for heating, cooking, and drying foods such as chili peppers. Chili peppers dried over arsenic-rich coals are believed to be the principal source of arsenic exposure, although high arsenic levels (>3,000 ppm) are found in kitchen dust, indoor air, and other foods. The arsenic content of drinking water samples was less than 50 ppb and does not appear to be an important factor. Those affected exhibit typical symptoms of arsenic poisoning including hyperpigmentation (flushed appearance, freckles), hyperkeratosis (scaly lesions on the skin, generally concentrated on the hands and feet), Bowens disease (dark, horny, precancerous lesions of the skin), and squamous cell carcinoma. Detailed chemical and mineralogical characterization of the arsenic-bearing coal samples from this region indicate arsenic concentrations as high as 35,000 ppm! For comparison, the mean concentration for arsenic in U.S. coal is approximately 24 ppm, with a maximum value of about 2000ppm. The high-arsenic coals in Guizhou Province contain a variety of As-bearing phases including pyrite, arsenopyrite, and As-bearing clays, phosphates, sulfides, and sulfates. However, the majority of the arsenic appears to occur as arsenate arsenic in the organic matrix. Geoscientists can help to minimize the health problems by mapping the arsenic content of the coals commonly used for residential energy needs and by identifying the form(s) of arsenic in the coal and detailing their interactions with foods dried over the burning coals.

16. Cancer and Cardiovascular Mortality among Residents in the Arseniasis-endemic Area in Southwestern Taiwan A 12-year Follow-up Study

L.I. Hsu, M.J. Lin, C.J. Chen

Graduate Institute of Epidemiology, School of Public Health, National Taiwan University

In southwestern Taiwan, there are four townships including Paimen, Hsuechia, Putai and Ichu in the arseniasis-endemic area where the water in artesian wells had elevated arsenic levels up to 1.4 mg/L. Our previous studies showed the residents in this endemic area had an increased risk of various cancers, atherosclerotic diseases, abnormal microcirculation, hypertension, diabetes and lens opacity. A cohort of 2962 residents in the endemic area was recruited from 1985 to 1989. Their health status have been followed for 12 years. Compared with the Taiwan general population, the significantly increased SMR were observed in whole malignant neoplasms (SMR=3.1), liver cancer (SMR=2.4), coloncancer (SMR=2.2), lung cancer (SMR=3.4), bladder-cancer (SMR=27.3), kidneycancer (SMR=14.2), diabetes (SMR=1.9), hyper-tension(SMR=2.2), heart disease (SMR=2.8), cerebrovascular diseases (SMR=2.0) and diseases of arteries, arterioles and capillaries(SMR=7.5). In three categories of cumulative arsenic exposure (0, 0.1-19.9, 20+), the significant dose relationship between the exposure and the mortality were observed in lung cancer(RR=1.0, 2.7, 6.2), bladder cancer (RR=1.0, 1.5, 2.7), kidney cancer(RR=1.0, 1.2, 2.0) and ischemic heart disease (RR=1.0, 2.2, 2.6). The BFD patients had significantly higher cancer risk of bladder cancer (RR=3.3), kidney cancer (RR=3.6), ischemic heart disease (RR= 3.4), cerebrovascular diseases (RR=1.8) and diseases of arteries, arterioles and capillaries (RR=16.4). Our study found the significant association between long-term arsenic exposure and mortality of various vascular abnormality and cancers especially for lung and urinary organs

17.Characteristics of Arsenic Poisoning in China

T. Yoshida[1], H. Aikawa[1], K. Sakabe[1], H. Yamauchi[2], F. Kayama[3], W. Fujimoto[4], L. Nakai[5], G.F. Sun[6,7], G.J. Dai[6,7], H.X. Gao[6,7]

1.Tokai Univ. Sch.Med. 2.St. Marianna Univ. Sch. Med. 3.Jichii Univ. Med. 4.Okayama Univ. Sch. Med. 5.Tokyo Science Univ., Japan. 6.China Medical Univ. 7.Fluoride and Arsenic Society of China, China

China is known to be one of the epidemic arsenic (As) poisoning country. Causes of chronic As poisoning in China is classified into three types. The first type occurs by drinking groundwater from wells contaminated with natural As in high concentrations. This type is observed in Inner Mongolia, Shanxi and Xinjiang. The second is caused by fumes from As-rich coal. Guizhou is one of epidemic area of this type. People use the coal for cooking, heating, and drying crops. Inhalation of contaminated indoor air or intake of As deposited crops leads to exposure of As. The third is observed in industries, mainly in nonferrous smelters. Fumes from ore contained As are inhaleted during smelting. We started collaborative research in China in 1996. In this paper we report our studies in Inner Mongolia and in an As mine in Yunnan as examples of the first and the third type, respectively. The As exposure of the first type supposedly began in late 1970s when people became wealthy enough to afford their own pumps for the wells (depth: 10-20m) near their houses. But unfortunately, deep groundwater contained 0.15-2.0mg/L As. Until then they had been using public open wells. Open wells were shallower (depth: 2-3m)and contained high amount of fluoride (F), but lower As. Several years contained high amount of fluoride (F), but lower As. Several years after they started to utilized pumps, part of inhabitants had developed skin dyspigmentation (depigmentation and/or hyperpigmentation) on the trunk. Depigmentation was the earlier and therefore the dominant manifestation in the affected people. In common cases, the hyperkeratosis on the palms and/or the soles began several years after the dyspigmentatin had developed. Our recent observation on the people exposed to extremely high dose of As often showed that they developed hyperkeratosis prior to dyspigmentation. We could not find any person with Bowens disease or skin cancer, maybe because the duration of the As exposure for them was shorter than thirty years. We observed some cases with these skin malignancies in other areas where As exposure period was longer. Synchrotron radiation induced X-ray analysis on hair samples revealed that habitants intook many kinds of elements, and major significant elements were As and F. Analysis of As and F (2.397mg/L As and 2.11mg/L F, respectively) in urine samples collected from them showed their intook amount of As and F was very high, compared to those (0.263mg/L, 0.87mg/L, respectively) from controls living in non-epidemic regions near the field. Skin biopsy taken from pigmented skin regions in the back showed several histological changes: both acanthosis and atrophy in the epidermis, increase of melanin granules in basal cells, large elongated keratinocytes with a large nucleus and eosinophilic cytoplasm in the basal cell layer, milanophages in the upper dermis, mild or moderate nuclear atypicality of keratinocytes in some specimens. Significantly increased 8-hydroxyproline in urine from the exposed people suggested there was DNA damage to some extent. An As mine in Yunnan produces arsenic sulfide in high purity. Arsenic sulfide is easy to burn and turns into arsenious acid. Miners were exposed to the fumes after the blast. They had also exposed to As by drinking groundwater from 1971, when water supply service was established. They had a long history of As exposure and were suffering from lung cancer and/or skin cancer.

18. A Retrospecive Cohort Study on the Relationship Between High-Arsenic Exposure through Drinking Water and Lung Cancer

X.F. Liang, Q. Dai, G.Y. Zhang, Z.R. Zhou,
Y.M. Zhang, M.Y. Zhang, X.Y. Ren, Z.D. Luo

Huhhot Sanitation and Anti-epidemic Station 010020

In order to study the relationship of high arsenic content in drinking water to lung cancer, 885 residents who were born before Jun 1,1975 and existed of Jun 1,1975 have been made the retrospective cohort study in 2 villages of Tumotezuoqi. Based of a total of 19021 person-years as well as 13 lung cancer. The results showed that the relative risk of lung cancer in arsenic exposure group was 9.48 for males and 3.15 for females. The attributable risk percent of lung cancer in arsenic exposure group was 89.45% for males and 68.25% for females. The risk factors significantly associated with lung cancer mortality included arsenic related disease and ingested arsenic exposure. There was a significant dose-response relationship between the total arsenic ingested and mortality rate of lung cancer. There are also a poor association on lung cancer between arsenic exposure and cigarette smoking.

This project is funded by the National Fund for the Research Project The Study of the Epidemic Arsenic-related Cancers and Trace Elements in Drinking Water in the Area of Hohhot, Inner Mongolia, 39460070

19. Arsenic Problem in Drinking Water in Bangladesh Context

B.A. Hoque, S. Yamamura, H.A. Heijnen, G. Morshed, F. Khan

Environmental Health Programme, Health Population Extension Division, International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR, B)

Although arsenic concentrations above health standards in groundwater have been reported from several countries, Bangladesh has the most serious groundwater arsenic problem in the world in terms of the population exposed. About 21million peoples may be exposed to arsenic concentration in drinking water above 0.05 mg/l.

About 95% of 120 million people drink tubewell water. It took about 30 years to supply tubewell water and bring relevant behavioral changes among the people for drinking tubewell water as opposed to surface water. Surface water is more or less abundantly available but heavily conta- minated with fecal matter. Diarrhoeal diseases are associated with the first or second highest causes of morbidity and mortality rates in children.

About 26% of the countries 4 million tubewells (approximately) may be contaminated with more than 0.05mg/l of arsenic. The regional variation is wide. This calls for need for individual testing of every tubewells in most areas of the country for cost-effective intervention. About 80% of the people are unaware about the problem.

Main constraints observed in arsenic mitigation efforts include lack of: (i) appropriate arsenic detecting field kit (ii) knowledge about causes of arsenic (iii) diagnosis, treatment and documentation of arsenic health problems (iv) awareness about arsenic contamination among majority people (v) knowledge about appropriate water supply options and (vi) coordination and collaboration among the stakeholders. The country, its partners and international communities are working on these issues. We will present data on the constraints and on-going initiatives. It is expected that exchange of information at regional and global forum like this will contribute towards addressing of this problem.

20. Association Between Chronic Arsenic Exposure and Children's Intelligence in Thailand

U. Siripitayakunkit[1], P. Visudhiphan[2], M. Pradipasen[3], T. Vorapongsathron[4]

1.Division of Epidemiology, Ministry of Public Heath, Nonthaburi, 11000
2.Department of Pediatric, Faculty of Medicine,Ramathibodi Hospital, Mahidol University, Bangkok,10400
3.Department of Nutrition
4.Department of Biostatisics, Faculty of Public Health, Mahidol University, Bangkok, 10400

Background Previous studies have reported high arsenic level in hair of children at Ronpiboon subdistrict. It is possible that the accumulation of arsenic in their bodies will associate with intelligence.

Methods We measured the arsenic level in hair using AAS method as the indicator of chronic arsenic exposure and IQ with WISC. Potential confounders were collected at the same time period of this cross-sectional study between 16 January and 5 March, 1995. To explore the association, multiple classification analysis was conducted with data from 529 children aged 6-9 years who lived in Ronpiboon district since birth.

Results This study found association between arsenic and childrens intelligence. After adjusting for confounders, we observed statistically significant relationship that arsenic could explain 14% of variance in children's IQ.

Conclusions This result revealed that chronic arsenic exposure as shown by hair samples was related to retardation of intelligence in children. Prevention of further arsenic exposure and health status monitoring of children with arsenic accumulation should be implemented.

21. Long-Term Arsenic Exposure and Incidence of Non-Insulin-Dependent Diabetes Mellitus: A Cohort Study in Arseniasis-Hyperendemic Villages in Taiwan

C.H. Tseng[1], T.Y. Tai[1], C.K. Chong[3], C.P. Tseng[4], M.S. Lai[5], B.J. Lin[1], H.Y. Chiou[2], Y.M. Hsueh[2], C.J. Chen[6]

1.Department of Internal Medicine, National Taiwan University Hospital; Taipei, Taiwan;
2.Graduate Institute of Public Health, Taipei Medical College, Taipei, Taiwan;
3.Department of Rehabilitation, Chang Gung Memorial Hospital, and Chongs Physical Medicine and Rehabilitation Clinic, Taipei, Taiwan;
4.School of Medical Technology, Chang Gung University, Tao-Yuan, Taiwan;
5.Central Bureau of National Health Insurance, Taipei, Taiwan;
6.Graduate Institute of Epidemiology, College of Public Health, National Taiwan University, Taipei, Taiwan.

Diabetes prevalence in arseniasis-hyperendemic villages in Taiwan was reported to be significantly higher than the general population. The aim of this cohort study was to further evaluate the association between ingested inorganic arsenic and incidence of non-insulin-dependent diabetes mellitus in these villages. A total of 446 non-diabetic residents in these villages were followed biannually by oral glucose tolerance test. Diabetes was defined as a fasting plasma glucose level≥7.8mmol/L and/or a 2-hour post-load glucose level≥11.1mmol/L. During the follow-up period of 1499.5 person-years, 41 cases developed diabetes, showing an overall incidence of 27.4 per 1,000 person-years. The incidence of diabetes correlated with age, body mass index and cumulative arsenic exposure. The multivariate-adjusted relative risks were 1.58, 2.28 and 2.12 for an age 55vs <55 years, a body mass index 25vs <25 kg/m2 and a cumulative arsenic exposure 17vs <17 mg/L-years, respectively. The incidence density ratios (95 % confidence interval) between the hyperendemic villages and two non-endemic control townships were 3.55(3.51-3.60), 2.32(1.10-4.90), 4.31(2.42-7.67), and 5.48(2.23-13.45), respectively, for the age groups of 35-44, 45-54, 55-64, and 65-74 years. The findings are consistent with our previous cross-sectional observation that ingested inorganic arsenic is diabetogenic in human beings.

22. The Evaluation of Arsenic Consumption and Adverse Skin Effects

Z.D. Luo[1], Z.R. Zhou[1], G.Y. Zhang[1], Y.M. Zhang[1], Q. Dai[1], X.Y. Ren[1], X.F. Liang[1], M.Y. Zhang[1], Q.J. Sun[1], C.Z. Zhang[1], S.B. Tucker[2], LS. Loo[2]

1. Huhhot Health Anti-epidemic Station, Arsenic Section, Huhhot, Inner Mongolia, China
2. The University of Texas Medical School, Department of Dermatology, Houston, Texas

Introduction At the Second International Conference on Arsenic Exposure and Health Effects, San Diego, 1995, Z.D. Luo et al from Huhhot Sanitation reported arsenical intoxication from the drinking of contaminated wells in his region and brought this problem to the attention of the Chinese government. Several investigative groups from various countries have visited this location to study the skin effects of arsenic consumption.

Methods and Materials The study was conducted in three villages, Tie Men Jeng, Zhi Ji Liang, and Hei He, to determine villagers working conditions, skin types, smoking histories, palmar, plantar keratoses, and skin dyspigmentations (color change) and neoplasms. People from the village were requested to present for clinical examination. A questionnaire was completed and skin examination for arsenical keratoses, skin dyspigmentation, and skin neoplasm was performed.

Results A total of 142 individuals were examined in the village. There were 48% men and 52% women. The ages varied from 5 to 72 years old for men and 6 to 71 for women. The mean age for men was 32.9 years old and 35.8 years old for women. Working conditions, type of clothing, skin types and smoking histories are expressed in Table 1.

We further characterized these 142 villagers into different age groups from <15, 30, 35, 40, 45, 50, 55, 60, 65, and 70 respectively. The diagnostic, suggestive, and possible arsenical keratoses, neoplasms, and possible arsenical color changes are expressed in Figure 2.

50% of skin cancers typical of arsenic occurred on routinely sun-exposed areas, 30% at occasionally sun-exposed skin areas, and 20% occurred on non-sun exposed skin areas as expressed in Figure 3.

In terms of body surface area, 25% is routinely sun exposed including face, scalp, neck, arms, and hands, 45% is occasionally sun-exposed such as lower legs, feet, chest, and back, and 30% is non-sun exposed skin including buttocks, lower abdomen, genitalia, and thighs.

23. The Cell-Type Specificity of Cancer Associated with Arsenic Ingestion

H.R. Guo

Department of Environmental and Occupational Health
Medical College, National Cheng Kung University, Tainan, Taiwan

Associations between arsenic ingestion and occurrence of cancers have been noted for quite a long time. Moreover, since decades ago, researchers had noticed excess cases of angiosarcomas of liver, an extremely rare disease, among people with exposure to arsenic. To evaluate further such associations for cancers of other organ system, a series of ecologic studies were conducted on 243 townships in Taiwan. The incidence rates of various type of cancers between 1980 and 1987 were calculated using data collected by the National Cancer Registry Program. The proportions of wells with various specified arsenic levels in each township were used as indicators of exposure. As the result, associa -tions between high arsenic levels in drinking water with transitional cell carcinomas of the bladder, Kidney and ureter and all urethral cancers combined were observed in both genders. Such associations were also observed in adenocarcinomas of the bladder among males, but not in squamous cell carcinomas of the bladder or renal cell carcinomas or nephroblastomas of the kidney, Among skin cancers, such associations were observed in basal cell carcinomas and squamous cell carcinomas, but not in malignant melanomas or dermatofibrosarcomas. Among lung cancers, a similar association was observed in squamous cell carcinoma, but not in adenocarcinomas. The results suggested that the carcino-genicity of ingested arsenic is cell-type specific.

24. Environmental Risk Assessment of Hazardous Materials in Water System of Sapporo City, Japan

Y. Sato, M. Aoki, A. Tabata, T. Kamei, Y. Magara

Graduate School of Engineering, Hokkaido University, Sapporo, Japan

Just over 1.8 million people of Sapporo city depends on the Toyohira River as a source of raw water supply. As both a mining industry and hot spa resorts are located along the upstream of the Toyohira River, it has long been speculated that the Toyohira River is sometimes significantly enriched with arsenic and other hazardous compounds such as antimony. Accordingly, contamination of drinking water by a mine and hot spa resorts discharges remain sources of potential health hazard. Therefore, a year-long survey was undertaken to identify the major sources of hazardous compounds such as arsenic and factors such as the fluctuation with time of concentration. Similarly, the fate of arsenic in the sludge settled out at both Jozankei and other domestic sewage plant located downstream of the Toyohira River was investigated to minimize the hazard posed by the arsenic in the sludge at the final land disposal site.

The results of investigation are: As the amount of arsenic and boron emerging from the gaps of base rocks of the river bed constitutes the greatest source of arsenic (around 22kg -As/day, 200kg-B/day) and changes in river flow rates have a significant effect on the arsenic and boron concentration of the river water. Arsenic concentration in raw water for public water supply was reduced to around 10 μ g/L as a result of arsenic removal at Jozankei sewage treatment plant and the dilution by several tributaries entering the Toyohira River. Mean arsenic concentration of potable water was reduced to around 3 μ g /L by full conventional water treatment train. However, as boron can not be removed by full conventional water treatment train dilution by water released from reservoirs is necessary during long droughts to minimize the boron concentration.

25. Arsenic Groundwater Contamination and Sufferings of People in Bangladesh and West Bengal-India

U.K. Chowdhury[1], B.K. Biswas[1], T.R. Chowdhury[1], B.K. Mandal[1], G. Samanta[1], G.K. Basu[1], C.R. Chanda[1], S. Roy[2], B. Ahmed[2], Q. Quamruzzaman[2], D. Chakraborti[1]

1.School of Environmental Studies, Jadavpur University, Calcutta- 700032, India
2.Dhaka Community Hospital, Dhaka, Bangladesh

There are (approximately) 20 countries and regions in the world where arsenic contamination of groundwater has become known and four of them (Bangladesh; West Bengal-India; Inner Mongolia; Xinjiang and Taiwan, China;) are in Asia. However, worlds 2 biggest cases of groundwater contamination and worst sufferings of people have been in Bangladesh and West Bengal-India. The total area and population of Bangladesh and West Bengal-India are 148393 sq.km and 120 million and 89192.4 sq.km and 68 million respectively. We have so far analysed 12084 and 55166 hand-tubewells from 64 districts of Bangladesh and 9 affected districts of West Bengal-India. Arsenic found in 52 districts (out of 64) above WHO recommended value (0.01 mg/l) and in 42 districts (out of 64) above 0.05 mg/l in Bangladesh and for West Bengal-India(in 9 districts)43.6% of the tubewells are safe to drink(<0.01 mg/l)and 34.8%have arsenic above 0.05mg/l.We have analysed 3332 hair, 3321nail, 1043 urine and 373 skin-scale from Bangladesh and 7135 hair, 7381 nails, 9295 urine and 165 skin-scale from West-Bengal-India. The analytical report of these samples show that 81%,94%and 95% of hair, nail and urine for the samples of Bangladesh and 57%,83%and 92% of the samples of West Bengal-India we have analysed have arsenic in hair, nail and urine above normal or toxic level (for hair).We had examined at random 11,180 people from affected villages of Bangladesh and 29035 people from West Bengal-India for arsenical dermatological features and out of them we could identified 24.47%and 15.02% people with arsenical skin lesions respectively. Thus in Bangladesh more people are affected from arsenical skin lesions than in West Bengal-India. Children in the affected villages of Bangladesh are more affected (6.5%) than in West Bengal-India(1.7%).We have identified patients sufferings from all types of arsenical skin lesions and also from Gangrene and cancer.

26. Hepatocyte and Neurone Apoptosis Induced by Chronic Fluorosls in Rats

G.S. Li, X.H. Lu, L. Jing

Norman Bethune University of Medical Sciences,
Changchun, 130021 , China

Fluoride-induced apoptosis has not been reported in vivo except in some cultured cells. The objective of the present work is to study whether apoptosis can be induced in rats by chronic fluorosis. The experiment was divided into two parts: (l) Hepatocyte apoptosis Adult Wister rats were kept on a balanced diet with adequate calcium and drinking water supplemented with sodium fluoride (F,200 mg/L) for 8 weeks. The hepatocyte apoptosis was determined by flow cytometry (FCM). The percentage of DNA fragmentation (apoptotic peak value) was 13.73+4.05 % in group treated with fluoride while it was 0.67+ l .11 % in the control ($p<0.001$). Similar result was obtained in the rats maintained on a monotonous diet with low calcium and fluoridized water (F, 100 mg/L) for two months, but no preventive effect was seen when calcium was added to the diet; (2) Neurone apoptosis The rats were treated as the same as above mentioned. The brain samples were dissected from cerebral cortex, hippocampus, and thalamus and neurone was measured by FCM. In each part of the brain the percentage of DNA fragmentation was much higher in fluoride-treated group than that of the control. For example, in the cerebral cortex the apoptotic peak value was 49.60 $\pm$ 0.70% in fluoride treated group while it was 25.36+ 0.80% in the control ($p<0.01$). These results demonstrate that hepatocyte and neurone apoptosis can be induced in vivo by chronic fluoride poisoning. Our data also suggest that oxidative stress may play some role in the inducement of hepatocyte apoptosis and ICE (Interleukin-l β convert enzyme, Caspase-1) may participate in the regulation of neurone apoptosis induced by fluoride.

27. Modification Of Membrane Lipids In Rat Brain, Liver And Kidney With Chronic Fluorosis

Z.Z. Guan[1,3], K.Q. Xiao[1], Y.A.Wang[2,3], J.L. Liu[1], G. Dallner[3]

1. Department of Pathology
2. Department of Scientific Research Administration, Guiyang Medical
3. College, Guiyang 550004, Guizhou, China
4. Clinical Research Center, Karolinska Institute, S-14186 Huddinge, Sweden

72 Wistar rats were fed either 30ppm or 100ppm fluoride for seven months to produce animal model with chronic fluorosis. The levels of membrane phospholipid and neutral lipid in brain, liver and kidney from rats were investigated. The major individual phospholipid classes, such as phosphatidylethanolamine, phosphatidylcholine, cardiolipin, phosphatidy-linositol, phosphatidylserine, sphingomyelin and lyso-phosphatidylcholine, were analyzed by high-performance liquid chromatography (HPLC). Fatty acid composition was measured by gas chromatography. Three neutral lipid species, such as ubiquinone, cholesterol and dolichol, were analyzed by HPLC. After seven months of fluoride treatment, the contents of phosphatidylethanolamine, phosphatidylcholine and phosphatidylserine were decreased in the organs influenced by fluorosis as compared to control. Changes of fatty acid composition were observed in some individual phospholipid from the organs with fluorosis. There were no changes in amounts of cholesterol and dolichol between the organs with and without fluorosis. Some interesting changes in ubiquinone levels were observed following chronic fluoride treatment. In brain, after three months of fluoride treatment, ubiquinone content was lower compared to control, however, at seven months the content was increased in the rats treated with the higher concentration of fluoride. In liver and kidney with fluorosis, levels of ubiquinone were lower as compared to control. Modifications in specific membrane lipids in brain, liver and kidney with chronic fluorosis could be involved in the pathogenesis of this disease.

28. Effects of Fluoride on the Cell Cycle and Apoptosis in Vitro Organ Culture of bone

K.T. Liu, G.Q. Wang, S.Z. Wang, J.Y. Wu, B.Y. Xiao

Department of Environmental Health, Xinjiang Medical University, Xinjiang 830054

Objective To investigate the effects of fluoride on the cell cycle and apoptosis of long bone. Methods: Cell cycle, DNA content and apoptosis were observed with flow cytometry (FLM), using the technique of organ culture of bone.

Results (1) The concentration of fluoride at 2.5-5.0 μ g/mL did not influence the DNA contents and cell cycle distributions in vitro organ culture of long bone. Fluoride at 10.0 μ g/mL increased the number of cells in S phase, but not changed that in G_1/G_0 and G_2/M phase. Fluoride at 20.0 μ g/mL not only increased the number of cells in S phase, but also decreased that in G_2/M phase. Fluoride, as a stimulative factor, interrupted the normal signal tranducer and inhibited cell from S-phase to G_2/M~phase and made cell cycle stop in S phase. The cell proliferation was influenced. (2) The concentrations of fluoride at 2.5~10.0 μ g/L did not induce apoptosis to increase in vitro. But the number of apoptotic cells showed a significant increase at 20.0 μ g/mL of fluoride. Conclusion: It is possible that the damage of fluoride on skeleton may be related with the promoting apoptosis and disconcerting cell cycle distributions.

29. Inhibition of Growth and α -Amylase Activity in Germinating Mung Bean Seeds by Arsenic , Cadmium , Copper , Mercury , And Zinc

M.H. Yu, C. Keeney, M. Logan, C. Bellona, L. Dier-Ackley

Huxley College of Environmental Studies, Wastern Washington Univesity, Bellingham, Washington, USA

Many environmental toxicants cause adverse effects on seed germination, as manifested by impaired root elongation and development of seedlings. Root elongation is thus widely used as an end point in testing the phytotoxicity of environmental toxicants. However, the mechanism by which these toxicants cause impaired root growth is not well understood. We reported previously that exposure to fluoride (F) resulted in depressed root elongation and α -amylase activity in mung bean seedlings. In this study, we compared arsenic (As) with several heavy metals including cadmium (Cd), copper (Cu), mercury (Hg), and zinc (Zn) on their effects on root growth and α -amylase activity in germinating seeds. Onedayold mung bean (Vigna radiata) seedlings were exposed to varying concentrations of As_2O_3, $CdCl_2$, $CuCl_2$, $HgCl_2$ and $ZnCl_2$, for 72 hours. Seedlings treated with water were used as control. The growth of the seedling was assessed by measuring the length of the radicles, while α amylase was studied using crude enzyme extracts prepared from the cotvledons . All the test chemicals depressed root elongation and α -amylase activity, and the decreases were concentration dependent. Furthermore, among the test chemicals used, As_2O_3 was found to be the most potent inhibitor of seedling growth and α -amylase activity. Since the growth suppression induced by the test chemicals generally correlated with their inhibitory effect on α -amylase activity , it is concluded that the observed suppression of mung bean germination may be due, in part at least, to their inhibitory effect on α -amylase activity in vivo .

30. Decreased Serum Levels of Nitric Oxide Metabolites among Residents in an Endemic Area of Chronic Arsenic Poisoning in Inner Mongolia, China

J.B. Pi[1], Y. Kumagai[2], G.F. Sun[1], H. Yamauchi[3], T. Yoshida[4], A. Endo[2], L.Y. Yu[1], K. Yuki[2], T. Miyauchi[2], N. Shimojo[2]

1.China Medical University, China
2.University of Tsukuba Japan
3.St.Marianna University School of Medicine, Japan
4.Tokai University School of Medicine, Japan

Background Long-term arsenic intake causes skin lesion, peripheral vascular disease, ischemic heart disease, neuropathy and/or cancer. The cardio/peripheral vascular manifestations observed by chronic exposure to arsenic are similar to the disorders caused by impaired physiological actions of nitric oxide (NO). This suggest that systemic NO production may be down-regulated during chronic exposure to arsenic, but no information is available on the relationship between NO and arseniasis in human. **Methods** The subjects were thirty-three residents who have drunk well water containing higher concentration of inorganic arsenic (mean value of 0.41g/ml) for about 18 years, in Wuyuan, Inner Mongolia, China, and 10 healthy controls who lived near this area, but exposed to minimal concentration of arsenic (mean value of 0.02 μ g/ml). Serum concentration of nitrite/nitrate which are stable metabolites of NO was evaluated as index NO production in vivo. Effects of inorganic arsenic on enzyme activities of neuronal and endothelial NO synthase were also examined in vitro. **Findings** Steady-state serum nitrite/nitrate concentration(mean±SD=24.67±14.12M)in residents drinking the higher concentration of arsenic was about half of that(51.58±10.88 μ M)of controls. Blood levels of arsenic and its methylated metabolites were inversely correlated with serum levels of nitrite/nitrate in the total samples: inorganic arsenic, γ =0.52,P<0.001; monomethyl arsenic, γ = 0.45,P<0.005; dimethyl arsenic, γ =0.37,P<0.05. Peripheral vascular symptom, but not skin lesions was significantly associated with low of serum nitrite/nitrate levels in the arsenicexposure group. Incubation of enzyme preparations for neuronal and endothelial NO synthase with inorganic arsenite or arsenate resulted in a significant suppression of enzyme activity of endothelial NO synthase, but not neuronal NO synthase. **Interpretation** The results support our hypothesis that long-term exposure to arsenic by drinking well water affects NO formation, resulting in decrease in serum nitrite/nitrate level. Therefore, it is likely that peripheral vascular diseases caused by arsenic is partially attributable to impairment of NO production in vivo.

31. Cytogenetic Alterations Induced by Inorganic Arsenic in Human Cells

T.C. Lee, L.H. Yih, S.C. Huang

Laboratory of Molecular Toxicology, Institute of Biomedical Sciences, Academia Sinica, Taipei, Taiwan

Arsenic is widely distributed in nature and released into the environment through industrial processes and agricultural usage. Epidemiological investi -gations have revealed that exposure to arsenic is highly correlated with increased risks of human lung, skin, prostate, liver, and bladder cancers. While most carcinogens are mutagens, arsenicals are not mutagenic in bacterial or mammalian cells. However, arsenic can induce chromosome aberrations, sister chromatid exchanges, morphological transformation and gene amplification in a variety of in vitro culture systems. We have recently shown that arsenite induced mainly kinetochore-positive MN (K^+-MN) in human diploid fibroblasts (HFW) cells by low dose exposure (< 5 μ M) whereas mainly kinetochore-negative MN (K^--MN) by high dose exposure. These results indicate that arsenite is aneugenic at low doses whereas clastogenic at high doses. Our studies further demonstrated that arsenite treatment results in prolongation of mitosis and induction of altered chromosome segregation, aneuploidy and chromosome instability in human fibroblasts. We have also found that arsenite could mimic colchicine or nocodazole to arrest the mitotic cells in cultured cells. However, unlike spindle poisons, arsenite at the dose range used (< 5 μ M) does not inhibit the spindle fiber formation, but conceivably deranges the spindle apparatus, such as prolongs aster fibers, elongates polar distance and enhances microtubule intensity in HeLa cells. By an in vitro turbidity assay, arsenite may enhance microtubule polymerization. These results suggest that arsenite may disturb mitotic progression through its interaction with microtubules resulting in decrease of the dynamic of microtubules. Chromosomal alterations are closely associated with initiation, promotion, and progression of cancer development, therefore, further investigation is needed to characterize the relationship between arsenic induced mitotic disturbance and carcinogenicity.

32. Biomarkers of Effects Caused by Arsenic

J.C. Ng[1], L.X.Qi[1], C.Garnett[1], S.Kratzmann[1], B.Chiswell[2], M.R. Moore[1]

1.National Research Centre for Environmental Toxicology, The University of Queensland, Australia
2.Chemistry Department, The University of Queensland, Australia

Lipid peroxidation, an oxidative reaction due to hydroxyl free radical attack on the polyunsaturated fatty acids, results in the production of hydro lipid peroxides and malondialdehyde (MDA). A relatively simple, but sensitive and specific, method has been developed for the measurement of MDA in biological fluids to investigate the potential for the use of MDA as a biomarker of effects due to arsenic exposure. In this study, an approximately two-fold increase in the level of urinary MDA excretion, which persisted for 6 days after dosing of sodium arsenite, was observed in rats given an oral dose of arsenic. This result indicates that arsenic exposure induces lipid peroxidation after a single sub-lethal dose of arsenic. Arsenic is known to affect the activity of a number of enzymes, and some of these may have potential for use as biomarkers of effects. Most promising is the range of effects which arsenic causes on the group of enzymes responsible for haeme biosynthesis and degradation resulting in the production of porphyrins. In our study, a HPLC method has been developed to investigate the alteration of porphyrins profile in the rat as a potential biomarker of effects induced by a sub-lethal dose of sodium arsenite or sodium arsenate, or arsenic-contaminated soil. The results indicate that a single dose of arsenite or arsenate induces increases of porphyrins in various tissues including blood, liver, kidney and urine, and that the changes in porphyrins profile depend both on the arsenic species and with the dosage of exposure. However, contaminated soils had little if any biological effects in the pattern of the porphyrins profile of rats given such soils, confirming the limited bioavailability of arsenic from these soils tested in these animals in our previous studies. The present study substantiates the view that measurement of malondialdehyde and porphyrin concentrations can serve as biomarkers of clinical effects of arsenic exposure. These biomarkers can potentially be used for health risk assessment in humans who live in arsenic-endemic areas.

33. Study of Arsenic Carcinogenicity Using the In-Vitro and In-Vivo Systems

J.C. Ng[1], L.x. Qi[1], J.P.Wang[1,2], X.L.Xiao[1,3], M.Shahin[1], A.S. Prakash[1]

1.National Research Centre for Environmental Toxicology, The University of Queensland, Australia
2.Xinjiang Institute for Disease Control and Research, Xinjiang, PR China
3.China Agricultural University, Beijing, PR China

Inorganic arsenic compounds have been classified as Group 1 carcinogens. This is supported by human epidemiological evidence of the carcinogenic effects of inorganic arsenic from inhalation exposure, and a correlation between oral exposure to arsenic and incidence of cancer of the skin, liver and other organ systems. There is noticeable absence of two-year carcinogenicity studies in animals by either the inhalation or oral route of exposure. Results so far published in the literature provide very limited supportive evidence of arsenic carcinogenicity in animals. In light of the classification of arsenic as a carcinogen based on human epide-miological data, it would seem prudent to firmly establish that it is a carcinogen in rodents using a two-year animal study. Such a mouse model has been successfully developed in our research centre. When mice exposed to drinking water containing 500 μ g As/L for over two years, high incidences of tumors were developed in a variety of tissues, particularly in lung, intestinal tract and skin. This work demonstrates that arsenic causes tumors in multiple sites and that this mouse model should be a useful tool for the study of the mechanism of arsenic carcinogenicity in humans.

For the mechanistic study of arsenic carcinogenicity, molecular biological studies were initially carried out using the in-vitro system. Our studies suggest that sodium arsenite, sodium arsenate, monome-thylarsonate and dimethylarsenate, even at orders of magnitude higher than physiological concentrations, do not alkylate DNA nor do these com-pounds form adducts with DNA in systems which have been tested so far.

However, mutation studies on tumor specimens obtained from our in-vivo experimental mice have shown great promise thus far. Preliminary results suggest that there are point mutations on codons between147 and 150 of exon 5 in the P53 gene. This is a very significant finding of this type. To our knowledge this is the first such metal specific mutations have been found in animal studies. We are currently investigating mutation patterns in other genes in this in-vivo system.

34. Histological Assessment of Arsenic Induced Lesions: The Development of the International Tissue and Tumor Repository for Chronic Arsenosis in Humans

J.A. Centeno[1], L. Martinez[1], N.P. Page[1], F.G. Mullick[1], R.B. Finkelman[2], H. Gibb[3], D. Longfellow[4], Y.P. Liu[4], C. Thompson[5]

1.Armed Forces Institute of Pathology, Washington, DC, USA
2.US Geological Survey, Reston, VA
3.US Environmental Protection Agency, Washington, DC
4.National Cancer Institute, Bethesda, MD
5.Claudia Thompson, National Institute of Environmental Health Sciences, Research Triangle Park, NC

Background: Arsenic-induced health problems have reached epidemic proportions in Bangladesh, India, and China. In Bangladesh and neighboring West Bengal (India), thousands of wells drilled to provide water for irrigation and drinking have mobilized arsenic from underground rocks and have now contaminated large areas of these countries with high levels of arsenic. In China, the exposure of rural residents that use arsenic-containing coal is equally of concern. Although there is significant evidence demonstrating the human carcinogenic properties of arsenic, the molecular mechanisms of arsenic-induced carcinogenesis in humans and the apparent diversity of human sensitivity to arsenic remains largely unexplored area of arsenic research. In part, this is due to the lack of investigations using human tissues. While tissues and clinical data may be available in various locations throughout the world, they have not been systematically collected, evaluated and validated using well-established criteria for accurate clinicopathologic diagnosis. The lack of a central repository and diagnostic center for such materials renders the conduct of meaningful studies difficult.

Design and Results: In response to this critical need, several US agencies and international organizations have developed the International Tissue and Tumor Repository for Chronic Arsenosis in Humans (ITTRCA). The objectives of the ITTRCA are to serve as a centralized facility for the archival and histological assessment of clinical and pathological specimens from arsenic-exposed groups, to formulate an internationally-agreed upon system of nomenclature for skin lesions and arsenic-induced malignancies, to develop chemical analytical techniques and preservation methods for the determination of the various arsenic species in tissues, and to develop a computerized database on chronic arsenic cases. The purpose of this presentation is to provide an overview of the ITTRCA, to provide details on the histological assessment of four sentinel cases of chronic arsenosis, and to discuss the environmental, clinical and pathological features of arsenic-induced lesions.

35. Effect of Arsenite on Gap Junctional Intercellular Communication Between Human Skin Fibroblast Cells

F.R. Deng, X.B. Guo

Department of Environmental Health, Beijing Medical University, Beijing, China

Objective The aim of this study is to investigate the effect of arsenite on gap junctional intercellular communication (GJI) between human skin fibroblast cells.

Method GJIC between human skin fibroblast cells was detected by scrape loading/dye transfer assay.

Result Arsenite at concentration from 0.005 μ mol/L to 5.0 μ mol/L significantly inhibited the dye transfer between human skin fibroblast cells in a dose dependent manner.

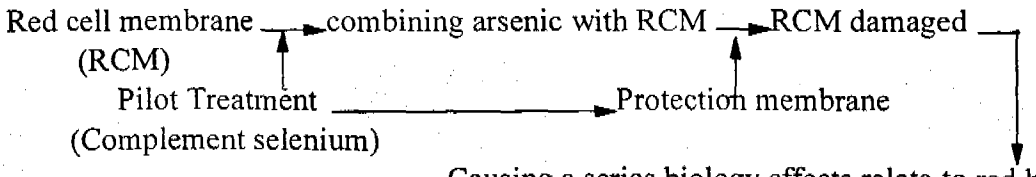
Conclusion The inhibition of GJIC may be an early and specific effect of arsenic on cells. Our results suggest that arsenic may play an important role in the process of tumor promotion.

36. Red Blood Cell Membrane Damaged and Mechanism of Endemic Arsenism

H.Z. Ma[1], Y.J. Xia[1], K.G. Wu[1], G.J. Yu[1],
Y.H. Li[1], S.F. Hou[2], L.S. Yang[2]

1. Institute of Endemic Disease for Prevention and Treatment in Inner Mongolia, Huhehote, China, 010020
2. Chinese Academic of Science, Institute of Geography, Beijing, 100101

Arsenism may cause many organs and tissues damage. It must have a common target in the body The main purpose in this study is that put forward a model of mechanism with red blood cell (RBC) membrane as object.



1.Arsenic content in RCM increased: patient's is 0.101ug/mg membrane protein(MP), the control is 0.002-0.007 μ g/mg-MP. 2.RBC membrane is damaged and morphology changed. 3.Electric charge of RBC surface changed: The mobility of RBC electrophoresis changed. The control is 18 s'/cm, the patient's is 34 s'/cm. 4.C3b receptor of RBC surface is changed: immune adherence (RCIA) decreased. 5.Enzyme activity of RBC membrane decreased: Na^+K^+ATPase of control is 6.32 +1.21 activity unite (AU), the patient's is 4.03 + 1.09 AU; The control is 1127.48 AU, the patients is 794.32 AU, The control GSH-Px is 1 14.9+20.1 AU; the patient is 73.6+22.8 AU. 6.RBC gathering changed, especially in the micro-blood vascular. 7.Microcirculation changed. 8.The patient's extra-thrombosis in vitro is longer and heavier than control.

Effect of cardiac and cerebrovascular system:

1.At first, hemoglobin of some of patients increased, then decreased. 2. The rate of abnormal electrocardiogram is higher than control, and most of abnormal are myocardial ischemia. 3.Disease and symptoms of brain nerve system were more than the control group. 4. The rate of abnormal electroencephalograph reached 39.5%.

After supplementing selinium:

1. Red blood cell membrane was repaired. 2. Enzyme activity of RCM was increased. 3. Microcirculation of patients was improved. 4.The clinical symptoms were improved.

37. Experimental Studies on Fluoride-Arsenic Joint Action

J.Y. Wu, K.T. Liu, W. Lian, J.H. Dai, P. Jiang, Y. Gong

Department of Environmental hygiene, Xinjiang Medical University, Urumqi , 830054

Objective To investigate the absorption and excretion of fluoride-arsenic joint action, and judge the model of fluoride-arsenic joint action in vivo.

Methods: Six volunteers and six local inhabitants were exposed to fluoride and arsenic for five days. Total intake and excretive contents were assayed. Results: 1.Intake of fluoride was 5.3~8.3 mg/ person /day in volunteers. Absorption of fluoride in digestive tract was 95~97%. Excretive content of fluoride was 3.1~5.0 mg/person/day. The proportion of urinary fluoride accounting for total eliminated fluoride was 91-95%. Cumulative rate was 41~47%. Biological half life ($T_{1/2}$) was 0.5 day. Intake of fluoride was 5.5mg/person/day in local inhabitants. Excretive content was 4.6 mg/person/day. Cumulative rate decreased significantly ($P<0.05$). 2. Intake of arsenic was 270~1150 g/person/day in volunteers. Absorption of arsenic in digestive tract was 93~95%. Excretive content of arsenic was 110~510 μ g/person/day. The proportion of urinary arsenic accounting for total eliminated fluoride was over 85%. Cumulative rate was 57~60%. $T_{1/2}$ was 1.5~2 days. Absorption and excretion of arsenic were not interrupted by fluoride. 3.There were no significant changes of the content of serum sulfhydryl. pyruvic acid and urinary hydroxyproline in every group ($P>0.05$).

Conclusion With respect to effect on human health, fluoride and arsenic seemed to be unilateral action. Therefore, to increase the excretion of fluoride and arsenic will be an effective means of preventing and treating fluoride-arsenic joint poisoning.

38. Low Arsenic Methylation Capability, Low Serum Carotene Level and Arsenic-induced Peripheral Vascular Disease

Y.M. Hsueh[1], C.H. Tseng[2], Y.L. Huang[1], H.Y. Chiou[1], W.L. Wu[1], L.Y. Shih[1], Y. F. Ko[1], M.H. Yang[3], C. C. Huang[3], C.J. Chen[4].

1.School of Public Health and Graduate Institute of Public Health, Taipei Medical College,
2.Department of Internal Medicine, National Taiwan University Hospital,
3.Department of Nuclear Science, National Tsing-Hua University, Hsinchu,
4.Graduate Institute of Epidemiology, College of Public Health, National Taiwan University, Taipei, Taiwan.

The objective of this study was to explore the associations of serum micronutrients level and arsenic methylation capability with the development of the PVD. Long-term exposure to inorganic arsenic has been well documented to induced peripheral vascular disease (PVD), and there seem to be variations in individual susceptibility to arsenic-induced health hazards. A total of 81 PVD patients and 216 healthy controls were recruited and examined in this study. Systolic blood pressures on bilateral ankle (posterior tibial and dorsal pedal) and brachial arteries of study subjects were measured by Doppler ultrasonography, and the PVD was diagnosed as an ankle-brachial index (the ratio between ankle and brachial systolic pressure) <0.90 on either side. Serum levels of α - and β -carotene, retinol and α -tocopherol were tested by high-performance liquid chromatography (HPLC). Urinary arsenic was examined by HPLC to separate arsenite, arsenate, monomethylarsonic acid and di-methylarsinic acid; and then quantified by hydride generator linked to atomic absorption spectrometry. The cumulative arsenic exposure was derived from arsenic concentration in artesian well water and duration of consuming the well water. Multiple logistic regression analysis showed a significant dose-response relationship of PVD risk with the cumulative arsenic exposure, the percentage of inorganic arsenic in total amount of urinary inorganic arsenic metabolites as an indicator of poor arsenic methylation capability, and the serum level of α -carotene. The multivariate-adjusted odds ratios (and 95 % confidence intervals) were 3.6 (1.1-12.6), 3.1 (1.2-7.9) and 0.3 (0.1-0.9), respectively, for the highest quartile group compared with the lowest quartile group of the cumulative arsenic exposure, the percentage of inorganic arsenic in total amount of urinary inorganic arsenic metabolites and the serum level of α -carotene. The risk of PVD was significantly associated with the cumulative arsenic exposure in a dose-response relationship. The higher the serum carotenes level, the lower the PVD risk; but the poorer the arsenic methylation capability, the higher the PVD risk.

39. The Immunological Effects of As_2O_3 in Mice

J. Cheng, S.F. Zhu

Division of Toxicology, School of Public Health, Shanxi Medical University, 030001

The inhibitory effects of As_2O_3 to the function of immune system in mice were observed in this study. After mice were given As_2O_3 orally at dose 1.15mg/kg, 2.3mg/kg, 4.6mg/kg, it could inhibit the production of hemolysin, the values of HC50 were decreased to 43.77, 33.34, 13.14 respectively, and the differences (compared to the control group 65.89) were significant ($p<0.05$). As_2O_3 could also inhibit the function of reticuloendothelial system in mice, the values of K in carbon clearance test were decreased to 0.060, 0.054, 0.047 respectively, the differences (compared to the control group 0.084) were significant ($p<0.05$). At the same time in the selenium groups, organic selenium was given to mice at dose 0.1mg/kg , hericium erinaceus polysacchrides(HEPS) 100mg/kg, the results showed that both groups showed antagonistic effects toAs_2O_3 . The study suggested that As_2O_3 could inhibit the immune function of mice, and organic selenium and HEPS at certain doses could antagonize those effects.

40. Histological Study on the Skin Lesion of Patients with Endemic Arsenism

Y. Wu[1], D.S. Wu[2], F.S. Liu[3]

1. Histology Teaching Section, Inner Mongolia Medical College, Huhhot, 010059, China
2. Sanitation and Antiepidemic Station of Inner Mongolia
3. Institute of Oncologv, Chinese Academy of Medical Sciences

Endemic arsenism is a general disease mainly with skin lesions characterized by pigmentation, hyperkeratosis and skin carcer, which are coexistent in various skin lesions. This study was carried out based on the epidemiological survey of endemic arsenism caused by drinking water with high arsenic content among the local inhabitants in such districts as Zhi Jiliang and Tie Men Geng in Huhhot 24 patients suffering from arsenism with serious skin lesions or with suspicions skin carcer receive a intravital microscopy. Their skin lesion samples were observed by means of light microscopy and electron microscopy. The results showed that among the 24 cases, 8 cases suffered from skin cancer with 2 cases belonged to squamous epithelial carcinomas and 6 cases Bowen's disease (epidermoid squamous carcinomas in situ), while the other 16 cases had skin pigmentation with varying degrees. Under light microscopy, an increasing was observed in the number of melanin granules in basal cells, while multiplication and atrophy appeared alternately in stratum spinosum. The same results were obtained by electron microscopy. Tonofilaments were clearly seen in stratum spinosum. Desmosome was changed remarkably, becoming larger and longer with its intermediate line thicker, wider and longer. Therefore we think that skin is one of the parts for arsenic accumulation which may induce skin lesions and canceration. Generally, there is a very long incubation period for arsenical skin carcinomas. The incubation period of Bowens disease is over 10 years and invasive skin Carcinomas appear about 20 years after touching arsenic or drinking water with high arsenic content. There is a statistical relationship between the mortality of skin carcinomas and drinking water with high arsenic content. The results obtained from one research made in Taiwan has showed if a person takes in a total of about 20 g of arsenic in his lifetime, his prevalence rate of skin carcinoma is 6%. Our research experiment provides relevant theratical basis for further prevention and medical treatment on endemic arsenical skin carcinomas.

41. Purified Thioredoxin Reductase from Mouse Liver Is Inhibited by Methylarsenicals and Arsinothiols

S. Lin[1], W.R. Cullen[2], D.J. Thomas[3]

1. Curriculum in Toxicology, UNC-Chapel Hill, North Carolina 27599
2. Dept. of Chemistry, Univ. of British Columbia, Vancouver, Canada
3. Experimental Toxicology Division, NHEERL, U.S.EPA, Research Triangle Park, NC 27711

Thioredoxin reductase (TR, EC 1.6.4.5) was purified 5800-fold from the livers of adult male B6C3F1 mice. The estimated molecular weight of purified TR was about 57 kDa. Enzyme activity was monitored by the NADPH-dependent reduction of 5, 5' dithiobis (2-nitrobenzoic acid) (DTNB) and was fully inhibited by 1M aurothioglucose. The potencies of arsenicals and arsinothiols, complexes of AsIII-containing compounds with L-cysteine or glutathione, were tested as inhibitors of DTNB reductase activity. Pentavalent arsenicals were much less potent inhibitors than were trivalent arsenicals. Among all arsenicals, CH3AsIII was the most potent inhibitor of TR. CH3AsIII was found to be a competitive inhibitor of the reduction of DTNB (Ki~100nM) and a noncompetitive inhibitor of the oxidation of NADPH. The inhibition of TR by CH3AsIII was time dependent and irreversible. Reduction of TR by NADPH was found to be a prerequisite to inhibition by CH3AsIII. Unlike 1-chloro-2,4-dinitrobenzene, an irreversible inhibitor of DTNB reduction by TR, CH3AsIII did not increase the enzymes NADPH oxidase activity. Thus, CH3AsIII, a putative intermediate in the pathway for the biomethylation of As, is a potent and irreversible inhibitor of an enzyme involved in the response of the cell to oxidative stress.

42. The Major Ingestion Pathways of Arsenic in Endemic Arsenosis Areas in Guizhou Province, China

B.S. Zheng[1], Z.H. Ding[1], J.M. Zhu[1], J. Zhang[1], J.P. Long[1], D.X. Zhou[2], Y.S. Zhou[2], C. Zhou[3], D.N. Liu[1]

1.State Key Laboratory of Environmental Geochemistry, Institute of Geochemistry, Guiyang , Guizhou, P.R. China, 550002)
2.Sanitation and anti-epidemic station of Qianxinan Autonomous Prefecture, Xingyi, Guizhou, P.R. China 562400
3.People's Hospital of Qianxinan autonomous prefecture, Xingyi, Guizhou, P.R. China 562400

Arsenic-poisoning occurring in agricultural areas in southwestern Guizhou Province, China, has been a problem for half a century. By 1998, over 3000 cases of arsenic poisoning had been identified and more than 100000 people from 6 counties were under threaten. In 1992~1993, samples of coal, rocks, soil, surface water, ground water, air and food such as chili peppers were collected in endemic and control areas. Samples of urine, blood and hair were also collected from arsenic-poisoned patients as well as healthy population in a control area. Arsenic content of the samples was determined by Ag-DCC method. The results showed that arsenic content of coal used in domestic homes in endemic area is up to 8300 mg/kg with an average of 876.3 ± 1702.3 (mg/kg). The coal is burned inside houses in open pits for heating, cooking and crop drying. Arsenic is precipitated and concentrated in corn (5~20ppm), chili (100~800ppm) and other foods, resulting in arsenic poisoning. In most areas, arsenic concentration in the drinking water unpolluted by indoor combustion of high-arsenic coal is below 50ppb. The estimated sources of arsenic exposure in this cohort include food (50~80%), air (10~20%), water (1~5%) and indoor fly ash (1~3%). This paper presents the major ingestion pathways of this type Arsenism and the corresponding geochemistry of high-arsenic coal.

43. Fluoride Sorption Studies on A Chemically Amended Silty Clay Sediment (Illite)

M. Agarwal, K. Rai, R. Shrivastav , S. Dass

Department of Chemistry, Faculty of Science, Dayalbagh Educational Institute, Dayalbagh, Agra 282 005 (INDIA)

Batch equilibration studies for the sorption of fluoride (F) by a silty clay sediment (SCS, dominantly illite), amended with Al (alumina, Al_2O_3), Fe (ferric chloride, $FeCl_3$) and Ca (calcium carbonate, $CaCO_3$) were conducted under the experimental conditions: a amending cation concentration (s): 50, 100, 200 mg/g clay;b) pH=4, 5, 6, 7 and 10; c) $[F^-]_{INITIAL}$= 0.13, 0.26, 0.53. 0.79, AND 1.32mM; d) clay amount = 5, 10, 25, 50, and 100g / L, and e) shaking time = 5, 10, 20, 60, 90, and 180 minutes. SCS incubated with the simultaneous addition of Al, Fe and Ca exhibited maximum sorption of F^- (95%) even at the lowest added cation concentration (50 mg /g) as compared to control (38%). The sorption by SCS incubated separately with Fe: sample type I_l (94-98%), Al: sample type A_l 78-94%), and Ca: sample type L_l (31-52%) decreases in the same order. F^- sorption was found to increase with the increase in concentrations of amending cationsAl and Ca, while sorption is virtually independent of the concentrations of Fe. In general F^- sorption decreases with the rise in pH. The sorption by A_l, L_l, I_l and unamended SCS (sample type C) was estimated in solutions of increasing F^- concentrations (0.13-32mM) which could be described with the van Bemmelen-Freundlich equation. A_l, I_l, L_l, and C exhibited H, H, C and L type isotherms (Sposito 1984), respectively. A positive correlation was observed between increase in F-sorption and clay amount. F^- added to the system undergoes rapid chemical reaction with considerable sorption being achieved at five minutes equilibrium .

The result of the present study indicates the potential of the clay to be developed as a viable defluoridating agent.

44. Speciation and Dispersion of Arsenic in a Tailings Dam and Surrounding Soils

M.E. Gutiérrez-Ruiz[1], Fernàndez-Lomelin[1],P.,[2] Sommer Cervantes[1], I. Busch[1], J.[1], A. Torrens[2]

1. LAFQA, Instituto de Geografia, Ciudad Universitaria, Coyoacan Mexico, D.F. 04510
2. Dept. Of Civil Enginneering University of Maryland

Introduction During the mineral concentration process, the arsenic present in ore mineral deposits is concentrated in tailings. Since there is a lack of information in Mexico about environmental pollution related to tailings dams, a study to measure*As* con centration in tailings, water and soils was carried out in a dam located in a dry zone with a mean annual precipitation of 510mm. Soils are medium textured and generally of alluvial origin, shallow, with petrocalcic horizons or duripans at 50depth and a poor agricultural production.

Material and Methods The design for soil sampling was done with geostatistical criteria (n=164). Seven sites in the tailings dam were selected, sampling at two depths. Solids were digested with HCl-HNO_3-microwave; total As with AAE-HG (Varian SpectrAA10 Plus-Varian, VGA 77); speciation of As with HPLC-HG-AAE using 10 M HCl (1:10 solid:solution) and distilled water. Sequential extraction was carried out with distilled water, 0.1M calcium phosphate solution and acetate acid buffer (pH=5).

Results and discussion Soils were mostly neutral but pH decreased near the dam and tailings are basic. Electrical conductivity of soils is low and high in tailings. Tailings and soils are low in %C. Compounds of As(V) were detected giving evidence of arsenopyrite oxidation. The total As and As(V) concentrations were higher in the crust of tailings, than in deeper samples. The As concentration is also higher in the superficial layer of soils indicating non transportation to deeper horizons. Spatial dependence of the data could be demonstrated by geostatistical analysis. Two dispersion directions were identified N-S and E-W., The As concentration was very low in the liquid phase of wetlands formed with water from the tailings dam, due to precipitation and/or adsorption phenomena.

45. Geochemistry of Fluorine-Rich Coal Related to Endemic Fluorosis in Guizhou Province, China.

H.E. Belkin[1], R.B. Finkelman[1], B.S. Zheng[2]

1. 956 National Center, U. S. Geolog ical Survey, Reston, Va 20192, USA

2. Institute of Geochemistry, Chinese Academy of Sciences, Guiyang 550002, China

Determining the relationship between emission of hazardous substances into the environment and effects on human health is a challenging responsibility. Endemic fluorosis is very prevalent in China covering 29 provinces, municipalities, and various autonomous regions. The affected areas can be classified according to the sources of fluorine, into three types: pollution from domestic coal combustion, high fluoride groundwater, and drinking fluorine-rich tea (brick tea) in excess. Our collaborative study in Guizhou Province concerns only fluorosis associated with domestic coal combustion. It is estimated that more than 10 million people suffer from fluorosis caused by coal combustion. Both dental and skeletal fluorosis has been identified.

Southwest Guizhou Province contains moderate coal resources in the Longtan Formation of Permian age. As part of a broader geochemical investigation to study the arsenic and trace element enrichment of these coals, we have analyzed coals, related rocks, and clays for fluorine with the proton-induced gamma emission (PIGE) technique. Our preliminary results are consistent with previous studies and show that mineralized coals have values which range from 150 to 2300 ppm, whereas local non-mineralized coals typically contain about 100 ppm F or less, similar to the world average. However, it is important to understand that the coal, burned domestically, is actually burned as a mixture of coal and local clay. The local clay we have analyzed contains about 800 ppm F, although values as high as 10,000 ppm have been reported. Scanning electron microscopy and electron microprobe studies are ongoing to discern the mode of occurrence of the fluorine in the coal. Preliminary results suggest that the fluorine in contained in the clays. Minerals containing high concentrations of fluorine, for example, apatite, were observed only rarely, and when observed did not occur in sufficient concentrations to account for the abundance of fluorine. This is consistent with the concentration of Ca and P in the coal.

The etiology of the fluorine intake by the population is related to the combustion of fluorine-rich coal, converting relatively insoluble fluoride to soluble fluoride. Although the air and dust in houses burning a fluorine-rich coal/clay mixture is contaminated, the predominant vector for human intake is ingestion of contaminated corn and chili peppers. These vegetables are typically dried over open, unvented coal-burning stoves.

The geologic and geochemical challenge will be the determination of the relative contribution of the coal and clay to the fluorine problem in various areas of China and the mapping and identification of acceptable alternative sources.

46. Effects of Aluminium (Al^{3+}), Calcium (Ca^{2+}) and Iron (Fe^{2+}) on Diffusive Mobility of Fluoride in Soil

K. Rai, M. Agarwal, S. Dass, R. Shriivastav

Department of Chemistry, Faculty of Science, Dayalbalbagh Educational Institute, Dayalbagh, Agra, 282 005, INDIA

Effects of three prominent naturally occurring fluoride binding cations viz., Al^{3+}, Ca^{2+} and Fe^{3-} on one dimensional diffusive mobility of the fluoride (F), a biologically important anion, have been investigated in an alluvial soil (Entisol)under the experimental conditions: bulk density =1.56 g cm^{-3}, soil water content =0.25 cm^{3} cm^{-3}, pH =7.3±0.5, soil amending concentration of cations=1560 μ g g^{-1} and temperature = 290 K, Employing the suitably amended (with Al^{3+} /Ca^{2+} /Fe^{3+}) and unamended soils, experiments were performed by joining the two open ends of the F loaded soil core (termed as source section: length 5cm , diameter 2.13 cm) with soil core (termed as soil section: length 6cm, diameter 2.13cm) ensuring proper sealing of all the joints and ends, to avoid any moisture loss. After 4-6 days of incubation, in each 1cm segment of this system the water soluble F was measured. Results indicate that the F mobility in soil decreases linearly with the rise in the soil amending concentrations of Ca^{2+} (correlation coefficient(r= 0.98 at N=16), Fe^{3+} (r= 0.99 at N=18) and Al^{3+} (r= 0.75 at N=15). The rise in F amounts migrated across the source sectionsoil section junction, i.e. q, with the increase in incubation time, t, is also evident ($q \cong t^{1/2}$). Employing the mass balance principle and considering sorption/desorption phenomena, the transient state values (Kemper, 1986) of the porous diffusion coefficients (Dp) for fluoride mobility in soil have also been determined. The obtained values are comparable with the earlier such values quoted for other ions viz. NO^{3+}, Cl etc. by various workers.

The study provides a valuable insight to the phenomenon of diffusion in an alluvial soil in the context of the mechanistic role that this process might play in the ultimate uptake of F by plants.

47. A Study on the Diffusive Mobility of Fluoride

K. Rai, M. Agarwal, S. Dass, R. Shrivastav

Department of Chemistry, Faculty of Science, Dayalbagh Educational Institute, Dayalbagh, Agra, 282 005, INDIA

The diffusive mobility of F in soil, which is an important phenomenon that governs the uptake of F^- by plants (Davison, 1984), has been studied in an alluvial soil and its three soil separates, S_1, S_2 and S_3(particle size < 0.05, 0.16-0.05 and 0.26-0.16 mm, respectively) at varying soil water content (θ)(0.11, 0.19, 0.24 and 0.29cm^3/cm^{-3}),F-concentration gradient in soil (762,610,305and 152 μ g g^{-1}),pH of soil (4,6,and8)and incubation time (4 and 16 days).Experiments were performed by joining the two open ends of `F-loaded core'(source section: length 5cm, diameter 2.15cm with soil cores(soil section: length 6cm,diameter 2.15cm) through proper sealing of all the joints to avoid any moisture loss. After incubation, water soluble F^- was measured in each 1cm slice of this system. Employing the simple mass balance principle the porous diffusion coefficient (Dp) for F diffusion was calculated. Results indicate that the diffusive mobility of F^- increases with increase in soil- water content and F concentration gradient. The observed Dp values in three soil separates are in order $S_2 > S_3 > S_1$ which means that F mobility is greater in soil that is neither very coarse nor very fine. Besides the F mobility was found greater in the acidic soil than in the alkaline. Plausible mechanisms have been suggested to explain the observed variations in F mobility.

48. Investigation of Prevention and Cure of Endemic Fluorosis and Arsenism

S.Z. Sun[1], Y.Y. Chen[2], X.M. Chen[3], G.F. Sun[4]

1. Institute of Environmental Health and Engineering, CAPM, Beijing 100050, China
2. Institute of Environmental Health Monitoring, CAPM, Beijing 100021, China
3. College of Public Health, Tongji Medical University, Wuhan 430030, China
4. College of public Health, China Medical University, Shenyang 110001 , China

This project is a subject that tackles key problems of preventive medicine for the Ninth Five-Year Plan. It is granted by the National Commission of Science and Technology.
The main researches are as the following:
l. Reduction of fluoride and arsenic levels from outside environments, and decrease the exposure concentrations of these contaminant to endemic inhabitants. This sector of subject includes the following topics.
1.1 Defluoridation of drinking water by adsorption onto hydroxyapatite, or a metal compounding material.
l.2 Removal of arsenic from drinking water by adsorption onto modified bone char, or a metal compounding material, and coagulation and precipitation by , hydroxyapatite .
l.3 Fixation of fluoride in burning coal by combination with a calcic compound.
l.4 Elimination of fluoride in air vapors and particulates for air purification.
2 Antagonism of some preparations toward the adverse effects of fluoride in human bodies thus accelerates the excretion of fluoride. This sector of subject includes three topics:
2.1 Preventive anti-fluorosis preparations--The main ingredient is a zinc salt which is composed of a boron or selenium containing compound. Investigation of formulation, antagonistic results and toxic effects of these preparations.
2.2 Restorative anti-fluorosis preparations-- The principal ingredient is a kind of boron or selenium compound. Investigation of formulation, antagonistic results and toxic effects of these preparations.
2.3 Anti--oxidative preparation --Investigation on antagonestic effects and mechanisms of action of reduced glutathione (GSH), β -carotine and superoxide dismutase (SOD).
The above work is ongoing. In which, a lot of tasks are in progress of field testing and verification.

49. Surgical Treatment of Spinal Cord Injure Resulting from Fluorosis

L.Z. Li, R. Tian

The Red Cross Hospital, Tianjing, China

The author has been successful in diagnosis and treatment 102 cases of spinal cord compression of skeletal fluorosis in advance stage. During the period of two years following-up, total effective rate is 90%. It is improving traditional way with less blood in operation and shorten operation time. The author has summarized a complete surgical way and skill. It is a new starting point in surgical treatment of fluorosis.

50. Project for Improvement of Drinking Water in Rural Area of Baicheng Prefecture

T. Sakaguchi

Kyowa Engineering Consultants Co, Ltd. Tokyo, Japan

The Project for Improvement of Drinking Water in the Rural Area of Baicheng Prefecture (the Project) was originally planned by the Jilin Province Patriotic Health Campaign Committee targeting a population of 1,800,000 in Jilin Province. Some water sources in the Project area are affected by fluoride and the number of patients suffering from related diseases was 390,000.

The Project was implemented under the Japan's Grant Aid extended in March, 1993, giving priority to improvement drinking water quality in worse affected 335 communities with population of 310,000 by changing water source from shallow ground water to deep ground water. The Project includes supply of equipment and materials for not only the construction of deep wells and local water supply system, but also for their maintenance and monitoring of water quality. Total project cost was about one billion (J￥1,000,000, 000)in Japanese Yen.

All construction works and installation of equipment were carried out with funds from Government of China, Provincial Government and Local Government, and completed in August, 1997.

After the Project decrease in the incidence rate of fluorosis from 50.0% to 47.69%, osteoporosis from 6.40% to 5.21% and intestinal diseases from 0.211% to 0.162% respectively have been observed. Condition of some patients is reported have improved to be able to walk alone and take charge of easy work Survey also shows that annual income of some families in the Project area has increased by 20%.

51. Effect of β -Carotene and SOD on Lipid Peroxidation Induced by Fluoride

L.Y. Qiu, G.F. Sun

School of Public Health, China Medical University, Shenyang 110001, China

The effect of β -carotene and SOD on lipid peroxidation of rat induced by fluoride in vitro and in vivo was studied by rat liver microsomal system and by adding fluoride (150mg/L) to drinking water. In vitro the experimental results showed that fluoride could significantly increase the content of lipid peroxide (LPO) of rat liver microsomal system, and the lipid peroxidation was antagonized by adding β -carotene and SOD to rat liver microsomal system simultaneously. In vivo the experimental results showed that β -carotene and SOD took positive role on the growth of rats, The growth rate of rats in β -carotene-treated and SOD-treated groups were higher than that of simple fluoride . We also found that the LPO levels of serum , liver, kidney and heart increased and the SOD, GSH-Px and GSH levels decreased in the simple fluoride-treated group. This suggested that the ability of the anti-oxidation in fluoriosed rats declined. The LPO level of the body was much lower and the function of anti-oxidation was considerably improved by adding β -carotene and SOD.

52. Study on Hyperthermy Regeneration of Bone-salt Reagent for Defluoridation

L.F. Wang, L. Zhang, S. L. Wang, Y. Yang,

Xinjiang Institute for Endemic Disease Control and Reseasch,Urumqi 830002, China

Endemic fluorosis caused by excess fluoride intake from drinking water is a serious public health problem in some areas of China and other countries of the world at present. Bone char, as a raw bone-salt, may be used to reduced the fluoride concentration in drinking water to acceptable level. However, its regeneration is frequent and demand much sodium hydroxide as regenerative reagent. Therefore it is not only high cost for water treatment but also too difficult to operate in domestic defluoridation. A new regeneration method for bone-salt combined with much fluoride has been developed in our laboratory, which based on the phenomenon that the fluoride in bone-salt could be released at hyperthermy of 250～550℃. With the defluoridation capacity of bone char regenerated as index, the rules of regeneration were studied in different temperatures. In both groups of 350℃ and 425℃, it was high than that of sodium hydroxide group. In the group of 350℃ treating in 0.5～24hours, it was ranged of 2.57～4.05 F mg/g, and tends to increase with treatment time prolonged. However it was 2.74～4.84 F mg/g with a peak at the time of one hour in the group of 425℃. Under same conditions, the capacities were alike in both of bone char and purified bone-salt. It is a cheap and efficient regenerative method for bone char in household defluoridation.

53. The Effects of GSH taken orally on Lipid Peroxidation Induced by Fluoride*

G. Liang[1], X. M. Zhang[1], H. Zhao[2], J.C. Tang[2], Y.Y. Li[3], F.J. Li[3], G.F. Sun[3]

1. Sanitation and Anti-epidemic Station of Shenyang, Shenyang,110031
2. Sanitation and Anti-epidemic Station, Dadong District, Shenyang,110042
3. School of Public Health, China Medical University, Shenyang ,110001

Objective: To study the effects of GSH in diffderent dose group taken orally on lipid peroxidation induced by Fluoride.
Methods: The experiments were studied by means of subchronic animal experiment.
Results: In the simple fluoride-treated group :The Contents of MDA in serum、liver、kidney and brain of rat increased significantly ;The activities of SOD in blood、liver、kidney、heart and testis decreased significantly. After taking orally GSH, the contents lipid peroxide MDA were significantly inhibited; Activities of SOD were recovered on different degrees. Meanwhile, inorganic GSH could accelerate the excretion of urine F^-.
Conclusion: Fluoride could induce lipid peroxidation and decrease the capacity of anti-oxidation in rats,but GSH could antagonize the lipid peroxidation ,improve the capacity of anti-oxidation in rats.

*The project is the tackle key problem of nation

54. Fluoride Concentration of Korean Beverage Measured by F-Ion Selective Electrode and Ion Chromatography

H.W. Ahn

Department of Environmental Engineering, College of Engineering,
University of Suwon

In Korea, fluoride (F) was first introduced into the municipal drinking water of Jinhae, Kyung-Nam province in 1981 for the prevention of dental caries. Ever since, growing numbers of communities have favored fluoridation and more than 10 water treatment facilities out of total 61 are now fluoridated. The efficacy and safety of fluoridation are recently questioned in Korea, but F research except dentistry has not been carried out extensively until now in spite of the long history of fluoridation (more than 15 years). Thus, F concentration of the beverage consumed in Korea was measured by F-ion selective electrode and ion chromatography to assess F exposure. The samples used in this study were tea, sports drink and fruit juices which are widely consumed in Korea. As we expected, various tea (green tea, black tea, persimmon tea, eucommia tea and so on) contains high level of F, ranging from 150 μ g/g-dry weight to 679 μ g/g-dry weight. On the other hand sports sport drinks and fruit juices contain much lower concentration than tea. Fluoride concentrations of sports drinks (Never Stop, Power Aid, Enerbit, Getorade, Pocarisweat) and fruit juices(Woo Ri grape juice, Eve grape juice, Hi-C orange juice, Family orange juice) lie in the range from 0.1ppm to 0.29ppm and from 0.15ppm to 0.32ppm respectively. Further, F concentrations in air, food and water have to be measured for F exposure assessment, but this study shows that the beverage contributes significantly to total F exposure. Thus, the amount of exposed F has to measured and used to determine whether extar F supply like water fluoridation is required or not.

55. Combined Toxicity of Fluoride and Arsenic Trioxide in Ovary and Uterus of Mice and Its Amelioration by Ascorbic Acid

N.J. Chinoy

Reproductive Endocrinology and Toxicology Unit Zoology Department, School of Sciences Gujarat University Ahmedabad-380 009, India

The combined effects of sodium fluoride (NaF, 5mg/kg body weight) and arsenic trioxide (0.1 and 0.5mg/kg body weight) treatment for 30 days were studied on the mice ovary and uterus. The effects of withdrawal of treatment and feeding ascorbic acid during this period were also studied. The results revealed that the combined treatment caused adverse effects on ovarian and uterine protein levels which were significantly decreased by both high and low doses of arsenic trioxide. The glycogen metabolism was altered with significant accumulation of glycogen in uterus concomitant with a decrease in phosphorylase activity. These changes might be related to the alterations in histology of both ovary and uterus after treatment which would result in less glandular secretions thus affecting homeostasis of uterus.

The ovarian folliculogenesis and steroidogenesis were also altered in treated mice as is evident from follicular atresia, cholesterol but decline in activities of 3 β and 17 β hydroxysteroid dehydrogenases .

The effects were similar by low and high dose arsenic treatments but more severe by the latter.

The cessation of treatment for another month after 30 days treatment resulted in significant recovery in all induced effects. However, the recovery was very significant in both tissues and all parameters studied by withdrawal + ascorbic acid feeding (15mg/kg body wt). .

The results revealed that the combined toxicity of NaF+arsenic trioxide (low and high dose) could be mitigated by ascorbic acid .

56. Arsenic Metabolism in Humans and Its Modulation by Selenium

K.H. Hsu[1], H.Y. Chiou[2], C.J. Chen[3]

1. Laboratory for Epidemiology, Department of Health Care Management, Chang Gung University, Taiwan
2. School of Public Health, Taipei Medical College, Taipei, Taiwan
3. Graduate Institute of Epidemiology, College of Public Health, National Taiwan University, Taipei, Taiwan

The perspective of this study is to investigate the factors influencing arsenic metabolism and possible intervention of selenium for chronic arsenic-exposed persons in I-Lan county. Both selenium and arsenic in general behave as metabolic antipodes, each can be used to alleviate the symptoms of poisoning of the other. This study compared arsenic methylation pattern and total selenium in urine of adult residents and school children in terms of increasing levels of arsenic exposure in their drinking water before and after selenium supplements. The major detoxification of inorganic arsenic is through the methylation of arsenite to monomethyl- and dimethyl- arsenic acids through which the metabolites are purportedly less toxic and are eliminated quickly in urine. Therefore, arsenic methylation capacity is a very important characteristic that may affect the risk of developing various arsenic-related diseases. Selenium is thought to significantly mobilize and deplete tissue arsenic in experiment animals as well as in humans. The intervention of selenium to chronic arsenic-exposed people was experimented. Further more, the competitive role of selenium on arsenic methylation was elucidated.

We have collected 24-hour urine from arsenic-exposed population in ChuanWei, I-Lan county, including 196 school children and 46 adult residents. This study had firstly demonstrated that lifestyle variables and arsenic exposure had effects on the arsenic methylation capacity. Secondly, increasing urinary selenium was correlated with increasing total arsenic excretion and decreasing percent of inorganic arsenic after adjusting effects of other confounding factors. At last, we have observed some changes of urinary arsenic metabolites and its total excretion before and after selenium supplements, however the differences were not statistically significant. We have come to a further understanding of the role of selenium on the changes of pattern in urinary arsenic metabolites. The findings give a clue of interventions by selenium for chronic arsenic-exposed persons.

57. Effects of Organ-selenium on Cell Membrane Structure and Function of Endemic Arsenism

Y.J. Xia[1], S.F. Hou[2], K.G. Wu[1], L.S. Yang[2], S.M. Tian[1], W.Y. Wang[2], H.Z. Ma[1]

1. Institute of Prevention and Treatment of Endemic Disease, Huhhot, Inner Mongolia, 010020
2. Chinese Academy of science, Institute of Geography, Beijing, 100101

Patients with endemic arsenism were treated with organ-selenium. Changes of red blood cells membrane (RBCM), GSH-Px, SOD on the RBCM and microcirculation around treatment were compared. The results showed that the improve rate of organ-selenium group is 72%. After curing 3, 9, 14 months, the GSH-Px activity of organ-selenium group increased from 76.3 active units to 85.8, 114.6, and 106.3 active units respectively, while no changes were observed in the control group. After curing 3 and 9 months, the SOD activity of organ-selenium group increased from 1043 ng/mg.Hb to 1127 and 949 ng/mg. Hb, no changes were observed in the control group either. The microcirculation improved evidently and was related to the improvement degree of RBCM. These results suggested that RBCM played an important role in keeping stability of inner body environment, regulating and maintaining normal cell activity. The arsenic can cause cell membrane damaged and function disorder. The selenium can protect cell membrane and against arsenic. We have observed above mention that through comparing test selenium group and non-take selenium control group. All these suggested that the organ-selenium may be a sound effective medicine for the cure of arsenism.

58. Environmental Arsenic Levels and Human Health

R.E. Grissom

Agency for Toxic Substances and Disease Registry Atlanta, GA, U.S.A.

Arsenic is a commonly reported substance at sites containing hazardous materials. The presence of arsenic in an environmental medium does not necessarily mean that it a health threat since arsenic is a naturally occurring element found in different forms and concentrations in soil, water, air, and food. Assessing the impact of environmental arsenic levels on public health has routinely involved the assumption that exposure is occurring through a single pathway and route (e.g., ingestion of arsenic-contaminated soils). Site-specific concentrations of arsenic are evaluated and decisions about public health impacts are made based on the relationship between the estimated dose and health guideline values for cancer and non-cancer endpoints. Two primary sources of uncertainty in estimating health threats from exposure to environmental arsenic include dose estimation and toxicologic evaluation of the estimated dose. Knowledge concerning pathways, routes, and levels of environmental arsenic; frequency and duration of exposure; community awareness; and geographic and seasonal differences are important in dose estimation. It is critical to obtain a complete exposure estimate to be certain that the risk assessment does not underestimate the true exposure. Most epidemiologic data are derived from ingestion of arsenic contaminated water or medicinals such as Fowler's Solution, and occupational inhalation of arsenic. The relevance of these studies in evaluating health threats at other sites is equivocal. Recent studies investigating exposures to arsenic in residential areas have been conducted in the U.S. and Canada and are useful in a weight-of-evidence approach in assessing health threats from exposure to arsenic in residential areas.

59. Arsenic Contamination of Drinking Water: an Alternative Viable Concept of Mitigation

M. Rahman1, Q.Q. Zaman1, A.H. Milton1, S. Roy1, D. Chakrabarty2, B. Biswas2, U.Choudhury2, G. Samanta2

1. Dhaka Community Hospital, 190/1 Wireless Railgate. Magbazer, Dhaka-1217 Bangladesh.
2. School of Environmental Studies, Jadavpur University, Calcutta- 700032, India

The problem of arsenic contamination in groundwater is not a new problem in the world. In addition to skin lesions and cancers, other arsenic related community health issues are also emerging. Epidemiologists have identified that the incidence of diabetes is much higher in areas where high levels of arsenic exist than is the case in other areas. Earlier health hazards created by arsenic were as a result of inhaling industrial pollution in copper industries, ingestion of food, contamination by food preservatives and from vegetables contaminated by arsenic containing insecticides. Ingestion of arsenic via drinking water as a result of hydro-geological conditions is limited outside Asia. The contamination of arsenic in the ground water of Bangladesh and West Bengal, India, has attracted the attention of scientists from all over of the world. The magnitude and gravity of arsenic contamination in Bangladesh is so extensive that the country is going to face the greatest natural disaster of the century because of arsenic in drinking water. More than 95% of our people drink safe water from hand tube-wells. It was a great achievement in Bangladesh to change attitudes and habits towards drinking water. It took more than two decades to change the traditional habits of drinking water from surface water sources to using ground water sources. After identifying people affected by arsenic related ill-health and identifying high concentrations of arsenic in tube-well water, the safe water from tube-wells has now been questioned. It took very strong efforts to convince all agencies to admit to this high risk situation. The civil society of Bangladesh now understands that we have to face reality and decide on a sustainable and affordable mitigation program. Dhaka Community Hospital (DCH) is the only agency who in 1996-97 realized the health effects due to arsenic contamination and brought the problem to public attention. Being a health delivery organization, providing affordable quality health services to the people, we feel proud of having been able to publicize the issue and being able to accept the problem as a serious public health issue in Bangladesh. DCH has so far surveyed all districts of Bangladesh jointly with the support of the School of Environmental Studies (SOES), Jadavpur University, Calcutta, West Bengal, India, and identified 52 districts contaminated with arsenic (more than 0-01 mg/L). Of the 12,000 water samples tested by AAS, about 60% of the samples contain arsenic, at the level of more than 0-01 mg/L. About 45 million people in this area are at risk to drinking arsenic contaminated water. According to a British Geological Survey report, 90% of domestic tube-wells are at risk to contamination. Bangladesh has more than 45 million tube-wells. The DCH-SOES joint survey has so far identified 26 districts with arsenicoses patients. We need more research work to fully understand this arsenic problem of disastrous proportions. We have still only identified the tip of the iceberg. We feel that good nutrition should be given priority to reduce and protect people from arsenic toxicity. More than 65% of people to Bangladesh live in the rural areas with minimum nutrition. DCH has been implementing house to house surveys of tube-wells and registering all family members in 500 villages in 28 districts throughout Bangladesh. We have also identified alternate water sources, used by communities in 200 villages. The survey of the first 200 villages showed that, more than 40% people are still using surface water. We are also making people aware of the need for safe water and improved nutrition during the survey. We now face intense pressure from these communities who are perplexed as to what to do as a viable alternative options which will provide them with safe and affordable water. The people of Bangladesh have become victims of arsenicoses because of drinking safe underground portable water. Now various commercial companies are coming to sell us field test kits & different types of water filters. These should be tested properly before a long term mitigation programme is implemented.

60. Preliminary Results of a Study on Safe Water Supply Options in Rural Bangladesh.

B.A. Hoque, K. Firoz, M.R. Munshi, G. Morshed, M.A. Mahmud

Environmental Health Programme, Health Population Exteision Division, Internation Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR, B)

Lack of knowledge about supply of safe drinking water in arsenic affected areas of Bangladesh is one of its main mitigation constraints. About 80% of the people in arsenic contaminated areas are unaware about this problem. Agencies are often reluctant to make people aware about arsenic problems as they cannot provide with/suggest solution for safe water against an identified contaminated well to its users.

We are studying: (i) alum treatment of surface water, (ii) bleaching powder treatment of surface water, (iii) alum treatment of arsenic contaminated water (iv) 24-hours storage of arsenic contaminated water, (v) chemical treatment of arsenic contaminated water, (vi) sharing of use of arsenic safe water tubewells, (vii) pond-sand filter, (viii) dug-well handpump (ix) home-made filters with local materials and (x) rain water harvesting, and (xi) community based arsenic treatment. We are using both laboratory and field experimental approaches. This study is being carried out in Singair sub-district of Manikgonj district.

The results of options listed under item (i) to (v) showed nil to 100% efficiencies based on characteristics of the water, and acceptance of the method by the users. Performance of pond sand filters and dug-well handpumps were significantly influenced by seasons. Results of home-made filter, community-based arsenic treatment plant and rain-water harvesting method were encouraging.

Further and more studies are needed for all above-mentioned options. We hope that the exchange of information.

61. Treatment of Arsenic Related Skin Cancer With Recombinant Interferon Alfa-2b

X.F. Liang[1], G.Y. Zhang[1], Y.M. Zhang[1], Z.R. Zhou[1], Q. Dai[1], M.Y. Zhang[1,2], X.Y. Ren[1], Q.J. Sun[1], Z.D. Luo[1], S.B. Tucker[2], LS. Loo[2]

1.Huhhot Health Anti-epidemic Station, Arsenic Section, Huhhot, Inner Mongolia, China
2.The University of Texas Medical School, Department of Dermatology, Houston, Texas

Introduction At Inner Mongolia, China, arsenic can be found in drinking water. Consumption of high arsenic well water has been associated with skin cancer. Interferon Alfa-2b produces antiviral, anti-tumor, and immune enhancing responses. It has been used for treatment of sun related non-melanoma skin cancer. A patient with arsenic induced Bowens disease was treated with Interferon Alfa-2b to evaluate its efficacy against this type of tumor.

Methods and Materials A patient was selected for this clinical trial who had multiple lesions of Bowens disease, one of which was confirmed histopathologically, from the three villages of Tie Men Jeng, Zhi Ji Liang, and Hei He, Inner Mongolia, China. Recombinant Interferon Alfa-2b (Schering Corporation, N.J.) was reconstituted to a concentration of 1.5 million units per 0.4ml per injection. The injection was performed to blanch the entire tumor and a small margin of surrounding normal skin using a 30 gauge needle. This was performed 3 times per week for 3 weeks. Before and after the treatment, the lesion was photographed at various stages.

Result The tumor completely resolved with treatment.

Conclusions 1.Our clinical findings indicate that recombinant interferon Alfa-2b is of benefit with arsenic induced Bowens skin cancer.2.This treatment may avoid surgical procedures and subsequent scars.

62. Evaluation on New Arsenic Removing Materials

Y. Zhang[1], H. Yan[1], M. Yang[1], X. Huang[2]

1. State Key Laboratory of Environmental Aquatic Chemistry, Research Center for Eco-Environmental Science, Chinese Academy of Sciences, Beijing, 100085)
2. Department of Environmental Engineering, Tsinghua University, Beijing 100085

Two types of arsenic removing materials, a polymeric ferric silicate chloride (PFSC) coagulant and a rare earth metal based inorganic adsorbent, were prepared, and their performance for arsenic removal was evaluated respectively. The performance of arsenic(V) removal by PFSC was compared with that by $FeCl_3$. It was found that, in a neutral pH range, 5mgFe/L PFSC was needed for reducing arsenic(V) from 0.90mg/L to an undetectable level (lower than 5ppb), while 20mgFe/L $FeCl_3$ was needed for the same purpose. On the other hand, the performance of the inorganic adsorbent for arsenic (V) removal was compared with that of activated alumina an conventional adsorbent for arsenic(V) removal. The effect of Ce-Fe absorbent is more effective than that of activated alumina. Experimental results show that the capacity of rare earth metal based absorbent is almost constant at a value of 15.96mg As(V)/g in a wide pH range of 3~7, while the maximum adsorption capacity of activated alumina of 8.55mg As(V)/g was obtained in a much narrower pH range of 3.5 to 5.5. The performance of the two materials was much better than that of their respective counterpart.

63. Removing Arsenic from Drinking Water. A Brief Critical Review of Some Key Issues

A.M. Sancha

Department of Civil Engineering. University of Chile.
Blanco Encalada 2002, Santiago, Chile,

Theoretically, arsenic removal from water can be achieved by using various methodologies whose application at full scale might not be as successful as at jar tests carried out in the laboratory. The difference between the laboratory and full scale performances reflects the result of the difference that exists between working with and without control of all variables. At full scale variables such as temperature and pH are difficult to control and the water matrix may contain some elements that interfere in the removal process. These interferences may not be detected when working at laboratory test with analito solutions in distilled water.

A good method to approach the problem of arsenic removal from water requires that, besides considering the water matrix effect, different variables be taken into consideration. For instance, the treatment of water supplied to a population whose supply is made through a pipe distribution system is different from the water treatment made at family level or that of small communities that get their water supply from individual sources.

This paper shows a critical review of some issues that have incidence in the choice of the removal method and the efficiency to be expected, such as: arsenic speciation; chemical analysis methodologies, removal technologies; water quality and arsenic removal; water quality goals and associated costs. All issues are based on the experience achieved after numerous studies about arsenic removal from water carried out in Chile in the last 25 years.

64. Study on the Material and Device of Eliminating Arsenic

Q.X. Zhang[1], F.H. Bai[2], Z.Q. Wang[3]

1.Shanxi Sanitation and Anti-epidemic Station
2.Design Institution of Shanxi Xinhua Chemistry Plant
3.Shanying Sanitation and Anti-epidemic Station

A new technique for water disposal-flocculent bed of compound material for eliminating arsenic and its device was introduced in this study. The research suggests that this compound material is more efficient than others to eliminate arsenic. Its efficiency of eliminating arsenic was 90.89% when the device was continuously operating in laboratory, and 99. 25% when intermittently operating in the area of disease taking place. Compared with other materials, this one's efficiency of eliminating arsenic was higher, and it has the lower cost, longer life. It needn't reproduce and no second pollution would take place. It vas not influenced by the difference of arsenic ions. The device has the rational structure, and it is easily operated. It is suitable to use this device widely in the area of disease taking place. It is a technique for eliminating arsenic that has the deep potential of developing.