

ISOZYMES:
Organization
& Roles
Evolution
Genetics &
Physiology

ISOZYMES: **Organization and Roles** **in Evolution, Genetics and Physiology**

Proceedings of the September 6-13, 1992 Congress at
Novosibirsk, Russia

The Seventh International Congress on Isozymes

Editors

Clement L. Markert, Ph.D.

*Department of Animal Science
North Carolina State University
Raleigh, North Carolina 27695, USA*

John G. Scandalios, Ph.D.

*Department of Genetics
North Carolina State University
Raleigh, North Carolina 27695-7614, USA*

Hwa A. Lim, Ph.D.

*Computational Genetics & Biophysics
Supercomputer Computations Research Institute
Florida State University
Tallahassee, Florida 32306-4052, USA*

Oleg L. Serov, Ph.D.

*Institute of Cytology & Genetics
Russian Academy of Sciences
Siberian Department
630090 Novosibirsk 90, Russia*



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**ISOZYMES — ORGANIZATION AND ROLES IN
EVOLUTION, GENETICS AND PHYSIOLOGY**
(7th International Congress on Isozymes)

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Organization and Roles

Evolution, Genetics and Physiology

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SCRI DIRECTOR'S STATEMENT

It is a great pleasure for the Supercomputer Computations Research Institute (SCRI) to take part in *The 7th International Congress on Isozymes*, held at the House of Scientists, Novosibirsk, September 6-13, 1992.

With this congress and these proceedings, we are certain that we have made significant progress both in advancing the knowledge and further perfecting the tools in this exciting research area. Being a high performance computing institute, our emphasis is on the development of computational techniques and use of computers as tools in scientific, engineering and technological researches. The fundamental belief is that the most efficient mechanism for making computational advances is to have talented computational scientists working in the immediate area of like-minded others in the same or related fields. As a result, SCRI was established in 1984 to encourage interdisciplinary research and cross-disciplinary fertilization of computational techniques using the current generation of high performance computers. The basic theme is that developments in computational science is applications-driven.

The study of isozymes is an excellent example of an interdisciplinary research requiring the utmost in the imagination and expertise of many disciplines. We anticipate that computers, which have permeated almost every facet of our daily life, will play an integral role in the research in the near future. We also hope that in future sequels to the congress, reports on computational work will play a bigger part.

We are pleased to take part in preparing this proceedings volume. We also look forward to playing a major role and making new personal connections in future congresses. Together we will continue to make progress in this very important and exciting field of research.

March, 1994

Dennis W. Duke
Director, SCRI

PREFACE

Since the isozyme concept was formulated some thirty-five years ago, and especially after the advent of transgenic technology, the deep interest in the area has led to thousands of research investigations and many international conferences on the subject. The *7th International Congress on Isozymes*, held at House of Scientists, Novosibirsk, Russia and hosted by the Institute of Cytology and Genetics, Russian Academy of Sciences on September 6-13, 1992, was a sequel to the by now well-known international congresses on isozymes. This is the first time such a congress was held in Russia.

Speakers were leading experts in their respective fields, and participants were from countries like Australia, Belorussia, Canada, China, France, Germany, Greece, Israel, Japan, Russia, Ukraine, USA, and others. This volume is based on selected oral presentations in the Congress. Among some of the key issues and challenges discussed are: isozymes in population and evolution genetics, isozyme markers in gene mapping, isozymes in plant genetics, role of isozymes in normal physiology, the use of isozymes in human population biology, molecular organization and developmental regulation of isozymes and other related topics.

Many of our colleagues put considerable effort into ensuring the success of this congress, and we are very grateful to them. We would also like to thank Academician V.K. Shumny, Director of Institute of Cytology and Genetics, for his support, and acknowledge the contributions of many others too numerous to mention. Thanks also go to Donna E. Burnette and David Peindexter for making these proceedings possible, and Professor Dennis W. Duke, Director of SCRI, whose support and encouragement helped to make the preparation of these proceedings so much easier and smoother.

Last but not least, the organizing committee of the conference also deserve special thanks because, without them, the congress would not have been possible.

March, 1994

C.L. Markert
J.G. Scandalios
H.A. Lim
O.L. Serov



Opening ceremony. Academician V. Shumny, Director of Institute of Cytology & Genetics, addressing the participants. (l to r) Serov, Shumny, Markert and Korochkin.



At the banquet table.



Group photo of conference participants during a picnic on an island on the O6 Sea— a man-made sea.



Mushroom picking on the island.



Waiting to be picked up to return to the mainland after the picnic on the island.



An evening of cultural dance at the Novosibirsk State University.



Business dinner at the Serov's residence. Back row (l to r) Korochkin, Holmes (Chairman of upcoming 8th Congress), Mrs. Serov, Scandalios, Markert; front row (l to r) Lim and Serov.



Closing ceremony. Dr. Markert making the closing remark.

Contents

I Plenary Session	1
Clement L. Markert	3
<i>"Transgenic Creation of Novel Isozyme Systems for Challenging and Studying the Physiology and Development of Organisms"</i>	
O.L. Serov	13
<i>"Isozymes as Markers for Spatial Organization of Translation Process for Allelic mRNAs"</i>	
John G. Scandalios	23
<i>"Engineering Organisms for Tolerance to Oxidative Stress: The Maize Superoxide Dismutases"</i>	
II Isozyme Markers in Gene Mapping	39
Eugene I. Karakin	41
<i>"Interactions of Recessive and Dominant Oncogenes during Tumorigenesis: Protein Pattern and Expression of c-src Gene Family in Normal Brain and in 4(2)gl Malignant Brain Tumor of Drosophila melanogaster"</i>	
John L. VandeBerg	53
<i>"Mapping the Genome of a Marsupial, <i>Monodelphis domestica</i>: Application to Skin Cancer Research"</i>	
Suren M. Zakian	65
<i>"The Possible Influence of Heterochromatin on the X-Inactivation in Female Hybrid Voles of the Microtus Genus: A Hypothesis"</i>	
III Developmental Regulation of Isozymes	81
Erwin Goldberg	83
<i>"Molecular Biology of Spermatogenesis"</i>	
V.P. Mishin	95
<i>"The Structure and Regulation of Mammalian Tyrosine Aminotransferase and Proopiomelanocortin Genes"</i>	
Pavel V. Sergeev	107
<i>"Molecular Genetic Analysis of the Gene Encoding a Tissue Specific Isozyme of Esterase"</i>	

IV	Role of Isozymes in Altered Physiology	125
R.W. Gracy		127
	<i>"Isozymes and Aging: How Do Enzymes Wear Out"</i>	
Lyudmila F. Gulyaeva		147
	<i>"Strain- and Tissue-Specific Expression of Rat Cytochrome P-450 IIB Subfamily Isozymes During Different Inductions"</i>	
Roger S. Holmes		153
	<i>"Effects of Ethanol Feeding on High-Density Lipoproteins and Lipoprotein (a) in Baboons"</i>	
V	Isozymes in Plant Genetics	169
Evgenii V. Levites		171
	<i>"Genetic Control of Isozymes in the Sugar Beet"</i>	
Birgit Pelzer-Reith		179
	<i>"Post-transcriptional Expression of Class I and Class II Aldolase in synchronized Euglena gracilis"</i>	
Sophie N. Priyatkina		191
	<i>"Isozyme Markers in the Genetic Studies of Rye Secale cereale L."</i>	
Ronald W. Skadsen		203
	<i>"Molecular Analysis of the Expression of α-Amylase Isozymal Genes in Germinating Barleys of Differing Gibberellin Sensitivity"</i>	
S. Athanasios Tsiftaris		213
	<i>"Gene Expression in Maize Inbreds and Hybrids"</i>	
VI	The Use of Isozymes in Human Population Biology	225
M.H. Crawford		227
	<i>"Molecular Genetics, Protein Variation, and the Population Structure of the Evenki"</i>	
VII	Isozymes in Population and Evolution Genetics	243
Ifor R. Beacham		245
	<i>"The Structure and Regulation of L-Asparaginase Isozymes from Bacteria"</i>	
H.A. Lim		253
	<i>"Computer Studies of Molecular Evolution of Gene Families Coding for Proteins"</i>	
Eviatar Nevo		267
	<i>"Evolutionary Significance of Genetic Diversity in Nature: Environmental Stress, Pattern and Theory"</i>	

Yuichi Tanabe 297
"Biochemical-Genetic Studies on Phylogeny of the Duck Breeds"

Part I

Plenary Session

The Great Creation of Novel Genetic Systems for Challenges and Studies in the Physiology and Development of Organisms

OSWALD T. MURPHY

North Carolina State University Raleigh, North Carolina

Part I

Plenary Session

1. Introduction

2. DNA Recombination

3. Gene Transfer

4. Gene Expression

5. Gene Regulation

6. Gene Mutations

7. Gene Deletions

8. Gene Insertions

9. Gene Amplification

10. Gene Silencing

11. Gene Editing

12. Gene Therapy

13. Gene Discovery

14. Gene Conservation

15. Gene Evolution

16. Gene Speciation

17. Gene Divergence

18. Gene Convergence

19. Gene Hybridization

20. Gene Introgression

21. Gene Gene Flow

22. Gene Genetic Drift

23. Gene Bottleneck

24. Gene Founder Effect

25. Gene Genetic Isolation

26. Gene Gene Pool

27. Gene Genetic Diversity

28. Gene Genetic Variation

29. Gene Genetic Structure

30. Gene Genetic Differentiation

31. Gene Genetic Speciation

32. Gene Genetic Adaptation

33. Gene Genetic Evolution

34. Gene Genetic Change

35. Gene Genetic Innovation

36. Gene Genetic Progress

37. Gene Genetic Development

38. Gene Genetic Growth

39. Gene Genetic Expansion

40. Gene Genetic Contraction

41. Gene Genetic Regression

42. Gene Genetic Stagnation

43. Gene Genetic Decline

44. Gene Genetic Collapse

45. Gene Genetic Extinction

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Part I

Plenary Session

Transgenic Creation of Novel Isozyme Systems for Challenging and Studying the Physiology and Development of Organisms

Clement L. Markert*

* North Carolina State University Raleigh, North Carolina

1.1	Introduction	3
1.2	LDH Isozyme System	4
1.2.1	Evolution	4
1.2.2	Physiological Effects - Addition of Isozymes	6
1.2.3	Physiological Effects - Deletion of Isozymes	6
1.2.4	Promoter Regulation of Gene Expression	6
1.2.5	Switching Promoters Among Genes	8
1.3	Plant Catalase Genes in Mice	8
1.4	Injection of Entire Chromosomes Into Egg Nuclei	9
1.5	Summary	9
1.6	Acknowledgments	9

1.1 Introduction

The study of isozymes has provided new insights into the structure and function of the genome, the regulation of gene function during cell differentiation and development, and specifically into the structure, function, and evolution of isozymes themselves. Although isozymes have always been of basic significance to cell physiology we are only now beginning to exploit our new ability through transgenic technology to create new isozyme systems designed to change cell physiology to suit our experimental goals and also to fulfill many practical purposes in genetic engineering including the cure of genetic diseases.

Before the era of transgenesis we had to rely on naturally occurring isozyme systems to explore their biological significance. The systems revealed by research were adequate initially to keep us challenged but eventually new discoveries waned in number and significance. Now, however, there are virtually no limits. We can make all the isozyme systems we wish. Every gene from any organism, and truly artificial genes manufactured in the laboratory, can now be used by transgenic techniques to equip cells with new genes to make new isozyme systems. Moreover we can place these genes at different places in the genome and also equip them with different ancillary sequences—promoters, enhancers, introns, etc., to regulate the time, place, and quantity of gene activity. We can even transplant whole chromosomes or any fraction of a chromosome and expect to elicit genetic function leading to additional enzyme synthesis and novel cell physiologies.

Of course, most of these transgenically created isozyme systems will not prove beneficial to the cell or to the organism. Any change is likely to prove deleterious. After all, every gene must have been duplicated many times in evolution, but few of the duplications have survived as functioning genes coding for specific enzymes. Evolutionary selection eliminated nearly all these duplications or suppressed them by one cytogenetic mechanism or another. Probably additions to the genome by transgenesis will suffer the same fate, although we can experimentally select to preserve those we wish to survive. In the past only those duplications that produced beneficial isozyme systems survived. Nevertheless such duplications of DNA