

## Progress in Environmental Microbiology and Biotechnology in Korea

(Analysis of research papers on environmental microbiology and biotechnology published in the journals of Korea)

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The research trend of environmental microbiology and biotechnology was studied by analyzing the papers on microbial ecology, environmental microbiology, and biotechnology for bioremediation published in Korea. Ten journals published by seven societies during the past 20 years from 1963 to 2003 were surveyed (Table 1). The papers on environmental microbiology and biotechnology were analyzed in terms of seven different subjects.

**Table 1. Korean journals on Environmental Microbiology and Biotechnology surveyed in this study**

Journal	Society	Inaug. year	Language
Korean Journal of Microbiology(KJM)	MSK (한국미생물학회)	1963	Korean
Korean Journal of Limnology (KJL)	KSL (한국육수학회)	1968	Korean
Korean J. of Microbiology and Biotechnology (KJMB)	KSMB (한국미생물·생명공학회)	1973	Korean
Korean J. of Environmental Engineering (KJEE)	KSEE (대한환경공학회)	1979	Korean
Korean J. of Environmental Agriculture (KJEA)	KSEA (한국환경농학회)	1982	Korean
Korean J. of Environmental Biology (KJEB)	KSEM (한국환경생물학회)	1983	Korean
Korean J. of Biotechnology and Bioengineering (KJBB)	KSBB (한국생물공학회)	1990	Korean
J of Microbiology and Biotechnology (JMB)	KSMB (한국미생물·생명공학회)	1991	English
J of Microbiology (JB)	MSK (한국미생물학회)	1995	English
Biotechnology and Bioprocess Engineering (BBE)	KSBB (한국생물공학회)	1998	English

Total 1,707 papers accounted for this study were composed of 16.0% of the total papers published in those journals (Table 2). The numbers of papers published in the journals were drastically increased since mid 1980's, and the papers published in last 8 year from 1996 were counted to be about 60% of total papers. The subjects of microbial degradation of pollutant chemicals, distribution of microorganisms in water and soil ecosystems, survey for pollution and protection of ecosystem, and effects of environmental factors and pollutants on microorganisms were major interest for study to produce 70% of the total papers on environmental microbiology and biotechnology. Those papers published by the Microbiological Society of Korea, Korean Society for Microbiology and Biotechnology, and Korean Society of Limnology were

comprised 30.3, 15.5, and 15.8% of total 1,707 papers, respectively (Table 3).

**Table 2. Papers of Environmental Microbiology and Biotechnology appeared in 10 journals in Korea**

Year	Subject								Subtotal	Rate (%)	% out of total
	I	II	III	IV	V	VI	VII	VIII			
1967-1970	8	1	0	11	0	0	1	0	21	1.2	22.5
1971-1975	14	1	0	6	5	2	1	4	33	1.9	15.6
1976-1980	9	1	0	13	14	7	5	1	50	2.9	15.4
1981-1985	22	12	0	19	19	2	29	4	107	6.3	12.6
1986-1990	32	12	10	25	41	21	25	10	176	10.3	13.2
1991-1995	75	32	9	28	81	36	27	23	311	18.2	12.4
1996-2000	103	41	30	47	175	33	70	44	543	31.8	15.8
2001-2003	71	64	28	57	96	31	72	47	466	27.3	20.5
Total	334	164	77	206	431	132	230	133	1,707	100%	16.0%
Ratio (%)	19.6	9.6	4.5	12.1	25.3	7.7	13.5	7.8	100%		

- I Distribution of microorganisms in water and soil environments
- II Physiological activities of microorganisms in ecosystem
- III Molecular ecology and analysis of genes in ecosystem
- IV Effects of environmental factors and pollutants on microorganisms
- V Microbial degradation of pollutant chemicals
- VI Molecular biology of enzymes and genes involved in pollutant degradation
- VII Survey for pollution and protection of ecosystem
- VIII Wastewater treatment by microorganisms

**Table 3. Statistics of Environmental Microbiology and Biotechnology papers appeared in 10 journals**

Society	Journal	No. of Issues In 2003	No. of EM+B papers	% out of total papers in each journal	Ratio(%) of each journal	Year of publication
MSK(한미)	KIM+JM		518	25.1	30.3	
	KJM	4	369	22.6	27.6	1963 (41 y)
	JM	4	149	27.5	8.7	1995 (9 y)
KSMB(한미+생공)	KJMB+JMB		265	8.3	15.5	
	KJMB	4	131	8.3	7.7	1973 (31 y)
	JMB	6	134	8.2	7.9	1991 (13 y)
KSL(한독)	KJL	4	26	26.1	15.8	1968 (36 y)
KSEB(한환생)	KJEB	4	142	31.8	8.3	1983 (4 y)
KSBB(한생공)	KJBB+BBE		147	8.8	8.6	
	KJBB	6	106	7.4	6.2	1990 (14 y)
	BBE	6	41	10.2	2.4	1996 (8 y)
KSEE(대환공)	KJEE	12	200	7.8	11.7	1979 (25 y)
KSEA(한환농)	KJEA	4	182	28.9	10.7	1982 (22 y)
				1,707	100 %	

The numbers of research papers presented as poster on environmental microbiology and biotechnology were counted to be more than 20 percents of total papers in every annual meetings provided by both Microbiological Society of Korea and Korean Society for Microbiology and Biotechnology. A special symposium on environmental microbiology was first held by the Microbiological Society on Korea in 1988. Since the beginning of 1990's, both societies have provided such symposia in every annual meetings with particular topics on environmental microbiology and biotechnology (Table 4). Such particular symposia have been organized by the Federation of Korean Societies of Microbiology at the international

meetings every year from 2001.

**Table 4. Symposia on Environmental Microbiology and Biotechnology held by MSK and KSMB**

Year	MSK		KSMB	
	Subject	No of paper	Subject	No of paper
1988	10. Environmental microbiology	10		
1992	4. Korea-USA joint environmental microbiology	10	4. Environmental microbiology	5
	10. Environmental microbiology	5		
1995	4. Microbial ecology	5		
	10. Microbial diversity	10		
1996	4. Environment and ecology	4	4. Environmental microbiology	6
1997	4. Molecular biological approach to microbial ecology	4	4. Environmental microbiology	5
1998	4. Bioremediation	5	4. Environmental microbiology	5
			10. Environmental microbiology	6
1999	4. Microbial degradation of pollutant chemicals	10	4. Environmental biotechnology	3
			10. Biotransformation of pollutant chemicals	6
2000	5. Biodegradation of xenobiotics	5	5. Microbial response and degradation of endocrine disruptors (toxic compounds)	5
			10. Microbial treatment of pollutant organics	7
2001	5. Microbe-environment interaction	4	5. Bioremediation and environ microbiology	9
	11. Environmental microbiology	4		
	11. (Fed): Ecology and Pathology		5	
2002	7. (GIM): Bioremediation		5	
	10. (Fed): Phylogeny and Biodiversity of Microorganisms		7	
	10. Molecular microbial ecology	4		
	Microbial responses to stresses and environmental stimuli	4		
	Microbes from diverse environments	5		
2003	5. Diversity of microbial resources	5	6. Genomic approaches for microbial resources	4
	Microbial ecology in environmental processes	6	Environmental biotechnology in post-genome era	5
	10. (Fed-BioExpo): Application of Microbial Ecology		6	

Since the beginning of microbiology study in early 1960's, various microorganisms were surveyed from ecosystems and environmental factors were investigated for their effects on microbial function in 1970's (Table 5). The environmental pollution and its influence on microbial functions became the focus of study in 1980's, and then microbial degradation of the pollutant chemicals and analysis of the enzymes and genes responsible for the degradation were intensively studied in 1990's. Recently, the molecular microbial ecology and molecular biotechnology for bioremediation have become the major topics of research in environmental microbiology and biotechnology.

The major interests for research on environmental microbiology and biotechnology in the decade of 2000's are expected to be as follows: Environmental genomics and proteomics, Metagenomic library for unculturable microorganisms, Biosensors for monitoring of pollutants and toxic chemicals, Microarray for diversity of particular genes and microorganisms in extreme environments, Bioinformatics for particular

microbial functions, and Biotechnology for on site and *in situ* bioremediation.

**Table 5. Trends of Environmental Microbiology and Biotechnology research in Korea**

Decade	Major subjects for research
1960's	<ul style="list-style-type: none"> <li>▪ Beginning of microbiology in general aspects</li> <li>▪ Microbial functions in conventional foods</li> </ul>
1970's	<ul style="list-style-type: none"> <li>▪ Survey of microorganisms in ecosystem</li> <li>▪ Effect of environmental factors on microbial functions</li> </ul>
1980's	<ul style="list-style-type: none"> <li>▪ Environmental pollution and public health</li> <li>▪ Effects of pollutants on physiological functions</li> </ul>
1990's	<ul style="list-style-type: none"> <li>▪ Microbial degradation of pollutant chemicals and analysis of the enzymes and genes</li> <li>▪ Molecular biological studies on microbial ecology and biotechnology for bioremediation</li> </ul>
2000's	<ul style="list-style-type: none"> <li>▪ Environmental genomics and proteomics</li> <li>▪ Metagenomic library for unculturable microorganisms</li> <li>▪ Biosensors for monitoring of pollutants and toxic chemicals</li> <li>▪ Microarray for diversity of particular genes and microorganisms in extreme environments</li> <li>▪ Bioinformatics for particular microbial functions</li> <li>▪ Biotechnology of on site and <i>in situ</i> bioremediation</li> </ul>

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