

芽胞杆菌分类研究进展

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摘要: 芽胞杆菌属 *Bacillus* 是一类产芽胞的革兰氏阳性细菌, 好氧或兼性厌氧生活, 产生具有抗逆性球形或椭圆形芽胞。芽胞对高温、紫外线、干燥、电离辐射和很多有毒的化学物质都有很强的抗性。由于芽胞的特性, 使得芽胞杆菌的分类研究越来越重要。《国际系统与进化微生物学杂志》是由普通微生物学会 (SGM) 出版的, 是国际微生物分类学界公认的一份权威性杂志, 它发表和收录了所有的微生物新种发表情况。本文主要介绍了全球近 10 年在 IJSEM 上芽胞杆菌分类论文发表的情况, 并对几个值得重视的问题进行了评述。

关键词: IJSEM; 芽胞杆菌; 分类

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Study on Genus *Bacillus* Classification

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Abstract: The genus *Bacillus* contains Gram-positive, aerobic or facultatively anaerobic bacteria that are able to produce bacterial endospores. Spores have a very strong resistance to heat, ultraviolet light, dry, ionizing radiation and a lot of toxic chemicals. As spore properties, *Bacillus* research has becoming more and more important. International journal of systematic and evolutionary microbiology (IJSEM), published by the Society for General Microbiology (SGM), is the leading forum for the publication of new taxa of bacteria and yeasts. The papers were mainly introduced references of *Bacillus* in IJSEM in the past ten years, and approached several desirable questions.

Key words: IJSEM; *Bacillus*; Classification

《国际系统与进化微生物学杂志》(International Journal of Systematic Evolutionary and Microbiology, 简称 IJSEM) 是由普通微生物学会 (SGM) 出版的, 是国际微生物分类学界公认的一份权威性杂志, 目前世界上研究发现的微生物种类均以在此刊物上发表的种名和被此刊物收录的种名为有效名称。因此, 《国际系统与进化微生物学杂志》(IJSEM) 是微生物分类学领域的基石。IJSEM 收录了从 1951 年以来几乎所有的关于芽胞杆菌分类的文章, 目前国际上认为只有被 IJSEM 收录的细菌种名才能算是有效命名。芽胞杆菌分类研究日益成为国内外研究的热点, 刘波^[1]

在《芽胞杆菌文献研究》列出了芽胞杆菌属的 244 个种。

芽胞杆菌是一类好氧或兼性厌氧并能产生抗逆性芽胞的细菌, 能在极端条件下生存。芽胞杆菌是一类重要的资源微生物, 与人类社会关系密切, 可用于分解原油, 防治植物病害, 降解土壤中难溶的含磷、含钾化合物等。芽胞杆菌包含许多特殊功能菌株, 在工业、农业、医学等科学领域有重要作用, 有着十分广泛的应用价值。

本文主要介绍近 10 年各国芽胞杆菌在该杂志发表论文的情况, 以新种的发表文章为主, 并对芽胞杆菌的分离鉴定方法发表一些观点看法。

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1 各国芽胞杆菌文章发表的论文情况

按通讯作者统计,自 2001 年至 2010 年 8 月世界各国芽胞杆菌分类文章发表情况^[2-99]见表 1 和图 1。从图 1 中可以很明显的看出韩国、日本的芽胞杆菌分类论文发表比较多。韩国每年都有大量新种发现,在 IJSEM 上发表的论文总数中占的比例最大,其次是日本。中国从 2005 年开始有芽胞杆菌分类文章的发表,但是数量并不少,仅次于日本。

从表 1 中可以看出,每年芽胞杆菌新种文章发

表数量总体呈上升趋势。韩国和美国每年都有芽胞杆菌分类文章发表,日本除 2001 年外,每年也都有新种文章发表。韩国每年都有 3 篇以上关于芽胞杆菌新种的文章发表,从 2001 年至 2010 年 8 月为止总共发表 67 篇文章。其次日本总共发表 41 篇,美国虽然每年都有文章发表,但总数比较少,只有 15 篇。中国从 2005 年开始发表芽胞杆菌新种文章,至 2010 年 8 月各共有 40 篇。西班牙共有 16 篇,印度、泰国、比利时各有 10 篇。德国、澳大利亚、俄罗斯各有 6 篇,英国有 8 篇,意大利有 7 篇,其他国家总共有 23 篇。

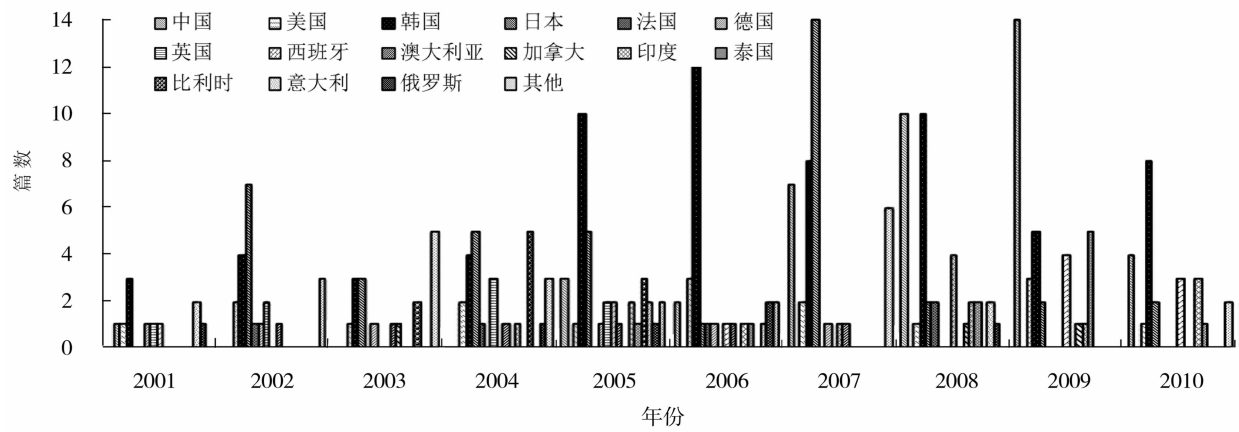


图 1 近 10 年各国芽胞杆菌分类文章发表数量

Fig. 1 The published papers of *Bacillus* in every country in the past ten years

表 1 近 10 年各国芽胞杆菌分类文章发表数量

Table 1 The published papers of genus *Bacillus* in every country in the past 10 years

年代	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	总和
中国	0	0	0	0	3	2	7	10	14	4	40
美国	1	2	1	2	1	3	2	1	3	1	17
韩国	3	4	3	4	10	12	8	10	5	8	67
日本	0	7	3	5	5	1	14	2	2	2	41
法国	0	1	0	1	0	1	0	2	0	0	5
德国	1	1	1	0	1	1	1	0	0	0	6
英国	1	2	0	3	2	0	0	0	0	0	8
西班牙	1	0	0	0	2	1	1	4	4	3	16
澳大利亚	0	1	1	1	1	1	1	0	0	0	6
加拿大	0	0	1	0	0	0	0	1	1	0	3
印度	0	0	0	1	2	1	0	2	1	3	10
泰国	0	0	0	0	1	1	0	2	5		9
比利时	0	0	2	5	3	0	0	0	0	0	10
意大利	2	0	0	0	2	1	0	2	0	0	7
俄罗斯	1	0	0	1	1	2	0	1	0	0	6
其他国家	0	3	5	3	2	2	6	0	0	2	23
总和	10	21	17	26	36	29	40	37	35	23	274

2 我国芽胞杆菌分类研究状况

按第一作者和通讯作者进行统计,我国从2005年才有芽胞杆菌新种文章的发表。发表新种的单位数量从高到低依次为中科院(9篇)、云南大学微生物所(8篇)、中国农业大学(5篇),南京农业大学(2篇),武汉大学(2篇),首都师范大学(1篇),兰州大学(1篇),香港大学(1篇)。

国内微生物分类研究做的是最多的是以东秀珠等为首的中国科学院微生物研究所微生物资源前期开发国家重点实验室和云南大学微生物所。我国地大物博,资源丰富,为芽胞杆菌分类研究提供了有利的条件。近年来我国学者对芽胞杆菌的研究逐渐增多,通过芽胞杆菌分类的研究,发现新的功能基因,并将研究结果应用于工业生产上,从而促进社会发展。

3 芽胞杆菌分离鉴定的建议

目前为止,我们发现的芽胞杆菌的新种,无论是从土壤中分离到的,还是从灰尘、水样中分离到的,都是采用稀释涂布平板法进行分离得到的^[100]。为了快速分离到芽胞杆菌将样品溶液80℃水浴除去非耐热的菌,这样只能说得到的大部分是芽胞杆菌,但是仍有一部分非芽胞杆菌。而分离到的菌即使是芽胞杆菌,大部分又都是普通已知的菌种,所以用我们常规通用的分离方法进行分离发现新种的机会几乎为零。即使分离到新种,鉴定方法也很繁琐,需要很久时间才能将菌准确鉴定到种。在鉴定期间有可能自己发现的新种被人抢先发表。为此,本文就对芽胞杆菌的新种分离鉴定提供一些总结和建议。

芽胞杆菌的分离筛选目前主要是采用传统的分离方法,效率低,既浪费财力又浪费人力,为了提高分离效率,快速排除已知菌,应寻找新的筛选方法。种的鉴定目前主要是通过形态学特征、化学特征、16S rRNA测序、DNA-DNA杂交^[101-102],成本较高,分子杂交也比较难于操作。希望能寻找新的基因,快速简便地将分离到的芽胞杆菌鉴定到种。应该按照分类学的要求,吸取基因组学、生物信息学的最新成就,探索新的生物大分子,用以建立新的分类系统,使分类学更能反应生物进化的本来面目和生物之间的真实关系。

Cohn建立的芽胞杆菌属*Bacillus*,由于其模式菌株所包括的表型特征范围较广泛,很多生理生

化和遗传学特征迥异的细菌都可以归入芽胞杆菌分类范畴内。不同的文献来源,由于收集统计的时间、范围、内容、分类体系等的差异,所收集的芽胞杆菌种名数量不同。芽胞杆菌是一个很大的类群,产生的生物活性物质很多,是很有开发潜力的资源,很有必要加强这群微生物的分类工作。国内外的许多研究工作表明,设计新的独特的芽胞杆菌分离鉴定方法,为分类学和资源开发利用提供新资源具有重要的意义。

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