European microbiology performs extraordinarily strong when compared to other life science disciplines. Its “hottest topics” are genomics and microbiomics, disease mechanisms and therapy of pathogens, and biofilm formation.

Microbiology has definitely faced a revolution in the last decade. The basis for this has been the rapid advance of powerful high throughput sequencing techniques, which instantly paved the way for massive application of genomics and even metagenomics to the field. Accordingly, in a growing number of studies, it’s no longer one or two microbes that count but rather their totality present in a given habitat. Just think, in which diverse environments such microbial communities or “microbiomes” have already been described: the human gut and skin, the air over New York, the Sargasso Sea, deep sea vents, honeybee colonies, Antarctic ice....

Nevertheless, this rapid development hasn’t automatically cleared the way for “genomicists” to completely dominate the landscape of total microbiology publications. Certainly, there are still enough single “protagonists” left that continue to attract a lot of research activity – and, therefore, also citations. Most of those, of course, belong to the area of human pathogens, such as Mycobacterium, Rickettsia or Staphylococcus. On the other hand, a couple of microorganisms that have proven valuable for certain biotechnological applications or production have also entered this category. Examples are electrochemically active bacteria, like Shewanella and Aeromonas, or “food-producing” microbes like Lactobacillus (yoghurt).

The real “victims” of that recent development – at least in terms of publications and citations – have obviously been the long-standing microbial models for genetic research, headed by E. coli, Bacillus subtilis or yeast. Publications studying “only” basic genetic problems in one of those former “powerhorses” have definitely lost ground within “total microbiology”.

From “individuality” to “totality”

Before discussing the results of our publication analysis on microbiology in more detail, you should also be aware of some inevitable methodological constraints.

In order to compare performance of the individual European countries in microbiology research (as shown in the “blue” table on p. 37), we had to restrict the analysis “merely” to the papers published in the 95 journals listed in Web of Science’s category “microbiology”. Certainly, many of the “top papers” in microbiology are published in multidisciplinary science journals like Nature, Science or Proc. Natl. Acad. Sci. Regrettably, however, we had to omit them, at least from this part of the analysis. The reason is that the database used, Web of Science, doesn’t provide any reliable tools to automatically extract relevant “microbiology” articles from those multidisciplinary journals. And before assigning too many “false positives” to the individual countries, we decided to restrict this analysis to the specialist journals only. Nevertheless, we believe that such a “trimmed” survey still provides sufficiently valid indicators for the countries’ overall productivity in microbiology research.

However, as for the rankings of the most-cited researchers and papers (see tables, p. 38) there were no such limitations. They could be analysed from publications in all journals.

France, Belgium and Denmark are “strong performers”

Applying these directives, we find the “usual three” on top of the nations’ list when it comes to total citations. With their articles, published in microbiology journals during the twelve-year period 1997-2008, England, Germany and France have respectively accumulated 302,000, 289,000 and 253,000 citations to-date. “Silver medallist”, Germany, however, needed more “mass” than the other two to achieve its almost 290,000 citations. With a total of 15,000 papers, including at least one co-author from a German lab, England (12,800) and France (12,000) were clearly left behind. On the other hand, both these nations achieved considerably higher mean rates of citations per article than Germany, which finally enabled England to pull ahead of Germany and climb to the top of the “total citations” list.
At the same time, England’s average of 23.6 citations per microbiology article proved to be the third-highest value of all European countries. Even higher ratios were obtained by their colleagues from Switzerland (25.2) and the Netherlands (24.0).

Another “strong performer” was Belgium, climbing to 8th place by total citations and 4th place by mean citation rate. Also interesting: Sweden wasn’t as successful as in most other life science disciplines; however, Denmark instantly stepped in to rescue the Scandinavian honour by performing clearly “better than usual”.

Altogether, European microbiology appears to have remained unimpressed by the aforementioned changes of the last decades and, thus, has been successful in maintaining its high status among the European life science disciplines. This becomes even more obvious when comparing European microbiology to the “rest of the world”. The USA was considerably outcompeted by Europe’s performance, which is not the case in many other life science fields. The same is true for Japan and Canada who this time lagged far behind Europe’s number three, France.

The five most-cited microbiology papers to have appeared between 1997 and 2008 with corresponding addresses in Europe clearly demonstrate the trend outlined earlier: all of them exclusively come from the field of microbial (meta-)genomics – three complete genome sequences and two method papers about analysing sequence data from microorganisms.

**Where has *E. coli* gone?**

This fact, of course, raised a problem on the identification of the most-cited European microbiology researchers. Which of the authors on those highly-cited genomics papers can really be regarded as microbiologists and who “merely” contributed technological expertise in sequencing or bioinformatics? Drawing this boundary, for example, led to including Julian Parkhill (3rd) and Gordon Dougan (7th) in the list, but excluded Bart Barrell and Michael Quail – despite the fact that all four shared authorship on many microbial genomics papers from the Wellcome Trust Sanger Centre in Hinxton.

Apart from microbial genomics, what further “hot topics” in European microbiology are represented by the most-cited authors? *Rickettsia* specialist Didier Raoult from Marseille, in first place, heads the group of medical microbiologists studying certain human pathogens. Further members are, for example, David Denning (5th, *Aspergillus*), Jerome Etienne (13th, *Staphylococcus*) or Peter Vandamme (17th, *Burkholderia*). In contrast, other medical microbiologists like Brian Spratt (14th) and Michael Givskov (25th) have specialised on the role of microbial biofilms in disease formation.

Related to this group are a couple of researchers studying therapy development and microbial mechanisms of drug resistance. Representatives are Rino Rappuoli (4th), Patrice Nordmann (16th) and Peter Andersen (20th).

 Completely distinguishable from them are “biotechnological microbiologists” like Willy Verstraete (9th), “microbial ecologists” as represented, for example, by Rudolf Aman (2nd) and Michael Wagner (10th) or the bacterial cell biologists Pascale Cossart (12th) and Jeff Erington (22nd).

Last but not least, good old “taxonomy, systematics and phylogenetics” is also still on the list. See, for example, Jean Swings (23th) and Erko Stackebrandt (24th).

But where has *E. coli* gone? Despite definitely being the most famous bacterium in research, it was simply not present in the “top 30”.

**Ralf Neumann**
Publication Analysis 1997-2008 – Microbiology

Most Cited Authors...

3. Julian Parkhill, Wellcome Trust Sanger Ctr. Cambridge 12,928 115
4. Rino Rappuoli, Novartis Vaccines & Diagn. Siena 12,212 260
7. Gordon Dougan, Wellcome Trust Sanger Ctr. Cambridge 9,582 209
10. Michael Wagner, Microbial Ecol. Univ. Vienna 8,919 138
17. Peter Vandamme, Microbiol. Lab. Univ. Ghent 7,924 242
20. Peter Andersen, Statens Serum Inst. Copenhagen 7,592 148
27. Fernando Baquero, Microbiol. Univ. Hosp. Ramón y Cajal Madrid 7,058 198

... and Papers

1. Cole, ST; Brosch, R; Parkhill, J; [...]; Taylor, K; Whitehead, S; Barrell, BG
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5. Andersson, SGE; Zomorodipour, A; Andersson, JO; [...]; Eriksson, AS; Winkler, HH; Kurland, CG
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