"Toxin experts", ranked by size: Poison dart frogs

Publication Analysis 1996-2007

Toxicology

The United Kingdom (UK) dominated European toxicology research. The most cited researcher comes from Sweden, which also performed strongly as a nation. Apoptosis and endocrine disruption emerged as the hottest topics.

Three years ago, the US-based Society of Toxicology (SOT) was approached by the National Library of Medicine and asked to provide an update of the definition of toxicology. The SOT immediately assembled a small working group that soon came up with the following abridged definition: "Toxicology is the study of the adverse effects of chemical, physical or biological agents on living organisms and the ecosystem, including the prevention and amelioration of such adverse effects."

In addition, the group elaborated with a slightly more comprehensive version, as follows (note the expressions in italics): "Toxicity is the adverse end product of a series of events that is initiated by exposure to chemical, physical or biological agents. Toxicity can manifest itself in a *wide array of forms*, from mild biochemical malfunctions to serious organ damage and death. These events, any of which may be reversible or irreversible, include absorption, transport, metabolism to more or less toxic metabolites, excretion, interaction with cellular macromolecules and other modes of toxic action. Toxicology *integrates* the study of all of these events, at *all levels of biological organization*, from molecules to complex ecosystems. The *broad scope* of toxicology, from the study of fundamental mechanisms to the measurement of exposure, including toxicity testing and risk analysis, requires an *extensively interdisciplinary approach*. This approach utilizes the principles and methods of other disciplines, including molecular biology, chemistry (analytical, organic, inorganic and biochemistry), physiology, medicine (veterinary and human), computer science and informatics."

So, why bombard you with such a convoluted formal linguistic definition? Well, to make one point clear at least: given such a high degree of interdisciplinarity, analysing and comparing publication outputs as well as citation numbers of European toxicologists must undoubtedly account for some inherent imbalance. Of course, it is not as blatant as comparing apples and oranges but more along the lines of peaches and nectarines.

Peaches and nectarines

Take for example two toxicologists – one working on the basic molecular mechanisms of toxin-induced cellular apoptosis, the other investigating the chemical structures of toxic secretions from some exotic marine snails. Will the latter ever be likely to accumulate more citations on his papers than the former?

That's what one should bear in mind when inspecting the pure numbers of our analysis of European toxicology publications which appeared between 1996 and 2007.

As for other earlier biomedical disciplines we also had to restrict the analysis of the European countries' publication performances in toxicology research to the specialist journals of the field since Thomson Reuter's citation database "ISI Web of Science" provides no tools to exclusively extract toxicology articles from multidisciplinary journals like *Nature* or *The Lancet* with sufficient reliability. Of course, this way some of the most prominent papers in the field might have been omitted from this part of the analysis. Nevertheless, we believe a survey, restricted to the expert journals in toxicology, certainly provides sufficiently valid indicators for the productivity of the individual countries' toxicology research over the period 1996 to 2007 (see tables on this page). For the rankings of the most-cited researchers and papers in toxicology (see tables p. 42), however, publications in all journals were included.

Now for the results. Regarding the countries' overall publication numbers, the first six places can be grouped into three distinct couples: The UK and Germany both pro-

duced about 7,000 papers each in toxicology journals between 1996 and 2007, France and Italy almost 4,000, with Sweden and the Netherlands generating around 2,700.

When it comes to citation numbers, these pairs are torn apart, again due to different average citation numbers per paper: The UK with 15.9 citations per article (c.p.a.) clearly leaves Germany (12.1 c.p.a.) behind – 112,000 citations in total versus 85,000; France with 52,500 citations altogether outperforms Italy, who achieved "only" 45,000, whereas Sweden distances itself somewhat from the Netherlands with 41,500 versus 38,500 citations.

Switzerland beaten only by ... New Zealand

Sweden owes this remarkably high placing by total citations mainly to its high number of average citations per article among European countries (15.3). Only the articles from Switzerland (16.6) and the UK (15.9) are cited more often on average.

However, when looking beyond the European borders, these three are clearly beaten by a stunning 23.5 citations per article for toxicology papers by authors from New Zealand. Furthermore, the total number of citations for European toxicology articles 1996-2007 almost equals the corresponding number for US toxicology papers. The US researchers, however, collected their close to 550,000 citations for fewer articles than their European colleagues: 40,000 versus 44,000.

Let's turn to the most-cited authors and papers. Apart from indicating the high quality of an individual's work, these lists also serve as a mirror to reflect which issues are "hot" in the field and, therefore, are highly-cited. Hence, in toxicology apparently apoptosis constitutes one of the most foremost topics since it takes top positions on both the author and the paper lists. The work of the most-cited European toxicologist, Sten Orrenius from the Karolinska Institut in Stockholm, clearly centres around the mechanisms of cellular apoptosis; and out of the same stable comes the most-cited European toxicology paper of 1996 to 2007, written by the group of Pierluigi Nicotera (9th) when he worked in Constance, Germany.

A whole systems approach

John Sumpter from Brunel University, UK, in second place, however, stands for a completely different subfield: ecotoxicology. He is one of the first pioneers to show that some toxins in the environment cause endocrine disruption in certain animals leading to, for example, intersexuality. That this is indeed a very hot topic and is also impressively documented by the fact that Sumpter co-authored all four papers at positions 2-5 in the list of the most-cited papers.

Third on the podium is Jeremy Nicholson from Imperial College London, who represents a different aspect of toxicology research, again. He is a specialist in applying high resolution NMR and pattern recognition methods for the investigation of perturbed biochemical processes in toxic states. He recently shifted towards more of a whole systems approach and has since co-pioneered the application of metabonomics to toxicological problems.

At this point in the author's list, you have probably taken on board the aforementioned high interdisciplinarity of toxicology. However, you will definitely no longer be able to escape this notion when moving on to the fourth in the list, Kari Hemminki from the German Cancer Research Center (DKFZ) in Heidelberg – he mainly investigates the epidemiological aspects of toxicological problems.

RALF NEUMANN

Europe...

Country	Citations	Articles	Cit./Art.
1. UK	112,172	7,062	15.9
2. Germany	85,376	7,034	12.1
3. France	52,566	3,986	13.2
4. Italy	44,939	3,767	11.9
5. Sweden	41,444	2,702	15.3
6. Netherlands	38,731	2,755	14.1
7. Switzerland	24,197	1,457	16.6
8. Spain	23,382	2,598	9.0
9. Finland	18,935	1,535	12.3
10. Denmark	17,893	1,327	13.5
11. Belgium	17,185	1,339	12.8
12. Norway	9,803	806	12.2
13. Poland	9,472	1,320	7.2
14. Israel	7,715	614	12.6
15. Austria	6,712	627	10.7
16. Turkey	6,206	1,098	5.7
17. Hungary	5,246	485	10.8
18. Portugal	5,105	565	9.0
19. Czech Rep.	4,152	509	8.2
20. Greece	3,959	496	8.0

Articles appeared between 1996 and 2007 in journals as listed by *Scopus*. Numbers for articles and citations were taken from the portal *SCImago Journal & Country Rank* (*www.scimagojr.com*) applying the subcategory "toxicology". A country's figures are derived from articles where at least one author working in the respective European nation is included in the author's list. Israel is included because it is a member of many European research organisations (EMBO, FEBS etc.) and programmes (FP7 of the EU,...).

... and the World

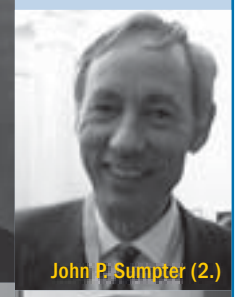
	Citations	Articles	Cit./Art.
Europe	543,153	43,688	12.4
USA	549,893	39,831	13.8
Japan	73,820	9,589	7.7
Canada	60,785	4,629	13.1
New Zealand	25,183	1,073	23.5
Australia	21,791	1,811	12.0
India	14,972	2,989	5.0

Publication Analysis 1996-2007 – **Toxicology**

Most Cited Authors...

		Citations	Articles
1.	**Sten Orrenius**, Toxicol., Environ. Med. Karolinska Inst. Stockholm	10,301	145
2.	**John P. Sumpter**, Inst. for the Environ. Brunel Univ. Uxbridge/UK	9,940	98
3.	**Jeremy K. Nicholson**, Biol. Chem. Imperial Coll. London	8,845	281
4.	**Kari Hemminki**, Mol. Epidemiol. Ger. Canc. Res. Ctr. Heidelberg	8,043	468
5.	**Gerald M. Cohen**, MRC Toxicol. Unit Univ. Leicester	7,466	79
6.	**Boris Zhivotovsky**, Toxicol. Environ. Med. Karolinska Inst. Stockholm	6,234	131
7.	**John C. Lindon**, Biomol. Med., Imperial Coll. London	6,066	183
8.	**Jean Cadet**, Lab. Lésions des Acides Nucl. CEA Grenoble	5,852	215
9.	**Pierluigi Nicotera**, MRC Toxicol. Unit Univ. Leicester	5,632	89
10.	**Elaine Holmes**, Biomol. Med. Imperial Coll. London	5,478	149
11.	**Ian Kimber**, Toxicol. Univ. Manchester	5,360	248
12.	**Magnus Ingelman-Sundberg**, Mol. Tox. Karolinska Inst. Stockholm	5,170	149
13.	**Klaus Aktories**, Toxicol. Univ. Freiburg	5,070	170
14.	**Helmut Bartsch**, Toxicol. German Canc. Res. Ctr. Heidelberg	4,842	162
15.	**Marcel Leist**, Mol. Toxicol. Univ. Constance	4,681	70
16.	**Gaetano Di Chiara**, Toxicol. Univ. Cagliari	4,612	84
17.	**Ken Donaldson**, Resp. Toxicol. Ctr. Inflammat. Res. Univ. Edinburgh	4,439	135
18.	**Ake Bergman**, Environm. Chem. Univ. Stockholm	4,210	142
19.	**B. Kevin Park**, Mol. Pharmacol. and Toxicol. Res. Grp. Univ. Liverpool	4,053	156
20.	**Ari Hirvonen**, Finnish Inst. Occupat. Hlth. Helsinki	3,945	131
21.	**David A. Basketter**, Dermatol. St. Thomas Hosp. London	3,937	207
22.	**Rebecca J. Dearman**, Syngenta Ctrl. Toxicol. Lab Macclesfield/UK	3,918	175
23.	**Charles R. Tyler**, Environm. & Mol. Fish Biol. Grp. Univ. Exeter	3,905	80
24.	**Andrew R. Collins**, Rowett Res. Inst. Aberdeen	3,861	84
25.	**David H. Phillips**, Inst. Canc. Res. Sutton/UK	3,659	122
26.	**Abraham Brouwer**, Inst. Environm. Studies Free Univ. Amsterdam	3,565	91
27.	**Aalt Bast**, Human Toxicol. Univ. Maastricht	3,513	153
28.	**Susan Jobling**, Inst. for the Environ. Brunel Univ. Uxbridge/UK	3,493	36
29.	**Bernd Kaina**, Toxicol. Univ. Mainz	3,433	126
30.	**Marion MacFarlane**, MRC Toxicol. Unit Univ. Leicester	3,316	45

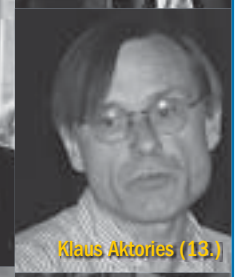

Sten Orrenius (1.)


John P. Sumpter (2.)


Jeremy Nicholson (3.)


Kari Hemminki (4.)


Elaine Holmes (10.)


Klaus Aktories (13.)


Gaetano Di Chiara (16.)


Susan Jobling (28.)

Citations of articles published between 1996 and 2007 were recorded until May 2008 using the database *Web of Science* from Thomson Scientific. The "most cited papers" had correspondence addresses in Europe or Israel.

... and Papers

	Citations
1. Leist, M; Single, B; Castoldi, AF; Kuhnle, S; Nicotera, P Intracellular adenosine triphosphate (ATP) concentration: A switch in the decision between apoptosis and necrosis. *JOURNAL OF EXPERIMENTAL MEDICINE 185 (8): 1481-1486 (1997)*	919
2. Jobling, S; Sheahan, D; Osborne, JA; Matthiessen, P; Sumpter, JP Inhibition of testicular growth in rainbow trout (Oncorhynchus mykiss) exposed to estrogenic alkylphenolic chemicals. *ENVIRONMENTAL TOXICOLOGY AND CHEMISTRY 15 (2): 194-202 (1996)*	673
3. Desbrow, C; Routledge, EJ; Brighty, GC; Sumpter, JP; Waldock, M Identification of estrogenic chemicals in STW effluent. 1. Chemical fractionation and in vitro biological screening. *ENVIRONMENTAL SCIENCE & TECHNOLOGY 32 (11): 1549-1558 (1998)*	658
4. Jobling, S; Nolan, M; Tyler, CR; Brighty, G; Sumpter, JP Widespread sexual disruption in wild fish. *ENVIRONMENTAL SCIENCE & TECHNOLOGY 32 (17): 2498-2506 (1998)*	544
5. Routledge, EJ; Sumpter, JP Estrogenic activity of surfactants and some of their degradation products assessed using a recombinant yeast screen. *TOXICOLOGY AND CHEMISTRY 15 (3): 241-248 (1996)*	535