INSTITUTIONAL PRODUCTION CUTTING ACROSS DISCIPLINARY BOUNDARIES: AN ASSESSMENT OF CHEMICAL RESEARCH IN MEXICO

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Abstract: A comparative analysis was carried out on the publication output of four of the Mexican teaching and research institutions most active in chemical research using different data sources. The papers included in the 1992 annual reports for all four institutions were compared with those included in two commercial databases: CA SEARCH, Chemical Abstracts online service covering journals in chemistry and related fields, and National Citation Reports (NCR) for Mexico, a service provided by ISI (Institute for Scientific Information) covering mainstream journals in all fields of science and technology. Three of the four institutions were found to be more visible in NCR than in CA SEARCH: in the case of the one of the institutes with a strong research commitment, almost 75% of papers in the annual report were recorded in NCR. Better coverage of chemical and biochemical journals where Mexican scientists publish was found in NCR than in CA SEARCH, suggesting that the former is a more suitable data source for quantifying Mexican chemical research than the latter in spite of its higher level of specialization.

1. INTRODUCTION

Increasing opportunities on many scientific fronts coupled with diminishing financial resources have led to an increasing requirement for assessment in publicly-funded research (1). The relatively recent concept of accountability in science implies the need for a consensus among science administrators, policy makers, funding bodies, as well as among the scientists themselves, with regard to the parameters by which activities in science and technology can be measured. Of equal importance to the establishment of a suitable set of parameters within any given environment is a general agreement on the methods and procedures adequate for their generation, particularly in respect to the data sources used. The increase in the use of commercial bibliographic databases has brought with it the need for the assessment of their worth in the measurement of research performance.

When comparing units active in a particular research area, it is convenient to define these units in terms of whole institutions, particularly in developing countries where research units are small. However, the research interests of a specific institute often cut across disciplinary boundaries producing differences in dissemination channels used for the presentation of research results. If there are important differences between institutions in this respect then we have to choose a database where the productions of both institutions are equally represented. As most bibliographic databases have a certain focus with respect to both subject and geographic coverage, the choice of a particular service could favour one institute over the others in terms of visibility. Moed *et al.* in their comparison of the

performance of research groups in Dutch universities suggested a crucial part of this type of research performance analysis lies in a sophisticated combination of bibliometric and university data (2). University data are required to adequately define the research units and its actors, and the bibliometric data, either provided by the university itself, or by using suitable bibliographic databases, to determine research output.

Chemical research has been the subject of different studies of this type. The production of Spanish universities was analyzed using Chemical Abstracts and the Spanish ICYT databases (3), while national performances in analytical chemistry core journals were determined using the Science Citation Index tapes (4). In the present study we tried different methodological approaches to compare the output of the four national institutions most active in chemical research in Mexico. Our starting points were the 1992 publication lists provided by these institutions. The papers on these lists were compared with the production reported for these institutions in 1992 in the CA SEARCH online service, and in the National Citation Reports (NCR) for Mexico datafiles purchased from ISI (Institute for Scientific Information). Our general objective was to evaluate the visibility in these two commercially available databases, of the total production in chemistry of the four institutions under study, and to ascertain the suitability of these two databases to carry out a comparative study of the publication output of Mexican institutes carrying out chemical research.

2. METHODOLOGY

Three series of publication lists were obtained for four of the Mexican institutes most active in chemical research, all located in Mexico City. The names, principal thrust and number of researchers are given in Table 1.

Institutions	Principal Activity	Number of Researchers*
National Autonomous University of Mexico (UNAM), Institute of Chemistry	Research	40
National Autonomous University of Mexico (UNAM), Faculty of Chemistry	Teaching	38
National Polytechnic Institute (IPN), Centre for Research and Advanced Studies (CINVESTAV): Department of Chemistry	Research	13
Autonomous Metropolitan University (UAM), Iztapalapa Campus: Depts. of Chemistry, Engineering [Chemical Engineering Area], Physics [Polymer Area]	Teaching	23

* Members of the Mexican National Researchers System in the areas of Chemistry and Chemical Engineering 1990

Table 1. Mexican Institutes included in the Analysis of Chemical Research

2.1 Annual Publication Lists provided by the four Mexican Institutes

These were obtained by the following means: Institute of Chemistry, and the Faculty of Chemistry from the 1992 Annual Report of the UNAM (5); the unpublished lists of the CINVESTAV of the IPN, and the different units of the UAM, directly from the authorities of the institutions concerned. Three records were eliminated from the total of 64 publications contained in the annual report of the Institute of Chemistry, 2 of which gave a 1991 publication date, and a third was a 1991 publication

erroneously attributed to 1992. Two monographs were eliminated from the Faculty of Chemistry's list of articles in international journals.

2.2 Publications registered in CA SEARCH

The results of a search carried out on the 1992 records of the Chemical Abstracts online retrieval service, CA SEARCH, indicating an address within the Mexican Republic, were downloaded and incorporated into a database in FOXPRO version 2.0. The 705 records retrieved were individually checked for the presence of the four institutions in this study and coded accordingly (see below). CA SEARCH is a service provided by the American Chemical Society which scans more than 8,000 journal titles, plus patents, proceedings, technical reports, theses, and books published world-wide in the fields of Chemistry: organic, analytical, physical, applied, macromolecular, biochemical, and chemical engineering. The addresses reported are those which refer to the location at which the work was done or where correspondence regarding the document is to be sent (6).

2.3 Publications registered in National Citation Reports for Mexico

The 1992 records of these data files were searched for the occurrence in the address field of the names of the four institutions under analysis, and records coded accordingly. These data files were bought from ISI as part of a customized service providing publication and citation data on any country, retrieved from their databases. Records containing Mexican addresses were sent to us in diskette form and were subsequently loaded and searched in a FOXPRO version 2.0 database. Scientific and technical journals covered in the ISI datafiles correspond to approximately 3,300 titles covered by the Science Citation Index, plus additional titles included in the series of Current Contents. All author addresses included in the original documents are reported in this database.

Coding of Mexican institutions was carried out with respect to all records in both the 1992 NCR and the CA SEARCH files. Each institution was assigned a unique ten letter code. We further identified departments, faculties, and institutes wherever possible for the three major institutions, UNAM, UAM and IPN, included in our analysis.

Once coding was completed publication lists were drawn up corresponding to the records for the 4 institutions present in the 2 data sources. The 3 publication lists, namely annual reports, NCR records, and CA SEARCH records, were compared for the 4 institutions, and the number of overlaps ("hits") and unique records for each data source calculated. A concurrence index was developed to indicate the frequency with which the papers included in the annual reports were covered by the 2 commercial databases. The characteristics of the literature included in the different lists were examined in an attempt to find an explanation of possible discrepancies found.

We also looked at the respective coverage of journals in different fields in NCR and CA SEARCH where Mexican papers were published in 1992, as well as the relative subject emphasis of the 1992 papers in CA SEARCH published by researchers from the 4 Mexican institutions. This was done by aggregating the CA SEARCH subject codes into the following four main subject areas: General Chemistry; Biochemistry; Pharmacology and Toxicology; Industrial Chemistry.

3. RESULTS

3.1 Concurrence in the Coverage of NCR and CA SEARCH with respect to the Institutional Annual Reports.

Of the 61 papers for 1992 given in the annual report of the Institute of Chemistry, UNAM, 45 were found in NCR, 29 in CA SEARCH (Figure 1). The 13 records unique to the annual report of the Institute were checked in the SCI CD-ROMs for 1992 and 1993 with the following results: 4 reported only foreign addresses, 9 were not found (including 4 in publications reporting advances, or trends, and 2 in well-known proceedings series). The 3 records unique to NCR were 2 papers in the journal *Planta Medica*, published in Germany, and 1 in the *Journal of Chemical Ecology*. The 4 papers found in both NCR and CA SEARCH were all in *Acta Crystallographica Section C*, published at the end of 1992, suggesting that these were published following the compilation of the annual report. No additional records were found in CA SEARCH.

In the case of the Faculty of Chemistry, UNAM, of a total of 135 documents included in their annual report for 1992, only 25 were present in the NCR database, and 22 in CA SEARCH (Figure 2). The large discrepancy between the total number of papers in the institutional report and those found in the two databases is due to the presence of papers written in institutional and national publications not covered by the commercial services, several of which referred to educational topics. A total of 28 papers reported in either NCR or CA SEARCH, or both, were not included in the institutional report. The annual report of this institution was the only one to be divided into 2 sections listing articles in national and international journals, 77 and 58, respectively. Only 4 of the 77 articles in national journals were found in the databases, 3 of which were in NCR and 1 in CA SEARCH.

The Department of Chemistry of the CINVESTAV showed a smaller number of 1992 documents, 32 in all. Twenty-one of these were in NCR and 19 in CA SEARCH (Figure 3). Because of the inability to distinguish the papers written by the members of the Chemistry Department from those of other departments, the figures given for the total numbers of records in the NCR and CA SEARCH refer to all documents attributed to the CINVESTAV.

The total number of papers reported from the 3 departments of the UAM involved in chemical research, namely the Department of Chemistry, the Department of Engineering: Chemical Engineering Area, and the Department of Physics: Polymer Area, was 88 (Figure 4). Of these, 31 were present in NCR and 42 in CA SEARCH, suggesting a greater compatibility of the journals included in the Chemical Abstracts Service than those in NCR, with respect to the titles where the UAM chemists publish. As was the case with the Department of Chemistry of the CINVESTAV, it was impossible to differentiate between the different departments of the UAM with respect to the total numbers of papers reported in the 2 databases due to the lack of precision in reporting departmental affiliation in these data sources.

The results for the 4 institutions are summarized in Table 2. Concurrence indices were calculated with respect to the number of agreements ("hits") found between the papers listed in the annual reports, and those found in the two databases. The Institute of Chemistry of the UNAM, was found to have the highest concurrence index of 0.74 with respect to NCR which was considerably greater than the figure of 0.48 for CA SEARCH. The other research institute in our study, namely the Department of Chemistry of the CINVESTAV, also showed indices higher than 0.5 with respect to both databases, however, there was more compatibility with CA SEARCH than with NCR. The 2 teaching

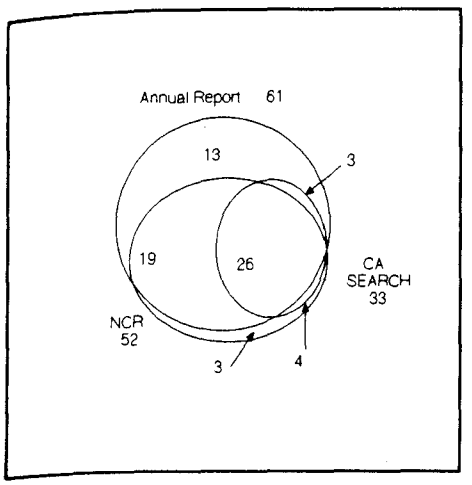

Figure 1. Concurrence of Papers reported for the Institute of Chemistry, UNAM in the three Data Sources

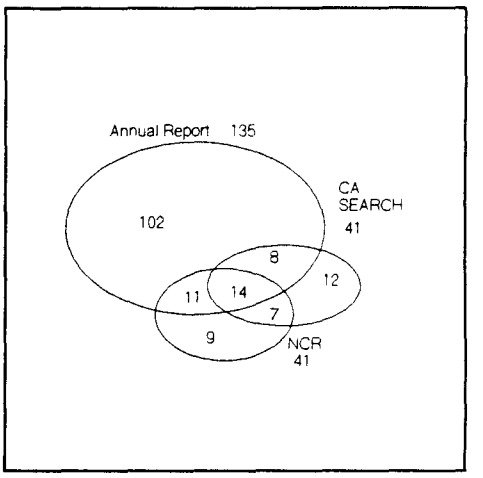

Figure 2. Concurrence of Papers reported for the Faculty of Chemistry, UNAM in the three Data Sources

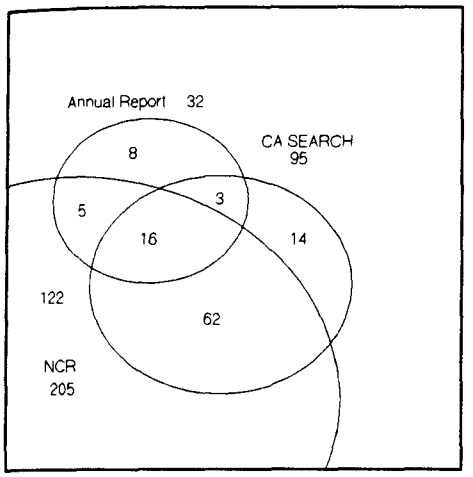

Figure 3. Concurrence of Papers reported for the Dept. of Chemistry, CINVESTAV in the three Data Sources

Note: Total figures for the NCR and CA SEARCH refer to all papers published by the CINVESTAV.

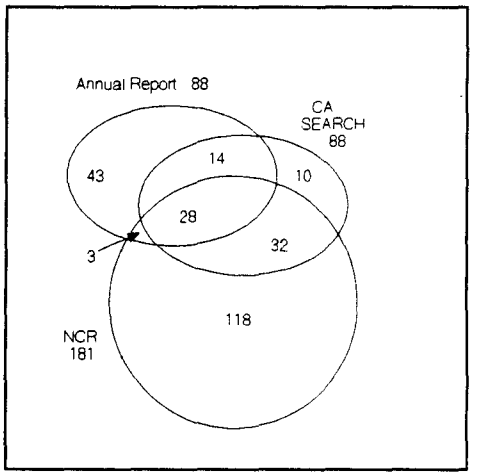

Figure 4. Concurrence of Papers reported for the three Departments in Chemistry, UAM in the three Data Sources

Note: Total figures for the NCR and CA SEARCH refer to all papers published by the UAM.

institutes showed much lower levels of concurrence, particularly in the case of the Faculty of Chemistry, UNAM which was probably due to the presence of a considerable number of national publications in their annual report. Overall little difference was found with respect to the representation of the annual reports of the 4 institutions as a group between the 2 databases, with a low level of concurrence (less than 0.4) occurring in both instances.

Institution	Annual Report	NCR	Concurrence Index	CA SEARCH	Concurrence Index
Inst. Chem. UNAM	61	45	0.74	29	0.48
Fac. Chem. UNAM	135	25	0.19	22	0.16
Dept. Chem. CINVESTAV	32	21	0.66	19	0.59
Depts. UAM	88	31	0.35	42	0.47
Total	316	122	0.39	112	0.35

Table 2. Indices of Concurrence ("hits") between the Number of Papers included in the Annual Reports, and in NCR or CA SEARCH

3.2 Journal Coverage of NCR and CA SEARCH with respect to Mexican Papers

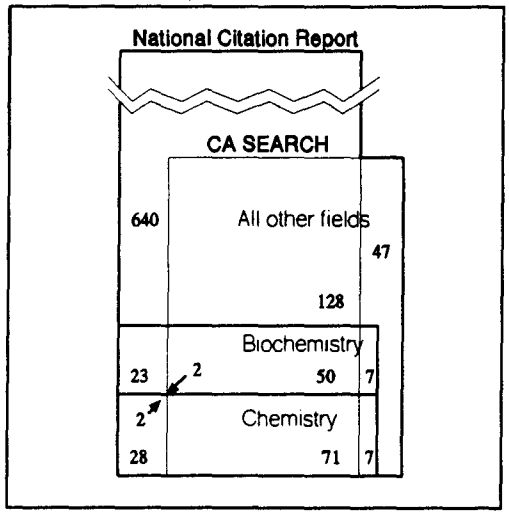

Figure 5. Relative Coverage of NCR and CA SEARCH of Journals where Mexican Papers were published in 1992

Figure 5 indicates the relative coverage of journals in chemistry, biochemistry, and all other fields, in both NCR and CA SEARCH where Mexican papers were published in 1992. Four journals were classified in both chemistry, and biochemistry, 2 of which are included in both databases. In spite of the fact that NCR is a multidisciplinary file, it included more chemistry journals where Mexican papers were published in 1992 than did CA SEARCH which focuses on chemistry and related areas. As a consequence more Mexican papers in chemistry were reported by NCR than by CA SEARCH. The same was found to be true for the biochemical journals.

3.3 Subject Areas of Papers in CA SEARCH published by 4 Mexican Institutions carrying out Chemical Research

Figure 6 illustrates the relative emphasis on the different subject areas of chemical research of the 4 Mexican institutions as indicated by their 1992 papers reported in CA SEARCH. While all 4 published general chemistry papers, the other 3 subject areas were selectively covered. For instance, CINVESTAV focused on biochemistry, and pharmacology and toxicology, the UAM giving preference to industrial chemistry. The Institute of Chemistry of the UNAM concentrated on fundamental chemistry and the Faculty of Chemistry of the same University published in a broad range of subjects.

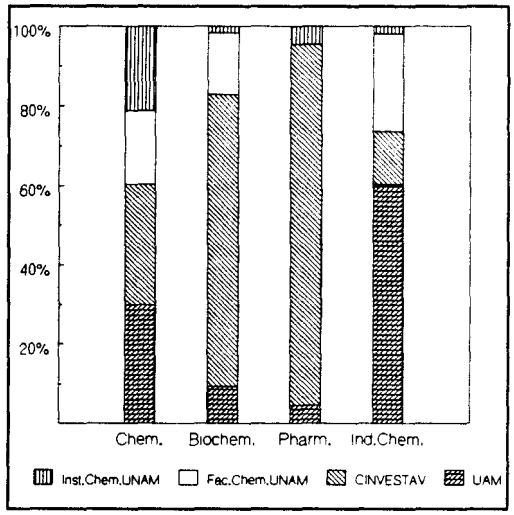

Figure 6. Relative Importance of Publications of Mexican Institutions in four Subject Areas in CA SEARCH

4. DISCUSSION

It is commonly suggested that science and technology indicators established for the scientifically advanced countries, such as the measurement of papers published in mainstream science and technology journals, are not suitable for measuring science carried out within the smaller, scientific communities found within developing countries. Third World countries adopt different strategies from those of developed countries with respect to thematic and research orientations, ways of treating science, and also ways of disseminating results (7). It is not surprising then that with the emphasis in poorer countries on the need of science for development, universally applied indicators will not adequately reflect the effort made in the more applied, local science characteristic of many developing nations.

However, science policy initiatives are not uniform for the developing world; priority is given in some cases to science, and scientists able to compete in the international market place. Mexico, for example, has followed a policy in recent years of the need for excellence in the scientific endeavour. Evaluation of scientific performance is based on parameters established in the scientific centre, with publication in the international literature being favoured over that destined for local consumption. The fact that NCR proved to be a better source of information for papers published in the field of chemistry than CA SEARCH can perhaps be explained by the importance given within the Mexican scientific community of publishing in mainstream journals.

Our results on chemical research in Mexico suggest that the balance between the commitment to research and to teaching in these institutions will affect the level of visibility of publication output in the international database services. The research performance of institutions committed to a high profile at international level, such as the Institute of Chemistry of the UNAM, are far better represented in NCR than are institutions where teaching is the major component. Such is the case of the Faculty of Chemistry, the sister institution of the Institute of Chemistry, where applied studies are published in local and national journals not present in NCR. Another important difference with

reference to the specific characteristics of the 4 institutions under study is the varying emphasis on the distinct subject fields conforming chemical research.

When considering the relative merit of NCR and CA SEARCH for carrying out bibliometric studies on Mexican chemical research it is important not to overlook two important points. Firstly, CA SEARCH, unlike NCR, reports only first author addresses, a situation which restricted our 1992 papers identified through CA SEARCH to those where the Mexican scientist is the first author. This implies that we were only able to find concurrence between CA SEARCH and the lists of publications in the annual reports with respect to first authors. Consequently the Chemical Abstracts database is likely to contain more Mexican papers than could be identified in the present study. Secondly, it should not be forgotten that CA SEARCH is a far more useful tool for carrying out bibliographic searches on chemical literature than NCR due to its wider coverage of document types, its detailed and specialized classification of topics in chemistry, and retrieval access via chemical structures.

The 28 papers reported in the two commercial databases which were not reported in the Faculty of Chemistry's annual report indicates an inefficient system for reporting papers, as well as a situation detrimental to the research image of the Faculty. In addition, 16 of these 28 papers were in the mainstream journals covered by **Science Citation Index**, or **Current Contents**, out of a total of 59 international contributions indicated in the Annual Report for 1992. Including these would have increased the contribution to the mainstream scientific literature by 27%.

Another factor affecting apparent omissions in the reporting of institutional papers is that annual reports are often compiled towards the end of the year in question, or early on in the following year, which might not allow for papers published towards the end of the year to be included. Institutional policy often dictates the exclusion of papers reported as accepted for publication, or in press, as they often refer more accurately to manuscripts submitted for publication. Papers published while members of staff are on sabbatical in other institutions are often included in the annual reports of the home institutions even though this address is not reported in the paper. Martin and Irvine in their study on radio astronomy research consider that publication lists provided by the institutions concerned are unlikely to contain more than about a 5% error (8). However, our results are indicative of a much higher error rate, perhaps due to the lack of an adequate procedure for the collection of research statistics in some Mexican institutions.

Our study was restricted by our desire to compare Mexican groups carrying out chemical research within the confines of institutional frameworks. For this reason we found ourselves comparing whole institutions with single departments, or conglomerates of departments, carrying out research in distinct areas of chemistry and related fields. Even though our findings do not reflect the relative merit of each of the units analyzed they do indicate the methodological problems inherent in comparative output analysis using commercial databases. They also throw light on the variability and unreliability of institutional reporting in Mexico, brought about in part by the application of different criteria for the elaboration of annual reports. In the special case of chemical research in Mexico, the differences in the nature and extent of the reported publication output can be attributed to the unequal balance given to research and teaching functions by the various institutions involved, as well as the different areas of chemistry in which they concentrate their research activity.

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