

# 37 years of scientific activity in a Biochemistry Department in Brazil – patterns of growth and factors leading to increased productivity

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## Introduction

Scientific activity in Brazil has experienced accelerated growth in the past decades, with an increase in productivity which greatly surpasses the international average. This growth has occurred mostly at the expense of centers of excellence in the larger public universities, which account for the vast majority of the country's scientific output.

## Methods

The aim of our study was to evaluate the production of the Department of Biochemistry at University of Rio Grande do Sul (UFRGS), as well as identifying factors within the local and national scenarios which have influenced its production pattern. For this means, we undertook a search for the scientific production in periodicals by all individuals listed as part of the Department's faculty from its foundation in 1971 through the year of 2007. The number of articles published by each active faculty member of the department in every year was obtained from the *Curriculum Lattes* database as registered in CNPq, the main scientific regulation agency in Brazil. The number of theses supervised by the faculty members at the Department of Biochemistry was also obtained from *Curriculum Lattes*.

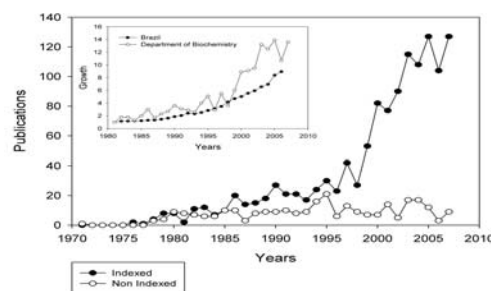
Total publication numbers for the Department were obtained by adding the numbers for each faculty member, taking care to avoid overlapping in the case of collaborations. Indexed articles were defined as those indexed in the Institute for Scientific Information (ISI) in the Journal Citation Report, from which impact factors for each article were also drawn. Impact factors were based on this source. Publications mentioned in the faculty's curriculum but not in periodicals indexed by the ISI were considered as non-indexed.

Data on local and external factors which could be related to the evolution of scientific production at the Department over the years were obtained through from the Department's administrative records. Important dates were registered, including the opening of the Department's master's (MSc) and PhD programs, the arrival of important researchers, major financial grants and others. We also obtained data on the establishment of national scientific policies (such as financial stimuli for

productive researchers and evaluation systems of postgraduate programs) from the national research (CNPq) and superior education (CAPES) agencies.

## Results and Discussion

From 1971 to 2007, the total scientific output of the Department of Biochemistry in periodicals amounted to 1534 articles, of which 1247 were indexed by the ISI. Scientific production by the Department steadily grew from 1977 onwards, and sharply rose in the mid-1990s, with the number of indexed articles per year quadrupling between 1995 and 2007 (Figure 1). Meanwhile, non-indexed scientific production remained in a low level throughout the period.

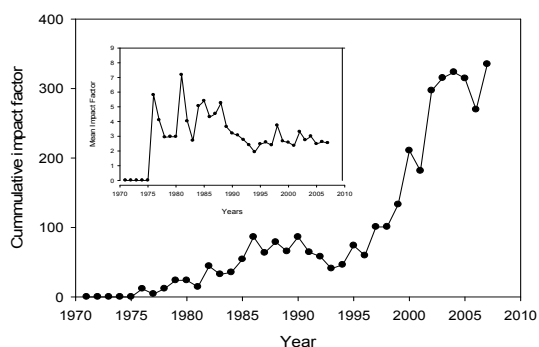


**Figure 1. Scientific publications by faculty members at the Department of Biochemistry of UFRGS from 1971 to 2007**

To try to analyze if the quantitative growth of the Department's production was accompanied by an increase in its visibility, we analyzed the mean impact factors of indexed articles published in the period. The increase in the number of articles led to a natural increase in the cumulative impact factor of published articles over the past decade (Figure 2). The inset shows that mean impact factors remained relatively stable, although the peaks reached before the 1990s were mostly due to a relatively small number of articles in high-visibility journals in a period when total productivity was low, leading to a high average impact.

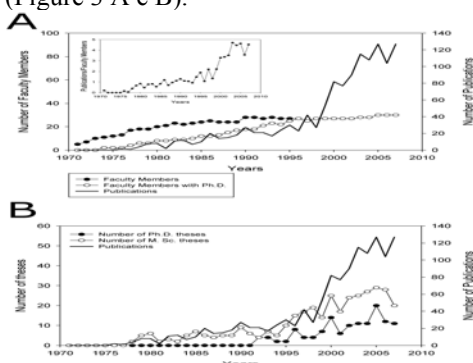
Creation and growth of research groups are seen as an important factor in the growth of Brazilian research activity (Leta et al., 1998 Human resources and scientific productivity in Brazil. *Scientometrics*, 41: 313-324). We decided to analyze the research production of individual researchers within the

department's faculty over the years to try to visualize this trend. The scientific output of the various research groups in the department grew over time. However, the distribution of scientific production among faculty members significantly changed over time, from a scenario in which one senior researcher dominated the department's research activity to one in which various researchers shared the department's productivity in a more equal fashion (data not shown).



**Figure 2: Cumulative impact factor of articles published every year from 1971 to 2007 (JCR). Inset: Mean impact factor**

The increase in qualified faculty was accompanied by a significant increase in the number of postgraduate theses produced in the Department. This was driven by the creation of its postgraduate master's and PhD programs in 1977 and 1992, respectively, and favored by the increase in research activity and in the capability of the faculty in supervising students. It also closely accompanies the increase in the Department's scientific output, a relation which has also been shown to occur between the total Brazilian scientific output and number of postgraduate students (Leta et al., 1998). (Figure 3 A e B).



**Figure 3 (A) Total number of faculty members (black) and number of faculty members with a PhD (white). (B) Number of MSc (white) and PhD (black) theses produced.**

Finally, to try to correlate the temporal pattern of growth of the Department with important events in its history and in the history of the country, we listed some of these events in a chronological

fashion. Important events in this list include the arrival of experienced researchers from abroad, the creation of the Department's MSc and PhD programs, major research institutional grants, national productivity stimuli through the institution of personal grants for active researchers, and the current model of evaluation of postgraduate programs (heavily based on research output).

**Table 2. Landmark dates in the history of the Department of Biochemistry at the Universidade Federal do Rio Grande do Sul and in the recent history of Brazilian science.**

YEAR	EVENT
1971	Foundation of the Department of Biochemistry at UFRGS
1976	Arrival of 1 <sup>st</sup> senior professor (from Argentina)
1977	Opening of postgraduate MSc program
1983	Collaboration with another public university for institution of a collective PhD program
1986	Arrival of 2 <sup>nd</sup> senior professor (from England)
1990s	Institution of personal financial grants for active researchers
1992	Opening of the department's own PhD program
1993	1 <sup>st</sup> Study and Project Financing agency (FINEP) grant
1996	2 <sup>nd</sup> FINEP grant; 1 <sup>st</sup> National Support Program for Nuclei of Excellence (PRONEX) grant
1997	Opening of the department's new headquarters
1998	Start of the current national evaluation model for postgraduate courses by CAPES
2004	3 <sup>rd</sup> FINEP (obtained through the Basic Health Sciences sector of the University)
2005	2 <sup>nd</sup> PRONEX grant
2006	IBN.Net

## Conclusions

The high productivity of indexed articles, which are the main research product of Biochemistry Department, was obtained without changes in the number of professors, which was constant from the 90s until the present moment (an average of 30 professors). Additionally, the increased productivity has proportionally grown according to the number of graduate students, therefore correlating the graduation program with the development of a research center of excellence and human resources formation. The formation of new research groups by renowned international professors and the internal policies which contributed the Department's productivity were important factors to the constant increase in the number of indexed articles known internationally. The Biochemistry Department contributed considerably to the scientific production of the UFRGS and its growth was accompanied by Brazil development.

## Acknowledgments

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