



Perceptions of Latin American scientists about science and post-graduate education: Introduction to the 5th issue of *CBP-Latin America* [☆]

Marcelo Hermes-Lima ^{a,*}, Cássia Polcheira ^{a,b}, Michelangelo Trigueiro ^c, Rene Oliveira Beleboni ^d

^a Oxyradical Research Group, Departamento de Biologia Celular, Universidade de Brasília, Brasília, DF, 70910-900, Brazil

^b Escola Superior de Ciências da Saúde, FEPECS, Brasília, DF 70710-907, Brazil

^c Departamento de Sociologia, Universidade de Brasília, Brasília, DF, 70910-900, Brazil

^d Unidade de Biotecnologia, Universidade de Ribeirão Preto, Ribeirão Preto, SP, 14096-900, Brazil

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ABSTRACT

Although science and engineering (S&E) publications and doctoral degree awards in Latin America had experienced an impressive growth in the past decades, a qualitative evaluation of this increased output must be performed. Previous studies have indicated that growth in visibility of Latin American science – determined by ratio of citations per paper – has not kept pace with the increase in number of publications. In the present editorial, we analyzed – by means of a 12-item questionnaire – the individual perceptions of forty senior researchers involved in *CBP-Latin America* (29 Brazilians and 11 non-Brazilians) plus a special group composed by six extraordinary Latin American scientists (the “masters”). The questionnaire – using 6-point Likert-like scale for quantification of perception – focused on issues surrounding doctoral educational system as well as the governmental educational policies and publication pressure from funding agencies. In general, the most striking result was the perception (by 82% of respondents) of lack of job opportunities for people holding a PhD diploma in the field of comparative biochemistry and physiology. Other major trends include (i) lack of satisfaction with governmental policies for science and post-graduate education due to policies promoting mass production for papers and PhD diplomas (65–77% of respondents felt that way) (ii) that current PhD students are doing an adequate job, but have not improved in quality as compared to those from 10 years ago (the same was observed for PhD thesis in terms of present *versus* past), and (iii) that research infrastructure and the curricula of post-graduate courses do not constitute a problem, but (iv) recent-PhDs are not as fit as they should be in paper-writing skills, especially as perceived by Brazilian respondents. The general perceptions were very similar among Brazilians, non-Brazilians and “masters”. The use of a larger study-population, with scientists of more diverse fields is the next logical step to best evaluate the level of satisfaction about science and post-graduate policies in the continent. Finally, this fifth and last special issue of *CBP-Latin America* celebrates the contribution of 20 new manuscripts, which adds up to 118 published studies highlighting the depth, breadth and enthusiasm of Latin American comparative biochemistry and physiology – enjoy.

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1. Preface

This is the 5th and last volume of the project *CBP-Latin America*, where 118 original papers and 5 editorial articles (including this) were published by many authors from several countries from Latin America. The original idea behind this ambitious project (which started in mid 2004) was presented in our first editorial article, by [Hermes-Lima and Navas \(2006\)](#). The second to fourth volumes of *CBP-Latin America* were introduced by [Zenteno-Savín et al. \(2007\)](#), [Navas and Freire \(2007\)](#), and [Hermes-Lima et al. \(2007a\)](#), respectively, each focusing on

relevant aspects surrounding science, specifically comparative science, while also introducing the topics of the individual studies.

The current issue presents twenty publications in the field of comparative physiology and biochemistry (CPB); see more about *CBP-Latin America* in Section 6. Before presenting the studies themselves, we shall discuss the perceptions of scientists – those involved in this editorial project – about the facts and policies of science and post-graduate education in Latin America.

2. Science and post-graduate education in Latin America

In recent years, the scientific growth experienced by Latin American countries in the last 10–15 years has been broadly discussed, particularly, considering the increased number of publications in science and engineering (S&E) and S&E doctoral degrees awarded in this period

[☆] With the special participation of Natacha C. Santos, CNPq, Brasília, Brazil.

* Corresponding author. Tel.: +55 61 3307 2043, +55 61 3307 3270; tel./fax: +55 61 3307 3202.

E-mail addresses: m_hermes_lima@yahoo.com.br, hermes@unb.br (M. Hermes-Lima).

(Glanzel et al., 2006; Hermes-Lima et al., 2007a,b). The number of Latin American publications (in Pascal database) increased from 6994 in 1990 to 17,919 in 2004, reaching a share 3.4% of the world's scientific publications compared to only 1.8% in 1990 (Science Watch, 2001; Hill, 2004; Hermes-Lima and Navas, 2006; Hermes-Lima et al., 2007a,b). In addition, looking at the absolute number of papers in all academic areas, Brazil – the largest nation in Latin America – reached the 17th position in a 10-year coverage (see Table 1).

Moreover, the number of S&E doctoral degrees awarded in Latin America increased from a total of 1695 to 7815 from 1990 to 2004. The expectation of continued increases of these parameters in the coming years remains high (Science Watch, 2001; Hill, 2004; Triunfol, 2007). Between 1976 and 2004, the number of Brazilian post-graduate programs (for MSc and PhD) increased in a vigorous manner, from 673 to 2993 courses in different fields – an increase of 5.5% per year (CAPES, 2004). Moreover, in accordance with the current *Brazilian National Plan to Post-Graduate Studies* (2004–2010), the graduation of 45,000 and 16,000 Masters and PhDs, respectively, is expected in the year 2010 alone (see Table 2 for number of PhD diplomas in several countries). The increased number of doctoral awards and the current accountability expectations might be explained by an attempt to diminish the cumulative deficit of doctoral graduates in Latin American countries in relation to developed ones. In fact, even taken into account these recent efforts and discounting the effect of “Brain-Drain” (emigration of scientists; see Saravia and Miranda, 2004), the quantity of researches in the European Union, Canada and USA (in 2002–2004) was 2439, 3922 and 4605 per million inhabitants, respectively. By comparison, this number is only 261 in Latin America and the Caribbean (in 2002), even after the 4.6-fold increase in Latin American S&E doctoral degrees from 1990 to 2004 mentioned above (UNESCO, 2005; Hermes-Lima et al., 2007a).

When looking at the scenario discussed above, and only evaluating the absolute growth in numbers of S&E publications and PhD diplomas, Latin American science and post-graduate education seems to be moving forward along the right tack. However, looking at the concepts of visibility and recognition of science, as defined by Leta and Chaimovich (2002), for example the ratio of citations per

Table 1
Publications and citations per paper (CpP) among selected nations in 1997-to-2007

| | Papers | CpP |
|--|-----------|-------|
| <i>Selected developed nations ranked by CpP</i> | | |
| Switzerland (16) | 159,667 | 14.32 |
| USA (1) | 2,864,275 | 13.63 |
| Denmark | 87,496 | 12.91 |
| Netherlands (12) | 220,881 | 12.85 |
| Iceland | 3964 | 12.52 |
| Sweden (15) | 168,574 | 12.18 |
| England (4) | 653,177 | 12.18 |
| Finland | 82,001 | 11.57 |
| Canada (7) | 393,143 | 11.14 |
| Germany (3) | 738,067 | 10.75 |
| France (5) | 529,636 | 10.22 |
| Australia (11) | 249,892 | 9.77 |
| Italy (8) | 371,205 | 9.68 |
| Japan (2) | 777,992 | 8.50 |
| Spain (10) | 270,139 | 8.32 |
| <i>Selected developing nations ranked by CpP</i> | | |
| Mexico (1996 to 2006) | 57,602 | 5.54 |
| Brazil (17) | 137,159 | 5.25 |
| South Korea (14) | 192,361 | 5.22 |
| Argentina (1994 to 2004) | 40,438 | 5.17 |
| India (13) | 215,847 | 4.15 |
| China (6) | 471,890 | 4.02 |
| Russia (9) | 275,945 | 3.83 |

Source: In-cites, December 2007 (<http://www.in-cites.com/countries/2007allfields.html>). Number in parenthesis indicates the world rank – 1st to 17th – in the amount of papers for the period 1997–2007.

Table 2
PhD defenses (in all areas) in selected countries^a

| | 1990 | 2000 | 2005 | Increase 1990/2000 | Increase 1990/2005 |
|----------|----------------|--------|--------|--------------------|--------------------|
| Brazil | 1410 | 5335 | 8987 | 3.8 fold | 6.4 fold |
| Chile | 29 | 83 | 222 | 2.9 fold | 7.7 fold |
| Mexico | 201 | 1035 | 1783 | 5.1 fold | 8.9 fold |
| Colombia | 6 ^b | 28 | 60 | – | 10 fold |
| Cuba | 233 | 291 | 440 | 1.2 fold | 1.9 fold |
| USA | 38,277 | 44,947 | 52,855 | 1.2 fold | 1.4 fold |

^a Source: <http://www.ricyt.edu.ar/indicadores/comparativos/20.xls>.

^b 1998.

paper (CpP), a bit of disappointment arises. The increased scientific performance (as publication output) of Latin America during the past 10–15 years was not paralleled by an increase in recognition (or visibility), as demonstrated by a small increase in CpP over time (Hermes-Lima et al., 2007b). In fact, the rate of growth of CpP per year was about 3 fold smaller in Brazil and Mexico than that obtained by Spain or Australia. Moreover, developing nations are also lagging behind in absolute values of CpP compared to developed nations (see Table 1). In the case of Brazil, the increase in paper output has not been matched by increased visibility (Glanzel et al., 2006), “making it important to devise policies to increase the quality of Brazilian scientific output” (Loureiro and Augusto, 2008).

A comparison of CpP in specific areas of knowledge also shows frustrating trends: the average CpP values for G7 and three Latin American countries (Brazil, Mexico and Argentina) in the area of biology and biochemistry are 15.2 and 5.1, respectively. In molecular biology and genetics, average CpP values are 24.3 for G7 countries and 7.0 for Brazil, Mexico and Argentina, respectively (Hermes-Lima et al., 2007b).

As in the case of publication output, a comparative evaluation of post-graduate programs in Latin America is an urgent necessity. Governments produce complex peer-based evaluations and some are available on the web (e.g., www.capes.gov.br). In Brazil, post-graduate programs are required to submit biannual reports that are evaluated by a group of experts in each specific area (Spagnolo and Souza, 2004). However, the perception of scientists regarding governmental policies of post-graduate science education, the science educational system and its efficacy, are not evaluated.

In this study, we investigated the perception of senior Latin American researchers in the area of CPB about several issues surrounding the post-graduate educational system (including academic performance of PhD students and quality of PhD theses), as well as the governmental educational policies and publication pressure from funding agencies. This study was based on a questionnaire sent to over 200 senior researchers involved in the *CBP-Latin America* project (40 replies were obtained), plus a special group of six extraordinary senior Latin American scientists. The results were quite surprising.

3. Methodology

This paper is based on a broad survey about the profile, perceptions and backgrounds of senior comparative physiology and biochemistry (CPB) researchers – defined as those coordinating a research group – involved with the project *CBP-Latin America* (2004 to 2007). An interview-questionnaire was developed and e-mailed to 204 researchers from Latin American countries involved in the *CBP-Latin America* project, either as authors and/or referees. 122 Brazilians and 80 non-Brazilians received the questionnaire in Portuguese or Spanish, respectively. We obtained replies from 29 Brazilians and 11 non-Brazilians (24% and 14% of each “population”, respectively). The non-Brazilians respondents were from Chile ($n=2$), Mexico ($n=4$) and Argentina ($n=5$). Of the Brazilian respondents ($n=29$), ten were from the State of São Paulo, which is responsible for 1/3 of Brazilian GDP (researchers from São Paulo were major contributors in *CBP-Latin America*; Navas et al., 2007). The other Brazilians were from Distrito

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