

Five indexes of claims of intellectual and industrial property: Technology Readiness Levels, articles, reviews, and patents.

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PRESENTATION

Here, the usual classifications of scientific journals and databases are used: in review articles (R), the main contribution is critical analysis of previously published studies, and in research articles (A), ideas published for the first time. The scientometrics of the relative importance between the three main research modalities A , R and patents (P) can give rise to important inferences regarding the maturity and fertility of a given technological route, considering its Technology Readiness Levels (TRL) (ISO 16290:2013 - Space Systems — Definition of the Technology Readiness Levels (TRLs) and Their Criteria of Assessment, 2013; Rodrigues et al., 2021). It is natural to expect the R and P numbers to grow non-linearly, but proportional to TRL levels and less rapidly than A . Exceptions, such as the faster growth of patent filings than that of article publications, generally indicate important disparities between industrial and scientific activity.

In these five index, the logic is to compute the largest expected set in the numerator, but this relationship can be inverted in certain cases and moments, generating positive results less than unity: the *Revision Index* (R -I or ϕ) and *Patent Index* (P -I or ψ) (Equation 1 and 2, respectively); the *Patent-Peer Reviewed Reviews Index* (PR -I or λ) and *Patent-Peer Reviewed Article Index* (PA -I or φ) (Equation 3 and 4, respectively). The ξ it is an indicator of the relationship between the main forms of *New Techno-Scientific Knowledge* and their *Reviews* (NK -I) (Equation 5).

$$\phi = \frac{\sum_{i=1}^m A_r}{\sum_{i=1}^n R_r} \quad (1)$$

$$\psi = \frac{\sum_{i=1}^m A_r}{\sum_{i=1}^q P_r} \quad (2)$$

$$\lambda = \frac{\sum_{i=1}^n R_r}{\sum_{i=1}^q P_r} \quad (3)$$

$$\varphi = \frac{\sum_{i=1}^m A_r + \sum_{i=1}^n R_r}{\sum_{i=1}^q P_r} \quad (4)$$

$$\xi = \frac{\sum_{i=1}^m A_r + \sum_{i=1}^q P_r}{\sum_{i=1}^n R_r} \quad (5)$$

Where

A = Only article (data paper), article (early access) and article (proceedings paper).
R = Review.
P = Patent. Each patent record is computed, and the same technology can be protected in different offices.
Subscript "r" = Technological route.

The λ and ψ disaggregating (and φ aggregate) the relative importance of A and R studies in relation to P , respectively. The ϕ is a metric usual in the Scopus, WOS basis and others. The emergence of bibliometrics/scientometrics efforts (ϕ descending) is not common in the early stages of TRL; presupposes accumulation of knowledge, experiments, technical reports. A significant accumulation or wide spatial dispersion of publications, in the A and/or P form, often indicate the need for R specific, as well as can indicate undesirable imbalances between claims of intellectual and industrial property rights, inspiring analysis and decision-making in science and technology policies.

Table 1 shows these indices, using real data from the referred research areas, between the 1990s and the 2020s (Ibero-American and global approaches were used).

Table 1 - Five indexes of claims of intellectual and industrial property in the Policosanol extraction routes.

Route	PR-SD ^a						Extraction Patent (Fullpat)		World					Index				
	World			Iberoamerican			World	Ibero-America	World					Iberoamerican				
	Total	A	R	Total	A	R			φ	ψ	λ	φ	ξ	φ	ψ	λ	φ	ξ
1 PC in General	801	635	121	231	213	9	100	67	5.25	6.35	1.21	7.56	6.07	23.67	3.18	0.13	3.31	31.11
3 Saponification	14	13	1	2	2	0	27	20	13.00	0.48	0.04	0.52	40.00	n.a.	0.10	0.00	0.10	n.a.
4 Solvent Extraction	19	17	2	6	6	0	64	36	8.50	0.27	0.03	0.30	40.50	n.a.	0.17	0.00	0.17	n.a.
5 Molecular distillation	9	8	1	4	2	2	3	0	8.00	2.67	0.33	3.00	11.00	n.a.	n.a.	n.a.	n.a.	n.a.
6 Transesterification	7	6	1	8	8	0	1	1	6.00	6.00	1.00	7.00	7.00	n.a.	8.00	0.00	8.00	n.a.
7 Supercritical CO ₂	33	29	4	2	2	0	29	21	7.25	1.00	0.14	1.14	14.50	n.a.	0.10	0.00	0.10	n.a.
8 Ultrasonic-assisted	56	35	21	10	10	0	19	13	1.67	1.84	1.11	2.95	2.57	n.a.	0.77	0.00	0.77	n.a.

a PR-SD - Peer-Reviewed Scientific Document: article (new search), review, meeting abstract, editorial material, correction, letter, proceedings paper, article (data paper), article (early access), article (proceedings paper) and news item.

Source: Author's elaboration. June 29, 2024.

Funding: This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (Capes) - Finance Code 001: Process: 88887.465369/2019-00 (Capes) - Date: 01/10/2019 to 30/09/2023. In other part, this study was financed by Institutional Internationalization Program – CAPES – PrInt: Process: 88887.468908/2019-00 (Call no. 41/2017); Date: 01/02/2020 to 31/12/2020. This work was conducted during a scholarship supported by the Institutional Sandwich Doctorate Program Abroad (PDSE) at the Federal University of Bahia (UFBA), Salvador, Brazil, and University of Valladolid (UVA), Palencia, Spain.

Acknowledgment To Questel, for the kind permission to use and free training of the Orbit®. To Dr. D. Kouloukoui for technical advice. To Prof. H. Suzuki, for generously sharing information on patent prospecting. To Dr. Jesús Martín-Gil of Department of Agricultural and Forestry Engineering, University of Valladolid (UVA), for the guidelines during the Institutional Sandwich Doctorate Program Abroad (PDSE).

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