Number 3 Issue 2 June 2013

# International Biotechnology Color Journal

A Scientific Peer Reviewed Journal with Focus on BIOTECHNOLOGY
and Covering Its Many Hues, Tints, Tones & Shades

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A view of IBCJ features and performance from the perspective of publication ethics, in the era of open-access scientific communications


## Special issue:
## IBCJ, a non-profit journal with genuine academic interests

Produced and hosted by *Centro de Investigación Científica de Yucatán, A.C.*,
in collaboration with *Universidad Nacional Autónoma de México*,
and the *International Foundation for Biotechnology Research & Early Stimulation in the Culture of Health, Nutrition, Sport, Art, Science, Technology & Society*
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The International Biotechnology Color Journal appears every 4 months in the last week of February, June and October of each year, starting in October 2011. It is a non-profitable Electronic Publication. In its initial phase it does not requires neither publication nor access fees. Its goal is the publication of Original Scientific Information, previously unpublished, and provided by the contributing authors out of its own will. *Int. biotechnol. color j., ISSN 2226-0404.*



## The INTERNATIONAL BIOTECHNOLOGY COLOR JOURNAL

(IBCJ)

is the official quarterly publication of the **International Foundation for Biotechnology Research & Early Stimulation in the Culture of Health, Nutrition, Sport, Art, Science, Technology & Society A.C.** (IFBR&ESCHNSAST&S).

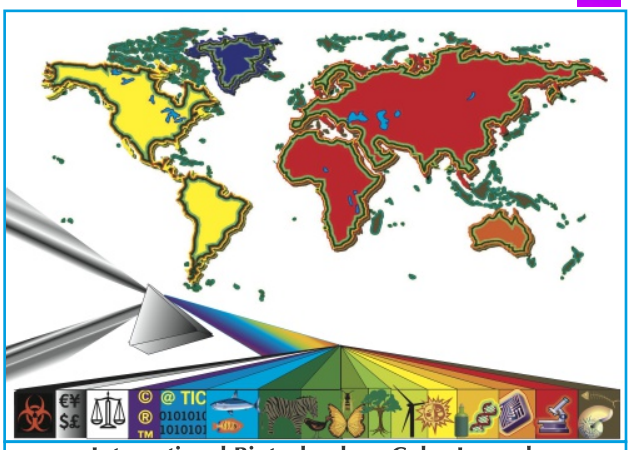
The IFBR&ESCHNSAST&S is a civil association and nonprofit organization.

Its main goal is to help bringing together efficient biotechnological solutions for many human problems, with the need for environmentally friendly and sustainable processes.

As means to such goal, the Foundation counts on education to create social awareness to biotechnology's benefits and risks, and to promote the formation of highly qualified professionals and research scientists.

The constitutive act of the foundation was signed in the Heroic City of *Huajuapan de León, Oaxaca*, on September 14th, 2009, at the *NOTARÍA PÚBLICA No. 61 de los ESTADOS UNIDOS MEXICANOS*. As .

Susana Lozano Muñiz
President of the Foundation

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Director: Rogelio Rodríguez Sotres, Faculty of Chemistry, Universidad Nacional Autónoma de México. Cd. Universitaria. Ave. Universidad 3000, C.P. 04510, Coyoacán, D.F. México. E-mail: *sotres@unam.mx*
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## Editorial section

International Biotechnology Color Journal (IBCJ) is an electronic Open Access journal, devoted to the publication of peer-reviewed articles covering all the fields of biotechnology.

ICBJ goal is to provide a forum for reviews, short notes on relevant findings, essays with new advances, relevant updates, book reviews, and letters to the editor, and scientific communications, all dealing with several aspects of Biotechnology.

Instructions for every type of contribution are presented in the journal's Homepage and a brief summary is presented at the end of this issue. The Editorial Board of IBCJ is fully committed to publish novel contributions in all areas of biotechnology. Submissions are reviewed from a rigorous optic of scientific criticism and all original contributions within the scope of the journal are welcomed.

If you are interested in participating as reviewer, please send us a letter, and a CV stressing your experience in the filed. Send this information by e-mail to "Dr. Jose Juan Zúñiga Aguilar" <zuniga@cicy.mx>

## Editorial comments to the contents of this issue

By José Juan Zúñiga-Aguilar, Chief editor.

In the present issue, a letter to the editor by Rodríguez-Sotres and Plasencia discribes the curresnt state of affairs in IBCJ as an open access publication, in the context of the open access editorial industry. This well documented work poses some important questions about the ethics of some editorials.

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International Biotechnology Color Journal
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Regular Issue, February 2013

# International Biotechnology Color Journal is a non-profit publication with genuine scientific and academic interest.

Rogelio Rodríguez-Sotres* and Javier Plasencia†.

Department of Biochemistry, Facultad de Química, Universidad Nacional Autónoma de México.

†e-mail: javierp@unam.mx

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## ABSTRACT

Recently, a novel form of editorial predatory business has emerged and proliferated, relaying on the Open Access Publishing model of operation. These so-called “editorials” display a deep contempt of scientific publication ethics, all at the purpose of juicy profit. In the present contribution, the non-profit scholar organization International Biotechnology Color Journal policies are analyzed in terms of the currently accepted code of conduct for journal publishers.

*To whom all correspondence should be addressed: Ave. Universidad 3000, Cd. Universitaria, Coyoacán 04510, Mexico City, Distrito Federal, Mexico.

Tel: (+52)5556225285. Fax: (+52)5556225329.

E-mail:sotres@unam.mx.

## Abbreviations:

IBCJ, International Biotechnology Color Journal; OAP, Open Access Publishing; NPSO, non-profit scholar organization; PE/J, predatory editorials and/or predatory journals.

## Key words

Ethics in Scientific Publishing; International Research Journals; Biotechnology Journals; Open Access Publishing model; non-profit scholar organizations.

## Introduction

At a prominent place in the building behind the advancement of science, the scientific communication should be as widespread and accessible as possible. On one hand, a scientist must try to reach every possible colleague working on its own field, or related ones, to ensure his work can eventually become part of the field's common knowledge (1). On the other hand, the cost and effort of reaching every possible colleague would become unmanageable, if there were not professional editorial organizations, who deal with production and distribution of well-structured papers, describing properly the research work performed (2). Both parts need a framework to make a fair judgment of the scientific value of reports submitted to an editorial office, the authors to make their work worth of consideration to their colleges, the editorials to gain credibility and be worth paying for this task (1).

At the current rate of daily scientific contributions (2), in addition to these issues, any editorial scientific organization should provide a framework to grant friendly access to as many potential readers as possible. The assembly of the required infrastructure, besides being an intimidating endeavor, has a financial cost (2,3), and through history, scientific editorial organizations have developed different approaches to raise funds, and it seems natural that many scientific editorials have become profitable and legitimate business companies. However, comply with the law and adherence to the professional and scientific ethical standards are constraints of a different nature. Scientific publication is fundamentally an activity based on trust, and to be trustworthy both, scientists and publishers, must regard professional ethics as top priority over other, sometimes conflicting, pressures.

Ideally, basic science is a relevant component of the mankind's commonwealth of knowledge and a parameter of a country's development, therefore, access to scientific reports should be widespread and open. Nevertheless, knowledge may be applied to the development of costly technological solutions, which are no longer considered a general mankind's asset, but are subjected to intellectual and commercial rights. The borderline is faint and a matter of ongoing debate (4). The present paper discusses the ethical dilemma emerging from the economics of the activities associated to common knowledge dissemination, specifically addressing the recent appearance of the so-called "predatory editorials" and "predatory journals" (PE/J).

## Discussion

### The printed-paper model of scientific communication.

Ethical practices in scientific communication have clearly two interdependent components: First, the group of scientists performing the research and authoring a manuscript should stick to a strict code of ethics in both aspects. While crucial, these aspects are beyond the scope of the present contribution and have been discussed extensively elsewhere (5,6,7). On the second instance, those individuals responsible for the production of the paper and who make it accessible to the scientific community should compromise between their financial health and the need to make a fair scientific review of received manuscripts, following high standards.

In the best scenario, profit becomes independent of the scientific value of the manuscripts accepted and published. Unfortunately, this scenario can only be found in editorials where profit is not an issue, as in those funded by scholar institutions with exclusive government or mixed government-private funding. Scholar institutions with enough funding to support a large editorial organization are scarce, and thus, a profound ethical conviction is essential to most other editorial organizations; as otherwise, financial needs and sometimes unmoderated ambition may obliterate ethical considerations and carry individuals or complete organizations to malpractice.

In the old model, publications were disseminated through printed matter, and in such context the production and delivery of printed issues were too costly to be covered solely by the author payments. The editorials sold subscriptions to a journal at high prices, due to the reduced number of potential readers for highly specialized scientific publications. In this old model, price limited the access to scientific knowledge, especially to scientists in non-developed countries. However, with the globalization and penetration of internet as the media for most remote communications, scientific editorials have gradually moved from printed media into electronic formats. Printed journals are still produced and sold, but most scientific journals currently offer on-line access to their subscribers, and printed science may soon disappear. Through internet, access to a scientific publication can be granted and delivered globally in a few seconds. The internet protocols and modern software tools allow personalized, simultaneous, safe and friendly control of even millions of reader's requests. Moreover, on the very same platform, subscriptions or single article copies can be sold electronically.

### The on-line open access publishing model

As a natural result, a new model was devised: electronic Open Access Publishing (OAP, 8), and probably this model was pioneered by PubMed Central (2), an extensive abstracting, cross-reference, and self-archiving system, with a 12-months delay in open-access (known as green open-access). Elsewhere, as their first distinctive feature, OAP journals are produced and

disseminated through internet, considerably reducing production and delivery costs. Their second distinctive feature is the "gold open access", which stands for the lack of cost to any reader with internet access, with no embargo periods (9). At first sight, the OAP model appears as the ideal media for the scientific communication, with inexpensive and fast worldwide access (10).

The OAP model is considerably less expensive (11) and does not require a very wealthy organization, or a large market to provide funding. But nevertheless, the interests of the funding source, and the interests of the editorial company still conflict with the need to honor scientific and professional ethics (12).

In the printed-paper model, the creation of a new scientific editorial company had many requirements, including the need to reach with efficient mail services a strong and diverse scientific community, acting as editors and reviewers. In this old model, editors and reviewers were acquainted to each other, and it was frequent to develop a lack of trust to the work coming from distant and disconnected scientific community groups. Reputation became a very valuable asset to editors, who asked reviewers to privilege rejection in case of doubt. Good journals were known for their high rate of rejection of submitted manuscripts. Additional common criticisms within this publication model were: i) the tendency to reject papers coming from developing countries without a fair revision, probably due to the lack of trust towards unknown scientists, but also to keep the journal's reputation from authors not trained in recognized orthodox academies; ii) the unfair acceptance of submissions from well-known scientists, sometimes despite of serious reviewers criticisms to their work, or even without a proper peer review; iii) paper rejection or delay of contributions exposing flaws in work previously published in the same journal by "consecrated" authors.

In the OAP model the situation has become diverse, as scholar editorials are much less expensive, require less staff, can be hosted inside a few computers, and readily reach most, if not all, potential readers worldwide, their cost can be several times lower, even for multi-journal editorials (11). In OAP, funding can come from governments, scholar institutions, philanthropic foundations, companies providing equipment, consumables and services for research, or the authors willing to communicate their results. In fact, Open-access web sites can be generated by universities, companies, or persons, and many scientists have their own blogs and pages with variable contents.

It has been suggested that OAP was driven partly by anger against the exploitation of scientists by highly profitable commercial publishers, who asked them to volunteer for review for free (12), but the cost is still considered to be the major force behind its growth (8). Even major printed journals have their electronic edition, and many of them provide the "green open access" (9), where access to articles opens, usually 12-months, after it is first published.

## The role of scientific journals in the era of electronic communications

With the upcoming of global social networks, anyone can produce a paper and publish it on-line, but science is still in need for solid journal publishers, as the organizations where contributions within a particular scope are gathered, peer reviewed, professionally formatted, distributed, and stored for long-term future consultation (12). If properly handled, these organizations become a trustworthy library of independently peer-reviewed science papers, each journal with focus on a specific field.

Therefore, even in the global-social-network era and despite its negative aspects, peer-reviewed papers hosted by journal sites are still highly regarded as essential to science communication (13). It is a framework for the search of relevant literature supporting new research, it offers a stable reference system to connect current discoveries with past research, and it is a reference system to avoid publication duplicity, scientific misconduct, or unintentional misinformation.

Publication in peer-reviewed journal is regarded as proof of the contributions made by scientists to their own research field and constitute a key element in building a curriculum to get access to promotion and tenure within research and academic institutions and to obtain grants from science-funding bodies. The journal status is constantly evaluated through several impact metrics, aimed at individual papers, journals, and multi-journal editorial organizations (14). High-impact papers and/or papers published in high impact journals are valuable assets in the scientist curriculum. These are the grounds of the well-known "publish or perish" dilemma.

Initially, the scientific editorial industry raised serious concerns on the OAP model, predicting a growth in the number of low quality publications. However, a two-year study on the matter concluded that indexed OAJ are able to approach a similar scientific impact and quality as suscription journals, as evaluated by citation averages (9). In fact, the open access feature has been found to bias readers' attention, at least in some fields as most of the publications consulted are downloaded from websites (15). The subject is still under discussion, because statistical data may be indicative, but miss the details, sometimes important details (16).

## International regulatory bodies and predatory publishers.

Because journals are of capital importance to scientific communications, scientific careers are currently judged on the number and quality of published papers, and funding agencies pressure grantees to publish their findings, the market conditions are set for unscrupulous businessmen to take advantage and assemble OAP organizations with the sole aim of profit (17). The term "predatory" has been employed to designate these organizations (PE/J), that attempt to impress naive scientists

(usually young and inexperienced) by advertising a recognized editorial staff, a solid peer-reviewing system, short review and publishing times, and high impact sites. However, many of them have no remorse in accepting almost any contributions, as long as authors cover the publishing cost that range between $300 to $3,000 USD. The peer review system is poor, and also unexperienced, as naive scientists are also recruited as reviewers, who perceive such invitation as a sign of recognition in the field. Reviewing for scientific journals or being part of their Editorial Boards might be a valuable asset in the resumé of a young scientist, as long as the journal has credibility. However, if the journal turns to be questionable, unknowingly, these researchers may be jeopardizing their professional career, and will find very difficult to get their names removed from the journal's web page. Complaints have also come from scientists whose names are included in the Editorial Boards even without their consent.

The profits can be huge, as suggested by the current size of some of these editorials (17), and from their high expansion rates (16). Hindawi Publishing Corporation one of the world's largest OAP claimed revenues of $6.3m with a net profit of $3.3m for the first semester in 2012, and a profit margin of 52%, well ahead than Elsevier that showed a 36% profit margin in 2010 (23).

These editorials are hard to prosecute because: (i) the service they offer is provided, i.e. the article review process is mimic and afterwards the paper is published; (ii) in the eyes of the law, the quality and ethical standards in scientific publication are mostly a matter of expert opinion; except for the most extreme cases, such as clear scientific fraud, article duplicity, and plagiarism, where authors may share the guilt (7); (iii) the international nature of the market brings in the jurisdiction problem, the corresponding author usually works in a country different form the one where the editorial has its legal registration. For instance, the US has The Office of Research Integrity (ORI), created in March 1981, to investigate and prosecute, when necessary, cases of scientific misconduct (18), however, this Office will not deal with scientific misconduct in other countries, unless the implications reach a third-party in the US. Even in that last case, prosecution may be prevented by international regulations of law enforcement. In developing countries, there is usually a lack of regulation on the matter, as the local scientific community is smaller, and the general population is less aware of the scientific work done in their own country.

Given the limitations of laws to cope with the problem, regulation has to come from the scientific community and the editorial industry itself. Some enthusiastic members of the community have taken personal decisive actions. Such is the case of Jeffrey Beall, an academic librarian, who hosts a web site where a regularly updated list of PJ and PE is held (17). But different organizations have been created to aid the registration and documentation of electronic journals in the OAP model. For instance the Directory of Open Access Journals (DOAJ) has registered a very rapid increase in the new OAP journals constantly appearing on the internet (9), hitting the 1 million mark entries in 2013.Moreover, the Committee on Publication Ethics (COPE), created by a group of medical researchers in the UK, in 1997 (19). COPE has published a number of ethical guidelines for Journal Editor's and Editorial officers, and those willing to follow those guidelines may become members of COPE. Unfortunately, COPE membership has a cost, which may limit the integration of non-profit organizations.

On 2001, the Open Society Institute, with headquarters in Sofia, Bulgaria, created the Budapest Open Access Initiative (BOAI). Its goal was to promote open access journals and self-archiving, both as means to promote open access to peer-reviewed literature in all academic fields (20). A similar initiative starting as a letter from some leading scientists in the US to the publishers, developed into the Public Library of Sciences (PloS), which became an editorial in 2003 (21). Both BOAI and PLoS have issued clear and comprehensive guidelines of publication ethics and have become models to other OAP organizations.

A mention is also made of the Open Access Scholarly Publishers Association (OASPA; 22), created by a group of several independent OAP editorial organizations to represent their interests. Amongst other things, OASPA has set itself to the mission of promoting gold open-access journals, providing policies to keep them viable, and setting professional and ethical standards for this activity.

## How to identify predatory journals

As part of his Scholarly Open Access blog, Jeaffrey Beall published his second edition of a list of criteria for determining predatory OAP (23). Other sources, such as Nature magazine, have a checklist as well to identify reputable publishers (24). A full reproduction of these lists neither is useful, nor would be ethical, and only a brief outline is included here:

Editorial Board and Editorial Staff. Beware of Journals where the names, academic affiliations, and contact addresses of the staff, chief editor and/or editorial board are undisclosed, cryptic or are the same for several journals, with different scopes. Where the editorial board and staff is available, check its validity and seek for name alterations, wrong affiliations or "honorary editors" (playing no role in the journal); as these may be common practices in PE/J. Try contacting one or more members of the Editorial Board, those whose names you might recognize or would the best suited to handle your manuscript.

Publishing organization's business model. Be suspicious of sites where the supporting institutions, the business plan and financial model of the Publisher are missing, incomplete or cannot be verified. Keep your work away from sites where you experience difficulties in finding publication charge policies, the location of the editorial's headquarters, or where the country of origin and the internet address do not match.

Journal's Integrity. Do not put your manuscripts on

publishers or journals where the mission is vague, or does not match the journals title. Flaws or lack of rigor in the review process, forgery of citation indexes, or referring to impact indexes from resources that do not offer indexing, are also common among PJ/E. Check the contents of recent issues to verify the congruency with the scope of the journal. Sites such as DOAJ, WorldCat and JournalSeek do not offer citation impact services, but are often listed by these editorial as indexing reference. Sites such as Jstor, PubMed, or Ebsco, offer self-archiving and database search services, but do not intend to produce professional journal impact metrics. Sites as Scopus and particularly Google Scholar are great for information searching, but their search-engines do little or none filtering, almost any OAP will appear there. In Google Scholar, impact analysis is created on the fly, and may include temporary blogs, personal sites, and other citation sources beyond scientific peer-reviewed journals. This feature may be very useful for some aims, but cannot be compared to well-curated metrics such as the classic impact indexation from established organizations.

Other frequent signs. Look with suspicion those sites where author's guidelines are copied from another known journal, where the scope is extremely broad, where the journal's title makes a bizarre or contradictory combination of subjects, or mimics a prestigious journal, where you find poorly written/proofread articles, where the site is poorly maintained, or has too much advertisement. If none of the members of the editorial board has ever published in the journal, can also be a bad sign.

### Analysis of the International Biotechnology Color Journal current state.

Creation: The International Biotechnology Color Journal (IBCJ) was created as the official scientific publication of the "International Foundation for Biotechnology Research & Early Stimulation in the Culture of Health, Nutrition, Sport, Art, Science, Technology & Society A.C. (IFB)", a nonprofit organization, with legal registration in Oaxaca, Mexico.

Editorial support: IBCJ is not published by a professional lucrative editorial enterprise. Instead, it is a completely academic venture. It is administered, edited and produced by a small group of academics from several academic and research institutions around the world, though most, from Latin America.

Web hosting: IBCJ is currently hosted by "Centro de Investigación Científica de Yucatán A.C. (CICY)", a government-supported nonprofit research institute. CICY does not hold responsibility for the IBCJ's contents, but has kindly agreed to provide IBCJ with web hosting and technical support to run the site.

Funding: Since IBCJ production depends on academics, the expenses are due to provision of legal status, www domain registration, legal costs of intellectual property rights, and ICBN registration expenses. IBCJ is funded by donations from those interested in the Journal's creation and maintenance, including of course, members of the IFB. The staff does not earn an additional income for their activities in the Journal, so no funding is required to pay salaries, and the nonprofit status of the IFB and IBCJ qualifies for TAX exemption.

As a consequence of the above, NO CHARGES ARE MADE TO EITHER AUTHORS OF READERS. Invitations to submit a contribution are made through advertising in e-mail lists, or within the journal's issues. These are general not-personalized open invitations.

The International Biotechnology Color Journal is still very young as a scientific publication, and has published but a few articles, making very difficult to judge its impact. Based on a Google Scholar search, after filtration of those citations to IBCJ articles appearing in scientific articles, the 3-year impact index is 0.5. Again, this is not a formal and well curated impact report, but indicates that the journal has not gone completely ignored.

Submission rates are low, mostly because the journal does not enjoy wide recognition by the international scientific community. Nevertheless, articles are rigorously peer-reviewed.

Currently, the Journal's production staff cannot afford having DOI numbers. Due to the small number of articles, the publication frequency and submission rates, IBCJ does not qualify for inclusion on the classic indexation databases. The Journal's staff is searching for ways to overcome these limitations without having to charge authors or readers.

Given all its peculiar features, IBCJ can be considered a new model of publication. While still many issues have to be addressed to reinforce the Journal's value, we hope to solve them and become, eventually, a robust and recognized international scientific Journal.

## Conclusion

Even when OAP may soon dominate the scientific publishing industry, the traditional publishing model is unlikely to disappear, and both models can coexist, without conflict. However, as with many new business models, ethical standards and regulatory bodies should gain strength and recognition to allow users to identify predatory practices and protect themselves from abuse.

In the particular case of IBCJ, aspects are identified where the journal has to work to gain recognition: (i) make itself eligible for indexation, (ii) obtain funds to cover DOI numbers, (iii), eliminate delays in the publication of each issue, and (iv) perhaps becoming a member of COPE and/or other organizations. On the other hand, the journal's policies, editorial board, author instructions and other information about the journal can be found inside the journal's numbers, or at visible

places in the Journal's site, with gold open-access. Furthermore, as a non-profit organization, supported by the generous work of academics, and generously hosted by the CICY at no cost, IBCJ can hardly be regarded as predatory.

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## MISSION

The **International Biotechnology Color Journal** (*IBCJ*) is the official trimonthly scientific Journal of the International Foundation for Biotechnology Research & Early Stimulation in the Culture of Health, Nutrition, Sport, Art, Science, Technology & Society A.C., a nonprofit corporation.

IBCJ is devoted to facilitating the advancement of our understanding of Biotechnology in its broader definition: The application of science and technology to living organisms, as well as parts and models thereof, to alter living and non-living materials for the production of knowledge, goods and services.

IBCJ is committed to publishing original contributions of research in all areas related to the theory and practice of biotechnology in its broadest context (organized by color), including research articles and notes, critical reviews, essays, book reviews, letters, correspondence, and news features or views.

IBCJ intends to provide an excellent resource for the publication of peer-reviewed research papers with proven or likely implications for the past, current, and future practice of biotechnology.

## AUTHOR GUIDELINES

*IBCJ* will include current trends in scientific publication for the electronic format and international requirements for indexing. All manuscript should have a corresponding author. The corresponding authors assumes full responsibility for the published data, on behave of all authors.

**Authors must transfer the copyright of their article for International Foundation for Biotechnology Research & Early Stimulation in the Culture of Health, Nutrition, Sport, Art, Science, Technology & Society A.C.**

For review, manuscripts should be submitted to the *IBCJ* Chief editor, by e-mail, at:

**"Dr. José Juan Zúñiga Aguilar" *<zuniga@cicy.mx>***

Manuscripts submitted to the *IBCJ* will be assigned to one the scientific *IBCJ* Editor, according to the section suggested by the corresponding author. The *IBCJ* Scientific editor will determine if the manuscript is within the journal scope, has high scientific quality, is presented in a manner suitable for publication in a scientific peer-reviewed journal, the content has not been published elsewhere, and if it has not been previously rejected by this journal. If the submission is considered to meet all of the above criteria, it will be forwarded to additional to referees with enough expertise in the field, for further review. Referee's names will not be disclosed, but their comments will be forwarded to the authors.

**Area colors and their scope**

| | | |
|---|---|---|
| RED | Medical Biotechnology: | *human health & disease, novel medical diagnostics and tissue engineering.* |
| YELLOW | Nutritional Biotechnology: | *Food, nutrition science and neutraceuticals.* |
| BLUE | Marine and Fresh Water Biotechnology: | *Aquaculture and fisheries; coasts and sea; fish and aquatic animals: health, nutrition, reproduction, cloning and genetic modifications, pests and disease control* |
| DARK GREEN | Agricultural Biotechnology: | *Biotechnology for the cultivation, processing, and storage of plants. Plant tissue culture and micropropagation. Biofertilizers, agrobiochemicals, and plant pests and disease control. Biotechnology in plant ecology and biodiversity;* |
| SOFT GREEN | Animal Biotechnology: | Biotechnology for the production, processing, and storage of livestock. Pets and farm-animals disease, health, nutrition, reproduction, cloning, and genetic modification. |
| LIME GREEN | Biotechnology of Renewable Resources: | *Bioremediation & environmental Biotechnology. Biofuels and renewable bioenergy sources, and bioenergy sources. Biotechnology and sustainable development, competitive production, biomaterials.* |
| BROWN | Desert Biotechnology: | *Arid zone & desert Biotechnology; space and Geomicrobiology.* |
| DARK | Bioterrorism: | *Human and animal pathogen manipulation, bioterrorism, biowarfare, biocrimes, anticrop warfare* |
| PURPLE | Patents, IPR: | *Strategy for intellectual property protection, patents, publications, inventions* |
| WHITE | Biotechnology of GMO's: | Industrial Biotechnology of Genetically Modified Organism's. *Gene-based industrial applications* |
| GOLD | Bioinformatics: | *Computer applications to the study of biological systems. Micro and nanobiotechnology, mixed biological- electronic/electromechanical systems and biomachines (MEMS and NEMS, MST and NST).* |
| GREY | Fermentations and Classical Biotechnology: | *Industrial biotechnology: classical fermentation & bioprocess/bioengineering technology; engineering and technological equipment for bioproduction; output of science-intensive bioproducts* |
| IRIS | Multidisciplinary area: | *Biochemistry, molecular biology & biotechnology, Omics applications* |
| PLATINUM | Synthetic Biology | *Design and obtention of new biological components, devices, and systems. Applications of re-designed natural biological systems.* |
| SILVER | Biobusiness, Bioentrepreneuship & Marketing: | *Development economics, Biobusiness and marketing. Strategy for innovative economical development. Improvement of the system of the S&T and innovation activities management* |
| TRANSPARENT | Biotechnology, Bioethics & Society: | *Assesment of the public support to the scientific activity. Biotechnological potential and human resources* |
| INDIGO | Integrating science, education and manufacturing: | *Education & early childhood stimulation in the culture of health, nutrition, sport, art, science, biotechnology & society as information and telecommunication technologies TIC´S* |

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