NEWSLETTER

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Editorial

This edition of the Newsletter contains reports and information about activities of EUCHIS since April 2021.

Our optimism about the possibility of holding the long-planned conference in Kazan, after COVID-19 was less threatening, has been dashed by the terrible developments in Ukraine. We are sorry for our Russian colleagues who already spent a lot of energy and enthusiasm on preparing our conference. More than anything, of course, our sympathy is with our colleagues in Ukraine, but also in Russia: Science and culture know no borders.

Thus, the 14th EUCHIS conference, envisaged to take place in Fall 2022 or Spring 2023, had finally to be cancelled. Instead, it is now scheduled as 14th EUCHIS / 1st IFCCSC to be held in Iceland in Fall 2023. Detailed information shall be distributed, soon. We are very much looking forward to finally meet again, exchange ideas, plan collaborations. And, of course, also to our next General Assembly where we can finally elect new members or re-elect current members of our Board which has been on duty for much longer than originally anticipated.

The financial report 2021 and information about development of membership numbers are enclosed in the minutes of the annual Board Meeting which took place online in March 2022. Finances remain healthy, even though several members did not pay the annual fee in 2021. Up to date, no nomination for the Braconnot Prize and no applications for travel grants or student bursaries were received. Membership counts were 62 in April 2021, 65 in March 2022, and stand now at 68.

It seems that the publication activity of our members increased within the long period of home-office work. The bibliography counts two book chapters, 28 reviews, 211 research papers, and 14 patents, as cited in ScinceFinder® and selected for the period May 2021 – June 2022.

Finally, tables of contents are cited from four books which came to the attention of the Secretary. These are about biomaterials, drug delivery, and chito-oligosaccharides. Maybe, some of these are of interest for our readers.

This issue of the Newsletter also contains a short survey on quality-related issues in papers dealing with chitin or chitosans in general, and with their bioactivities in particular. This is very much an opinion paper co-authored by the current EUCHIS president, aimed to initiate a discussion on this important aspect which we believe to be crucial for the further development of chitin and chitosan related research and applications. Defining quality criteria might become one of the most important tasks of the International Federation of Chitin and Chitosan Societies, IFCCS, which we hope to see founded next year.

With best wishes,

Bruno Moerschbacher, President
Martin Peter, Secretary
Münster and Bonn, July 21, 2022

News and Notes

Events

13th Asia-Pacific Chitin & Chitosan Symposium (APCCS) and 32nd Annual Meeting of Korean Society for Chitin & Chitosan, Jeju Island, Republic of Korea, November 29 – December 2, 2022. Email lej120900@naver.com, Website www.apccs2022.org.

Workshop – Polysaccharides in drug delivery – on the road to innovation; Rome; Italy, Sapienza University, October 27 – 28, 2022 (www.epnoe.eu/workshop-rome-drug-delivery-2022-home/)

5th EPNOE International Junior Scientist Meeting, 8-9 September, 2022, Aveiro (Portugal) (www.epnoe.eu/juniorscientistmeetinghome/)

21st European Carbohydrate Symposium, Paris, France, July 9 – 13, 2023 (www.eurocarb2021.com)

8th EPNOE International Polysaccharides Conference, 18-22 September 2023, Graz, Austria (www.epnoe.eu/events/#UpcomingEvents)

European Polysaccharide Network of Excellence (EPNOE)

EPNOE is a non-profit Association promoting research, education, and knowledge-transfer between academia, industry, and civil society, in all fields related to polysaccharides science and technology (cited from www.epnoe.eu). A wealth of information, including a series of webinars, is accessible through EPNOE's website. EPNOE publishes very informative, open access Newsletters (www.epnoe.eu/subscribe-to-epnoe-publication-newsletter/). Subscription is available at no cost.

EPNOE and EUCHIS declared mutual interest to establish a connection between both associations. This will be of great interest, especially as it seems that Chitin / Chitosan are somewhat underrepresented in the EPNOE network. We are looking forward to defining the terms and conditions of a connection between EPNOE and EUCHIS, soon.

Webinars

Unfortunately, the very successful series of EUCHIS webinars are discontinued. There have been no volunteers to continue the series, after Gregor Tegl relinquished the coordination and supervision due to current time restrictions.

International Journal of Molecular Sciences (IJMS; www.mdpi.com/journal/ijms)

The Impact Factor stands now at 6.208 (2021).

IJMS is recruiting Editorial Board Members/Topic Editors/Guest Editors/Reviewers. If you or you know someone who might be interested in these positions and for more information, please feel free to contact IJMS.

Excerpt from a letter from IJMS, Feb. 14, 2022:

> *"We would be interested in having a collaboration on webinars (you could find an example by clicking on the following link: https://ijms-2.sciforum.net/). We will have a website for each webinar and can even create a series of EUCHIS-IJMS webinars, if interested.*
>
> *IJMS proposes to set up a Topical Collection for EUCHIS, in order to list papers submitted by their members, if interested. We will only publish papers by members in this Topical Collection and without a deadline for submissions. We believe that this is a good way to display the papers published by EUCHIS' members in IJMS. In this case, we would be happy if someone from the EUCHIS board will serve as the Academic Editor(s) of the Topical Collection. The Academic Editor(s) will also have the benefit of publishing one paper free of charge each year. However, they should be responsible for encouraging members to submit papers to the Topical Collection. Besides, every ten papers published in the Topical Collection, we will gladly make an ebook, and each Academic Editor will also receive a free hard copy. Contact: With all this information, may we kindly ask if this proposal would be interesting also for you?"*

Contact: Juan Martinez, Publishing Manager, MDPI Barcelona, E-mail: juan.martinez@mdpi.com

Minutes of the
European Chitin Society
Meeting of the Board

(Statutes, Item 17)

Date and Time: Friday, March 11, 2022, 10:00 – 11:55 a.m. (CET)
Location: Online via Zoom:

Participating: B. Moerschbacher, S. Bratskaya, I. Aranaz, M. Peter, K. Richter, L. David, M. Fenice, O. Goñi, M. Másson, Y. Skorik, M. Struszczyk

Agenda

1. Opening (B. Moerschbacher)
2. Ascertaining of quorum
3. Chair of the meeting
4. Keeping of minutes
5. Report of the President
6. Report of the Secretary, membership figures (M. Peter) (**Appendix 1**)
7. Financial report (K. Richter) (**Appendix 2**)
8. Braconnot Prize (**Appendix 3**)
9. Nomination of new Board members
10. Chitin/Chitosan conferences (B. Moerschbacher)
11. General Assembly: Agenda and Date
12. MDPI Award: Best PhD Thesis
13. Any other business

Topic 1

The meeting and the agenda were announced by e-mail on Febraury 9, 2022. No comments were received on the agenda, so it was approved.

The President, Professor Bruno Moerschbacher, opened the meeting and briefly commented on the main issues to be discussed.

Topic 2

Eleven of 16 Board members attended the meeting, forming a quorum.

Topic 3

The meeting is chaired by the President, B. Moerschbacher.

Topic 4

Minutes shall be kept by the Secretary, M. Peter

Topic 5

The President welcomes Professor Már Másson from Iceland as a new Board member and expressed his thanks for accepting the nomination.

A major issue of activities was the planning of the next EUCHIS conference and setting up a schedule to minimize overlapping of regional and international meetings (see Topic 10).

The series of EUCHIS Webinars was very successful. About 30 – 60 participants followed the presentations and discussions. As Gregor Tegl could not continue to host this series, volunteers are needed urgently for organizing a new series of seminars.

Topic 6 (Appendix 1)

EUCHIS counts 65 Members on January 31, 2022. A question was raised concerning the status "associate" member. According to Item 7 of the Statutes, this is determined by the Nationality and not by the country of residence.

Activities of the Secretary included writing of the minutes of the Board meeting, February 2021, and the General Assembly, March 2021, both published in Newsletter #48, administration of the members database, correspondence with the web administrator and with new members, writing of invoices for annual membership subscriptions as well as receipts for payments, and the preparation of Video meetings with the President and the Board. The bibliography of members was extracted from Internet databases.

Newsletters were published in January (#47) and April (#48), 2021. The next Newsletter is scheduled to appear in April 2022.

Topic 7 (Appendix 2)

In 2021, income in the amount of 1,949.03 € was exclusively from member subscriptions. Expenses (795.06 €) occurred for bank charges and internet administration. The balance per December 31, 2021, was 13,498.57 €. No expenses occurred in 2021 for conferences, travel grants, and bursaries. No applications were received for the Braconnot Prize.

Topic 8 (Appendix 3)

It was decided that applications for the Braconnot prize could be submitted any time. In the case that several candidates would be nominated, the prize could be awarded to two recipients who shall be invited to present a Braconnot Lecture during the next conference.

Topic 9

Nomination of Professor Már Másson (Iceland) to replace Professor Angeles Heras (Spain) was approved by the Board through e-mail voting on February 24 and 25, 2022 [12 yes, 0 no, 3 abstentions (i.e. no reply)]. Professor Másson shall remain in office until confirmation by the next General Assembly.

The current set of the Board was discussed under the rules of the Statutes, Items 12 – 15. As a new Board shall be elected in the next General Assembly, current Board members shall declare whether they would continue or rather prefer to leave the Board. With reference to this, the President will contact the Board members in due course. Nominations of new Board members are welcome.

Topic 10

The President summarized the situation concerning Regional (EUCHIS, APCCS, SIAQ) and International (IFCCS) conferences. In view of the ongoing pandemic and the current political and military situation in Eastern Europe, organization of a conference in Russia is presently not possible. It is envisaged now to have the next EUCHIS meeting in 2023. A conference calendar with a harmonized schedule of alternating regional and international meetings is presently discussed between the President of EUCHIS and Professor Hiroshi Tamura (Kansai, Osaka), coordinator of International Conferences in Japan, and Professor Waldo Argüelles, President of SIAQ. A final conference plan will be established, soon.

Topic 11

As the last General Assembly convened (online) in 2021, the next one is planned to take place as a physical meeting during the EUCHIS conference in 2023.

Topic 12

The secretary informs briefly about the "Best PhD Award", sponsored by MDPI-*Marine Drugs*.

Other issues were about MDPI-*IJMS*, the IF of which raised to 5.924 in 2020. A connection was established between the European Polysaccharides Network of Excellence (EPNOE). EPNOE shall be informed about events, including conferences, webinars, and receive copies of EUCHIS Newsletters. EPNOE offers Newsletters free of charge (Subscribe to EPNOE Publication Newsletter – EPNOE Website).

Topic 11

No other items were raised. The President thanks all participants and closes the meeting at 11:55

Münster / Bonn

March 17, 2022
B.M. Moerschbacher, President
M.G. Peter, Secretary

Appendix 1: Membership numbers 2021

Members per 2022-01-31

	Donor	Collective	Active	Associate	Student	Total
2021-01-26	**7**	**5**	**37**	**5**	**8**	**62**
Exits in 2021		**-1**	**-1**		**-3**	**-5**
Admissions in 2021 and 2022			**+1**	**+4**	**+3**	**+8**
2022-01-31	**7**	**4**	**37**	**9**	**8**	**65**

Members per Country (2022-01-31)

Country	Number
Austria	**1**
Belgium	**2**
Canada	**1**
France	**6**
Germany	**15**
Greece	**1**
Hungary	**1**
Iceland	**2**
India	**3**
Ireland	**2**
Italy	**5**
Netherlands	**1**

Country	Number
Norway	**3**
Poland	**3**
Portugal	**1**
Russia	**5**
Spain	**6**
Sweden	**1**
Turkey	**1**
U.A.E.	**1**
U.K.	**3**
U.S.A.	**1**
Total	**65**

Appendix 2: Financial Report 2021

Balance per 01.01.2021				**12.344,60 €**
Income	Members Subscriptions	1.949,03 €		
Total Income			**1.949,03 €**	
Expenses				
	Internet Expenses	-620,00 €		
	Bank Charges	-175,06 €		
Total Expenses			**-795,06 €**	
Income ./. Expenses				**1.153,97 €**
Balance per 31.12.2021				**13.498,57 €**

Appendix 3: Braconnot Prize

The deadline for nominations was extended to September 30, 2021. No nominations were made. A new deadline shall be set, and it is proposed that, in the case that several applications are submitted, the prize can be awarded to two laureates. A jury must be determined in due course.

Towards Quality Criteria for Publications dealing with Chitins or Chitosans - a Task for the International Federation of Chitin and Chitosan Societies?

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Abstract

During the 14th International Chitin and Chitosan Conference, ICCC 2018, in Osaka, Japan, representatives of many National and Regional Chitin and Chitosan Societies met to discuss the foundation of an International Federation of Chitin and Chitosan Societies (IFCCS), in an attempt to join forces of these societies on a global scale. Besides harmonizing the scheduling of international chitin and chitosan related conferences – ICCC, APCCS, EUCHIS, SIAQ – one of the most important tasks of IFCCS could be to define and suggest, and to regularly update, quality rules to be followed by authors, reviewers, and editors of publications reporting on research done with chitins or chitosans. We here report a short survey of papers dealing with bioactivities of chitosans, evaluating the quality of the data given concerning the chitosan or chitosans used. The results clearly highlight the need for an initiative to raise awareness on how strongly the quality of chitosan-related studies depend on the use of structurally well-characterized chitosan(s).

Introduction

We are all aware of the immense deluge of chitin/chitosan-related research papers and reviews that is overwhelming us. In 2021 alone, more than 5,000 papers had the word 'chitosan' and ca. 450 the word 'chitin' in their title (Web of Science) of which ca. 280 and 40, respectively, were reviews. This is enormous, and the magnitude becomes even more stunning when comparing the numbers to other polysaccharides such as 'cellulose' (ca. 5,000 papers / ca. 240 reviews), 'alginate' (ca. 1,800 / 60), or 'pectin' (700/30). According to internet sources, the global market for cellulose exceeded 200 billion dollars in 2018, while that for chitin is estimated at a mere 40 million (i.e., 0.04 billion!) dollars (pectins and alginates are supposed to be around 1 and 0.7 billion dollars, respectively). Admittedly, these numbers are extremely unreliable (you can also find a completely unrealistic 40 billion dollars for chitin). But it shows the unproportionally high interest in chitin and chitosans.

Of course, we like to take it as a sign indicating the prominent relevance of our pet functional biopolymer. But it also makes us groan when thinking of all the time required to at least superficially scan these publications, only all too often to find that they are not worth the time spent on them nor the energy used to display them on our screen. More than thirty years after the landmark paper from Kauss *et al.* (1989) establishing the crucial role of the degree of polymerization DP and the fraction of acetylation F_A of partially acetylated chitosan polymers in determining their functionalities and properties, more than twenty years after that of Vander *et al.* (1998) who corroborated and extended this observation to include chitosan oligomers, more than 15 years after the chitosan matrix (El Gueddari and Moerschbacher 2004) and the general law of behavior of chitosans in aqueous solutions (Lamarque *et al.* 2005) have been published to summarize the influence of DP and F_A on biological activities and physico-chemical properties of chitosans (plural!), respectively – the majority of authors still simply state that they worked with "chitosan" (singular!). No mention of the commercial or biological source; and in the rare cases where this is given, the production route is rarely mentioned. No mention of DP or F_A, nor of their dispersities $Đ_{DP}$ and $Đ_{FA}$ or of the pattern of acetylation PA; and in the rare cases where at least any of these values is given, the methods used to determine them are rarely mentioned. Admittedly, when we look at our own papers,

we sometimes have to include ourselves in this scolding. Though this has been our field of expertise for twenty years, we all too often failed to give all structural information in perfect detail. And then again, there are excellent papers also, from all around the world! Unfortunately, though, these are exceptions rather than the rule.

However, worse, this all too often poor quality even extends to reviews on chitosans, their properties and functionalities, and their potential applications. You would think that it is one of the most relevant roles of a review to distinguish high from poor quality in the original research papers included and cited, to point the finger towards this blatant failure to report the basic characteristics of the chitosan used which leads to non-reproducibility and makes independent verification impossible, to disregard such papers when trying to draw general conclusions across the spectrum of research described. But that is rarely the case. Most of the times, the reviews do nothing but summarizing a more or less random, individually biased selection of original papers and previous reviews already stating more or less the same, disregarding any quality control. And again, our own reviews of the past do not always stand this critical test of time, when looking at them today. As an example, of course, it is evident that the above cited four papers are a personally biased selection; others will consider other papers as landmarks. And also again: there are excellent reviews also, from all around the world. Not all is lost. Like with chitosans themselves, there are the Good, the Bad, and the Ugly (Bellich *et al.* 2016) of chitosan-related publications as well.

But there is a lot of the Bad, and too much of the Ugly. So perhaps, some rules should be established by the chitin and chitosan scientific community, should be adopted by national and regional chitin and chitosan societies, should be suggested to the most important journals in which chitin- and chitosan-related research is being published and reviewed – to see more of the Good in future. And of course, such rules would have to be updated regularly. When it was perhaps okay to talk and write about 'chitosan' twenty years ago without mentioning its DP and F_A, it is not okay anymore. And when it is perhaps okay today to talk and write about chitosans without mentioning their $Đ_{DP}$ and PA, it may not be okay anymore in ten years' time. This could become one of the most important tasks of an International Federation of Chitin and Chitosan Societies, the foundation of which was discussed by representatives of many National and Regional Chitin and Chitosan Societies during the 14th International Chitin and Chitosan Conference, ICCC 2018, in Osaka, Japan. These discussions have come to a transient halt during the pandemics which is causing a severe interruption in international conferences, but the task remains.

As a starting point, the corresponding author (BMM) asked three of his undergraduate students (CP, LM, JS), in preparation of their Bachelor theses, to analyze this situation, to think about it thoroughly and with fresh minds, and to make suggestions on quality criteria that should be followed when publishing about chitosans. They were supported throughout by two post-doctoral researchers (CR, PL), and the results were finally summarized by one recent doctoral graduate (EKR). Thus, the following analyses and suggestions are the result of a group effort, but involving members of a single group only. As a consequence, they are inevitably biased by our own narrow scientific interests, experiences, and expertise. We are well aware that this cannot yet be regarded as anything near final. It can only be the start of a work in progress towards something like a Standard Operating Procedure for chitin- and chitosan-related research papers and reviews. What we hope for is to get the stone rolling, to spark a discussion. Please do contribute your opinions by writing to the corresponding author (moersch@uni-muenster.de)!

Materials and Methods

To analyze the quality of publications dealing with the bioactivity of chitosans, we firstly agreed on 13 quality criteria we want to analyze. These criteria were divided into 'general criteria' that apply to all scientific publications on the one hand, and 'specific chitosan criteria' on the other hand. Furthermore, the specific chitosan criteria were separated into 'essential' and 'desirable' information. For evaluation, we defined a scoring system, in which every criterion can score 0, 1, or 2 points. This allowed us to rank publications which are not at all meeting the specific criterion (0 points), partly meeting it (1 point), or fulfilling it (2 points). Moreover, the scores of the essential, but not those of the desirable criteria were then multiplied by three, before the scores were added to yield a final General Score and a final Chitosan Score. For a personally unbiased selection of chitosan publications, we randomly selected the original articles from four reviews dealing with the bioactivity of chitosans. (Of course, one should hope that the authors of the reviews had already selected what they considered 'good' papers, so that the selection would not be a truly random one but should deviate towards higher scores compared to all chitosan-related papers.) From these, every fifth citation in the reference list was chosen; if a reference did not deal with chitosan (or a review was cited), the following paper was used for the evaluation. If the four following papers were all reviews or did not deal with chitosan, the cited paper preceding the originally selected reference was scored. In total, 61 papers were selected in this way, scored, and final scores were calculated. Just out of curiosity, these final scores were evaluated against the year of publication and against the impact factor (Clarivate) of the journal for the corresponding year, to analyze possible correlations.

Results and Discussion

To analyze the validity of original publications on bioactivities of chitosans, we defined a scoring system which comprises 13 different quality criteria (see Table 1). Of these, the first five criteria are not specific for papers dealing with chitosan, but they represent general quality essentials for any scientific publication: The first general criterion is the use of **appropriate statistical tests** of the results, to distinguish between significant and coincidental results (though being well aware that statistical significance does not automatically imply biological relevance!). Second, equally important is the use of **appropriate controls**. Often, multiple negative and/or positive controls are required to judge significance and relevance. For example, in an article investigating the influence of the nano-formulation of a carrier (could be a chitosan) to efficiently deliver a drug, there should be a negative control with the nano-formulated carrier without the drug, and one with the drug but without the nano-formulated carrier, ideally also one with the drug and the unformulated carrier, perhaps also a positive control with a standard carrier for the drug investigated, or with a standard drug for the carrier investigated, etc. Third, an **appropriate experimental design** is crucial, which comprises enough technical and enough independent biological replicates. Often, randomization of the replicates, *e.g.* in the field or in the microtiter plate, should be part of an appropriate experimental design. Forth, there need to be a fair and comprehensive **comparison of results with the literature**. Given the tremendous and apparently limitless amount of literature published, this criterion is equally difficult as it is important. Ideally, an author should know and critically understand all pertinent literature that was published previously – though that's not a challenge, it's impossible. So what we wanted to see was at least an attempt to discuss the results obtained in the light of literature, perhaps even to discuss how the state-of-the-art has changed by the results described. Fifth, and arguably most difficult, we believe that a paper should not only be purely descriptive (done this, seen that), but experiments should be designed and performed (or at least suggested) that can **explain the mechanisms** behind the effects observed. As a minimum, we wanted to see a hypothesis.

Beyond these general quality criteria which are essential for any scientific paper, we defined five essential and three desirable criteria that are specifically relevant for chitosan-related papers. Here, we focused on papers dealing with bioactivities of chitosans (because this is our own field of expertise, and the reviews we chose for selecting the original papers to be scored dealt with this topic). The first essential criterion, as described above, is that the chitosan used is described regarding its **DP and F_A** (where the degree of polymerization may be replaced by the molecular weight, and the fraction of acetylation by the degree of acetylation or the degree of deacetylation). To increase reproducibility, the **manufacturer** or producer of the chitosan applied (whether a commercial company or a colleague) needs to be mentioned, unless the chitosan was produced in-house in which case this needs to be described. Realizing the problems many authors would face in determining these structural parameters of the chitosans they use, details of the material used (such as catalogue and batch number) may to an extent replace this information (though it would be better to purchase the chitosan from a manufacturer giving these parameters). It should go without saying that the applied **concentrations** of chitosan (and other substances) in the bioactivity tests needs to be given and in fact, this information was rarely missing (we still kept it as a criterion so that even the poorest papers stood a chance of scoring at least this point with its triple weight). Equally, the **application method** of chitosan in a bioassay is important; it needs of course to be mentioned, e.g., whether a plant was sprayed or watered with a chitosan solution, or a mouse was injected or fed with it. You would be surprised how often this information was missing (not too often, but then again: too often).

Table 1: Quality criteria for publications dealing with chitosans. *Five general criteria and eight chitosan-related criteria were defined, and classified as either 'essential' or 'desirable'. For each criterion, 0, 1, or 2 points can be scored; scores of essential, but not of desirable criteria were weighted three times when calculating the final scores.*

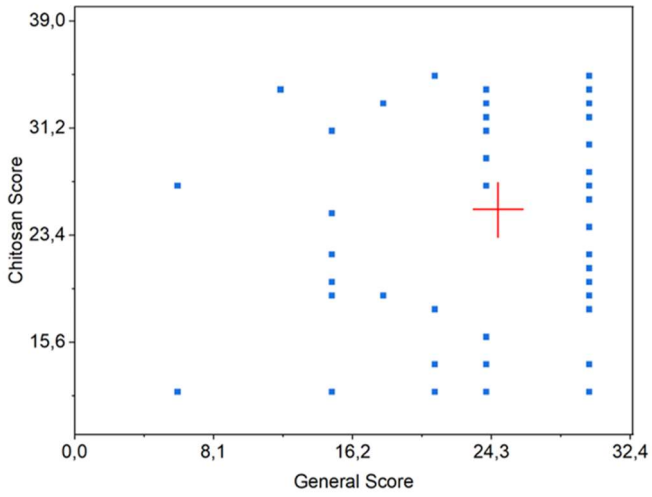
General Criteria (essential) × 3	Chitosan Criteria (essential) × 3	Chitosan Criteria (desirable) × 1
appropriate statistics	DP or MW	analytical method used for DP, *Đ*, and F_A determination
appropriate controls	F_A (DA or DDA)	
experimental design	manufacturer	preparation method and biological source
literature comparison	concentrations	range of preliminary experiments mentioned (e.g. concentrations and application methods tested)
elucidation of mechanism	application method	
maximum score 30	**maximum score 30**	**maximum score 6**

Besides these five essential quality criteria for chitosan-related papers, we defined three additional, desirable ones. This firstly includes information on the **methods used for DP and F_A determination**, as these can deeply influence the relevance of the structural data. As an example, if DP is determined using viscosimetry, an average value is obtained, while size exclusion chromatography can also inform about the dispersity of the sample. Conclusions concerning the influence of DP/MW on e.g. bioactivities can be strongly misleading if based on viscosimetry and, thus, mean values. We are convinced that the discrepancies in many results described, e.g. for the antimicrobial activities of chitosan oligomers, is caused by ignoring this factor. As a consequence, the full score was only given if the **dispersity *Đ*** was indicated. Another potentially important and, therefore, desirable information is the **preparation method** used in preparing the chitosan, because possible contaminants from the

process could unintentionally affect e.g. the bioactivity of the sample, and because the method used will most likely influence the structure of the chitosan obtained, e.g. concerning its pattern of acetylation PA or its dispersity in the fraction of acetylation $Đ_{FA}$. For similar reasons, the **biological source** of the chitosan used is a desirable information, as non-chitinous contaminants will differ between sources (and the purity of the chitosan used is almost never mentioned, certainly because it is not at all easy to determine). Our final desirable criterion concerned information regarding the range of e.g. concentrations or application methods or the like tested in **preliminary experiments** performed to determine the optimum parameter eventually used for the experiments.

We applied this scoring system to 61 original publications selected randomly from four review articles concerned with chitosan bioactivities. The maximum General Score reachable with this system is 30, the maximum Chitosan Score 36. On average, the papers reached a General Score of a good 24.8 (80%), with a spectrum reaching from a poor 6 (20%) to an excellent 30 (100%). The average Chitosan Score was an acceptable 24.5 (70%), with a range from a very mediocre 12 (30%) to an excellent 35 (100%). That is not too bad (we had feared worse). It tends to indicate that the authors of the review articles did indeed do a rather good job in selecting rather good papers. It would be interesting to see the result if we chose 60 papers truly by random, but we haven't done this yet.

We then checked possible correlations between General Score and Chitosan Score (Fig. 1). We had expected a positive correlation between the two Scores, assuming that authors who followed in general good scientific practice in publishing would do so also in relation to the information they give concerning the chitosan used. However, the scatter plot showed no correlation at all between these two Scores. We assume this to indicate that many authors are not aware of what is important in working with chitosans: had they known, the Chitosan Score of their papers had been as high as the General Score. The sad side of this story is that one must assume that these authors were also not aware of these aspects when choosing the chitosan for their research. Clearly, the chitosan community, and above all the chitin and



chitosan societies, have a job to do!

Fig. 1: Scatter Plot showing relations between Chitosan Score and General Score of 61 original papers cited in four review articles concerned with chitosan bioactivities. The red cross shows the average values of the two scores.

We then checked for possible correlations between either of the two Scores and the Year of Publication or the Impact Factor of the journal in which it was published (Fig. 2). Regarding a

possible correlation between Chitosan Score and Year of Publication, we had assumed that this score should increase over time – unlike the General Score which we expected to remain constant. The time scale covered by the articles scored ranged from 1985 to 2018. Structure-function relationships of chitosans have been investigated in depth over the past twenty years, so we expected that the older papers would score poorly. However, overall, there was no such correlation. Interestingly, when looking at the rather few (8) older papers included (1980-2000), most of them had a rather high General Score (around 25), while their Chitosan Score started low (15) but almost doubled over this time. Of course, these are not enough papers for a valid conclusion. But it might indicate that only good papers stand the test of time so that they are still cited after twenty years. Possibly, our scoring system is not detailed enough to visualize trends over the past two decades (2000-2020), but the wide spread of scores reached over this time tends to indicate again that the chitin and chitosan societies need to educate authors on what is important when working with chitosans.

Of course, one would hope to find a positive correlation between both Scores and the Impact Factor of the journal in which the papers were published, as high impact journals would be expected to be more critical and concerned about quality. When looking at the General Score, we observe a clear correlation between the minimum General Score and the Impact Factor, meaning that 'good' journals do not publish poor papers. (Concluding from this plot that low impact journals can publish excellent papers would not be correct – though we do not contradict this statement – because achieving a high General Score is not enough to indicate a good paper!) Again, this correlation is not seen when looking at the Chitosan Score. Both low and high impact journals have published papers with low and high Chitosan Scores, again indicating that even reviewers and editors of high impact journals seem not to be sufficiently informed concerning quality criteria in chitosans.

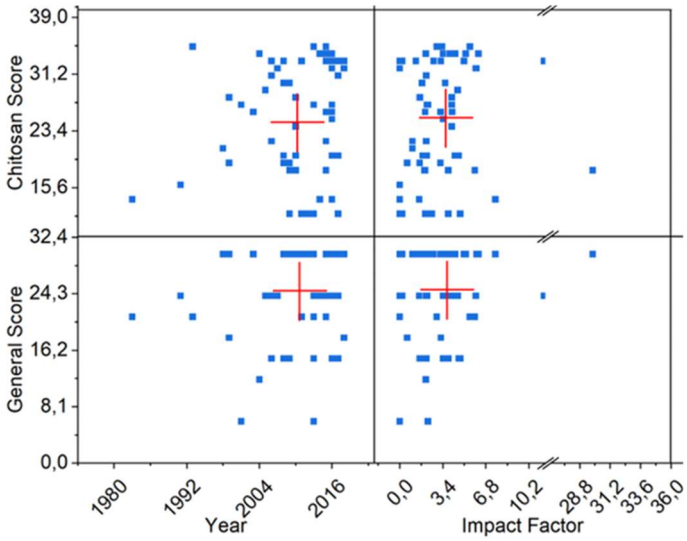


Fig. 2: Scatter Plots showing relations between General Score or Chitosan Score of 61 original papers cited in four review articles concerned with chitosan bioactivities, and the Year of Publication of the paper or the Impact Factor of the journal in which the paper was published. The red crosses show the average values of the factors involved.

Finally, a comparison of Impact Factor versus Year of Publication tends to indicate that chitosans are slowly finding their way into higher impact journals (Fig. 3). This would certainly be a positive development, and one that we should not endanger by submitting poor quality papers, but rather try to support by defining stringent quality criteria, and then also honoring them.

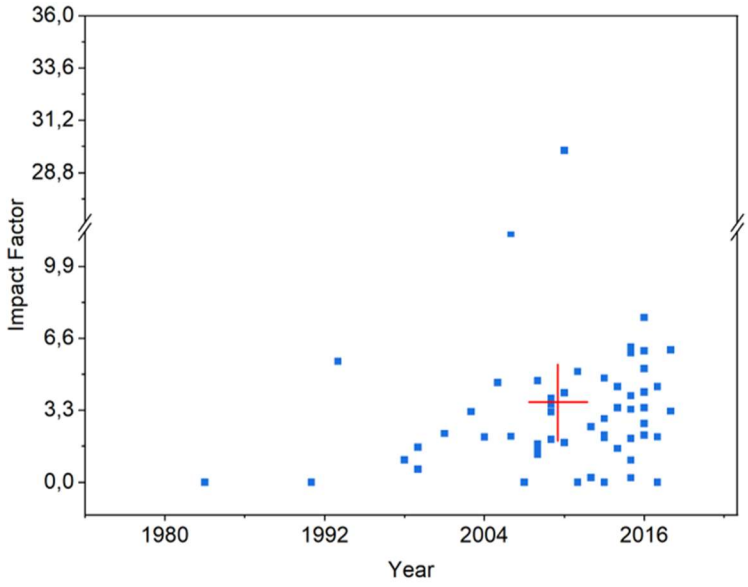


Fig. 2: Scatter Plot showing relations between the Impact Factor of journals in which 61 original papers cited in four review articles concerned with chitosan bioactivities were published, and the Year of Publication. The red cross shows the average values of the factors involved.

Conclusions

When we look at the grades the paper scored, all is not lost. But all is not good, either. Probably the most tell-tale result is the missing correlation between General Score and Chitosan Score, clearly pointing towards the need to educate researchers using chitosan about the need to use well-defined chitosans in their research. To harmonize suggestions between different chitin and chitosan societies should become a crucial task of the planned International Federation of Chitin and Chitosan Societies, IFCCS.

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