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Ultrasonics Sonochemistry in Latin America

It is a pleasure to introduce this Special Issue devoted to Ultrasonics Sonochemistry in Latin America. Considering that the number and quality of publications in the sonochemistry field in Latin America is still growing, as well as the relatively high number of submissions and papers published in the Ultrasonics Sonochemistry journal from Latin American researchers, this Special Issue presents a general view of very recent works in sonochemistry that should be on broad interest.

Brazil is the leading country in the ultrasonics sonochemistry field with the highest number of publications between Latin American countries. Brazil is among the top five countries when considering the manuscripts published in Ultrasonics Sonochemistry in the last five years.

In this Special Issue, eighteen papers have been published involving experimental research, reviews and theoretical aspects in many relevant topics. These papers were written by some of the best researchers working at Latin American universities and research institutes. They are related to special developments and applications and it is expected that this Special Issue will contribute to increase the developments in these fields.

As expected, most of the papers were submitted or had the participation of Brazilian researchers (12 papers, ~67%) followed by Mexican and Colombian researchers (4 papers, ~22%) and one paper from Argentina and Peru. An important aspect is the relatively high number of papers with international cooperation. About 28% of the accepted papers of this Special Issue were produced with collaboration of Latin American researchers with researchers from India and Australia (2 papers), USA (1 paper), Peru (1 paper), and one involving researchers of Brazil, Azerbaijan, Iran and Spain.

In this issue, Hakke et al. [1] described an interesting strategy for the ultrasound-assisted synthesis of starch nanoparticles used as nanofillers to increase the barrier properties of polyurethane films. This synthesized material, obtained by acid hydrolysis, presented important properties related to the mechanical and thermal properties and could be obtained using a pulsed mode ultrasound at low frequency. The microbial barrier of the produced film was increased by 99.9% with the barrier properties being improved with the increase of the starch nanoparticles content in the polymeric film.

The improvement of Jamun fruit dairy dessert processing by thermosonication (20 kHz) was reported by Lino et al. [2]. Ultrasound power was evaluated and the quality parameters of this dessert was improved when compared to the conventional heating process. With this thermosonication process, a better microbial inactivation and higher microbial stability during storage were observed. In addition, the content of monounsaturated and polyunsaturated fatty acids was increased. This process demonstrated the good expectations for new applications for other food matrices.

Two interesting reviews were published reporting the recent studies related to the sonoluminescence phenomenon and the recent works developed in the South region of South America by Saadah et al. [3] and Fiego et al. [4], respectively. In the first review, the reported studies in the past three decades involving the correlation between cavitation bubble temperature, sonoluminescence and interfacial chemistry were discussed [3], aiming to help for a better understanding of acoustic cavitation processes. In the second review, many of the most relevant contributions of ultrasound in organic and inorganic synthesis as well as in analytical methods published in the past ten years by researchers from the South Cone region were reviewed by Fiego et al. [4]. It was demonstrated that ultrasound can offer many advantages related to the reduction of reaction time, reproducibility, and also contribute to the development of greener approaches. It is expected that this review can motivate more research and collaborative works using ultrasound, especially in Latin America.

Another study, published by Rossi et al. [5], showed the advantages of using ultrasound (37 kHz) combined with chlorine dioxide for the *Salmonella* Typhimurium and *Escherichia coli* inactivation in poultry processing chiller tank water. It demonstrated an inactivation of 49% and 31% for *Salmonella Typhimurium* and *Escherichia coli*, respectively. An important comparison was performed when ultrasound replaced a stirring system where practically no inactivation for both microorganisms was observed.

Looking for the sonochemical degradation (375 kHz) of halogenated pharmaceuticals (cloxacillin, diclofenac, and losartan) in urine matrices, Serna-Galvis et al. [6] were able to evaluate the selectivity of the sonochemical system to degrade the target pharmaceuticals. By using a simulated matrix, over 43% of the target compounds were removed from solution. With the proposed system, the antimicrobial activity was decreased close to 100% after 75 min sonication in the synthetic urine, and about 20% was diminished after 90 min of treatment in the real matrix.

In the same way, Sierra et al. [7] proposed a method for antibiotics removal from aqueous solution using a low frequency (40 kHz) ultrasonic system. Cephalexin and doxycycline, two of the most used antibiotics to treat bacterial infections, were treated with the proposed system. The authors have evaluated the effects of operational parameters such as the pH of solution and the US power using response surface methodology and a face centered, central composite experimental design. Results showed a reduction of the organic carbon present in the solutions and a significant increase of ions (nitrates and sulfates) concentration, suggesting that part of the organic matter was transformed into CO_2, H_2O and inorganic species.

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Horninck et al. [8], proposed an ultrasound-mediated radical cascade reaction synthesis of functionalized indolines based on the use of acrylates and formamides as building blocks. A sono-Fenton process (20 kHz) was chosen to generate hydroxyl radicals and consequently, carbamoyl radicals, which in the presence of the proper radical acceptor can yield the functionalized indolines. Interestingly, when the reaction was performed without ultrasonic, under magnetic stirring (1500 rpm), no indoline formation was observed. On the other hand, a broad range of functionalized indolines in high yields (up to 99% in just 60 s of reaction) was observed, showing the potential of the proposed synthesis.

A combination of ultrasound (40 kHz), vacuum and/or ethanol as pretreatment to the convective drying of celery slices was investigated by Miano et al. [9]. The authors mentioned that there is a lack of studies combining emerging technologies to improve the convective drying of food products. In this work they demonstrated that pretreatment of ethanol with ultrasound was demonstrated to be more efficient for reducing drying time (38%) without reducing sample size after drying more than conventional drying.

Siqueira et al. [10] developed a laboratory made ultrasonic reactor (20 kHz) for the sonochemical extraction of catalase and lipase from biological samples and coupling it to a digital movie-based flow-batch analyzer for quantification of their enzymatic activities. The proposed system was applied to the analysis of samples of bovine and poultry liver. A full evaluation of ultrasound frequency, power, sonication time, and concentration of extraction agent was evaluated. Additional experiments using mechanical stirring (silent condition) were performed to compare the efficiency of the UAE process.

Silva et al. [11] evaluated an ultrasound-assisted system (19 kHz) for tung oil epoxidation. Tung oil is rich in α -eleostearic fatty acid and the use of acetic acid as percarboxylic precursor resulted in higher oil conversion and epoxy yield than the use of formic acid, and which valuable by-products can be produced. The use of formic acid resulted in a slightly lower oil conversion than acetic acid but with a much higher selectivity towards epoxidized tung oil. The analysis of the chemical composition of treated oil and the by-products produced during the reaction indicates that ultrasound favoured the epoxidation of oils containing conjugated double-bonds.

An interesting study about the effects of high-intensity ultrasound (20 to 100 kHz) application and post-mortem duration on the yield and physicochemical quality of rabbit meat in samples was performed by Carrillo-Lopez et al. [12]. They demonstrated that the application of ultrasound on rabbit meat modified quality variables depending on the post-mortem stage in which this technology was used during storage, showing that using ultrasound before freezing is a promising technique to improve the tenderness of rabbit meat.

Moosavi et al. [13] presented a review about the recent advances on decontamination of mycotoxin and inactivation of fungi by ultrasound. They reported that ultrasounds can inactivate some microorganisms and enzymes, and if the time, frequency, and intensity of ultrasound are optimized for each product. They also reinforced that ultrasound can be considered an effective method in decontaminating mycotoxins due to low processing temperature, less energy consumption, and less nutrient and flavour loss. However, the simultaneous use of US with thermal or non-thermal methods has shown some synergistic and antagonistic effects on fungal inactivation and mycotoxin decontamination.

Another interesting review about the ultrasound-assisted synthesis of pyrimidines and their fused derivatives was published by Mittersteiner et al. [14]. They presented a detailed summary about the effects of ultrasound on the construction and derivatization of the pyrimidine core through classical reaction. The following aspects were reviewed: chemo- and regioselectivity issues, and the results of conventional heating methods compared to ultrasound and mechanistic insights for key reactions.

Machado et al. [15] reviewed the green organic synthetic methods using ultrasound and heterogeneous catalysis promoted multicomponent reactions in last ten years. By considering that multicomponent reactions provide the synthesis of structurally diverse compounds, in a one-pot fashion, without isolation and purification of intermediates, the combination of these protocols has proved to be a powerful tool to obtain biologically active organic compounds with lower costs, time and energy consumption.

Oliveira el al. [16] evaluated the effect of low power and high-frequency ultrasound (1 to 3 MHz) on the transesterification of soybean oil, without the aid of external source and mechanical stirring. According to the authors, this approach can make the system even more environmentally friendly and economical for industrial applications. They demonstrated that the 1 and 3 MHz frequencies provided the energy required to homogenize the reagents achieving about 85% of conversion. The proposed method resulted in a significant decrease in electric power consumption and achieved.

Andrade et al. [17] reviewed the use of ultrasound for the remediation of contaminated waters with persistent organic pollutants, providing an overview of ultrasound applications to deplete organic contaminants in water media in the last two decades. According to the authors, ultrasound has shown to be technically feasible and economically viable, being less expensive than other advanced oxidation processes. Authors pointed out the need for cooperation between researchers from the most fundamental areas (physics and chemistry), with those from more applied areas (engineering) to implement ultrasound systems on a large scale.

Finally, Mendez-Arriaga and Vecitis [18] proposed a dual-high-frequency system from single-piezoelectric crystal for acesulfame degradation by hybrid advanced oxidation UV-sonochemistry process. Authors evaluated three conditions involving several frequencies as 376–376 kHz, resonant-added frequency (376–728 kHz), and a second harmonic-added frequency (376–752 kHz). They showed that dual-frequency synergy depends on the specific interactions between the native frequencies, phase shift and percentage of modulation as well as physicochemical character of the generated byproducts, preferential pathways and zone of degradation and the hydrodynamics into the sonoreactor in order to admit the hydroxyl radical recombination or maintain the radical attack together with pyrolysis degradation.

References

[1] V.S. Hakke, V.K. Landge, S.H. Sonawane, G. Uday Bhaskar Babu, M. Ashokkumar, E.M.M. Flores, The physical, mechanical, thermal and barrier properties of starch nanoparticle (SNP)/polyurethane (PU) nanocomposite films synthesised by an ultrasound-assisted process, Ultrason. Sonochem. 88 (2022) 106069.

[2] D.L. Lino, J.T. Guimarães, G.L.P.A. Ramos, L.A. Sobral, F. Souto, R.P.C. Neto, M.I. B. Tavares, C. Sant'Anna, E.A. Esmerino, E.T. Mársico, M.Q. Freitas, E.M.M. Flores, R.S.L. Raices, P.H. Campelo, T.C. Pimentel, M.C. Silva, A.G. Cruz, Positive effects of thermosonication in Jamun fruit dairy dessert processing, Ultrason. Sonochem. 86 (2022) 106040.

[3] N.S.M. Yusof, S. Anandan, P. Sivashanmugam, E.M.M. Flores, M. Ashokkumar, A correlation between cavitation bubble temperature, sonoluminescence and interfacial chemistry – A minireview, Ultrason. Sonochem. 85 (2022) 105988.

[4] M.J. Lo Fiego, A.S. Lorenzetti, G.F. Silbestri, C.E. Domini, The use of ultrasound in the South Cone region. Advances in organic and inorganic synthesis and in analytical methods, Ultrason. Sonochem. 80 (2021) 105834.

[5] A.P. Rossi, D.L. Kalschne, A.P.I. Byler, E.L.M. Flores, O.D. Leite, D. dos Santos, J. S. Barin, C. Canan, Effect of ultrasound and chlorine dioxide on Salmonella Typhimurium and Escherichia coli inactivation in poultry chiller tank water, Ultrason. Sonochem. 80 (2021) 105815.

[6] E.A. Serna-Galvis, J.F. Guateque-Londoño, J. Silva-Agredo, J. Porras, Y. Ávila-Torres, R.A. Torres-Palma, Superior selectivity of high-frequency ultrasound toward chorine containing-pharmaceuticals elimination in urine: A comparative study with other oxidation processes through the elucidation of the degradation pathways, Ultrason. Sonochem. 80 (2021) 105814.

[7] R.S.C. Sierra, H. Zúñiga-Benítez, G.A. Peñuela, Elimination of cephalexin and doxycycline under low frequency ultrasound, Ultrason. Sonochem. 79 (2021) 105777.

[8] M.M. Hornink, V.R. Nascimento, J.L. Couto, C.S. Santos, L.H. Andrade, Ultrasound-mediated radical cascade reactions: Fast synthesis of functionalized indolines from 2-(((N-aryl)amino)methyl)acrylates, Ultrason. Sonochem. 79 (2021) 105778.

[9] A.C. Miano, M.L. Rojas, P.E.D. Augusto, Combining ultrasound, vacuum and/or ethanol as pretreatments to the convective drying of celery slices, Ultrason. Sonochem. 79 (2021) 105779.

[10] L.A. Siqueira, L.F. Almeida, J.P.A. Fernandes, M.C.U. Araújo, R.A.C. Lima, Ultrasonic-assisted extraction and automated determination of catalase and lipase

activities in bovine and poultry livers using a digital movie-based flow-batch analyzer, Ultrason. Sonochem. 79 (2021) 105774.
[11] R.S. Silva, D.L.H. Maia, F.A.N. Fernandes, Production of tung oil epoxy resin using low frequency high power ultrasound, Ultrason. Sonochem. 79 (2021) 105765.
[12] L.M. Carrillo-Lopez, D. Robledo, V. Martínez, M. Huerta-Jimenez, M. Titulaer, A. D. Alarcon-Rojo, A. Chavez-Martinez, L. Luna-Rodriguez, L.R. Garcia-Flores, Post-mortem ultrasound and freezing of rabbit meat: Effects on the physicochemical quality and weight loss, Ultrason. Sonochem. 79 (2021) 105766.
[13] M.H. Moosavi, A.M. Khaneghah, F. Javanmardi, M. Hadidi, Z. Hadian, S. Jafarzadeh, E. Huseyn, A.S. Sant'Ana, A review of recent advances in the decontamination of mycotoxin and inactivation of fungi by ultrasound, Ultrason. Sonochem. 79 (2021) 105755.
[14] M. Mittersteiner, F.F.S. Farias, H.G. Bonacorso, M.A.P. Martins, N. Zanatta, Ultrasound-assisted synthesis of pyrimidines and their fused derivatives: A review, Ultrason. Sonochem. 79 (2021) 105683.
[15] I.V. Machado, J.R.N. dos Santos, M.A.P. Januario, A.G. Corrêa, Greener organic synthetic methods: Sonochemistry and heterogeneous catalysis promoted multi-component reactions, Ultrason. Sonochem. 78 (2021) 105704.
[16] P.A. Oliveira, R.M. Baesso, G.C. Morais, A.V. Alvarenga, R.P.B. Costa-Félix, Ultrasound-assisted transesterification of soybean oil using low power and high frequency and no external heating source, Ultrason. Sonochem. 78 (2021) 105709.
[17] F.V. de Andrade, R. Augusti, G.M. de Lima, Ultrasound for the remediation of contaminated waters with persistent organic pollutants: A short review, Ultrason. Sonochem. 78 (2021) 105719.
[18] F. Mendez-Arriaga, C.D. Vecitis, Dual-high-frequency from single-piezoelectric crystal for ACE degradation by hybrid advanced oxidation UV-sonochemistry process, Ultrason. Sonochem. 78 (2021) 105731.

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