MINISTÉRIO DA EDUCAÇÃO
SECRETARIA DE EDUCAÇÃO PROFISSIONAL E TECNOLÓGICA
INSTITUTO FEDERAL DE EDUCAÇÃO, CIÊNCIA E TECNOLOGIA DE SERGIPE

RELATÓRIO INDIVIDUAL DE TRABALHO

SEMESTRE LETIVO: 2023.2

IDENTIFICAÇÃO DO(A) SERVIDOR(A)

DOCENTE: Ligia Maria Santos de Oliveira	**SIAPE:** 2483103
VÍNCULO: (x) Efetivo | ( ) Substituto| ( ) Temporário	**REGIME:** ( ) 20h | ( ) 40h | (x) DE
CAMPUS: Aracaju	COORDENADORIA: COQUI-I
LINK CURRÍCULO LATTES: CV: **https://lattes.cnpq.br/6569591915017066**	**ATUALIZADO EM:** 17/03/2024
TELEFONE: (79) 99971-6699	**E-MAIL:** ligia.oliveira@ifs.edu.br

Orientações para preenchimento

- Indicar no campo "Concluído" o status da atividade:
    - Concluída integralmente (CI);
    - Concluída parcialmente (CP) – especificar percentual; ou
    - Não desenvolvida (ND).
- Atividades concluídas parcialmente e/ou não desenvolvidas devem ser justificadas no campo observações.

AULA

Disciplina	Concluído	Observações
COQUI.565 - PROCESSOS FÍSICO-QUÍMICOS EXPERIMENTAL - T1B	**CI**	Ministrei 10h na turma
COQUI.552 - QUÍMICA AMBIENTAL E DESENVOLVIMENTO SUSTENTÁVEL	**CI**	_______
COQUI.542 - QUÍMICA I	**CI**	_______
COQUI.551 - TÉCNICAS BÁSICAS DE LABORATÓRIO DE QUÍMICA	**CI**	_______

COQUI.571 - TECNOLOGIA INORGÂNICA	**CI**	Ministrei 42h na turma

MANUTENÇÃO DE ENSINO		
Atividade	Concluído	Observações
Manutenção de Ensino	**CI**	-----

APOIO AO ENSINO		
Atividade	Concluído	Observações
Atendimento, acompanhamento, avaliação e orientação de discente	**CI**	———
Participação em reuniões ordinárias e/ou extraordinárias	**CI**	———

ATIVIDADE DE PESQUISA APLICADA E INOVAÇÃO		
Atividade	Concluído	Observações
SCREENING FITOQUÍMICO E FÍSICO-QUÍMICO DOS EXTRATOS DAS FRUTAS QUIXABA (SIDEROXYLON OBTUSIFOLIUM) E CAMBUÍ (MYRCIARIA TENELLA O. BERG) PARA A PRODUÇÃO DE ALIMENTOS TERAPÊUTICOS FUNCIONAIS.	CI	

ATIVIDADE DE EXTENSÃO		
Atividade	Concluído	Observações
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GESTÃO E REPRESENTAÇÃO INSTITUCIONAL		
Atividade	Concluído	Observações
Coordenadora de Curso	CI	A atividade de Coordenadora de Curso é contínua

OUTRAS OBSERVAÇÕES

PUBLICAÇÕES		
PUBLICAÇÕES	TÍTULO	
	LOCAL DA PUBLICAÇÃO	
	EDITORA/ISBN/ISSN/DOI	
PUBLICAÇÕES	TÍTULO	
	LOCAL DA PUBLICAÇÃO	
	EDITORA/ISBN/ISSN/DOI	
PUBLICAÇÕES	TÍTULO	
	LOCAL DA PUBLICAÇÃO	
	EDITORA/ISBN/ISSN/DOI	
PUBLICAÇÕES	TÍTULO	
	LOCAL DA PUBLICAÇÃO	
	EDITORA/ISBN/ISSN/DOI	
PUBLICAÇÕES	TÍTULO	
	LOCAL DA PUBLICAÇÃO	
	EDITORA/ISBN/ISSN/DOI	

Aracaju, 15 de março de 2024.

Documento assinado digitalmente
LIGIA MARIA SANTOS DE OLIVEIRA
Data: 18/03/2024 18:12:59-0300
Verifique em https://validar.iti.gov.br

Docente

Coordenador

Documento assinado digitalmente
ROMULO ALVES DE OLIVEIRA
Data: 25/03/2024 15:38:03-0300
Verifique em https://validar.iti.gov.br

Gerente de Ensino

MINISTÉRIO DA EDUCAÇÃO
SECRETARIA DE EDUCAÇÃO PROFISSIONAL E TECNOLÓGICA
INSTITUTO FEDERAL DE EDUCAÇÃO, CIÊNCIA E TECNOLOGIA DE SERGIPE

PORTARIA N° 168, DE 15 DE JANEIRO DE 2020

A REITORA DO INSTITUTO FEDERAL DE SERGIPE, nomeada pelo Decreto de 03/10/2018, publicado no DOU de 04 subsequente, no uso das atribuições que lhe confere a Lei nº 11.892/2008,

RESOLVE:

Art. 1º Designar a servidora Lígia Maria Santos de Oliveira, matrícula SIAPE 2483103, ocupante do cargo de Professor do Ensino Básico, Técnico e Tecnológico, pertencente ao quadro de pessoal permanente desta Instituição Federal de Ensino, para a função de Coordenadora do Curso Integrado em Química, código FCC, Campus Aracaju.

Art. 2º Determinar à servidora que providencie junto ao Setor de Patrimônio da Unidade Gestora, para que no prazo de vinte quatro horas, efetue a carga patrimonial através do inventário de transferência de responsabilidade.

Art. 3º Esta Portaria entra em vigor nesta data.

RUTH SALES GAMA DE ANDRADE

MINISTÉRIO DA EDUCAÇÃO
SECRETARIA DE EDUCAÇÃO PROFISSIONAL E TECNOLÓGICA
INSTITUTO FEDERAL DE EDUCAÇÃO, CIÊNCIA E TECNOLOGIA DE SERGIPE

PORTARIA Nº 2104, DE 27 DE JULHO DE 2022

A REITORA DO INSTITUTO FEDERAL DE SERGIPE, nomeada pelo Decreto de 03/10/2018, publicado no DOU de 04 subsequente, no uso das atribuições que lhe confere a Lei nº 11.892/2008,

RESOLVE:

Art. 1º Designar os servidores abaixo relacionados, sob a presidência do primeiro, para comporem a Comissão de análise dos pedidos de transferência externa 2022, do curso Técnico de Nível Médio Integrado em Química, Campus Aracaju:

- Ligia Maria Santos de Oliveira, matrícula SIAPE 2483103

- Andréa Macleybiane Góis Tavares, matrícula SIAPE 1358116

- John Kennedy Azevedo Souza, matrícula SIAPE 1188530

Art. 2º Esta Portaria entra em vigor nesta data.

RUTH SALES GAMA DE ANDRADE

Assinado de forma digital por RUTH SALES GAMA DE ANDRADE:53289730549
DN: c=BR, o=ICP-Brasil, ou=AC SOLUTI Multipla v5, ou=09461647000195, ou=Presencial, ou=Certificado PF A3, cn=RUTH SALES GAMA DE ANDRADE:53289730549
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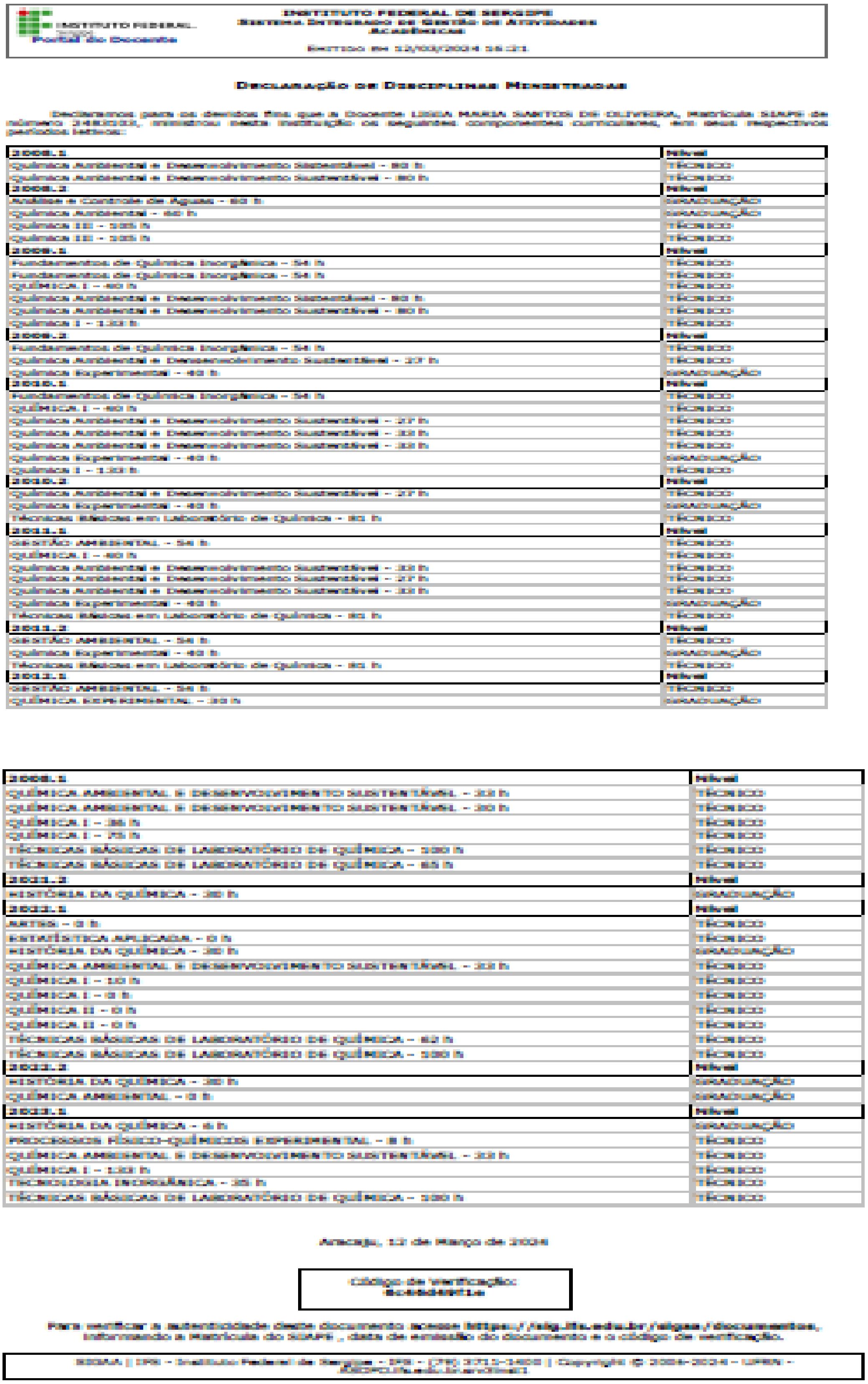

INSTITUTO FEDERAL DE SERGIPE
Sistema Integrado de Gestão de Atividades Acadêmicas

Emitido em 12/03/2024 16:21

Portal do Docente

Declaração de Disciplinas Ministradas

Declaramos para os devidos fins que a Docente LIGIA MARIA SANTOS DE OLIVEIRA, Matrícula SIAPE de número 2480333, ministrou nesta instituição os seguintes componentes curriculares, em seus respectivos períodos letivos:

2008.1	Nível
Química Ambiental e Desenvolvimento Sustentável - 80 h	TÉCNICO
Química Ambiental e Desenvolvimento Sustentável - 80 h	TÉCNICO
2008.2	**Nível**
Análise e Controle de Águas - 60 h	GRADUAÇÃO
Química Ambiental - 60 h	GRADUAÇÃO
Química III - 105 h	TÉCNICO
Química III - 105 h	TÉCNICO
2009.1	**Nível**
Fundamentos de Química Inorgânica - 54 h	TÉCNICO
Fundamentos de Química Inorgânica - 54 h	TÉCNICO
QUÍMICA I - 40 h	TÉCNICO
Química Ambiental e Desenvolvimento Sustentável - 80 h	TÉCNICO
Química Ambiental e Desenvolvimento Sustentável - 80 h	TÉCNICO
Química I - 120 h	TÉCNICO
2009.2	**Nível**
Fundamentos de Química Inorgânica - 54 h	TÉCNICO
Química Ambiental e Desenvolvimento Sustentável - 27 h	TÉCNICO
Química Experimental - 40 h	GRADUAÇÃO
2010.1	**Nível**
Fundamentos de Química Inorgânica - 54 h	TÉCNICO
QUÍMICA I - 40 h	TÉCNICO
Química Ambiental e Desenvolvimento Sustentável - 27 h	TÉCNICO
Química Ambiental e Desenvolvimento Sustentável - 33 h	TÉCNICO
Química Ambiental e Desenvolvimento Sustentável - 33 h	TÉCNICO
Química Experimental - 40 h	GRADUAÇÃO
Química I - 120 h	TÉCNICO
2010.2	**Nível**
Química Ambiental e Desenvolvimento Sustentável - 27 h	TÉCNICO
Química Experimental - 40 h	GRADUAÇÃO
Técnicas Básicas em Laboratório de Química - 81 h	TÉCNICO
2011.1	**Nível**
GESTÃO AMBIENTAL - 54 h	TÉCNICO
QUÍMICA I - 40 h	TÉCNICO
Química Ambiental e Desenvolvimento Sustentável - 33 h	TÉCNICO
Química Ambiental e Desenvolvimento Sustentável - 27 h	TÉCNICO
Química Ambiental e Desenvolvimento Sustentável - 33 h	TÉCNICO
Química Experimental - 40 h	GRADUAÇÃO
Técnicas Básicas em Laboratório de Química - 81 h	TÉCNICO
2011.2	**Nível**
GESTÃO AMBIENTAL - 54 h	TÉCNICO
Química Experimental - 40 h	GRADUAÇÃO
Técnicas Básicas em Laboratório de Química - 81 h	TÉCNICO
2012.1	**Nível**
GESTÃO AMBIENTAL - 54 h	TÉCNICO
QUÍMICA EXPERIMENTAL - 30 h	GRADUAÇÃO

2008.1	Nível
QUÍMICA AMBIENTAL E DESENVOLVIMENTO SUSTENTÁVEL - 33 h	TÉCNICO
QUÍMICA AMBIENTAL E DESENVOLVIMENTO SUSTENTÁVEL - 30 h	TÉCNICO
QUÍMICA I - 38 h	TÉCNICO
QUÍMICA I - 75 h	TÉCNICO
TÉCNICAS BÁSICAS DE LABORATÓRIO DE QUÍMICA - 100 h	TÉCNICO
TÉCNICAS BÁSICAS DE LABORATÓRIO DE QUÍMICA - 65 h	TÉCNICO
2021.2	**Nível**
HISTÓRIA DA QUÍMICA - 30 h	GRADUAÇÃO
2022.1	**Nível**
ARTES - 0 h	TÉCNICO
ESTATÍSTICA APLICADA - 0 h	TÉCNICO
HISTÓRIA DA QUÍMICA - 30 h	GRADUAÇÃO
QUÍMICA AMBIENTAL E DESENVOLVIMENTO SUSTENTÁVEL - 33 h	TÉCNICO
QUÍMICA I - 10 h	TÉCNICO
QUÍMICA I - 0 h	TÉCNICO
QUÍMICA II - 0 h	TÉCNICO
QUÍMICA II - 0 h	TÉCNICO
TÉCNICAS BÁSICAS DE LABORATÓRIO DE QUÍMICA - 62 h	TÉCNICO
TÉCNICAS BÁSICAS DE LABORATÓRIO DE QUÍMICA - 100 h	TÉCNICO
2022.2	**Nível**
HISTÓRIA DA QUÍMICA - 30 h	GRADUAÇÃO
QUÍMICA AMBIENTAL - 0 h	GRADUAÇÃO
2023.1	**Nível**
HISTÓRIA DA QUÍMICA - 6 h	GRADUAÇÃO
PROCESSOS FÍSICO-QUÍMICOS EXPERIMENTAL - 8 h	TÉCNICO
QUÍMICA AMBIENTAL E DESENVOLVIMENTO SUSTENTÁVEL - 33 h	TÉCNICO
QUÍMICA I - 120 h	TÉCNICO
TECNOLOGIA INORGÂNICA - 35 h	TÉCNICO
TÉCNICAS BÁSICAS DE LABORATÓRIO DE QUÍMICA - 100 h	TÉCNICO

Aracaju, 12 de Março de 2024

Código de Verificação:
[illegible]

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MINISTÉRIO DA EDUCAÇÃO
SECRETARIA DE EDUCAÇÃO PROFISSIONAL E TECNOLÓGICA
INSTITUTO FEDERAL DE EDUCAÇÃO, CIÊNCIA E TECNOLOGIA DE SERGIPE

PORTARIA N° 2070, DE 25 DE JULHO DE 2022

A REITORA DO INSTITUTO FEDERAL DE SERGIPE, nomeada pelo Decreto de 03/10/2018, publicado no DOU de 04 subsequente, no uso das atribuições que lhe confere a Lei nº 11.892/2008,

RESOLVE:

Art. 1º Reconduzir a Comissão de reformulação do PPC do curso integrado em Química, Campus Aracaju, com os servidores abaixo relacionados, sob a presidência do primeiro, instituída pela Portaria nº 1808, de 30/07/2020, com prazo para conclusão dos trabalhos até 18/10/2022:

- Lígia Maria Santos de Oliveira, matrícula SIAPE 2483103;

- Cristiane da Cunha Nascimento, matrícula SIAPE 2969556;

- John Kennedy Azevedo Souza, matrícula SIAPE 1188530;

- Cristiane Mirtes da Fonseca, matrícula SIAPE 1670428;

- Ênio Gomes Araújo, matrícula SIAPE 1449175;

- Paulo César Lima Santos, matrícula SIAPE 2450242;

- Adeline Araújo Carneiro Farias, matrícula SIAPE 1507176;

- Marize da Silva Martins, matrícula SIAPE 1673363;

- Geocelly Oliveira Gambardella, matrícula SIAPE 1643298.

Art. 2º Esta Portaria entra em vigor nesta data, convalidando os atos anteriores.

RUTH SALES GAMA DE ANDRADE

MINISTÉRIO DA EDUCAÇÃO
SECRETARIA DE EDUCAÇÃO PROFISSIONAL E TECNOLÓGICA
INSTITUTO FEDERAL DE EDUCAÇÃO, CIÊNCIA E TECNOLOGIA DE SERGIPE

RELATÓRIO INDIVIDUAL DE TRABALHO
SEMESTRE LETIVO: 2023.2

IDENTIFICAÇÃO DO(A) SERVIDOR(A)

DOCENTE: Laiza Canielas Krause	**SIAPE:** 1299237
VÍNCULO: ( ) Efetivo | (x) Substituto| ( ) Temporário	**REGIME:** ( ) 20h | (x) 40h | ( ) DE
CAMPUS: Aracaju	COORDENADORIA: COQUI
LINK CURRÍCULO LATTES: http://lattes.cnpq.br/9375759455831977	**ATUALIZADO EM:** 11/03/2024
TELEFONE: (79) 991447775	**E-MAIL:** Laiza.canielas@academicoifs.edu.br

Orientações para preenchimento

- Indicar no campo "Concluído" o status da atividade:
  - Concluída integralmente (CI);
  - Concluída parcialmente (CP) – especificar percentual; ou
  - Não desenvolvida (ND).
- Atividades concluídas parcialmente e/ou não desenvolvidas devem ser justificadas no campo observações.

AULA

Disciplina	Concluído	Observações
COQUI.515- FUNDAMENTOS DE QUÍMICA ANALÍTICA - T01B	CI	
COQUI.565 - PROCESSOS FÍSICO-QUÍMICOS EXPERIMENTAL-T01	CI	
IELT18A.05- QUÍMICA I - T01	CI	
COINF.87- QUÍMICA I - T01	CI	
COCC.287- QUIMICA I - T01	CI	
COINDELN.28. - QUÍMICA I - T01	CI	
COCC .301- QUÍMICA II - T01	CI	
PDES.26- QUÍMICA II - T01	CI	
COQUI.503- QUÍMICA II - T01	CI	

MANUTENÇÃO DE ENSINO		
Atividade	Concluído	Observações
Manutenção de Ensino	**CI**	-----

APOIO AO ENSINO		
Atividade	Concluído	Observações
Atendimento, acompanhamento, avaliação e orientação de discente	**CI**	———
Participação em reuniões ordinárias e/ou extraordinárias	**CI**	———

ATIVIDADE DE PESQUISA APLICADA E INOVAÇÃO		
Atividade	Concluído	Observações

ATIVIDADE DE EXTENSÃO		
Atividade	Concluído	Observações
--------	--------	--------

GESTÃO E REPRESENTAÇÃO INSTITUCIONAL		
Atividade	Concluído	Observações
Comissão de Avaliação de Projetos submetidos ao Programa Institucional de Bolsa de Iniciação Científica - PIBIC, nos editais n.ºs 01 e02/2023/PROPEX/IFS/ REITORIA,		PORTARIA Nº 1953, DE 01 DE AGOSTO DE 2023

OUTRAS OBSERVAÇÕES

PUBLICAÇÕES		
PUBLICAÇÕES	Liquid chromatographic fractionation of bio-oil from sugarcane bagasse: influence of heating rate on bio-oil yield and quality	
	REVISTA CADERNO PEDAGÓGICO – Studies	

	Publicações e Editora Ltda., Curitiba, v.21, n.3, p. 01-26. 2024.	
	ISSN: 1983-0882 /**DOI**: 10.54033/cadpedv21n3-049	
PUBLICAÇÕES	TÍTULO	
	LOCAL DA PUBLICAÇÃO	
	EDITORA/ISBN/ISSN/DOI	
PUBLICAÇÕES	TÍTULO	
	LOCAL DA PUBLICAÇÃO	
	EDITORA/ISBN/ISSN/DOI	
PUBLICAÇÕES	TÍTULO	
	LOCAL DA PUBLICAÇÃO	
	EDITORA/ISBN/ISSN/DOI	
PUBLICAÇÕES	TÍTULO	
	LOCAL DA PUBLICAÇÃO	
	EDITORA/ISBN/ISSN/DOI	

Aracaju, 12 de março de 2024

Documento assinado digitalmente
LAIZA CANIELAS KRAUSE
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____
Docente

Documento assinado digitalmente
LIGIA MARIA SANTOS DE OLIVEIRA
Data: 18/03/2024 18:27:33-0300
Verifique em https://validar.iti.gov.br

____
Coordenador

____
Gerente de Ensino

INSTITUTO FEDERAL
Sergipe
Portal do Docente

INSTITUTO FEDERAL DE SERGIPE
SISTEMA INTEGRADO DE GESTÃO DE ATIVIDADES ACADÊMICAS

EMITIDO EM 14/03/2024 14:11

DECLARAÇÃO DE DISCIPLINAS MINISTRADAS

Declaramos para os devidos fins que a Docente LAIZA CANIELAS KRAUSE, Matrícula SIAPE de número 1299237, ministrou nesta instituição os seguintes componentes curriculares, em seus respectivos períodos letivos:

2023.1	Nível
FUNDAMENTOS DE QUÍMICA ANALÍTICA - 100 h	TÉCNICO
PROCESSOS FÍSICO-QUÍMICOS EXPERIMENTAL - 8 h	TÉCNICO
QUÍMICA I - 100 h	TÉCNICO
QUÍMICA I - 66 h	TÉCNICO
QUÍMICA I - 66 h	TÉCNICO
QUÍMICA I - 66 h	TÉCNICO
QUÍMICA II - 100 h	TÉCNICO
QUÍMICA II - 66 h	TÉCNICO
QUÍMICA II - 33 h	TÉCNICO

Aracaju, 14 de Março de 2024

Código de Verificação:
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REVISTA CADERNO PEDAGÓGICO – Studies Publicações Ltda.
ISSN: 1983-0882

Liquid chromatographic fractionation of bio-oil from sugarcane bagasse: influence of heating rate on bio-oil yield and quality

Fracionamento por cromatografia líquida do bio-óleo do bagaço de cana-de-açúcar: influência da taxa de aquecimento no rendimento e na qualidade do bio-óleo

Fraccionamiento por cromatografía líquida del bioaceite del bagazo de caña de azúcar: influencia de la velocidad de calentamiento en el rendimiento y la calidad del bioaceite

DOI: 10.54033/cadpedv21n3-049

Originals received: 01/16/2024
Acceptance for publication: 02/23/2024

Nathalia Mendonça Conrado
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Anne Raquel Teixeira Cardoso
Doctoral Student in Chemical Engineering
Institution: Programa de Pós-Graduação em Engenharia Química, Universidade Federal de Santa Catarina (UFSC)
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E-mail: jadersonqmc@gmail.com

Thiago Rodrigues Bjerk
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E-mail: laiza_canielas@hotmail.com

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Doctor in Chemistry
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ABSTRACT

Brazil stands out in the field of using biomass as a source of energy and biomaterials, due to its territorial extension, biodiversity and climatic conditions. In this sense, one can highlight the high potential of bio-products generated from biomass. This is the case of sugarcane bagasse, produced in large quantities allied to the sugar and alcohol industry. In Brazil, much research has been done to improve its amount of fiber, aiming at the production of alternative fuels and generating the so-called "energy cane". Thus, it was studied the use of sugarcane bagasse for the production of bio-oil through pyrolysis and the isolation of fractions for industrial application. A comparison was also made between two types of sugarcane, a commercial variety (Saccharum sp.) and a variety with some genetic improvement (Erianthus arundinaceus). The final pyrolysis temperature was set at 500 ° C by varying the heating rates (25, 45, and 65 ° C min-1). The bio-oils were fractionated using preparative liquid chromatography and their fractions were analyzed by gas chromatography coupled to mass spectrometry. The fractionation of bio-oils increased the number of compounds identified by about 50%, besides allowing the isolation of apolar compounds. In addition, it was found that the genetic improved sugarcane presented higher bio-oil content, with higher hydrocarbon content, when compared to commercial sugarcane, demonstrating that the improvement process was efficient. Among the compounds identified were phenols, furfural derivatives and hydrocarbons, which indicates the potential use of bio-oil not only as bio-fuels, but also for industrial purposes.

Keywords: sugarcane, pyrolysis, fractionation, phenols.

MINISTÉRIO DA EDUCAÇÃO
SECRETARIA DE EDUCAÇÃO PROFISSIONAL E TECNOLÓGICA
INSTITUTO FEDERAL DE EDUCAÇÃO, CIÊNCIA E TECNOLOGIA DE SERGIPE

PORTARIA Nº 1953, DE 01 DE AGOSTO DE 2023

A REITORA DO INSTITUTO FEDERAL DE SERGIPE, nomeada pelo Decreto de 03/10/2018, publicado no DOU de 04 subsequente, e reconduzida pelo Decreto de 29/09/2022, publicado no DOU de 30 subsequente, no uso das atribuições que lhe confere a Lei nº 11.892/2008,

RESOLVE:

Art. 1º Designar os servidores abaixo relacionados, sob a presidência do primeiro, para comporem a Comissão de Avaliação de Projetos submetidos ao Programa Institucional de Bolsa de Iniciação Científica - PIBIC, nos editais n.ºs 01 e 02/2023/PROPEX/IFS/REITORIA, sob a coordenação da Pró-Reitoria de Pesquisa e Extensão - PROPEX, com prazo para a conclusão dos trabalhos até 31/10/2023:

Coordenação das Avaliações:

- José Osman dos Santos, matrícula SIAPE 1325698;
- Mário André de Freitas Farias, matrícula SIAPE 2476851;
- Carla Norma Correia dos Santos, matrícula SIAPE 1821935;
- Cristiane Mirtes da Fonseca, matrícula SIAPE 1670428.

Comitê Avaliador:

Adeline Araújo Carneiro Farias, matrícula SIAPE 1507176; Ciências Humanas;

- Alcides Luiz dos Anjos Hora, matrícula SIAPE 2257291; Engenharias;
- Aline Ferreira da Silva, matrícula SIAPE 1126357; Ciências Humanas;
- Anderson Nascimento do Vasco, matrícula SIAPE 1900076; Engenharias; Ciências Agrárias;
- Anselmo Araujo Matos matrícula SIAPE 2898089; Engenharias; Ciências Sociais Aplicadas;
- Bernadeth Moda de Almeida, matrícula SIAPE 1435049; Ciências Biológicas; Ciências da Saúde; Ciências Agrárias;
- Bruna da Costa Andrade, matrícula SIAPE 1883624; Ciências Exatas e da Terra; Engenharias;
- Cleide Ane Barbosa da Cruz, matrícula SIAPE 1105783; Ciências Sociais Aplicadas; Ciências Humanas;
- Cleidinilson de Jesus Cunha, matrícula SIAPE 1801025; Ciências Agrárias; Ciências Humanas;
- Cristiane Montalvão Guedes matrícula SIAPE 1584694; Ciências Sociais Aplicadas; Ciências Humanas;
- Diego Lopes Coriolano, matrícula SIAPE 2179008; Ciências Exatas e da Terra; Engenharias;
- Edson Leal Menezes Neto, matrícula SIAPE 279488; Ciências Exatas e da Terra; Engenharias;
- Eliane Dalmora Siape, matrícula SIAPE 1207078; Ciências Biológicas; Ciências Agrárias; Ciências Sociais Aplicadas; Ciências Humanas;
- Elza Ferreira Santos, matrícula SIAPE 1045098; Ciências Humanas; Linguística, Letras e Artes;
- Erica Moraes Santos de Souza, matrícula SIAPE 1763048; Ciências Agrárias;
- Fábio Brandão Britto, matrícula SIAPE 2318721; Engenharias; Meio ambiente
- Gilberto Messias Dos Santos Junior, matrícula SIAPE 1868636; Engenharias;
- Gilson Pereira dos Santos Júnior, matrícula SIAPE 1934434;Ciência da Computação; Educação Ciência Exatas e da Terra; Ciências Humanas;
- Herbert Melo Cruz , matrícula SIAPE 2420641; Engenharias;
- Herbet Alves De Oliveira, matrícula SIAPE 1837485; Ciências Exatas e da Terra; Engenharias;
- Hermenegildo Jorge Tavares Da Fonseca, matrícula SIAPE 6426517; Ciências Exatas e da Terra; Ciências Agrárias;

- Hestia Raissa Lima Precoma, matrícula SIAPE 1008609; Ciências Exatas e da Terra; Engenharias;
- João Batista Barbosa, matrícula SIAPE 1048808; Ciências Biológicas; Ciências da Saúde; Ciências Agrárias;
- João Batista dos Santos Filho, matrícula SIAPE 1733610; Ciências Exatas e da Terra;
- Jocelaine Oliveira Dos Santos, matrícula SIAPE 1813298; Linguística, Letras e Artes;
- José Adelmo Menezes de Oliveira, matrícula SIAPE 2108834; Ciências Humanas;
- José Damião de Melo, matrícula SIAPE 2642814; Ciências Exatas e da Terra; Engenharias; Ciências Agrárias; Ciências Sociais Aplicadas; Ciências Humanas; Linguística, Letras e Artes;
- Jose Damião de Melo, matrícula SIAPE 2642814; Ciências Exatas e da Terra; Engenharias; Ciências Sociais Aplicadas; Ciências Humanas; Linguística, Letras e Artes;
- José Wellington Carvalho Vilar, matrícula SIAPE 279482; Ciências Exatas e da Terra; Ciências Sociais Aplicadas;
- Juliana Dias Maia, matrícula SIAPE 1242975; Engenharias; Ciências Agrárias;
- Juliano Silva Lima, matrícula SIAPE 1891676; Ciências Biológicas;
- Junior Leal Do Prado, matrícula SIAPE 1540714; Ciências Exatas e da Terra; Ciências Humanas;
- Laiza Canielas Krause matrícula SIAPE 1299237; Ciências Exatas e da Terra;
- Liamara Perin, matrícula SIAPE 1728897; Ciências Agrárias;
- Luciana Bitencourt Oliveira, matrícula SIAPE 2467183; Ciências Exatas e da Terra; Meio ambiente
- Luciano de Melo, matrícula SIAPE 773702; Engenharias;
- Luciano Silva Vasconcelos, matrícula SIAPE 1274138; Ciências Sociais Aplicadas;
- Manoela Falcon Gallotti, matrícula SIAPE 1794503, Ciências Humanas; Linguística, Letras e Artes;
- Marcelo Machado Cunha, matrícula SIAPE 1354059; Ciências Exatas e da Terra;
- Marco Aurélio Pereira Buzinaro, matrícula SIAPE 1567152; Ciências Exatas e da Terra; Engenharias;
- Marcus Alexandre Noronha de Brito, matrícula SIAPE 1805785; Ciências Exatas e da Terra; Engenharias;
- Maria Engracinda dos Santos Ferreira, matrícula SIAPE 1722664; Ciências Exatas e da Terra; Engenharias; Agrimensura;
- Maria Geovânia Dantas Silva, matrícula SIAPE 1900076; Ciências Exatas e da Terra; Ciências Agrárias;
- Marlos Tacio Silva, matrícula SIAPE 1914915; Ciências Exatas e da Terra;
- Monica Alixandrina Da Silva Arruda Santos, matrícula SIAPE 2212348; Ciências Agrárias;
- Raquel Nominato Araújo, matrícula SIAPE 1378586; Ciências Agrárias; Ciências Sociais Aplicadas; Ciências Humanas;
- Rômulo Alves de Oliveira, matrícula SIAPE 1229278; Engenharias;
- Roseanne Santos de Carvalho, matrícula SIAPE 2632953; Ciências Exatas e da Terra; Engenharias; Ciências ambientais
- Rubens de Souza Matos Junior, matrícula SIAPE 2163237; Ciências Exatas e da Terra; Engenharias;
- Sérgio Carlos Resende, matrícula SIAPE 2212348; Ciências Agrárias;
- Sheila Costa dos Santos, matrícula SIAPE 2696245; Ciências Sociais Aplicadas;
- Tiago Cordeiro de Oliveira, matrícula SIAPE 1810658; Ciências Exatas e da Terra;
- Toniclay Andrade Nogueira, matrícula SIAPE 2929887; Ciências Exatas e da Terra; Engenharias;
- Vana Hilma Veloso Carvalho, matrícula SIAPE 1140889; Ciências Exatas e da Terra; Engenharias.

Art. 2º Esta Portaria entra em vigor nesta data.

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Sergipe

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MINISTÉRIO DA EDUCAÇÃO
SECRETARIA DE EDUCAÇÃO PROFISSIONAL E TECNOLÓGICA
INSTITUTO FEDERAL DE EDUCAÇÃO, CIÊNCIA E TECNOLOGIA DE SERGIPE
CONSELHO SUPERIOR

RELATÓRIO INDIVIDUAL DE TRABALHO

SEMESTRE LETIVO: 2023.2

IDENTIFICAÇÃO DO (A) SERVIDOR (A)

Docente ANDREA MACLEYBIANE GOIS TAVARES	**SIAPE** 1358116
Vínculo (X) Efetivo ( ) Substituto ( ) Temporário	**Regime** ( ) 20 h ( ) 40 h (X) DE
Campus ARACAJU	**Coordenadoria** CURSO TÉCNICO INTEGRADO EM QUÍMICA
Link Currículo Lattes https://lattes.cnpq.br/7057098435341604	**Atualizado em** 09 / 03 / 2024
Telefone 79 - 991364804	**E-mail** andrea.tavares@ifs.edi.br

Orientações para preenchimento

· Indicar no campo "Concluído" o status da atividade:o
Concluída integralmente (CI);
o Concluída parcialmente (CP) – especificar percentual; ou
o Não desenvolvida (ND).

· Atividades concluídas parcialmente e/ou não desenvolvidas devem ser justificadasno campo observações.

AULA		
Disciplina	Concluída	Observações
COINF.103 - QUÍMICA II	CI	Disciplina anual
COQUI.551 - TÉCNICAS BÁSICAS DE LABORATÓRIO EM QUÍMICA	CI	Disciplina anual
COQUI.566 - TÉCNICAS DE QUÍMICA ANALÍTICA	CI	Disciplina anual
COQUI.558 - QUÍMICA II	CI	Disciplina anual
MANUTENÇÃO DO ENSINO		
Atividade	Concluída	Observações
Planejamento, preparação de material didático	CI	--------
APOIO AO ENSINO		
Atividade	Concluída	Observações
AE1 **ATENDIMENTO, ACOMPANHAMENTO, AVALIAÇÃO E ORIENTAÇÃO DE DISCENTE**	CI	--------

AE2 **PARTICIPAÇÃO EM REUNIÕES ORDINÁRIAS E/OU EXTRAORDINÁRIAS**	CI	--------
AE3 **PARTICIPAÇÃO COMO MEMBRO REPRESENTANTE DE CONSELHO DE CLASSE**	CI	--------
ATIVIDADE DE PESQUISA APLICADA E INOVAÇÃO		
Atividade	Concluída	Observações
ATIVIDADE DE EXTENSÃO		
Atividade	Concluída	Observações
GESTÃO E REPRESENTAÇÃO INSTITUCIONAL		
Atividade	Concluída	Observações
OUTRAS OBSERVAÇÕES		
A docente possui horário especial (redução de 50% da jornada de trabalho) em vigor a partir de 12 de julho de 2021, pelo período de 03 anos, publicado na portaria nº 2425 de 20 de outubro de 2021.		
PUBLICAÇÕES		
Publicações	Título	
	Local da publicação	
	Editora/ISBN/ISSN/DOI	
Publicações	Título	
	Local da publicação	
	Editora/ISBN/ISSN/DOI	

Aracaju, 09 de março de 2024.

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Docente

Coordenador(a)

Diretor (a) / Gerente de Ensino

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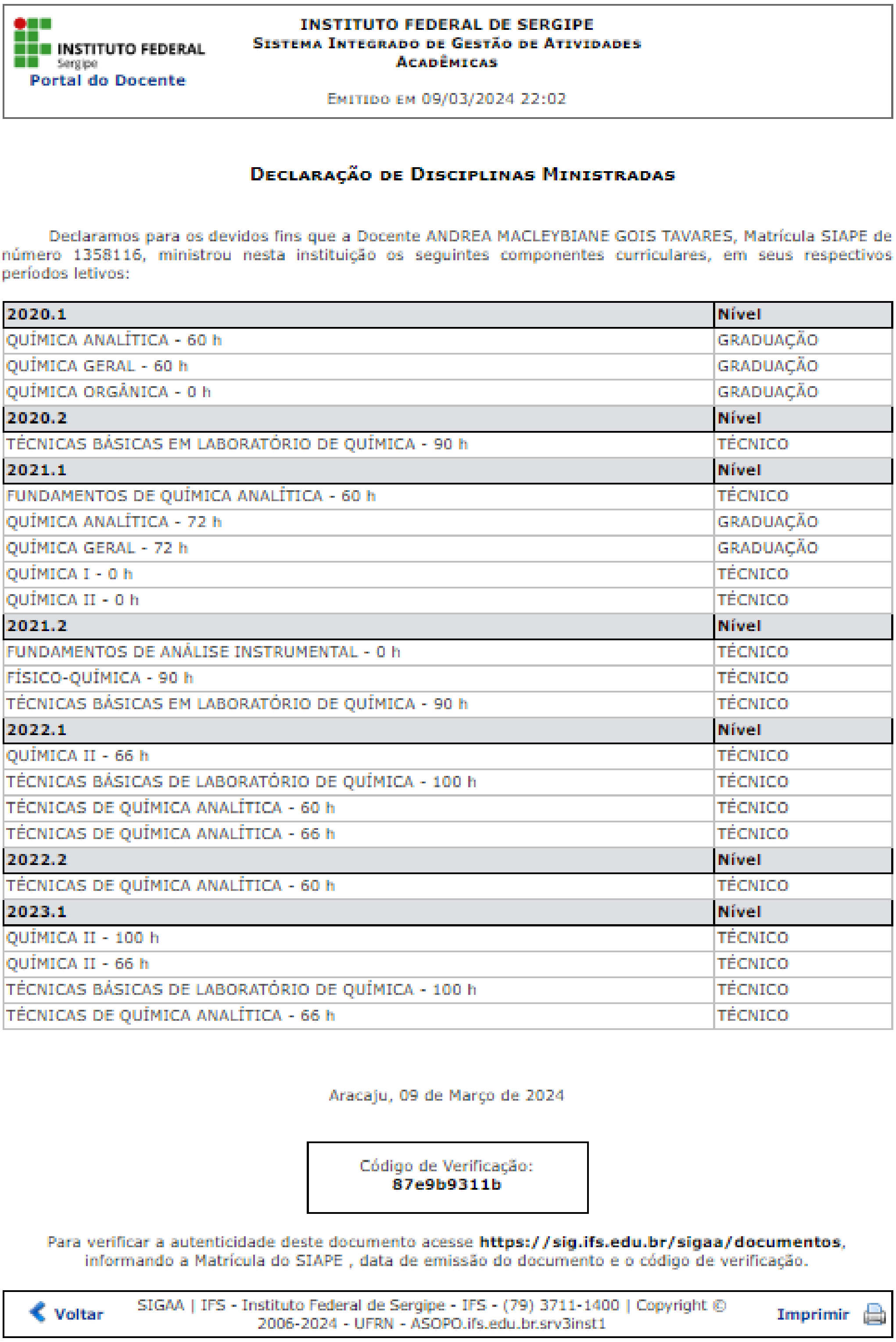
CONSELHO SUPERIOR

COMPROVAÇÕES



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Portal do Docente

INSTITUTO FEDERAL DE SERGIPE
Sistema Integrado de Gestão de Atividades Acadêmicas

Emitido em 09/03/2024 22:02

Declaração de Disciplinas Ministradas

Declaramos para os devidos fins que a Docente ANDREA MACLEYBIANE GOIS TAVARES, Matrícula SIAPE de número 1358116, ministrou nesta instituição os seguintes componentes curriculares, em seus respectivos períodos letivos:

2020.1	**Nível**
QUÍMICA ANALÍTICA - 60 h	GRADUAÇÃO
QUÍMICA GERAL - 60 h	GRADUAÇÃO
QUÍMICA ORGÂNICA - 0 h	GRADUAÇÃO
2020.2	**Nível**
TÉCNICAS BÁSICAS EM LABORATÓRIO DE QUÍMICA - 90 h	TÉCNICO
2021.1	**Nível**
FUNDAMENTOS DE QUÍMICA ANALÍTICA - 60 h	TÉCNICO
QUÍMICA ANALÍTICA - 72 h	GRADUAÇÃO
QUÍMICA GERAL - 72 h	GRADUAÇÃO
QUÍMICA I - 0 h	TÉCNICO
QUÍMICA II - 0 h	TÉCNICO
2021.2	**Nível**
FUNDAMENTOS DE ANÁLISE INSTRUMENTAL - 0 h	TÉCNICO
FÍSICO-QUÍMICA - 90 h	TÉCNICO
TÉCNICAS BÁSICAS EM LABORATÓRIO DE QUÍMICA - 90 h	TÉCNICO
2022.1	**Nível**
QUÍMICA II - 66 h	TÉCNICO
TÉCNICAS BÁSICAS DE LABORATÓRIO DE QUÍMICA - 100 h	TÉCNICO
TÉCNICAS DE QUÍMICA ANALÍTICA - 60 h	TÉCNICO
TÉCNICAS DE QUÍMICA ANALÍTICA - 66 h	TÉCNICO
2022.2	**Nível**
TÉCNICAS DE QUÍMICA ANALÍTICA - 60 h	TÉCNICO
2023.1	**Nível**
QUÍMICA II - 100 h	TÉCNICO
QUÍMICA II - 66 h	TÉCNICO
TÉCNICAS BÁSICAS DE LABORATÓRIO DE QUÍMICA - 100 h	TÉCNICO
TÉCNICAS DE QUÍMICA ANALÍTICA - 66 h	TÉCNICO

Aracaju, 09 de Março de 2024

Código de Verificação:
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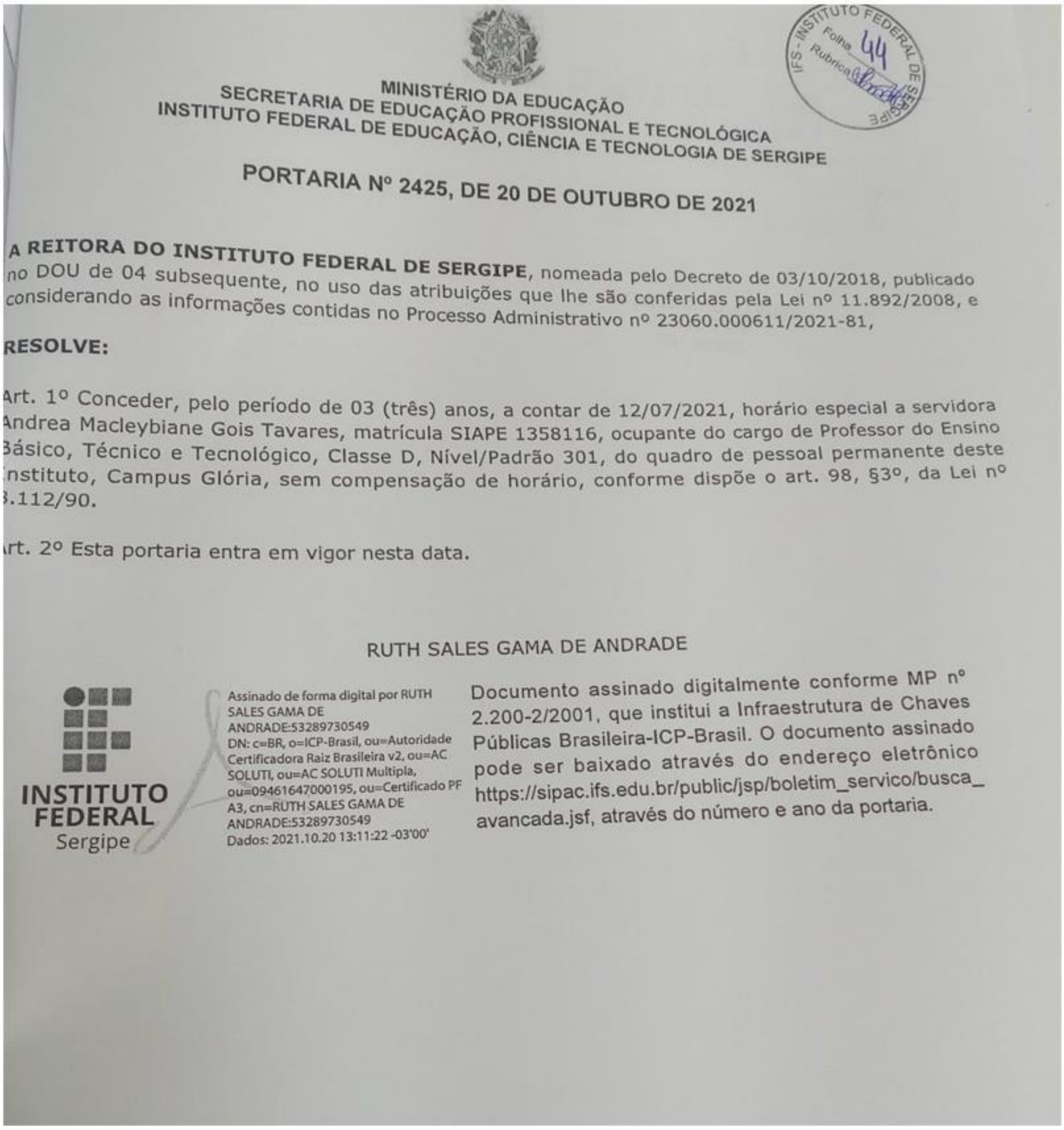

MINISTÉRIO DA EDUCAÇÃO
SECRETARIA DE EDUCAÇÃO PROFISSIONAL E TECNOLÓGICA
INSTITUTO FEDERAL DE EDUCAÇÃO, CIÊNCIA E TECNOLOGIA DE SERGIPE

PORTARIA Nº 2425, DE 20 DE OUTUBRO DE 2021

A REITORA DO INSTITUTO FEDERAL DE SERGIPE, nomeada pelo Decreto de 03/10/2018, publicado no DOU de 04 subsequente, no uso das atribuições que lhe são conferidas pela Lei nº 11.892/2008, e considerando as informações contidas no Processo Administrativo nº 23060.000611/2021-81,

RESOLVE:

Art. 1º Conceder, pelo período de 03 (três) anos, a contar de 12/07/2021, horário especial a servidora Andrea Macleybiane Gois Tavares, matrícula SIAPE 1358116, ocupante do cargo de Professor do Ensino ásico, Técnico e Tecnológico, Classe D, Nível/Padrão 301, do quadro de pessoal permanente deste nstituto, Campus Glória, sem compensação de horário, conforme dispõe o art. 98, §3º, da Lei nº .112/90.

rt. 2º Esta portaria entra em vigor nesta data.

RUTH SALES GAMA DE ANDRADE

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MINISTÉRIO DA EDUCAÇÃO
SECRETARIA DE EDUCAÇÃO PROFISSIONAL E TECNOLÓGICA
INSTITUTO FEDERAL DE EDUCAÇÃO, CIÊNCIA E TECNOLOGIA DE SERGIPE

PORTARIA Nº 1487, DE 26 DE MAIO DE 2023

A REITORA DO INSTITUTO FEDERAL DE SERGIPE, nomeada pelo Decreto de 03/10/2018, publicado no DOU de 04 subsequente, e reconduzida pelo Decreto de 29/09/2022, publicado no DOU de 30 subsequente, no uso das atribuições que lhe confere a Lei nº 11.892/2008,

RESOLVE:

Art. 1º Designar os membros permanentes do Conselho de Classe dos Cursos Técnicos Integrados - Campus Aracaju 2023.1, conforme segue abaixo:

CURSO TÉCNICO INTEGRADO EM QUÍMICA				
	DOCENTE	DOCENTE SUPLENTE	DISCENTE	DISCENTE SUPLENTE
1º ANO	Andrea Macleybiane Gois Tavares - SIAPE 1358116	Dirceu Passos Goes - SIAPE 1278198	Joana Ketllyn Nascimento de Araujo - Matrícula 2023305803	Jaiane Vieira de Oliveira - Matrícula 2023309526
2º ANO	Alzivane Santos Marins - SIAPE 1367216	Cristiane Mirtes da Fonseca - SIAPE 1670428	Iago Ramos da Silva - Matrícula 2022312590	Ana Cecilia Pereira Matos - Matrícula 2022310120
3º ANO	Paulo César Lima Santos - SIAPE 2450242	Tasso Gabriel Coelho Montenegro - SIAPE 2936594	Joanna Beatriz Correia dos Santos – Matrícula 2021300746	Amanda Evelyn dos Santos – Matrícula 2021308388

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SECRETARIA DE EDUCAÇÃO PROFISSIONAL E TECNOLÓGICA
INSTITUTO FEDERAL DE EDUCAÇÃO, CIÊNCIA E TECNOLOGIA DE SERGIPE

RELATÓRIO INDIVIDUAL DE TRABALHO

SEMESTRE LETIVO: 2023.2

IDENTIFICAÇÃO DO SERVIDOR

DOCENTE: Tasso Gabriel Coelho Montenegro	**SIAPE:** 2936594
VÍNCULO: (**x**) Efetivo | ( ) Substituto| ( ) Temporário	**REGIME:** ( ) 20h | ( ) 40h | (**x**) DE
CAMPUS: Aracaju	COORDENADORIA: COQUI
LINK CURRÍCULO LATTES: https://lattes.cnpq.br/4734774816447264	**ATUALIZADO EM:** 15 / 03 / 2024
TELEFONE: 79-988026072	**E-MAIL:** Tasso.montenegro@ifs.edu.br

Orientações para preenchimento

- Indicar no campo "Concluído" o status da atividade:
  - Concluída integralmente (CI);
  - Concluída parcialmente (CP) – especificar percentual; ou
  - Não desenvolvida (ND).
- Atividades concluídas parcialmente e/ou não desenvolvidas devem ser justificadas no campo observações.

AULA		
Disciplina	Concluído	Observações
QUI20A.11 - Introdução à Bioquímica	CI	
IELT18A.19 – Química II	CI	
COQUI.585 - Processos Orgânicos Experimentais (G1)	CI	
COQUI.585 - Processos Orgânicos Experimentais (G2)	CI	
QUI20A.14 - Processos Orgânicos Experimentais (N)	CI	
COQUI18.619 - Química Orgânica II	CI	

MANUTENÇÃO DE ENSINO		
Atividade	Concluído	Observações
Manutenção de ensino	CI	

APOIO AO ENSINO		
Atividade	Concluído	Observações
Atendimento, acompanhamento, avaliação de discente.	CI	
Participação em reuniões ordinárias.	CI	

ATIVIDADE DE PESQUISA APLICADA E INOVAÇÃO		
Atividade	Concluído	Observações
---	---	---

ATIVIDADE DE EXTENSÃO		
Atividade	Concluído	Observações
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GESTÃO E REPRESENTAÇÃO INSTITUCIONAL		
Atividade	Concluído	Observações
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OUTRAS OBSERVAÇÕES		

PUBLICAÇÕES		
PUBLICAÇÕES	TÍTULO	
	LOCAL DA PUBLICAÇÃO	
	EDITORA/ISBN/ISSN/DOI	

Aracaju, 15 de março de 2024.

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Docente

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Coordenador

Gerente de Ensino

MINISTÉRIO DA EDUCAÇÃO
SECRETARIA DE EDUCAÇÃO PROFISSIONAL E TECNOLÓGICA
INSTITUTO FEDERAL DE EDUCAÇÃO, CIÊNCIA E TECNOLOGIA DE SERGIPE

RELATÓRIO INDIVIDUAL DE TRABALHO

SEMESTRE LETIVO: 2023.2

IDENTIFICAÇÃO DO(A) SERVIDOR(A)

DOCENTE: Ana Paula Cavalcante de Oliveira	**SIAPE: 1433567**
VÍNCULO: (x) Efetivo | ( ) Substituto| ( ) Temporário	**REGIME:** ( ) 20h | ( ) 40h | (x) DE
CAMPUS: Aracaju	COORDENADORIA: COQUI-I
LINK CURRÍCULO LATTES: **http://lattes.cnpq.br/0151199855267669**	**ATUALIZADO EM:** 23/02/2024
TELEFONE: (79)988050148	**E-MAIL: anapaula.oliveira@ifs.edu.br**

Orientações para preenchimento

- Indicar no campo "Concluído" o status da atividade:
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    - Concluída parcialmente (CP) – especificar percentual; ou
    - Não desenvolvida (ND).
- Atividades concluídas parcialmente e/ou não desenvolvidas devem ser justificadas no campo observações.

AULA		
Disciplina	Concluído	Observações
COQUI18.592	CI	
COQUI.587	CI	
COQUI.586	CI	
COQUI.567	CI	

MANUTENÇÃO DE ENSINO		
Atividade	Concluído	Observações
AI	CI	

APOIO AO ENSINO		
Atividade	Concluído	Observações
Atendimento, acompanhamento, avaliação e orientação de discente	CI	
Participação em reuniões ordinárias e/ou extraordinárias	CI	

ATIVIDADE DE PESQUISA APLICADA E INOVAÇÃO		
Atividade	Concluído	Observações

ATIVIDADE DE EXTENSÃO		
Atividade	Concluído	Observações

GESTÃO E REPRESENTAÇÃO INSTITUCIONAL		
Atividade	Concluído	Observações
DEN	CI	Atividade da Diretoria de Ensino é contínua.

OUTRAS OBSERVAÇÕES

PUBLICAÇÕES		
PUBLICAÇÕES	TÍTULO	
	LOCAL DA PUBLICAÇÃO	
	EDITORA/ISBN/ISSN/DOI	
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PUBLICAÇÕES	TÍTULO	
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Coordenador

Gerente de Ensino

MINISTÉRIO DA EDUCAÇÃO
SECRETARIA DE EDUCAÇÃO PROFISSIONAL E TECNOLÓGICA
INSTITUTO FEDERAL DE EDUCAÇÃO, CIÊNCIA E TECNOLOGIA DE SERGIPE

PORTARIA Nº 3058, DE 01 DE NOVEMBRO DE 2022

A REITORA DO INSTITUTO FEDERAL DE SERGIPE, nomeada pelo Decreto de 03/10/2018, publicado no DOU de 04 subsequente, e reconduzida pelo Decreto de 29/09/2022, publicado no DOU de 30 subsequente, no uso das atribuições que lhe confere a Lei nº 11.892/2008,

RESOLVE:

Art. 1º Nomear, a partir de 01/11/2022, a servidora Ana Paula Cavalcante de Oliveira, matrícula SIAPE 1433567, ocupante do cargo de Professora do Ensino Básico, Técnico e Tecnológico, do quadro de pessoal permanente desta Instituição Federal de Ensino, para a função de Diretora de Ensino - DEN/DG, Campus Aracaju, CD-03.

Art. 2º Determinar à servidora que providencie junto ao Setor de Patrimônio da Unidade Gestora, para que no prazo de vinte quatro horas, efetue a carga patrimonial através do inventário de transferência de responsabilidade.

Art. 3º Esta Portaria entra em vigor nesta data.

RUTH SALES GAMA DE ANDRADE

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INSTITUTO FEDERAL DE EDUCAÇÃO, CIÊNCIA E TECNOLOGIA DE SERGIPE

RELATÓRIO INDIVIDUAL DE TRABALHO
2023.2

IDENTIFICAÇÃO DO(A) SERVIDOR(A)

DOCENTE: John Kennedy Azevedo Souza	**SIAPE: 1188530**
VÍNCULO: (x) Efetivo | ( ) Substituto| ( ) Temporário	**REGIME:** ( ) 20h | ( ) 40h | (x) DE
CAMPUS: Aracaju	**COORDENADORIA: COQUI**
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Orientações para preenchimento

- Indicar no campo "Concluído" o status da atividade:
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AULA			
Disciplina		concluído	Observações
IELT18A.36	QUÍMICA III	**CI**	
COINF.133	QUÍMICA III	**CI**	
COCC.316	QUÍMICA III	**CI**	
COQUI.521	QUÍMICA III	**CI**	
QUI20A.07	ÉTICA PROFISSIONAL	**CI**	
TÉCNICAS BÁS. DE LABORATÓRIO DE QUÌMICA- QUI20A.02 TO1 NA		**CI**	
COQUI 18.655	EDUCAÇÃO DE JOVENS E ADULTOS	**CI**	
CLM. 201	EDUCAÇÃO DE JOVENS E ADULTOS - T01	**CI**	

MANUTENÇÃO DE ENSINO		
Atividade	Concluído	Observações
Manutenção de Ensino	CI	

APOIO AO ENSINO		
Atividade	Concluído	Observações
Atendimento, acompanhamento, avaliação e orientação de discente	CI	
Participação em reuniões ordinárias e/ou extraordinárias	CI	
Representante Conselho de Classe Curso Técnico de Química Subsequente.	CI	

ATIVIDADE DE PESQUISA APLICADA E INOVAÇÃO		
Projeto	Concluído	Observações

ATIVIDADE DE EXTENSÃO		
Atividade	Concluído	Observações

GESTÃO E REPRESENTAÇÃO INSTITUCIONAL		
Atividade	Concluído	Observações
Comissão de Planejamento e Organização da Formatura Cursos de Graduação 2022.2- Campus Aracaju	CI	Portaria nº 1236, de 03/05/2023
Comissão de Reformulação Curso Técnico Integrado ao Ensino Médio em Química	CP	Portaria nº 2007, de 04/08/2023
Comissão de Organização da 20ª Semana Nacional de Ciência e	CI	Portaria nº 1783, de 03/07/2023

Tecnologia-SNCT campus Aracaju		
Conselho de Classe dos Curso Técnico de Química- subsequente	CI	Portaria nº 2732, de 19/10/2023

OUTRAS OBSERVAÇÕES

PUBLICAÇÕES		
PUBLICAÇÕES	TÍTULO	
	LOCAL DA PUBLICAÇÃO	
	EDITORA/ISBN/ISSN/DOI	
PUBLICAÇÕES	TÍTULO	
	LOCAL DA PUBLICAÇÃO	
	EDITORA/ISBN/ISSN/DOI	
PUBLICAÇÕES	TÍTULO	
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	EDITORA/ISBN/ISSN/DOI	

. Aracaju, 15 de Março de 2024

John Kennedy A. Souza

John Kennedy Azevedo Souza
Docente

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Coordenador

Gerente de Ensino

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INSTITUTO FEDERAL DE EDUCAÇÃO, CIÊNCIA E TECNOLOGIA DE SERGIPE

RELATÓRIO INDIVIDUAL DE TRABALHO

SEMESTRE LETIVO: 2023.2

IDENTIFICAÇÃO DO(A) SERVIDOR(A)

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AULA

Disciplina	Concluído	Observações
MÉTODOS ELETROANALÍTICOS	CI	Curso técnico Subsequente
MÉTODOS ÓPTICOS	CI	Curso Técnico Subsequente
TECNOLOGIA ORGÂNICA	CI	Curso Técnico Integrado.
TÉCNICAS DE QUÍMICA ANALÍTICA	CI	Curso Técnico Subsequente

MANUTENÇÃO DE ENSINO

Atividade	Concluído	Observações
Atendimento, acompanhamento, avaliação e orientação de discente	CI	-
Participação em reuniões ordinárias e/ou extraordinárias	CI	-
Orientação de estágio supervisionado	CI	-
Coorientação do DINTER	CI	Em andamento.

APOIO AO ENSINO		
Atividade	CI	Em andamento, devido à continuidade das atividades correlatas ao cargo.

ATIVIDADE DE PESQUISA APLICADA E INOVAÇÃO		
Atividade	CP	Em andamento
ATIVIDADE DE EXTENSÃO		
-	-	-
GESTÃO E REPRESENTAÇÃO INSTITUCIONAL		
Atividade	Concluído	Observações
Diretora da DAIE	CP	Em andamento, devido à continuidade das atividades correlatas à função.
OUTRAS OBSERVAÇÕES		
-		
-		

PUBLICAÇÕES		
PUBLICAÇÕES	TÍTULO	**Multi-residue analysis of fifty pesticides in river waters and in wastewaters**
	LOCAL DA PUBLICAÇÃO	*Environmental Science and Pollution Research* **volume 28**, pages 66787–66803 (2021)
	EDITORA/ISBN/ISSN/DOI	https://doi.org/10.1007/s11356-021-15134-4

Aracaju, 15 de março de 2024.

Luciana Bitencourt Oliveira

Docente

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Coordenador

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Gerente de Ensino

Environmental Science and Pollution Research
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RESEARCH ARTICLE

Multi-residue analysis of fifty pesticides in river waters and in wastewaters

Paula Paíga[1] · Sara Sousa[1] · José Vera[1] · Luciana Bitencourt[1,2] · Joana Vieira[3] · Sandra Jorge[3] · Jaime Gabriel Silva[4,5] · Manuela Correia[1] · Valentina F. Domingues[1] · Cristina Delerue-Matos[1]

Received: 15 March 2021 / Accepted: 22 June 2021

Abstract

Three sampling campaigns were performed in the Lis River (Leiria, Portugal) in February of 2018, November of 2018, and May of 2019. River water and wastewater (influent and effluent) samples of two wastewater treatment plants were target of the study. A total of 25 samples were collected and 50 pesticides were monitored, including organochlorines, triazines, pyrethroids, and organophosphorus, among others. Most of the detected pesticides were insecticides and mainly organochlorines. Concentrations between 1.29 and 2134 ng/L were found. Aldrin, γ-HCH, and cypermethrin were detected in some samples in μg/L, being γ-HCH the pesticide most frequently detected with concentration in μg/L level. The pesticides with the highest detection frequency were (i) cypermethrin, HCB, methoxychlor, and ζ-HCH in river waters; (ii) isoproturon, cypermethrin, methoxychlor, pyrimethanil, γ-HCH, dieldrin, diuron, α-HCH, and α-endosulfan in effluents; and (iii) diuron and isoproturon in influents. The detection of the organochlorides and their degradation products is a consequence of their persistence in the environment, as their usage has long been prohibited in the European Union. Pesticides were grouped by their types in herbicides, insecticides, or fungicides and the detection and concentration for each type were discussed with the climatic conditions. Pesticide toxicity index was determined in the samples collected in the river.

Keywords Gas chromatography · Liquid chromatography · Mass spectrometry · Rural and urban areas · Wastewater treatment plants · Water monitoring · Pesticide toxicity index

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Paula Paíga and Sara Sousa contributed equally to this work.

Highlights

- The total pesticides concentration increased from the river source to the mouth.
- Organochlorine group and insecticide type were the most detected pesticides.
- Levels of μg/L were found for γ-HCH and aldrin in river and α-and γ-HCH and cypermethrin in effluent samples.
- The highest detection frequency found in influent was 50%, in river 67%, and in effluent 100%.
- The concentration of chlorpyrifos, cypermethrin, and HCH pesticides exceeds the environmental quality standards.

Responsible Editor: Ester Heath

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Introduction

The use of pesticides has been increasingly widespread around the world. This practice has raised concern in the same proportion due to the persistence of pesticide residues in all environmental compartments (Cui et al. 2020). Each pesticide or pesticide class has a certain set of environmental concerns. Although suppliers provide good practices in economic and ecological terms, the effects of pesticides can include toxicity, bioaccumulation, persistence, and physiological responses in humans and wildlife (Hoffman et al. 2003). Runoff and wastewater effluents are important routes for the entry of pesticides into aquatic environments (Köck-Schulmeyer et al. 2013). Pesticides may enter sewage mainly by runoff or leaching from treated agricultural fields, disposal of unused products, accidental spills, washing sprayers and formulations bottles from rural areas, grass management activities (e.g. parks, highways, railways, and golf courses) or from pest control in private homes and gardens from urban areas (Barceló and Hennion 1997; Köck-Schulmeyer et al. 2013). Moreover, urban pesticide usage is random and can cause a major uncontrolled input to the wastewater treatment plant (WWTP). The amounts of pesticides in surface waters depend on several factors, such as physicochemical properties of the pesticides, a recent or non-recent application, soil characteristics, topography, and agriculture management practices. The intensive agriculture in the catchments of the rivers can also be considered a source pollution to the water course (Ferencz and Balog 2010; Leonard et al. 2001; Stamatis et al. 2010; Zhou et al. 2019). Pesticides are one of the classes of pollutants most studied by the scientific community in the aquatic environment. However, there are less studies in wastewater matrices because pesticides have been typically considered of agricultural instead of urban origin.

The water bodies that receive the effluents are significantly affected by the micropollutants that pass through the WWTP. Hence, it is important to include, in monitoring studies, influents and effluents from WWTPs located in rural and urban areas. The acquisition of new information on the behaviour of pesticides in these matrices is relevant to regulatory agencies. Le et al. report significant levels of pesticides, especially diuron, in WWTP effluent receiving agricultural streams (Le et al. 2017). Münze et al. analysed samples collected upstream and downstream of seven WWTPs in rural and suburban areas in Germany. Some of these WWTP effluents have been identified as the sole source of these pesticides (Münze et al. 2017).

In the European Union (EU), surface waters are regulated by European Directives, namely Directive 2000/60/EC (EC 2000) and Directive 2013/39/EU (EC 2013), which establish a framework for the protection of inland surface waters, transitional waters, coastal waters, and groundwater, setting limits on concentrations of priority substances such as pesticides, as well as environmental quality standards (EQS). Urban wastewater, on the other hand, is regulated by national legislation. In Portugal, the current regulation is the Decree Law 152/97 (DL 1977).

In the study region, the environment has been neglected and continuing pollution of the Lis River has existed for several years. The main polluting loads include agricultural, livestock, industrial effluents, and domestic and hospital wastewaters. Continuous monitoring of pollutants must be a priority, as exposure leads to dangerous effects that endanger human health and the quality of the environment. Subsequently, integrated within the project REWATER (Water JPI/0007/2016), the main objective of the present work was to monitor the presence of pesticides in river waters and wastewaters. For this purpose, three sampling campaigns were carried out between 2018 and 2019 and 50 pesticides belonging to different types and groups were assessed. Lis River crosses rural and urban areas and surface waters from the source to the mouth of the river were sampled as well as the influent and effluent of two WWTPs that discharge their effluents to the river. A total of 25 samples were collected. The physicochemical properties of the studied pesticides, as well as the climatic conditions in each sampling campaign, were discussed with the obtained results.

Experimental

Pesticides, degradation products, and internal standards

Information on the selected pesticides, the degradation products, the internal standards (IS), the chemical families, the physicochemical characteristics, the solvents used for the preparation of each stock solution, and the supplier companies are presented in Table SM1 (Supplementary Material). According to the physicochemical properties, 17 pesticides were analysed by gas chromatography-mass spectrometry (GC-MS) with selected ion monitoring (SIM) and GC-MS/MS and 33 pesticides were analysed by ultra-high performance liquid chromatography with tandem MS (UHPLC-MS/MS)).

River and WWTPs information, location of sampling sites, sampling, sample pH, and meteorological conditions at the time of sampling

Samples were collected in the course of the river and in two WWTP (influents and effluents) (Figure 1). The route of Lis River (Leiria, Center Region, Portugal) covers rural and urban areas and its basin is located in a calcareous area that allows

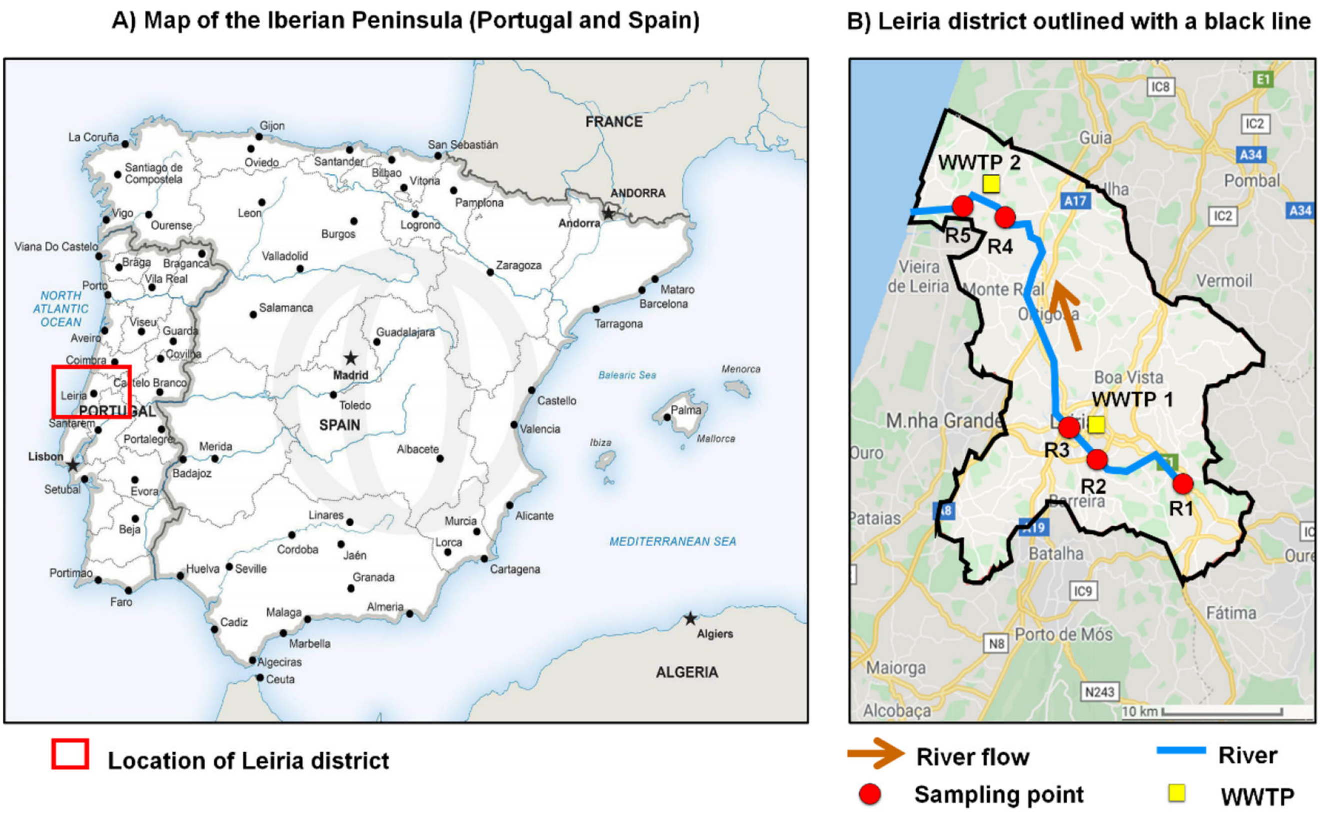


Fig. 1 Location of the sampling points in the Lis River and of the two Wastewater Treatment Plants target of the study

water infiltration (Paíga et al. 2016). This river receives inputs from agriculture, industrial and livestock production, and WWTP effluents. Detailed information on the location of the sampling points, inputs and treatment in each WWTP, and type, number, and pre-treatment of the samples collected in the river and WWTPs are presented in Table SM2 (Supplementary Material). Three sampling campaigns (SC) were carried out in Portugal rainy seasons: winter (February of 2018), autumn (October of 2018), and spring (May of 2019). This selection was based on the results obtained in monitoring studies, which reported higher levels of pesticides in wet seasons (Ramesh et al. 1990; Soares et al. 2013). A total of 25 samples were extracted and analysed within no more than one week upon arrival in the laboratory. Of these samples, 15 were river waters, 6 were WWTP effluents, and 4 were WWTP influents (Table SM2, Supplementary Material). The pH of the study samples varies from 7.3 to 8.1 in river water, 7.7 to 7.8 in WWTP effluent, and between 7.4 and 7.5 in WWTP influent samples, respectively.

The complexity of the analysed samples is higher in influent samples when compared with the remaining matrices. WWTP influents contain high amounts of non-volatile compounds, which may accumulate on the liner and chromatography column, compromising GC analysis by the adsorption of subsequent analytes (peaks poor defined or lost) (Stenerson et al. 2020). Hence, the authors decided not to analyse WWTP influents by GC. For this reason, WWTP influent samples were only analysed by LC.

The total precipitation and the minimum and maximum air temperatures in Portugal at the region where the sampling campaigns were performed (February 2018, October 2018, and May 2019) were obtained from the Portuguese Institute of the Sea and the Atmosphere (IPMA - Instituto Português do Mar e da Atmosfera) (IPMA 2020) (Table SM3, Supplementary Material).

Reagents, solvents, and materials

The detailed description of the reagents, solvents, and materials used for the extraction and analysis of the studied pesticides is listed in Table SM4 (Supplementary Material). For the pesticides analysed by GC (Table SM1, Supplementary Material), stock and working standard solutions were prepared in *n*-hexane and stored at 4 °C prior to use. As for the pesticides analysed by LC (Table SM1, Supplementary Material), individual stock standard solutions were prepared with a concentration of 1 g/L on a weight basis and stored at – 20 °C. Working standard solutions, containing all pesticides, were prepared in a mixture of acetonitrile LC-MS grade:ultrapure water (30:70, v/v).

Sample preparation using solid phase extraction

The volumes of the samples used in the solid phase extraction (SPE) were established according with a previous study on the extraction of pollutants in the matrices under study (Paíga et al. 2017). Thus, 250, 100, and 50 mL were the volumes used for river water, WWTP effluent, and WWTP influent samples, respectively. Different extraction procedures and cartridges were used for the pesticides under study due to their physicochemical properties (table SM1, Supplementary Material). Hence, for the pesticides analysed by GC, the SPE extraction was optimized and validated based on previous works (Fernandes et al. 2011; Pitarch et al. 2007). Due to the pKa of the studied pesticides and the type of samples, the SPE procedure used for the pesticides analysed by LC was adapted from the authors previous work (Paíga et al. 2017). The SPE extraction was performed in duplicate for each sample. A brief description of the procedures used in the SPE extraction is presented in section 1 of Supplementary Material.

Chromatographic equipment and conditions

Chromatographic analysis of 17 pesticides (Table SM1, Supplementary Material) was performed using GC-MS/SIM and confirmation was carried out using tandem MS/MS (ThermoScientific Trace-Ultra gas chromatograph coupled to an ion trap mass detector Thermo Polaris, operated in the electron impact ionization at 70 eV). GC-MS conditions are presented in Table SM5 (Supplementary Material). For the identification of these pesticides, the retention time, the ions ratios, and the National Institute of Standards and Technology (NIST) and Wiley pesticide libraries were used. Ion source, MS transfer and injector temperatures, carrier gas, column, oven temperature program, and software are detailed in Table SM6 (Supplementary Material).

For the remaining pesticides (Table SM1, Supplementary Material), a Shimadzu Nexera UHPLC system (Shimadzu Corporation, Kyoto, Japan) coupled to a triple-quadrupole mass spectrometer (Ultra-Fast Mass Spectrometry series LCMS-8030, Shimadzu Corporation, Kyoto, Japan) was used and operated in the electrospray ionization (ESI) mode. Modules, software, autosampler temperature, collision induced dissociation gas (CID), nebulizing and drying gas, and autosampler needle wash solvent are presented in Table SM6 (Supplementary Material). The precursor ion for each compound was selected by recording chromatograms of individual standards (100 mg/L) in full scan mode. Almost all studied pesticides, degradation products, and isotopically labelled internal standard (diuron-d6) showed higher response in positive electrospray ionization mode. Bentazone was the exception and higher response in the negative ionization mode was observed. Then, direct injection of individual standard solutions (10 mg/L) was performed, and the mass spectrometer was operated in multiple reaction monitoring mode (MRM). The two most intense MRM transitions were monitored for each pesticide, being the most intense used as quantifier and the second most intense used as qualifier. The individual MS/MS parameters are presented in Table SM7 (Supplementary Material). Source-dependent parameters were also optimized by direct injection, using a standard mixture solution at 10 mg/L. Then, mobile phases, isocratic or gradient elution, and chromatographic columns were tested. The optimum results of the source-dependent parameters, chromatographic program and the chromatographic column are listed in Table SM6 (Supplementary Material).

Validation of the analytical methods

Following the European Union criteria of 2002 (EC 2002), the applied analytical methods were validated in terms of linearity, method detection (MDL) and quantification (MQL) limits, recovery, matrix effects (ME), and successive injections of the standard solution (intra and inter-day precision). To assess the linearity of the method and the recoveries, river water and WWTP effluents and influents matrices were spiked at different concentration levels.

Pesticide toxicity index

The toxicity index (TI) is used to assess the potential toxicity in environmental samples of pesticide mixtures in a taxonomic group. TI was determined according to the studies performed by Nowell et al. and Covert et al. (Covert et al. 2020; Nowell et al. 2014) and calculated as the ratio between the concentration of the pesticide detected in the environmental sample and the toxicity concentration for the pesticide for the corresponding taxonomic group (LC50). The sum of TI is designed as PTI (sum of pesticide toxicity index). Based on Nowell et al., the PTI was calculated for fish and for cladocerans (Nowell et al. 2014). The concentration of the pesticide lethal for 50% of the exposed population (LC50, mg/L) was obtained from the Ecological Structure Activity Relationships (ECOSAR) Class Program (USEPA 2012). For pesticides detected in concentrations below the MQL or MDL, half of the MQL was considered (Paíga et al. 2019) for PTI assessment. PTI values greater than 1.0 indicate probable toxicity of the studied pesticides to the target aquatic organism, while PTI values between 0.5 and 1.0 indicate potential toxicity, and PTI values between 0.1 and 0.5 indicate limited toxicity (Battaglin and Fairchild 2002).

Results and discussion

Method performance

The results of the method performance are discussed in the following paragraphs and presented in Figure 2 and in Tables SM8 and SM9 (Supplementary Material). The retention time for each pesticide is listed in the table SM8 (Supplementary Material).

Calibration curves were constructed by plotting peak area against analyte concentration. Linearity of the chromatographic methods was satisfactory over the assayed range. Concentrations were between 15 and 500 μg/L for the pesticides analysed by GC and from 0.5 to 1000 μg/L for the pesticides analysed by LC. Correlation coefficients (R) higher than 0.99 were obtained for all pesticides. Quantification of the pesticides was made by internal standard calibration method.

MDLs and MQLs were obtained according to the signal-to-noise method (NATA 2013; Şengül 2016). The limits were determined in the samples in which pesticides were detected; otherwise, fortified samples were used. The results are presented in Figure 2 A and in Table SM8 (Supplementary Material). HCB, alachlor, ametryn, atrazine, diuron, isoproturon, propoxur, pyrimethanil, and terbuthylazine pesticides in river water, α-endosulfan, pyrimethanil, and terbuthylazine pesticides in WWTP effluent, and alachlor, ametryn, azinphos-methyl, isoproturon, metobromuron and propoxur pesticides in WWTP influent stand out for the lowest limits (between 0.020 and 1.1 ng/L) achieved in the study matrices. Limits increased with the complexity of the matrix under study and higher values were found in the WWTP effluent for the pesticides analysed by GC and in the WWTP influent for the pesticides analysed by LC. Chlorpyrifos, endrin, α-endosulfan, and β-HCH were the exception and presented higher limits in river water (Figure 2A). Both chromatographic techniques revealed accurate quantification and confirmation of trace levels of the pesticides under study in the analysed matrices, due to the obtained low limits showing a high sensitivity.

Recovery was calculated by comparing the area for samples spiked prior to SPE extraction (pre-spiked sample) with the area for samples spiked after SPE extraction (post-spiked sample). A minimum of three levels of fortification were performed. The previously optimized SPE extraction procedure using the Strata-X columns (Paíga et al. 2017) was a good option for the extraction of the pesticide analysed by LC (Table SM9, Supplementary Material). At pH 2, almost all the pesticides are in uncharged form (Table SM1, Supplementary Material) increasing the interaction of the pesticides with Strata-X cartridge. For all studied pesticides, recoveries were consistent in all fortification levels for each type of matrix (Table SM9, Supplementary Material). The average of the three levels of fortification is presented in Figure 2 B1. WWTP influent samples were not analysed by GC (see explanation in subsection 2.2); thus, 17 pesticides do not have results for recovery in this matrix. The lowest recovery was found for asulam with 49.3% in WWTP effluent and the highest recovery (114%) was observed for ζ-HCH and ametryn in river water and linuron in WWTP effluent (Figure 2, B1). Pesticides were also grouped into ranges of recoveries (Figure 2B2); most of the studied pesticides presented recoveries above 90% in the river water and in the WWTP influent and between 80 and 90% in the WWTP effluent. The SPE extraction procedures showed satisfactory recoveries for the studied pesticides in all the matrices.

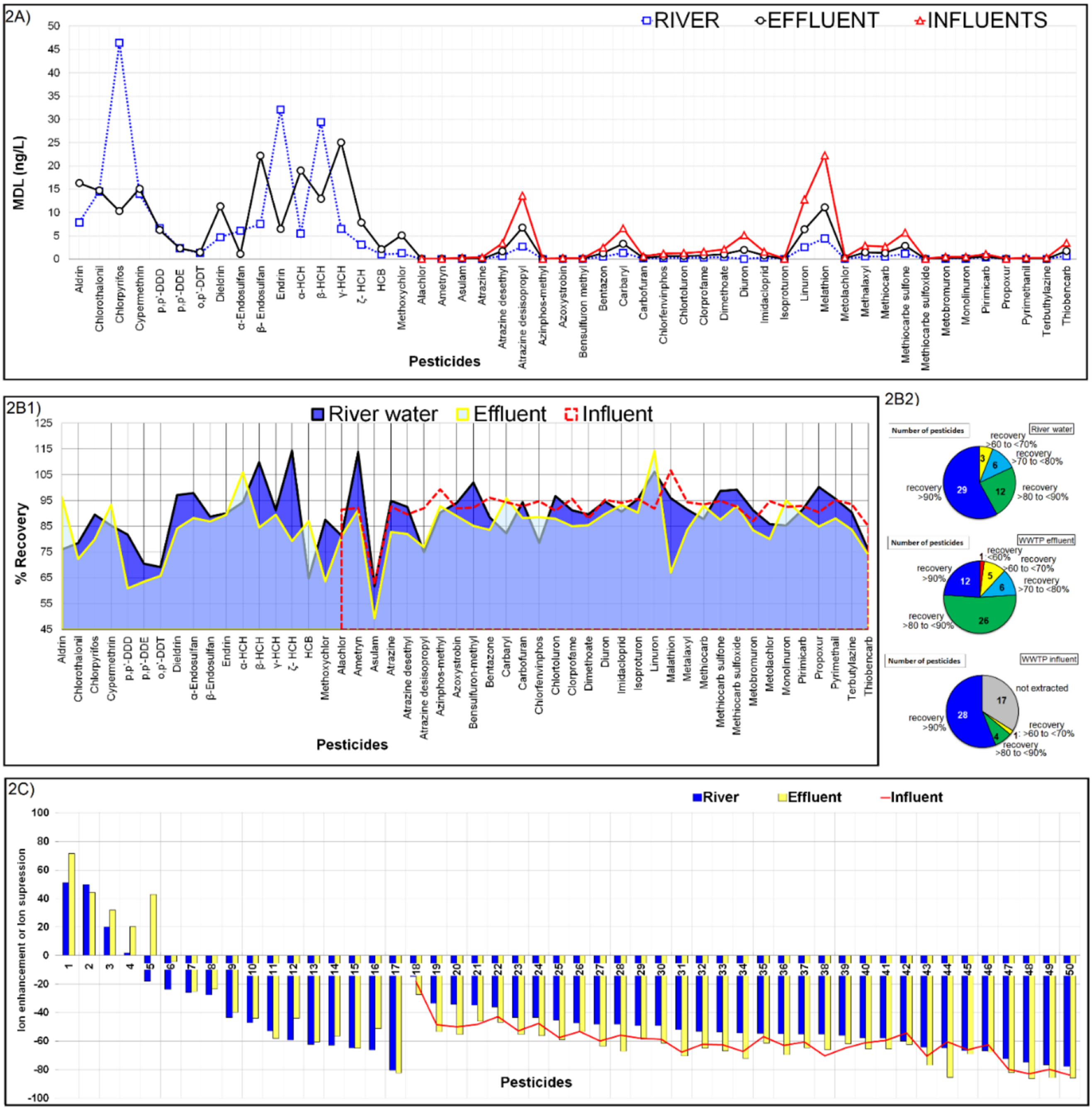
The area of the pesticide standard prepared in the sample matrix (M, Eq. (1)) was compared with the area of the pesticide standard prepared in the solvent (S, Eq. (1)) for ME determination. In Eq. (1), the area of the pesticide in the matrix without fortification or blank (B, Eq. (1)) was also used. B is equal to zero, if no peak was detected in the retention time of the pesticide. Ion suppression or ion enhancement signal was determined based on ME values (Eq. (2)). The calculations were performed using the following equations (Gros et al. 2012; Paíga et al. 2017):

$$\mathrm{ME} = ((\mathrm{M}-\mathrm{B})/\mathrm{S}) \quad (1)$$

$$\%\text{Ion suppression or ion enhancement} = (\mathrm{ME}-1) \times 100 \quad (2)$$

A zero, a positive, or a negative value indicate no effect, an ion enhancement signal, or an ion suppression signal, respectively. Values between − 20 and + 20% indicate minor ME (Gros et al. 2012, Paíga et al. 2017). Pesticides were organized from the highest to the lowest ion enhancement and then from the lowest to the highest ion suppression values (Figure 2C). Almost all pesticides had ion suppression signal in all matrices studied, except for chlorothalonil, β-, ζ-, and α-HCH in river water and chlorothalonil, β-, ζ-, α-, and γ-HCH in WWTP effluent. The highest ion enhancement signal was observed for chlorothalonil (in river water and WWTP effluent) and the highest ion suppression signal was found for methoxychlor in river water, for methoxychlor, linuron, methiocarb sulfone, imidacloprid, asulam, and methiocarb sulfoxide in WWTP effluent, and for imidacloprid and methiocarb sulfoxide in WWTP influent.

Intra-day precision was assessed by the injection in triplicate of a standard mixture with all pesticides at 500 μg/L on one day, and inter-day precision was assessed by the injection in triplicate of the same standard on different days. The methods showed good precision values (RSD (%), data not shown) ranging from 0.06% (atrazine desethyl) to 6.0% (monolinuron) for intra-day precision and from 0.54% (dieldrin) to 14% (*p,p'*-DDD) for the inter-day precision.



1	Chlorothalonil	9	α-endosulfan	17	Methoxychlor	25	Terbuthylazine	33	Pyrimethanil	41	Carbofuran	49	Asulam
2	β-HCH	10	p,p'-DDD	18	Thiobencarb	26	Diuron	34	Atrazine desisopropyl	42	Propoxur	50	Methiocarb sulfoxide
3	ζ- HCH	11	Dieldrin	19	Chlorfenvinphos	27	Azinphos-methyl	35	Chlortoluron	43	Melathion		
4	α-HCH	12	HCB	20	Alachlor	28	Azoxystrobin	36	Carbaryl	44	Linuron		
5	γ-HCH	13	o,p'-DDT	21	Metholachlor	29	Methalaxyl	37	Clorprofame	45	Dimethoate		
6	Chlorpyrifos	14	Aldrin	22	Monolinuron	30	Methiocarb	38	Bentazon	46	Ametryn		
7	Cypermethrin	15	β- endosulfan	23	Isoproturon	31	Pirimicarb	39	Metobromuron	47	Methiocarb sulfone		
8	p,p'-DDE	16	Endrin	24	Bensulfuron methyl	32	Atrazine desethyl	40	Atrazine	48	Imidacloprid		

Fig. 2 Validation tests (method detection limit (A), recovery (%) (B1 and B2), and matrix effect (C)) for all studied pesticides in the river water and wastewater (influent and effluent) matrices

Monitoring of pesticides in river water and in WWTP effluent and influent

The concentrations (± %RSD) of the pesticides found in the analysed samples are shown in Tables 1 and 2, for river water and wastewater samples, respectively. The analysis of the obtained results is presented in the following subsections.

Pesticides detected and concentration levels

Twenty-four pesticides were detected in at least one of the 25 analysed samples (river water or wastewaters) of which 7 pesticides, namely, atrazine, chlorpyrifos, diuron, HCB, HCH, isoproturon, and cypermethrin, are priority substances (DL 2015) (Table SM10, Supplementary Material). In at least one sample, 20 pesticides were detected in the river water and in WWTP effluent samples. The number of pesticides detected in the WWTP influent samples (3 pesticides) cannot be compared with the number of pesticides found in the river and in the WWTP effluent, as mentioned in subsection 2.2. It is also important to highlight that a higher number of pesticides was detected in the first SC (13, 15, and 3 pesticides) and in the second SC (13, 15, and 1 pesticides) when compared with the third SC (8, 8, and 1 pesticides) in river water, in WWTP effluent, and in WWTP influent, respectively. Furthermore, aldrin, chlorothalonil, *o,p'*-DDT, and pirimicarb were detected only in river waters and α-endosulfan, endrin, bentazone, and dimethoate were detected only in WWTP effluents. Cypermethrin was detected in all samples collected in the first and second SC in river water and WWTP effluent. Pesticides were quantified in concentrations ranging from 1.29 ng/L (pyrimethanil, R1, first SC) to 2134 ng/L (γ-HCH, WWTP-E2, second SC). Aldrin (1153 ng/L, second SC) in river water, γ-HCH (2134 ng/L, E2, second SC) in WWTP effluent and diuron (181 ng/L, I2, third SC) in WWTP influent were the pesticides with the highest concentration found in each type of matrix. Concentrations at μg/L level were found in some samples for the pesticides α- and γ-HCH, aldrin, and cypermethrin. On the other hand, concentrations below the MDL were found for the pesticides isoproturon, methoxychlor, β-HCH, and atrazine.

Findings in river waters samples

The number as well as the total concentration of pesticides increased along the river course (R1 to R5) in all SC and decreased from the first to the second and after for the third SC (Figure 3). In general, the highest concentration found in river water was at the sampling point R5. Analysing all sampling points in the first and second SC, the total pesticides concentration was higher than the legal limits on the quality of water intended for human consumption (Σ 500 ng/L; 98/83/EC) (EC 1998), except at R1 in second SC (Figure 3). Thus, it is important that surface water that can be further use for consumption go through a rigorous treatment process to remove compounds that could pose a threat to the health of humans and animals.

The pesticides chlorpyrifos, cypermethrin, *p,p'*-DDE, dieldrin, HCB, and the isomers β-, γ-, and ζ- HCH at the first SC and cypermethrin and HCB at the second SC were detected in all sampling points in the Lis River, revealing their persistence in the environment. The high persistence combined with high partition coefficient of HCB provides the necessary conditions for its bioaccumulation into organisms (Ritter et al. 1995). HCB has been detected in arctic air, water, and organisms (Barrie et al. 1992; Lockhart et al. 1992; Ritter et al. 1995; Thomas et al. 1992). In the present study, HCB was one of the pesticides found at lowest concentrations in the river water samples; however, its concentration was higher when compared to the results obtained in Portugal's Alqueva reservoir (8.57 ng/L) (Palma et al. 2014), Ria Formosa lagoon (6.10 ng/L) (Cruzeiro et al. 2015), and Douro river (5.38 ng/L) (Cruzeiro et al. 2016).

Higher concentrations at the sampling points downstream of the studied WWTPs were observed for the pesticides aldrin, chlorpyrifos, p,p'-DDE, cypermethrin, HCH isomers, diuron, isoproturon, and terbuthylazine. Their detection could be related to WWTP effluent discharge, as also to the persistence of these pesticides and by the unknow input to the river when these pesticides are not detected in the WWTP effluents. On the other hand, runoff from water and soil from agricultural or non-agricultural areas where pesticides were once applied could be a possible route for the entrance of pollutants upstream of the WWTPs effluent discharge, as was observed by the detection of pesticides in the source of the Lis River (R1) and at sampling point R2. The pesticides detected were chlorothalonil, chlorpyrifos, cypermethrin, p,p'-DDE, dieldrin, β-HCH, γ-HCH, ζ- HCH, HCB, methoxychlor, and pyrimethanil in sampling points R1 and R2 and isoproturon in sampling point R1 and pirimicarb in sampling point R2. Another issue that must be discussed is the concentration found in sampling point R4. This sampling point is located downstream of WWTP 1 effluent discharge and located upstream of WWTP 2 effluent discharge. When concentration in sampling point R4 is higher than the concentration found in samples collected in sampling point R5 (located downstream of WWTP 2 discharge), unknown inputs onto the river must be considered. This profile was observed for the pesticides chlorothalonil, chlorpyrifos, *p,p'*-DDD, *o,p'*-DDT, ζ- HCH, and methoxychlor.

Table 1 Results of concentration and standard deviation in river water samples

Chromatography	Pesticides	R1			R2			R3			R4			R5		
		Concentration (ng/L) ± %RSD			Concentration (ng/L) ± %RSD			Concentration (ng/L) ± %RSD			Concentration (ng/L) ± %RSD			Concentration (ng/L) ± %RSD		
		SC1	*SC2*	*SC3*	*SC1*	*SC2*	*SC3*	*SC1*	*SC2*	*SC3*	*SC1*	*SC2*	*SC3*	*SC1*	*SC2*	*SC3*
Gas chromatography	Aldrin	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	*1,153 ± 8.9*	n.d.
	Chlorothalonil	n.d.	*115 ± 0.94*	n.d.	n.d.	*119 ± 2.2*	n.d.	n.d.	*119 ± 0.70*	n.d.	n.d.	*128 ± 0.36*	n.d.	n.d.	n.d.	n.d.
	Chlorpyrifos	*192 ± 9.5*	n.d.	n.d.	*361 ± 7.6*	n.d.	n.d.	*312 ± 9.8*	n.d.	n.d.	*541 ± 5.3*	n.d.	n.d.	*312 ± 8.0*	*159 ± 7.9*	n.d.
	Cypermethrin	*102 ± 13*	*57.8 ± 15*	n.d.	*167 ± 12*	*76.1 ± 12*	n.d.	*249 ± 12*	*185 ± 13*	n.d.	*193 ± 11*	*108 ± 11*	n.d.	*364 ± 11*	*644 ± 5.4*	n.d.
	p,p’-DDD	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	*39.2 ± 0.70*	n.d.	n.d.	n.d.	n.d.
	p,p’-DDE	*8.24 ± 4.4*	n.d.	n.d.	*9.90 ± 6.6*	n.d.	n.d.	*9.77 ± 3.3*	n.d.	n.d.	*8.05 ± 0.56*	n.d.	n.d.	*12.8 ± 9.8*	n.d.	n.d.
	o,p’-DDT	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	*24.0 ± 0.49*	n.d.	n.d.	n.d.	n.d.
	Dieldrin	*16.8 ± 5.8*	n.d.	n.d.	*19.2 ± 5.1*	n.d.	n.d.	*14.8 ± 5.6*	n.d.	n.d.	*15.8 ± 12*	n.d.	n.d.	*18.7 ± 3.2*	n.d.	n.d.
	α-HCH	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	*183 ± 5.2*	n.d.	n.d.
	β-HCH	*226 ± 11*	n.d.	n.d.	*120 ± 5.5*	n.d.	n.d.	*195 ± 12*	n.d.	n.d.	*151 ± 1.9*	n.d.	*& lt;MDL*	*222 ± 11*	n.d.	*131 ± 30*
	γ-HCH	*365 ± 7.8*	n.d.	n.d.	*412 ± 11*	n.d.	n.d.	*600 ± 9.4*	n.d.	n.d.	*435 ± 0.24*	n.d.	*39.5 ± 9.66*	*1,085 ± 12*	n.d.	*77.8 ± 27*
	ζ- HCH	*119 ± 7.8*	*217 ± 5.4*	n.d.	*75.2 ± 10*	*239 ± 1.2*	n.d.	*110 ± 12*	*248 ± 4.2*	n.d.	*158 ± 11*	*232 ± 11*	n.d.	*151 ± 14*	n.d.	n.d.
	HCB	*31.5 ± 5.9*	*46.4 ± 6.6*	n.d.	*31.4 ± 4.2*	*40.9 ± 5.0*	n.d.	*31.2 ± 8.0*	*38.7 ± 1.4*	n.d.	*29.0 ± 0.33*	*44.5 ± 12*	n.d.	*30.9 ± 6.5*	*41.8 ± 8.3*	n.d.
	Methoxychlor	n.d.	*54.6 ± 1.7*	n.d.	n.d.	*60.6 ± 1.5*	*& lt;MDL*	n.d.	*54.0 ± 1.1*	*& lt;MDL*	n.d.	*77.5 ± 15*	*& lt;MDL*	n.d.	*63.0 ± 6.5*	*& lt;MDL*
Liquid chromatography	Atrazine	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	*& lt; MDL*	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	Diuron	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	*33.8 ± 3.8*	*52.6 ± 2.4*	*36.0 ± 6.5 ±*
	Isoproturon	*& lt; MDL*	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	*& lt; MDL*	n.d.	n.d.	n.d.	n.d.	*3.48 ± 18*	*1.74 ± 3.2*	*& lt; MDL*
	Pirimicarb	n.d.	n.d.	n.d.	n.d.	n.d.	*2.78 ± 2.2*	n.d.	n.d.	*2.59 ± 14*	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	Pyrimethanil	*1.29 ± 5.3*	n.d.	n.d.	n.d.	n.d.	*4.50 ± 12*	n.d.	n.d.	*4.27 ± 6.4*	n.d.	*10.4 ± 0.048*	*4.00 ± 17*	*4.83 ± 11*	*34.2 ± 3.7*	*5.49 ± 4.2*
	Terbuthylazine	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	*6.31 ± 12*	*8.11 ± 7.3*

Pesticides analysed by GC and by LC were organized in the table by alphabetical order

SC sampling campaign

n.d. not detected

Positive samples were italicised

The pesticides not listed in the table were not detected

The concentration found, in this study, for terbuthylazine was lower when compared with concentrations reported in other studies performed in Portugal, namely Douro river (369 ng/L) (Mansilha et al. 2011), Alqueva reservoir (254 ng/L) (Palma et al. 2014), Ria Formosa lagoon (22.1 ng/L) (Cruzeiro et al. 2015), and Águeda river basin (1885 ng/L) (Sánchez-González et al. 2013). Guillossou et al. reported the presence of cypermethrin at 75 ng/L in WWTP influent and at 20 ng/L in WWTP effluent while evaluating the removal of 48 organic micropollutants at the Seine Center WWTP in Colombes, France (Guillossou et al. 2019). Methoxychlor was detected in Portugal's river waters in concentrations of 11.6, & lt; 20, and 5.38 ng/L in Douro river (Mansilha et al. 2011), Lake Vela (Abrantes et al. 2010) and Tagus river (Cruzeiro et al. 2016), respectively.

Findings in wastewaters samples

Bentazone, dimethoate, pyrimethanil, terbuthylazine, atrazine, isoproturon, and diuron were detected in some samples of the WWTP effluents but were never detected in the corresponding untreated samples. Moreover, concentration in WWTP-E1 effluent (67.6 ng/L) for diuron was higher than the concentration found in WWTP-I1 influent (40.8 ng/L) in the first SC (Table 2). As stated by Margot J. et al. and Köck-Schulmeyer, pesticides had variable and frequently poor removal in the WWTPs (Köck-Schulmeyer et al. 2013; Margot et al. 2015). The release of the pesticides from the sludges on which these were adsorbed is due to their hydrophobicity (Figure SM1, Supplementary Material) and can be an explanation for the higher concentrations found in WWTP effluents than in WWTP influents. In 2011, Jelic et al. stated that pollutants adsorbed in the sludge during biological treatment were continuously released to the effluents of the WWTP, increasing their loads (Jelic et al. 2011). Hence, WWTPs are an important route of pesticide entry into the environment (Masiá et al. 2013). Concentrations in treated wastewater higher than in untreated sewage were also reported by other studies performed with other types of pollutants, per example: pharmaceuticals (Jelic et al. 2011; Reungoat et al. 2010). Moreover, the conversion of metabolites into the original pollutant due to the treatment performed in WWTP could also be one possible reason for the higher concentrations found in effluent than in influent samples (Jelic et al. 2011). In the case of pesticides, this statement can also be used to discuss the results, since the pesticides present in food can be metabolized and excreted by humans and animals (Köck-Schulmeyer et al. 2013). For instance, endosulfan metabolites (-sulfate, -ether, -lactone, and -diol) were detected in fatty and non-fatty tissues and fluids from women of reproductive age and children in Southern Spain (placenta, cord blood, and human milk) (Cerrillo et al. 2005). Glutathione conjugates are also known metabolites of pesticides (Fujioka and Casida 2007), which include organophosphate pesticides, such as chlorpyrifos (Mekonnen et al. 2019). Pesticides after entering living organisms are transformed to more hydrophilic compounds (metabolites) through enzymatic catalysed reactions (Mekonnen et al. 2019). Another possible reason discussed on literature is the rainfall events. Rainfall can change flow rate, concentration, and composition of sewage, and then affect wastewater treatment performance and the WWTP effluent quality (Köck-Schulmeyer et al. 2013; Rashid and Liu 2020). Furthermore, when hydraulic retention time (HRT) is not respected, unrealistic results in terms of removal efficiency could be obtained, due to the lack of correlation among WWTP effluent and influent samples. However, in the present study, HRT was considered in all SCs.

Pesticide's isomers

γ-HCH, when detected, was in general at a higher concentration when compared with the other isomers (Tables 1 and 2). Moreover, this pesticide was most often detected at μg/L level in WWTP effluents (Table 2). HCH isomers are the most prevalent halogenated organic insecticides that have been used primarily for crop protection (Bala et al. 2012). In the first SC, the isomers β-, γ-, and ζ-HCH were detected at all sampling points in river waters. The concentration of β-HCH at sampling points R1, R3, and R5 was very similar and slightly higher when compared with the concentration found in the remaining sampling points. Additionally, β-HCH was detected in both effluents from the two WWTPs. Therefore, the increase of this pesticide concentration at sampling points R3 and R5 could be related to the effluent discharge. α-HCH was detected in both WWTP effluents (E1 and E2) and only in one sample in the river water (R5, first SC). Its non-detection in the river could be related to its physicochemical properties and its very hydrophobic character that allows α-HCH to be adsorbed by the river sediments. Zhang et al. related the continuous inputs of HCHs into rivers in China due to sewage release in the river (Zhang et al. 2009). γ-HCH was found at concentrations of 0.22 to 4.25 μg/L in river water in Iran. The authors reported higher concentration for this isomer when compared to the isomer α-HCH (Abdolazim et al. 2013). Ferencz and Balog published in their study the detection of the HCH isomers in river waters, drinking waters from fountains, and tap-waters at concentration of ng/L in Romania (Ferencz and Balog 2010). The pesticide β-HCH was also found in Lake Vela in littoral Centre of Portugal at a concentration below 20.0 ng/L (Abrantes et al. 2010).

The β-endosulfan isomer was not detected in any of the analysed samples. However, α-endosulfan was detected in the WWTP effluents (E1 and E2) at the first and the second SC (Table 2). Antonious and Byers, and Leonard et al. reported, in their studies, that endosulfan isomers enter in the watercourse through runoff from water and soil (Antonious and

Table 2 Results of concentration and standard deviation in wastewaters samples (effluents and influents)

Chromatography	Pesticides	E1			E2			I1			I2		
		Concentration (ng/L) ± %RSD			Concentration (ng/L) ± %RSD			Concentration (ng/L) ± %RSD			Concentration (ng/L) ± %RSD		
		SC1	*SC2*	*SC3*	*SC1*	*SC2*	*SC3*	*SC1*	*SC2*	*SC3*	*SC1*	*SC2*	*SC3*
Gas chromatography	Chlorpyrifos	*261 ± 11*	n.d.	n.d.	*396 ± 4.4*	n.d.	n.d.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
	Cypermethrin	*573 ± 11*	*696 ± 3.2*	n.d.	*1,472 ± 4.0*	*1,331 ± 7.2*	n.d.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
	p,p'-DDD	*25.9 ± 7.6*	n.d.	n.d.	37.1 ± 4.6	n.d.	n.d.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
	p,p'-DDE	*83.0 ± 0.83*	*62.9 ± 1.1*	n.d.	*83.7 ± 4.3*	n.d.	n.d.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
	Dieldrin	*77.3 ± 4.5*	*561 ± 6.3*	n.d.	*73.8 ± 6.8*	*488 ± 1.8*	n.d.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
	α-Endosulfan	*77.3 ± 9.2*	*135 ± 1.8*	n.d.	*87.8 ± 3.2*	*107 ± 1.2*	n.d.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
	Endrin	n.d.	n.d.	n.d.	n.d.	*932 ± 2.6*	n.d.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
	α-HCH	*973 ± 5.3*	*1,120 ± 3.1*	n.d.	*941 ± 1.5*	*908 ± 9.3*	n.d.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
	β-HCH	*909 ± 7.5*	n.d.	n.d.	*758 ± 5.9*	n.d.	n.d.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
	γ-HCH	*1,678 ± 4.8*	*1,412 ± 1.1*	n.d.	*1,533 ± 6.8*	2,134 ± 0.18	n.d.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
	ζ- HCH	*600 ± 5.7*	n.d.	n.d.	*985 ± 3.9*	676 ± 2.9	n.d.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
	HCB	n.d.	*54.7 ± 8.6*	n.d.	n.d.	*55.7 ± 0,20*	n.d.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
	Methoxychlor	n.d.	*798 ± 5.7*	*161 ± 6.6*	n.d.	*840 ± 10*	*128 ± 6.6*	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
Liquid chromatography	Atrazine	*5.90 ± 4.0*	n.d.	n.d.	*14.4 ± 4.4*	n.d.	n.d.	*11.7 ± 9.9*	n.d.	n.d.	n.d.	n.d.	n.d.
	Bentazone	n.d.	n.d.	n.d.	*115 ± 21*	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	Dimethoate	n.d.	*25.1 ± 17*	*12.7 ± 3.1*	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	Diuron	*67.6 ± 9.9*	n.d.	n.d.	*106 ± 15*	*137 ± 12*	*168 ± 17*	*40.8 ± 10.2*	n.d.	n.d.	n.d.	n.d.	*181 ± 1.4*
	Isoproturon	*& lt; MDL*	*& lt; MDL*	*& lt; MDL*	*2.27 ± 12*	*11.3 ± 5.9*	*4.30 ± 8.1*	*& lt; MDL*	n.d.	*6.34 ± 19*	n.d.	n.d.	n.d.
	Pyrimethanil	n.d.	n.d.	*6.7 ± 12*	*21.1 ± 5.4*	*45.3 ± 7.6*	*14.2 ± 3.0*	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	Terbuthylazine	n.d.	n.d.	n.d.	n.d.	*8.98 ± 5.9*	*27.9 ± 9.4*	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.

Pesticides analysed by GC and by LC were organized in the table by alphabetical order

SC, sampling campaign; *E*, effluent; *I*, influent. The numbers 1 and 2 refer to WWTP1 and WWTP2

n.d. not detected

n.p. not performed (for GC analysis, WWTP influents samples were not extracted; thus, no results were obtained for GC pesticides)

Positive samples were italicised

The pesticides not listed in the table were not detected

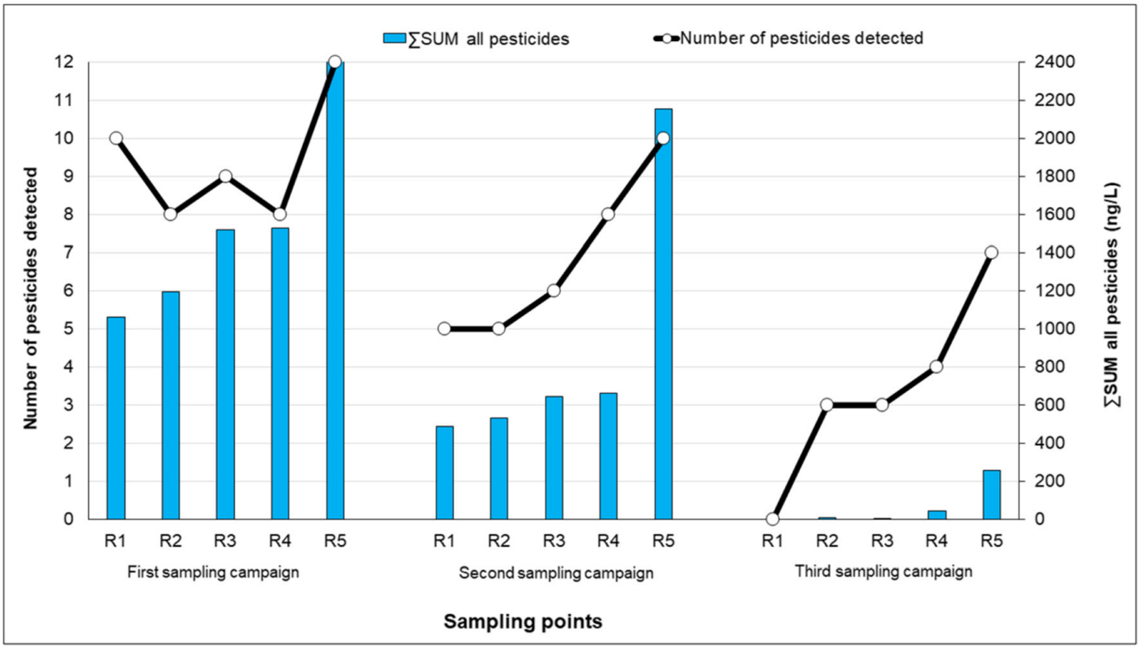


Fig. 3 Number of pesticides and the sum of concentration found in each sampling point for each sampling campaign (first SC - Winter, second SC - Autumn, and third SC - Spring)

Byers 1997; Leonard et al. 2001). Endosulfan, a hydrophobic chemical, is adsorbed by sediment particles in these runoffs (Antonious and Byers 1997) and both isomers are persistent when adsorbed by soils and sediments (Antonious and Byers 1997; Leonard et al. 2001; Rao and Murty 1980). Moreover, endosulfan is a mixture of two stereoisomers, α- and β-endosulfan in a ratio of 7:3. The α-isomer is thermodynamically more stable than the β-isomer which is irreversibly converted into α-form, although the conversion is slow (Singh 2016). Thus, the non-detection of some of the endosulfan isomers could be related to its hydrophobicity, half-life, and stability. In water, hydrolysis to the less toxic endosulfan diol is supposed to be the main transformation route (ATSDR-Endosulfan 2015).

Dieldrin, one of the first-generation organochlorine insecticides, is a persistent organic pollutant. The pesticides *o,p'*-DDT and aldrin are capable to be converted into more persistent metabolites (*p,p'*-DDE and dieldrin, respectively) than the original compound (Ritter et al. 1995). Moreover, dieldrin can be a metabolite but is also sold as a pesticide (FAO 2020). The high persistence of these metabolites was confirmed by the detection frequency of 100% for dieldrin and *p,p'*-DDE in the first SC. The pesticides from which they originated were only detected in the second SC and only in one sample, aldrin at sampling point R5 and *o,p'*-DDT at sampling point R4. However, when detected, these pesticides were at higher concentration than their metabolites. In other studies performed in Portugal, similar concentrations of dieldrin were found in Lake Vela (& lt; 20.0 ng/L) (Abrantes et al. 2010) and Douro river (12.0 ng/L) (Mansilha et al. 2011) but higher concentrations were found in Ria Formosa lagoon (163 ng/L) (Cruzeiro et al. 2015) and Tagus river (40.9 ng/L) (Cruzeiro et al. 2016). The detection of the organochlorides and their degradation products is a consequence of their persistence in the environment, as their usage has long been prohibited in the EU.

Pesticides vs partition coefficients

Other pesticides, in the present study, could have the same behaviour of endosulfan and HCH due to their partition coefficients (log Kow) (Table SM1, Supplementary material) and their half-life in the environment. Positive values for partition coefficients indicate some hydrophobic behaviour, higher values reveal more hydrophobicity (Kow ≥ 4), and low (log Kow & lt; 1) or negative values are an indicative of polar compounds (Cumming and Rücker 2017). As seen in Figure SM1 (Supplementary material), 10 pesticides are very hydrophobic (yellow colour), 34 pesticides have moderate hydrophobicity (red colour), and 6 pesticides are more hydrophilic (blue colour). The methiocarb degradation product (methiocarb sulfoxide) is the most hydrophilic and *o,p'*-DDT is the most hydrophobic pesticide. For all hydrophilic pesticides, no detection was observed in river water (Table 1) and WWTP influent (Table 2). The two pesticides detected with hydrophilic character in WWTP effluents were bentazone (E2, first SC) and dimethoate (E1, second and third SC). Some studies reported the detection of methiocarb at concentrations between 7 and 117 ng/L in the Pinios River in Greece (Fytiano et al. 2007) and non-detection in 123 samples from lakes, rivers, ponds, field watercourses, and drainages in Wielkopolska (Poland) (Drożdżyński 2008). Hydrophilic compounds are mobile in the aquatic environment and have a low sorption affinity due to their water solubility and polarity (Spahr et al. 2020). The detection of bentazone and dimethoate in WWTP effluents samples shows its non-removal during the treatment performed in each WWTP. As stated in the review article of Margot J. et al., polar pollutants are poorly removed (& lt; 50%) during WWTP treatment (Margot et al. 2015). Thus, removal efficiency (Köck-Schulmeyer et al. 2013; Margot et al. 2015), as also metabolites conversion (ATSDR-Endosulfan 2015; Fujioka and Casida 2007; Jelic et al. 2011; Köck-Schulmeyer et al. 2013; Mekonnen et al. 2019), rainfall events (Köck-Schulmeyer et al. 2013), and HRT (Köck-Schulmeyer et al. 2013) are some possible explanations for the non-detection in the untreated wastewater and detection in the treated wastewater. For the other hydrophilic compounds, their non-detection in any sample could be due to the non-application of these pesticides in agricultural or non-agricultural areas, or these are present in concentrations far below the MDL.

Type and group of the detected pesticides

In river water and WWTP effluent, three types of pesticides were detected, namely insecticides, herbicides, and fungicides. In WWTP influent, less pesticides were analysed and consequently cannot be compared with the other matrices. Atrazine, diuron, and isoproturon were the herbicides detected in WWTP influent (Table SM11, Supplementary Material). The highest value for type of pesticides and the highest number of pesticides were found for insecticides in river water and WWTP effluent. It must be enhanced that hog farming in Portugal is mostly located at the river basin in the region of the present study. The control of cockroaches, flies, and other insects is crucial as they can transmit diseases among pig's population (Linden 2013). Most of the detected pesticides in river and WWTP effluent samples were organochlorides (aldrin, *p,p'*-DDD, *p,p'*-DDE, *o,p'*-DDT, dieldrin, α-endosulfan, endrin, HCB, methoxychlor, and the isomers α-, β-, γ-, and ζ- HCH). The remaining detected pesticides belong to the 1,3,5-triazines (atrazine and terbuthylazine) and organophosphorus (chlorpyrifos and dimethoate) groups, with two pesticides detected in each group, and to the phenylamide (diuron), pyrethroid (cypermethrin), urea (isoproturon), benzothiazinone (bentazone), carbamate (pirimicarb), chloronitrile (chlorothalonil), and anilinopyrimidine (pyrimethanil) groups with one pesticide detected in each group.

Priority substances

Regarding the seven pesticides classified as priority substances (Table SM10, Supplementary Material) (DL 2015), concentrations were below the EQS limits established for the pesticides: atrazine, isoproturon, diuron, HCB, and the isomers α-, β-, and ζ- HCH in all samples collected in the river and above the limits for the pesticides γ-HCH (R3 and R5 in the first SC), chlorpyrifos (R4 in the first SC), and cypermethrin (R5 in the second SC) (Table 1). Diuron levels detected at the sampling point R5 were higher when compared to the study performed in Portugal's Águeda river basin (8 ng/L) (Sánchez-González et al. 2013).

Pesticides vs climatic conditions

Pesticides move away from the targeted application due to runoff, leaching, and drift (Barceló and Hennion 1997; Köck-Schulmeyer et al. 2013). The movement of the pesticides is influenced by climatic factors such as the amount, duration and intensity of rainfalls, air temperature, and air movement. Low rainfall indicate no runoff and no dissipation of pesticides into the water course (Wheeler 2002). Additionally, sunlight and temperature affects all abiotic and biotic transformation of pesticides reactions (Wheeler 2002). Moreover, as the samples were collected at different seasons, the type of pesticides applied could also be different depending on the target to be reached. The results shown in Table SM11 (Supplementary Material) were crossed with the climatic conditions presented in Table SM3 (Supplementary Material) for each SC. It was observed that in the campaign performed in 2019, the temperatures were higher, and precipitation was lower than in the two campaigns performed in 2018. These values are in accordance with the season (Spring) in which the campaign was carried out. Precipitation in the first and the second SC was similar, but air temperatures were higher during the second SC. In precipitation and with increase of air temperatures, fungi appear in agricultural crops. As presented in the Table SM11 (Supplementary Material), the total concentration of fungicides increased from the first to the second SC. In the third SC, precipitation decreased, and air temperatures increased again. Associated with higher luminosity, a decrease of the detection of fungicides was observed in river water and in WWTP effluents. Moreover, as the air temperature increased, the total concentration for herbicides was also higher as observed from the first to the second SC in river water and from the second to the third SC in WWTP effluents. In the case of insecticides, a decrease in total concentration was observed with the decrease of precipitation and/or the increase of air temperature.

Detection frequency

The detection frequency for the 24 detected pesticides in at least one of the 25 analysed samples is presented in Figure 4. The graphic in Figure 4 A was plotted from the highest to the lowest detection frequency obtained for river waters, since more samples were analysed in this matrix. The higher detection frequency was found for the pesticides cypermethrin and HCB (67%) in river waters, for isoproturon (100%) in WWTP effluents, and for diuron and isoproturon (50%) in WWTP influents. On the other hand, the lowest detection frequency was verified for the pesticides α-HCH, *p,p'*-DDD, atrazine, aldrin, and *o,p'*-DDT in river waters (6.7%), for endrin and bentazone in WWTP effluents (17%) and for atrazine (25%) in WWTP influents. Additionally, in WWTP effluents, 8 pesticides (cypermethrin, methoxychlor, pyrimethanil, dieldrin, diuron, α-endosulfan, and α- and γ-HCH) of the 20 detected pesticides have a detection frequency of 67% (Figure 4A). Most of the pesticides' detection frequencies ranged from & lt;25 to 50% in river waters, from 50 to 75% in WWTP effluents, and for two of the three detected pesticides in WWTP influent sample detection frequency was 50% (Figure 4B).

Potential toxicity results

PTI was determined in the river water sample collected in each sampling point of the river in the three SC. The results are presented in Figure 5. For the first SC, only sampling point R1 for fish had a PTI value lower than 1. On the other hand, for the second and third SCs only sampling point R5 had a PTI higher than 1 in fish as in *Daphnia magna*. The first SC had higher PTI values in all sampling points and taxonomic groups, except for sampling point R5 in fish where PTI was higher in the second SC. The sampling point R4 (first SC) and sampling point R5(second and third SCs) had the highest PTI values, which is in line with the results discussed in previous sections and higher PTI values were found in the samples collected at the end of the river course.

For fish, 16.7% of the samples had probability toxicity (PTI > 1.0), 3.3% of the samples had potential toxicity (PTI > 0.5),

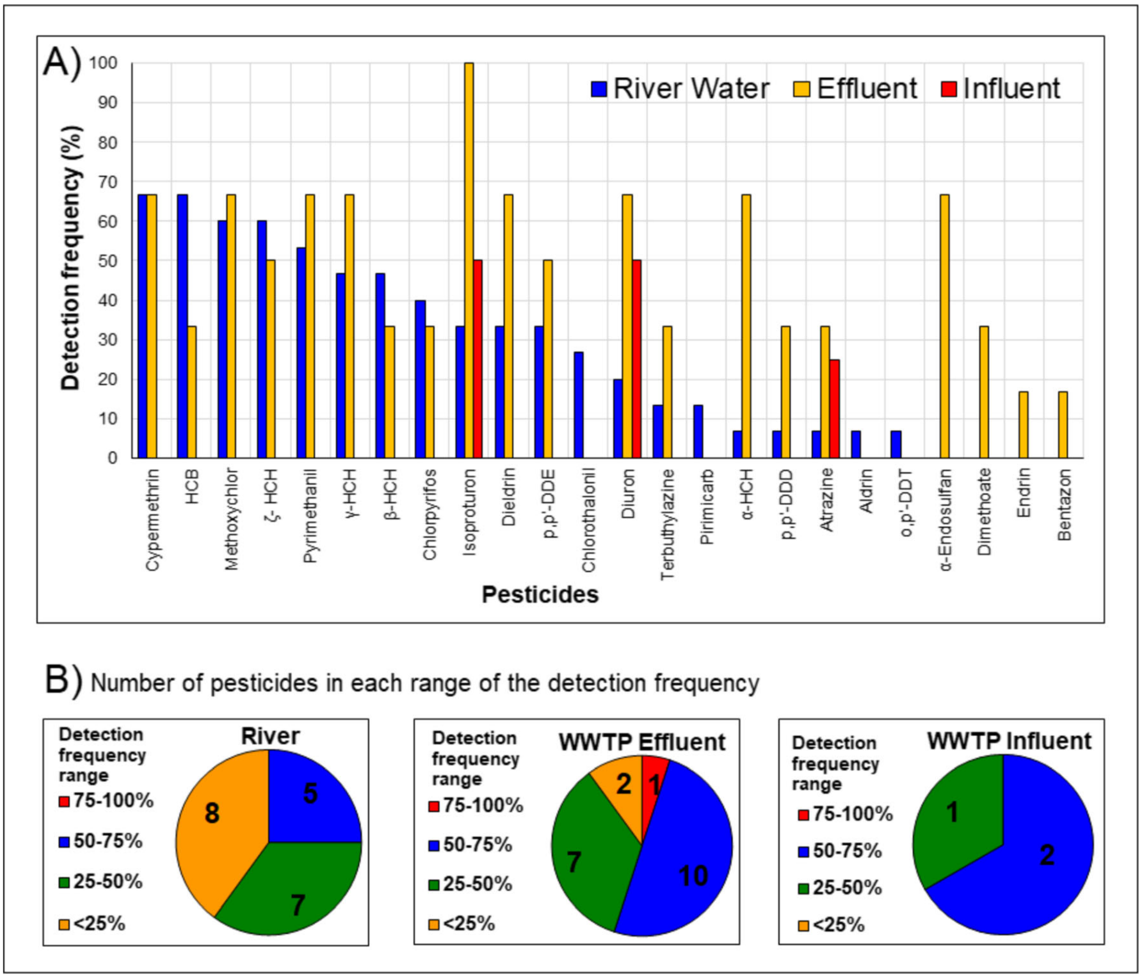


Fig. 4 Pesticide detection frequency in each analysed matrix (river water and WWTP effluent and influent)

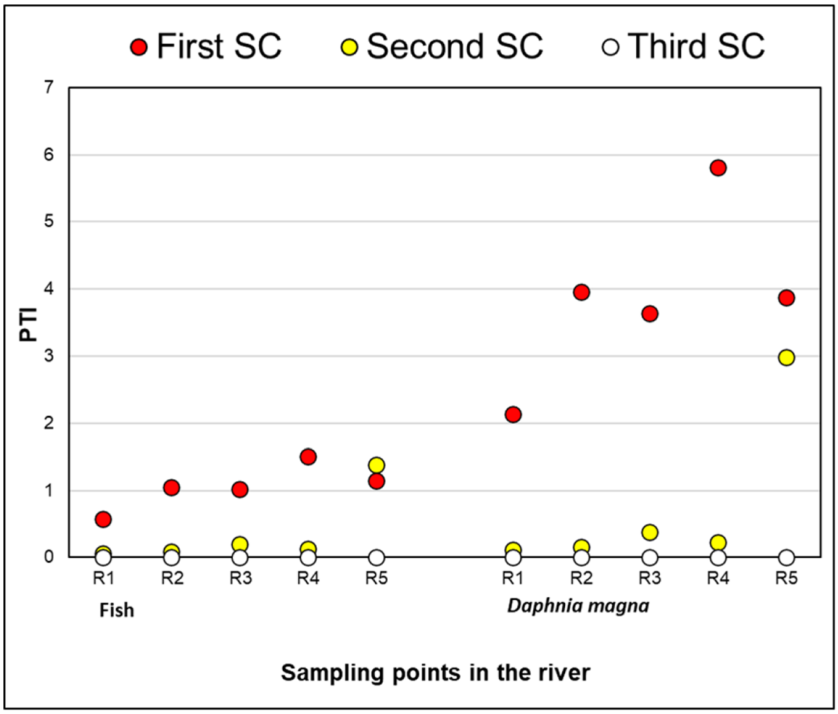


Fig. 5 Pesticide toxicity index for the river water samples in the three sampling campaigns for fish and *Dapnhia magna*

6.7% of the samples had limited toxicity (PTI > 0.1), and 23.3 % of the analysed samples had PTI lower than 0.1%. For *Daphnia magna*, 20.0% of the samples had probability toxicity, none of the analysed samples had potential toxicity, 13.3% of the samples had limited toxicity, and 16.7 % of the analysed samples had PTI lower than 0.1%.

Conclusion

Monitoring studies in the environment are extremely important due to the high number of chemicals used in our daily lives, in agriculture, and in industries. These pollutants reach different environmental compartments, being the water resource a major affected one. The contamination of aquatic environments is a worldwide problem. Thus, monitoring pesticides, from different types and groups, along the river (from source to the mouth) and in wastewaters is essential and the novelty of this study.

Using SPE extraction and GC and LC chromatography's, the proposed analytical method can be successfully applied for the determination of the selected pesticides in river waters and wastewaters (WWTP effluent and influent). Three SC were performed covering three seasons. Almost half of the study pesticides were detected (24 of the 50 pesticides) in at least one of the samples. Most of the detected pesticides belong to the insecticides type and organochlorine group. Concentrations were between 1.29 ng/L (pyrimethanil) in river and 2134 ng/L (γ-HCH) in WWTP effluent samples. In some sampling points, the highest concentration found was in the μg/L level for the pesticides γ-HCH and aldrin in river waters and for α- and γ-HCH, and cypermethrin in WWTP effluents. As the river receives new inputs on its route, the concentration of the pollutants increases in the direction in which the river flows. This increase is not related to the WWTP effluent discharge affecting the downstream sampling points (R3 and R5) alone; unknown inputs (from agricultural or non-agricultural application) also affect the pesticides concentration in all the river course. The pesticides γ-HCH, chlorpyrifos, cypermethrin, β-HCH, ζ-HCH, HCB, dieldrin, *p,p'*-DDE in the first SC and cypermethrin, HCB, and methoxychlor in the second SC were detected in all sampling points in the river which includes the source of the Lis River (R1). It is important to enhance the physicochemical properties that could be related to the detection or non-detection and the persistence of pesticides in the environment, factors that could be associated to their continued detection. The concentration of chlorpyrifos, cypermethrin, and HCH pesticides exceeds the environmental quality standards. The highest PTI was observed in samples collected in sampling points R4 (first SC) and R5 (second and third SCs) for fish and *Daphnia magna* with probability toxicity (PTI > 1.0). This study is of the utmost importance and can contribute to the population's awareness in achieving a sustainable use of pesticides and consequently reduce the risks and impacts of their use on ecosystems and human health.

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Sara Sousa: Methodology, Validation and Data Curation for the pesticides analysed in gas chromatography, Investigation, Writing - Review & Editing.

José Vera: Methodology, Validation and Data Curation for the pesticides analysed in gas chromatography; Investigation.

Luciana Bitencourt: Methodology, Validation, and Data Curation for the pesticides analysed in liquid chromatography, Investigation.

Joana Vieira: Conceptualization, Resources.

Sandra Jorge: Conceptualization, Resources.

Jaime Gabriel Silva: Conceptualization, Resources.

Manuela Correia: Conceptualization, Supervision, Writing - Review & Editing.

Valentina F. Domingues: Conceptualization, Supervision, Writing - Review & Editing.

Cristina Delerue-Matos: Conceptualization, Supervision, Project administration, Funding acquisition, Writing - Review & Editing.

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Data availability All data generated or analysed during this study are included in this published article [and its supplementary information files].

Declarations

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Consent for publication Not applicable.

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References

Abdolazim B, Nazari Z, Rabiee MH, Raeesi G, Oveisi MR, Sadeghi N, Jannat B (2013) The organochlorine pesticides residue levels in Karun river water. Jundishapur J Nat Pharm Prod 8:41–46. https://doi.org/10.5812/jjnpp.6783

Abrantes N, Pereira R, Gonçalves F (2010) Occurrence of pesticides in water, sediments, and fish tissues in a lake surrounded by agricultural lands: concerning risks to humans and ecological receptors. Water Air Soil Pollut 212:77–88. https://doi.org/10.1007/s11270-010-0323-2

Antonious GF, Byers ME (1997) Fate and movement of endosulfan under field conditions. Environ Toxicol Chem 16:644–649. https://doi.org/10.1002/etc.5620160407

ATSDR-Endosulfan (2015): Agency for Toxic Substances and Disease Registry. Toxicological profile for endosulfan. Chapter 6. Potential for Human Exposure. page 221-272. Available at: https://www.atsdr.cdc.gov/toxprofiles/tp41-c6.pdf (accessed 2 March 2020)

Bala K, Geueke B, Miska M, Rentsch D, Poiger T, Dadhwa lM, Lal R, Holliger C, Kohler H (2012) Enzymatic conversion of ε-hexachlorocyclohexane and a heptachlorocyclohexane isomer, two neglected components of technical hexachlorocyclohexane. Environ Sci Technol 46:4051–4058. https://doi.org/10.1021/es204143x

Barceló D, Hennion MC (1997): Techniques and instrumentation in analytical chemistry. trace determination of pesticides and their degradation products in water, 19. Elsevier Science B.V, Amsterdam, The Netherlands. Hardcover ISBN: 9780444818423, eBook ISBN: 9780080543123

Barrie LA, Gregor D, Hargrave B, Lake R, Muir D, Shearer R, Tracey B, Bidleman T (1992) Arctic contaminants: sources, occurrence and pathways. Sci Total Environ 122:1–74. https://doi.org/10.1016/0048-9697(92)90245-N

Battaglin W, Fairchild J (2002) Potential toxicity of pesticides measured in midwestern streams to aquatic organisms. Water Sci Technol 45:95–102. https://doi.org/10.2166/wst.2002.0213

Cerrillo I, Granada A, López-Espinosa M-J, Olmos B, Jiménez M, Caño A, Olea N, Fátima Olea-Serrano M (2005) Endosulfan and its metabolites in fertile women, placenta, cord blood, and human milk. Environ Res 98:233–239. https://doi.org/10.1016/j.envres.2004.08.008

Covert SA, Shoda ME, Stackpoole SM, Stone WW (2020) Pesticide mixtures show potential toxicity to aquatic life in U.S. streams, water years 2013–2017. Sci Total Environ 745:141285. https://doi.org/10.1016/j.scitotenv.2020.141285

Cruzeiro C, Pardal MÂ, Rocha E, Rocha MJ (2015) Occurrence and seasonal loads of pesticides in surface water and suspended particulate matter from a wetland of worldwide interest—the Ria Formosa Lagoon, Portugal. Environ Monit Assess 187:669. https://doi.org/10.1007/s10661-015-4824-8

Cruzeiro C, Rocha E, Pardal MÂ, Rocha MJ (2016) Environmental assessment of pesticides in the Mondego River Estuary (Portugal). Mar Pollut Bull 103:240–246. https://doi.org/10.1016/j.marpolbul.2015.12.013

Cui S, Hough R, Yates K, Osprey M, Kerr C, Cooper P, Coull M, Zhang Z (2020) Effects of season and sediment-water exchange processes on the partitioning of pesticides in the catchment environment: implications for pesticides monitoring. Sci Total Environ 698:134228. https://doi.org/10.1016/j.scitotenv.2019.134228

Cumming H, Rücker C (2017) Octanol−water partition coefficient measurement by a simple ^{1}HNMR method. ACS Omega 2:6244–6249. https://doi.org/10.1021/acsomega.7b01102

DL (1977) Decree Law. Decreto-Lei n° 152/97 de de 19 de Junho do Ministério do Ambiente e do Ordenamento do Território. DIÁRIO DA REPÚBLICA — I SÉRIE-A - N°139 — 19-6-1997, 2959-2968. Available at: https://dre.pt/application/conteudo/365343, Accessed date: 01 February 2021.

DL (2015): Decree Law. Decreto- Lei n° 218/2015 de 7 de outubro do Ministério do Ambiente e do Ordenamento do Território. Diário Da República, 1a Série-N° 196, 196, 8667–8685. Available at: https://dre.pt/application/file/a/70476114, Accessed date: 09 February 2020

Drożdżyński D (2008) Studies on residues of pesticides used in rape plants protection in surface waters of intensively exploited arable lands in Wielkopolska province of Poland. Ann Agric Environ Med 15:231–235

EC (1998): COUNCIL DIRECTIVE 98/83/EC of 3 November 1998 on the quality of water intended for human consumption. L 330. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31998L0083&from=EN, Accessed date: 04 February 2020), Official Journal of the European Communitie, pp. 32-54

EC (2000): DIRECTIVE 2000/60/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 October 2000 establishing a framework for Community action in the field of water policy. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32000L0060, Accessed date: 04 February 2020, Official Journal of the European Union, pp. 1-72

EC (2002): 2002/657/EC: Commission Decision of 12 August 2002 implementing Council Directive 96/23/EC concerning the performance of analytical methods and the interpretation of results.2002/657/EC. Available at: https://op.europa.eu/en/publication-detail/-/publication/ed928116-a955-4a84-b10a-cf7a82bad858/language-en, Accessed date: 14 April 2020. In: European Commission (Hrsg.), pp. 8-36

EC (2013): DIRECTIVE 2013/39/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 12 August 2013 amending Directives 2000/60/EC and 2008/105/EC as regards priority substances in the field of water policy. Available at: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:226:0001:0017:EN:PDF, Accessed date: 04 February 2020, Official Journal of the European Union, pp. 1-17

FAO (2020) APPENDIX 3-Fact sheets on pesticides. Available: http://www.fao.org/3/X2570E/X2570E07.htm, Accessed date: 11 April 2020

Ferencz L, Balog A (2010) A pesticide survey in soil, water and foodstuffs from Central Romania. Carpath J Earth Env 5:111–118 http://www.cjees.ro/viewTopic.php?topicId=80~. Corpus ID: 32012314

Fernandes VC, Domingues VF, Mateus N, Delerue-Matos C (2011) Organochlorine pesticide residues in strawberries from integrated pest management and organic farming. J Agric Food Chem 59: 7582–7591. https://doi.org/10.1021/jf103899r

Fujioka K, Casida JE (2007) Glutathione S-transferase conjugation of organophosphorus pesticides yields S-Phospho-, S-Aryl-, and S-alkylglutathione derivatives. Chem Res Toxicol 20:1211–1217. https://doi.org/10.1021/tx700133c

Fytiano K, Pitarakis K, Bobola E (2007) Monitoring of N-methylcarbamate pesticides in the Pinios River (central Greece) by HPLC. Int J Environ Anal Chem 86:131–145. https://doi.org/10.1080/03067310500248171

Gros M, Rodríguez-Mozaz S, Barceló D (2012) Fast and comprehensive multi-residue analysis of a broad range of human and veterinary pharmaceuticals and some of their metabolites in surface and treated waters by ultra-high-performance liquid chromatography coupled to quadrupole-linear ion trap tandem mass spectrometry. J Chromatogr A 1248:104–121. https://doi.org/10.1016/j.chroma.2012.05.084

Guillossou R, Le Roux J, Mailler R, Vulliet E, Morlay C, Nauleau F, Gasperi J, Rocher V (2019) Organic micropollutants in a large wastewater treatment plant: what are the benefits of an advanced treatment by activated carbon adsorption in comparison to conventional treatment? Chemosphere 218:1050–1060. https://doi.org/10.1016/j.chemosphere.2018.11.182

Hoffman DJ, Rattner BA, Burton Jr GA, Cairns Jr J (2003): eds. Handbook of ecotoxicology (2nd ed.). Boca Raton: Lewis Publishers. ISBN 1-56670-546-0. OCLC 49952447

IPMA (2020) Instituto Português do Mar e da Atmosfera (Portuguese Institute of the Sea and the Atmosphere). Available at: https://www.ipma.pt/pt/, Accessed date: 10 April 2020

Jelic A, Gros M, Ginebreda A, Cespedes-Sánchez R, Ventura F, Petrovic M, Barcelo D (2011) Occurrence, partition and removal of pharmaceuticals in sewage water and sludge during wastewater treatment. Water Res 45:1165–1176. https://doi.org/10.1016/j.watres.2010.11.010

Köck-Schulmeyer M, Villagrasa M, López de Alda M, Céspedes-Sánchez R, Ventura F, Barceló D (2013) Occurrence and behavior of pesticides in wastewater treatment plants and their environmental impact. Sci Total Environ 458-460:466–476. https://doi.org/10.1016/j.scitotenv.2013.04.010

Le TDH, Scharmüller A, Kattwinkel M, Kühne R, Schüürmann G, Schäfer RB (2017) Contribution of waste water treatment plants to pesticide toxicity in agriculture catchments. Ecotoxicol Environ Saf 145:135–141. https://doi.org/10.1016/j.ecoenv.2017.07.027

Leonard AW, Hyne RV, Lim RP, Leigh KA, Le J, Beckett R (2001) Fate and toxicity of endosulfan in Namoi River water and bottom sediment. J Environ Qual 30:750–759. https://doi.org/10.2134/jeq2001.303750x

Linden J (2013): Insect control on pig farms. Available at: https://thepigsite.com/articles/insect-control-on-pig-farms, Acessed date: 12 March 2020

Lockhart WL, Wagemann R, Tracey B, Sutherland D, Thomas DJ (1992) Presence and implications of chemical contaminants in the fresh waters of the Canadian Arctic. Sci Total Environ 122:165–245. https://doi.org/10.1016/0048-9697(92)90248-Q

Mansilha C, Melo A, Ferreira IMPLVO, Pinho O, Domingues V, Pinho C, Gameiro P (2011) Groundwater from infiltration galleries used for small public water supply systems: contamination with pesticides and endocrine disruptors. Bull Environ Contam Toxicol 87: 312–318. https://doi.org/10.1007/s00128-011-0337-5

Margot J, Rossi L, Barry DA, Holliger C (2015) A review of the fate of micropollutants in wastewater treatment plants. Wiley Interdiscip Rev Water 2:457–487. https://doi.org/10.1002/wat2.1090

Masiá A, Campo J, Vázquez-Roig P, Blasco C, Picó Y (2013) Screening of currently used pesticides in water, sediments and biota of the Guadalquivir River Basin (Spain). J Hazard Mater 263:95–104. https://doi.org/10.1016/j.jhazmat.2013.09.035

Mekonnen TF, Panne U, Koch M (2019) Glucosylation and glutathione conjugation of chlorpyrifos and fluopyram metabolites using electrochemistry/mass spectrometry. Molecules 24:898. https://doi.org/10.3390/molecules24050898

Münze R, Hannemann C, Orlinskiy P, Gunold R, Paschke A, Foit K, Becker J, Kaske O, Paulsson E, Peterson M, Jernstedt H, Kreuger J, Schüürmann G, Liess M (2017) Pesticides from wastewater treatment plant effluents affect invertebrate communities. Sci Total Environ 599-600:387–399. https://doi.org/10.1016/j.scitotenv.2017.03.008

NATA (2013): Guidelines for the validation and verification of quantitative and qualitative test methods. Technical Note 17. National Association of Testing Authorities, Australia. Available at: https://www.nata.com.au/phocadownload/gen-accreditation-guidance/Validation-and-Verification-of-Quantitative-and-Qualitative-Test-Methods.pdf, accessed 01 January 2021

Nowell LH, Norman JE, Moran PW, Martin JD, Stone WW (2014) Pesticide Toxicity Index—a tool for assessing potential toxicity of pesticide mixtures to freshwater aquatic organisms. Sci Total

Environ 476–477:144–157. https://doi.org/10.1016/j.scitotenv.2013.12.088

Paíga P, Santos LHMLM, Ramos S, Jorge S, Silva JG, Delerue-Matos C (2016) Presence of pharmaceuticals in the Lis river (Portugal): sources, fate and seasonal variation. Sci Total Environ 573:164–177. https://doi.org/10.1016/j.scitotenv.2016.08.089

Paíga P, Santos LHMLM, Delerue-Matos C (2017) Development of a multi-residue method for the determination of human and veterinary pharmaceuticals and some of their metabolites in aqueous environmental matrices by SPE-UHPLC–MS/MS. J Pharm Biomed Anal 135:75–86. https://doi.org/10.1016/j.jpba.2016.12.013

Paíga P, Correia M, Fernandes MJ, Silva A, Carvalho M, Vieira J, Jorge S, Silva JG, Freire C, Delerue-Matos C (2019) Assessment of 83 pharmaceuticals in WWTP influent and effluent samples by UHPLC-MS/MS: hourly variation. Sci Total Environ 648:582–600. https://doi.org/10.1016/j.scitotenv.2018.08.129

Palma P, Köck-Schulmeyer M, Alvarenga P, Ledo L, Barbosa IR, López de Alda M, Barceló D (2014) Risk assessment of pesticides detected in surface water of the Alqueva reservoir (Guadiana basin, southern of Portugal). Sci Total Environ 488-489:208–219. https://doi.org/10.1016/j.scitotenv.2014.04.088

Pitarch E, Medina C, Portolés T, López FJ, Hernández F (2007) Determination of priority organic micro-pollutants in water by gas chromatography coupled to triple quadrupole mass spectrometry. Anal Chim Acta 583:246–258. https://doi.org/10.1016/j.aca.2006.10.012

Ramesh A, Tanabe S, Iwata H, Tatsukawa R, Subramanian AN, Mohan D, Venugopalan VK (1990) Seasonal variation of persistent organochlorine insecticide residues in Vellar River waters in Tamil Nadu, South India. Environ Pollut 67:289–304. https://doi.org/10.1016/0269-7491(90)90067-M

Rao DMR, Murty AS (1980) Persistence of endosulfan in soils. J Agric Food Chem 28:1099–1101. https://doi.org/10.1021/jf60232a012

Rashid SS, Liu Y-Q (2020) Assessing environmental impacts of large centralized wastewater treatment plants with combined or separate sewer systems in dry/wet seasons by using LCA. Environ Sci Pollut Res 27:15674–15690. https://doi.org/10.1007/s11356-020-08038-2

Reungoat J, Macova M, Escher BI, Carswell S, Mueller JF, Keller J (2010) Removal of micropollutants and reduction of biological activity in a full scale reclamation plant using ozonation and activated carbon filtration. Water Res 44:625–637. https://doi.org/10.1016/j.watres.2009.09.048

Ritter L, Solomon KR, Forget J, Stemeroff M, O'Leary C (1995) A review of selected persistent organic pollutants: DDT, Aldrin, Dieldrin, Endrin, Chlordane, Heptachlor, Hexachlorobenzene, Mïrex, Toxaphene, Polychlorinated biphenyls, Dioxins, and Furans. PCS/95.39. A formal publication of the World Health Organization (WHO). Available at: https://www.who.int/ipcs/assessment/en/pcs953920040513.pdf, Acessed date: 01 February 2020.1-62.

Sánchez-González S, Pose-Juan E, Herrero-Hernández E, Álvarez-Martín A, Sánchez-Martín MJ, Rodríguez-Cruz S (2013) Pesticide residues in groundwaters and soils of agricultural areas in the Águeda River Basin from Spain and Portugal. Int J Environ Anal Chem 93:1585–1601. https://doi.org/10.1080/03067319.2013.814122

Şengül Ü (2016) Comparing determination methods of detection and quantification limits for aflatoxin analysis in hazelnut. J Food Drug Anal 24:56–62. https://doi.org/10.1016/j.jfda.2015.04.009

Singh SN (2016) Microbe-induced degradation of pesticides. Springer International Publishing.107. https://doi.org/10.1007/978-3-319-45156-5

Soares AFS, Leão MMD, de Faria VHF, da Costa MCM, Moura ACM, Ramos VDV, Neto MRV, da Cost aP (2013) Occurrence of pesticides from coffee crops in surface water. Ambi-Agua 8: 62-72. https://doi.org/10.4136/ambi-agua.1053

Spahr S, Teixidó M, Sedlak DL, Luthy RG (2020) Hydrophilic trace organic contaminants in urban stormwater: occurrence, toxicological relevance, and the need to enhance green stormwater infrastructure. Environ Sci-Wat Res 6:15–44. https://doi.org/10.1039/C9EW00674E

Stamatis N, Hela D, Konstantinou I (2010) Pesticide inputs from the sewage treatment plant of Agrinio to River Acheloos, western Greece: occurrence and removal. Water Sci Technol 62(5):1098–1105. https://doi.org/10.2166/wst.2010.932

Stenerson KK, Buchanan MD, Prevent GC (2020) Inlet Problems BEFORE They Cost You Time and Money. Reporter US, Volume 27.3. Available at: https://www.sigmaaldrich.com/technical-documents/articles/reporter-us/gc-inlet-problem-prevention.html, Acessed date: 14 April 2020, Reporter US

Thomas DJ, Tracey B, Marshall H, Norstrom RJ (1992) Arctic terrestrial ecosystem contamination. Sci Total Environ 122:135–164. https://doi.org/10.1016/0048-9697(92)90247-P

USEPA (2012): US Environmental Protection Agency. Ecological Structure Activity Relationships (ECOSAR) Predictive Model v1.11, Available at: https://goo.gl/xBM2VN

Wheeler W (2002): Pesticides in Agriculture and the Environment. 1st Edition. . CRC Press, New York, USA. ISBN-10 : 0824708091, ISBN-13 : 978-0824708092

Zhang P, Song JM, Yuan HM (2009) Persistent organic pollutants residues in the sediments and mollusks from the Bohai Sea coastal areas, North China: an overview. Environ Int 35:632–646. https://doi.org/10.1016/j.envint.2008.09.014

Zhou Y, Meng J, Zhang M, Chen S, He B, Zhao H, Li Q, Zhang S, Wang T (2019) Which type of pollutants need to be controlled with priority in wastewater treatment plants: traditional or emerging pollutants? Environ Int 131:104982. https://doi.org/10.1016/j.envint.2019.104982

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RELATÓRIO INDIVIDUAL DE TRABALHO
2023.2

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TELEFONE: 79-99825-9030	**E-MAIL:** elze.kelly@ifs.edu.br

Orientações para preenchimento

- Indicar no campo "Concluído" o status da atividade:
  - Concluída integralmente (CI);
  - Concluída parcialmente (CP) – especificar percentual; ou
  - Não desenvolvida (ND).
- Atividades concluídas parcialmente e/ou não desenvolvidas devem ser justificadas no campo observações.

AULA		
Disciplina	Concluído	Observações
COQUI18.662Físico-química para o ensino médio	**CI**	
COQUI18.608 Físico-Química I	**CI**	
COQUI 565 Processos Físico-químicos Experimental T01A	**CI**	
Físico-química II – 4º LQUI	**CI**	
Físico-química Experimental 5ºLQUI	**CI**	

MANUTENÇÃO DE ENSINO		
Atividade	Concluído	Observações
Manutenção de Ensino	**CI**	

APOIO AO ENSINO		
Atividade	Concluído	Observações
Atendimento, acompanhamento, avaliação e orientação de discente	**CI**	

Participação em reuniões ordinárias e/ou extraordinárias	**CI**	

ATIVIDADE DE PESQUISA APLICADA E INOVAÇÃO		
Projeto	Concluído	Observações
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ATIVIDADE DE EXTENSÃO		
Atividade	Concluído	Observações
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GESTÃO E REPRESENTAÇÃO INSTITUCIONAL		
Atividade	Concluído	Observações

OUTRAS OBSERVAÇÕES

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