
PLANT QUALITY RESEARCH

Chloroplasts are the organelles that define plants and the unique site of photosynthesis, the only significant mechanism of energy input into the biosphere. Adverse environmental conditions including high temperatures, cold, drought, and salinity cause protein stress and aggregation in plant chloroplasts. Recycling of damaged proteins is achieved by the action of molecular chaperones but, when recycling is not possible, toxic aggregated proteins have to be degraded by the action of proteases to avoid damage to the organelle. Chaperones and proteases act coordinately and constitute protein quality control (PQC) systems that are required for organismal survival. In chloroplasts, similar mechanisms ruled by the chaperone HSP70 survey for maintaining protein homeostasis (proteostasis).

In our group, we have unveiled a novel synergistic collaboration between the chaperone HSP70 and the protease CLP in preventing the accumulation of protein aggregates. In these synergistic interaction DNAJ proteins are key factors that provide specificity to the system, adaptors that recognise unfolded substrates and transfer them to the HSP70 for refolding, often in cooperation with CLPB3. However, when refolding is not possible, the DNAJ/HSP70 transfer substrates to CLPC1, a subunit of the CLP protease for degradation. The accumulation of protein aggregates unleashes a chloroplast-to-nucleus retrograde signalling pathway that specifically activates the transcription of chaperones at the nucleus, the chloroplast unfolded protein response (cpUPR).

In our goal to design new strategies to engineering plant stress tolerance, we are currently engaged in the study of three interconnected objectives:

- To identify novel substrates of DNAJ proteins in chloroplasts.
- To untangle the specificity of the different CLPC adaptors.
- To unveil components of the cpUPR signalling pathway.

PROFESSIONAL CAREER

2025/Current	CSIC researcher at the IBVF (Seville, Spain).
2020/2025	Talent Attraction fellow at CNB (Madrid, Spain).
2018/2020	Postdoctoral position at Prof. Dr. Paul Jarvis's research group at the University of Oxford (United Kingdom).
2016/2018	Marie Skłodowska-Curie fellow at Prof. Dr. Dario Leister's research group at Ludwig Maximilians University (LMU), Munich (Germany).
2014/2015	Postdoctoral position at Prof. Dr. Dario Leister's research group at the Copenhagen Plant Science Centre (CPSC) (Denmark).
2008/2014	Postdoctoral position at Prof. Dr. Manuel Rodriguez-Concepcion's research group at Centre for Research in Agricultural Genomics, Barcelona (Spain).

EDUCATION AND TRAINING

2008	Doctoral thesis: "Mechanism of protection against oxidative damage mediated by thioredoxins and peroxiredoxins in plants". Advisor: Prof. Dr. F. Javier Cejudo Fernández.
2004/2008	Predocctoral Grant, University of Seville (Spain).
2004/2005	Diploma of Advanced Studies, Ph.D program, Department of Vegetal Biochemistry and Molecular Biology, University of Seville.
2003/2004	Certificate of Teaching Aptitude, Complutense University of Madrid.

2002/2003	Collaboration Grant (Ministry of Education, Culture and Sports), Department of Vegetal Biochemistry and Molecular Biology.
2000/2003	Collaborating undergraduate student, Department of Vegetal Biochemistry and Molecular Biology.
1998/2003	University degree in Sciences of Chemistry, University of Seville.

PROJECTS AS PRINCIPAL INVESTIGATOR

1. Unravelling chloroplast retrograde signalling unleashed under protein quality control perturbation (RetroQuality). State Research Agency (AEI) (project PID2023-150687NB-I00, Total Project Budget 150.000€, Research Budget Allocation 120.000). From September 2024 to current.
2. Crosstalk between chloroplasts and other plant organelles (ChloroTalk). State Research Agency (AEI) (project CNS2022-135817, Total Project Budget 199.285€, Research Budget Allocation 126.500). From July 2023 to December 2025.
3. Unravelling chloroplast protein quality control for rational epigenetic reprogramming (EpiChloroplast). Autonomous Community of Madrid (project 2019-T1/BIO13731, Total Project Budget 301,000€, Research Budget Allocation 191,000). From July 2020 to June 2025.
4. New regulators of photosynthetic machinery and retrograde signalling in chloroplasts (ChloroQuality). State Research Agency (AEI) (project PID2020-118607RB-I00, Total Project Budget 75,625€, Research Budget Allocation 62,500€). From September 2021 to June 2024.
5. Dissecting chloroplast protein quality control specificity for rational plant reprogramming (ChloroQuality). H2020-MSCA-IF-2014_ST (project 656822, Total Project Budget 159,461€, Research Budget Allocation 19,200€). From January 2016 to December 2017.

PUBLICATIONS

1. Lopez B, Izquierdo Y, Cascon T, Zamarreño AM, Garcia-Mina JM, **Pulido P***, Castresana C* (2024) Mutant noxy8 exposes functional specificities between the chloroplast chaperones CLPC1 and CLPC2 in the response to organelle stress and plant defence. *Plant Cell Environ*, 47(7):2336-2350. <https://doi.org/10.1111/pce.14882>.
2. Isono E, Li J, **Pulido P**, Siao W, Spoel SH, Wuang Z, Zhuang X, Trujillo M (2024) Protein degrons and degradation: Exploring substrate recognition and pathway selection in plants. *Plant Cell*, 36, 3074–3098. <https://doi.org/10.1093/plcell/koae141>.
3. Llamas E, Koyuncu S, Lee HJ, Wehrmann M, Gutierrez-Garcia R, Dunken N, Charura N, Torres-Montilla S, Schlimgen E, Mandel AM, Theile EB, Grossbach J, Wagle P, Lackmann JW, Schermer B, Benzing T, Beyer A, **Pulido P**, Rodriguez-Concepcion M, Zuccaro A, Vilchez D* (2023) In planta expression of human polyQ-expanded huntingtin fragment reveals mechanisms to prevent disease-related protein aggregation. *Nat Aging*, 1345–1357. <https://doi.org/10.1038/s43587-023-00502-1>.
4. Llamas E*, **Pulido P*** (2022) A proteostasis network safeguards the chloroplast proteome. *Essays Biochem.*, 66 219–228. <https://doi.org/10.1042/EBC20210058>.
5. Thomson S, **Pulido P**, Jarvis P* (2020) Protein import into chloroplast and its regulation by the ubiquitin-proteasome system. *Biochem. Soc. Trans.*, 48(1): 71-82. (Impact Factor 2018: 5.407)
6. Rodriguez-Concepcion M, D'Andrea L, **Pulido P** (2018) Control of plastidial metabolism by the Clp protease complex. *J Exp Bot.*, 70(7): 2049–2058. (Impact Factor 2018: 5.360)

7. Kampinga HH, Andreasson C, Barducci A, Cheetham M, Cyr D, Emanuelsson C, Genevaux P, Gestwicki J, Goloubinoff P, Huertas-Cepas J, Kirstein J, Liberek K, Mayer M, Nagata K, Nillegoda NB, **Pulido P**, Ramos C, de los Rios P, Rospert S, Rosenzweig R, Sahi C, Taipale M, Tomiczek B, Ushioda R, Young JC, Zimmermann R, Zylicz A, Zylicz M, Craig EA, Jaroslaw M (2018). Function, evolution and structure of J-domain proteins. *Cell Stress Chaperones*, 24(1): 7-15. (Impact Factor 2018: 2.932)
8. **Pulido P**[†], Zagari N[†], Manavski N[†], Gawroński P, Matthes A, Scharff L, Meurer J, Leister D* (2018) CHLOROPLAST RIBOSOME ASSOCIATED supports translation under stress and interacts with the ribosomal 30S subunit. *Plant Physiol*, 177(4): 1539-1554. (Impact Factor 2018: 6.28)
9. **Pulido P***, Leister D* (2018) Novel DNAJ-related proteins in Arabidopsis thaliana. *New Phytologist*, 217(2): 480-490. (Impact Factor 2018: 6.635)
10. Llamas E, **Pulido P**, Rodriguez-Concepcion M* (2017) Interference with plastome gene expression and Clp protease activity in Arabidopsis triggers a chloroplast unfolded protein response to prevent accumulation of non-functional proteins. *PLOS Genet*. 13(9): e1007022. (Impact Factor 2017: 5.540)
11. Zagari N, Sandoval-Ibañez O, Sandal N, Su J, Rodriguez-Concepcion M, Stougaard J, Pribil M, Leister D*, **Pulido P**. (2017) SNOWY COTYLEDON 2 promotes chloroplast development and has a role in leaf variegation in both *Lotus japonicus* and *Arabidopsis thaliana*. *Mol. Plant*. 10, 721–734. (Impact Factor 2017: 9.326)
12. **Pulido P***, Llamas E, Rodriguez-Concepcion M* (2017) Both Hsp70 chaperone and Clp protease plastidial systems are required for protection against oxidative stress. *Plant Signaling & Behavior*, 12(3): e1290039. (Impact Factor 2016: 1.41)
13. Perello C, Llamas E, Burlat V, Ortiz-Alcaide M, Phillips MA, **Pulido P**, Rodriguez-Concepcion M* (2016) Differential Subplastidial Localization and Turnover of Enzymes Involved in Isoprenoid Biosynthesis in Chloroplasts. *PLOS One*, 11(2): e0150539. (Impact Factor 2016: 3.08)
14. **Pulido P***, Llamas E, Llorente B, Ventura S, Wright LP, Rodriguez-Concepcion M* (2016) Specific Hsp100 Chaperones Determine the Fate of the First Enzyme of the Plastidial Isoprenoid Pathway for Either Refolding or Degradation by the Stromal Clp Protease in Arabidopsis. *PLOS Genet*. 12(1): e1005824. (Impact Factor 2016: 6.100)
15. Llorente B*, D'Andrea L, Ruiz-Sola MA, Botterweg E, **Pulido P**, Andilla J, Loza-Alvarez P, Rodriguez-Concepcion M* (2016) Tomato fruit carotenoid biosynthesis is adjusted to actual ripening progression by a light-dependent mechanism. *Plant J*, 85(1): 107-19. (Impact Factor 2016: 5.901)
16. Pokhilko A, Bou-Torrent J, **Pulido P**, Rodriguez-Concepcion M, Ebenhöf O* (2015) Mathematical modelling of the diurnal regulation of the MEP pathway in Arabidopsis. *New Phytologist* 206(3): 1075-85. (Impact Factor 2015: 7.21)
17. Ghirardo A, Wright LP, Bi Z, Rosenkranz M, **Pulido P**, Rodriguez-Concepcion M, Niinemets Ü, Brüggemann N, Gershenson J, Schnitzler JP* (2014) Metabolic flux analysis of plastidic isoprenoid biosynthesis in poplar leaves emitting and nonemitting isoprene. *Plant Physiol*, 165(1):37-51. (Impact Factor 2014: 6.841)
18. Perello C, Rodriguez-Concepcion M, **Pulido P*** (2014) Quantification of plant resistance to isoprenoid biosynthesis inhibitors. *Methods Mol. Biol.*, 1153:273-83. (Impact Factor 2014: 1.49)
19. **Pulido P**, Toledo-Ortiz G, Phillips MA, Wright LP, Rodriguez-Concepcion M* (2013) Arabidopsis J-protein J20 Delivers the First Enzyme of the Plastidial Isoprenoid

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- Pathway to Protein Quality Control. *Plant Cell*, 25(10):4183-94. (Impact Factor 2013: 9.575)
20. **Pulido P**, Perello C, Rodriguez-Concepcion M* (2012) New insights into plant isoprenoid metabolism. *Mol. Plant*, 5(5):964-967. (Impact Factor 2012: 6.126)
 21. **Pulido P**[†], Spinola MC[†], Kirchsteiger K, Guinea M, Pascual MB, Sahrawy M, Sandalio LM, Dietz KJ, Gonzalez MC, Cejudo FJ* (2010) Functional analysis of the pathways for 2-Cys peroxiredoxin reduction in *Arabidopsis thaliana* chloroplast. *J Exp Bot.*, 61(14): 4043-54. (Impact Factor 2010: 4.818)
 22. Kirchsteiger K, **Pulido P**, Gonzalez MC, Cejudo FJ* (2009) NADPH Thioredoxin Reductase C Controls the Redox Status of Chloroplast 2-Cys Peroxiredoxins in *Arabidopsis thaliana*. *Mol. Plant*, 2(2):298-307. (Impact Factor 2009: 2.784)
 23. **Pulido P**, Dominguez F, Cejudo FJ* (2009) Oxidative stress and thiol-based antioxidant in cereals seeds. *Adv. Bot. Res.* 52: 437-460. (Impact Factor 2009: 1.333)
 24. **Pulido P**, Dominguez F, Cejudo FJ* (2009) A hydrogen peroxide detoxification system in the nucleus of wheat seed cells. *Plant Signaling & Behavior*, 4(1): 23-25.
 25. **Pulido P**, Cazalis R, Cejudo FJ* (2009) NADPH thioredoxin reductase accumulates in the nucleus of wheat seed cells suffering oxidative stress and supports the antioxidant activity of 1-Cys peroxiredoxin. *Plant J.*, 57:132-145. (Impact Factor 2009: 6.946)
 26. Spinola MC, Perez-Ruiz JM, **Pulido P**, Kirchsteiger K, Guinea M, Gonzalez MC, Cejudo FJ* (2008) NTRC: New ways of using NADPH in the chloroplast. *Physiol. Plant.*, 133(3): 516-24. (Impact Factor 2008: 2.334)
 27. Traverso JA, Vignols F, Cazalis R, Serrato A, **Pulido P**, Sahrawy M, Meyer Y, Cejudo FJ, Chueca A* (2008) Immunocytochemical localization of *Pisum sativum* TRXs *f* and *m* in non-photosynthetic tissues. *J. Exp. Bot.*, 59(6):1267-77. (Impact Factor 2008: 4.001)
 28. Cazalis R, **Pulido P**, Aussenac T, Perez-Ruiz JM, Cejudo FJ* (2006) Cloning and characterization of three thioredoxin *h* isoforms from wheat showing differential expression in seeds. *J. Exp. Bot.*, 57(10): 2165-72. (Impact Factor 2006: 3.630)

MANUSCRIPT UNDER REVISION

29. Nellaepalli S*, Baretic D, Brandner AF, Kubis-Waller S, Soufi Z, Cheng S, Kodru S, Fang J, Flores-Perez U, Ravikumar V, **Pulido P**, Fournier M, Ahel I, Khalid S, Jarvis RP* (202X) Assembly of two functionally-distinct protein import complexes in the outer membrane of plant chloroplasts. Target journal: *Nature Structural & Molecular Biology*. (bioRxiv: doi.org/10.1101/2025.10.27.683105)

DIRECTOR OF DOCTORAL THESIS

Catalina Perello – Defend in November 2013. In co-direction with Manuel Rodríguez Concepción – “Identification of mechanisms regulating plastid isoprenoid biosynthesis by the characterization of mutants of *Arabidopsis thaliana*”.

THESIS COMMITTEES

- Antonia Maria Gallardo Martinez. Función del sistema redox NTRC-2-Cys peroxirredoxinas en fases tempranas del desarrollo vegetal en *Arabidopsis thaliana*. Defense: 24th July 2024, Instituto de Bioquímica Vegetal y Fotosíntesis (IBVF-CSIC), Sevilla, Spain.
- Luis Gonzaga Heredia Martínez. Estudio funcional de la autofagia por estrés específico en el cloroplasto de la microalga modelo *Chlamydomonas reinhardtii*. Defence: 21th April 2022, Instituto de Bioquímica Vegetal y Fotosíntesis (IBVF-CSIC), Sevilla, Spain.

REFEREE/REVIEWER

- Journals: Nature Communications, Plant Cell, Plant Physiology, Plant J., J. Exp. Bot., J.B.C., Sci. Rep., Plant Cell & Environment, PLOS One, Annals Bot., Frontiers in Plant Science, Genes, Microbial Cell Factories, Genome, and others.
- Agencies: Agencia Estatal de Investigación (AEI), Marie Skłodowska-Curie actions (MSCA), Biotechnology and Biological Science Research Council (BBSRC), 'Deutsche Forschungsgemeinschaft' (DFG) German agency.

TEACHING EXPERIENCE

2016-2018	64 hours – Subject: Plant Science III, University of Munich (Germany). Department of Biology I
2003-2007	160 hours – Subject: Methods in Biochemistry. University of Seville (Spain), Department of Vegetal Biochemistry & Molecular Biology