Nelson Machado

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1. Scientific and professional profile and career

Nelson Machado (NM), obtained a PhD in Biochemistry, from the University of Coimbra (UC, Portugal), in 2012, having spent 1 year UMA (Malaga, Spain) during his PhD project. This work, where NM assessed SARs of distinct chromone derivatives, was based on the use of DFT methods coupled to spectroscopic vibrational techniques, including INS, thus including a visit to the ISIS Neutron and Muon Source (ISIS-RAL, Oxford, UK).

Afterwards, NM spent 1 year at UNIFI (Florence, Italy), working in the characterization of novel heme proteins adsorbed to Au nanorods/particles, resorting to spectroscopical means, to evaluate conformational changes upon interaction.

In 2014, NM joined UTAD (Vila Real, Portugal), as postdoctoral fellow. Here, NM has developed several characterization models based on IR (MIR and NIR intervals), resorting to Multivariate methods, such as PCA, and PLS-R/DA, gaining acquaintance in these methods, besides analytical techniques, such as HPLC. In 2018, while working in UTAD, NM completed a MSc in Oenology and viticulture, with a thesis on the feasibility of FTIR to support varietal (Tempranillo) improvement, as his thesis work.

From July, 2019, to May, 2023, NM worked as Senior Project Officer (SPO) at CoLAB V&W. Here, NM assumed a team leading role, working mainly in management and fundraising. NM, was co-responsible for securing funding for CoLAB V&W, with > 2.1M€ being allocated. Due to these tasks, during this period, his scientific work almost exclusively focused on the completion of 1 MSc and 3 PhD co-supervised theses.

Having joining INESC TEC in May, 2024, through the PhenoBot project, NM returned to a full-time research career, where he is focused on Systems Biology (BioSys) and development of High-Throughput methods (HTP).

NM displays a diversified track record, having published 45 peer-reviewed papers (11 first-authorships) in distinct areas, from molecular physical-chemistry to agrifood, having >1300 citations and an h-index 20 (SCOPUS).

2. Contributions to science and society

2.a. Contributions to the generation of new ideas, tools, methodologies or knowledge

In the Douro & Porto Hackathon -2021 Edition, participating as representative of CoLAB V&W, NM created the WaterFlow concept, with the goal of optimizing the water use in viticulture. This idea was further developed, under NM supervision, by a team of students led by CoLAB V&W elements, to which the “La Caixa” Prize 2022 has been awarded, allowing the deployment of a pilot. WaterFlow, was later funded by the “La Caixa” Foundation's 2023 Call, being presently under development.

Besides the initial conception and development of WaterFlow, which will ultimately result in a DSS to optimize the use of water, NM has participated in the development of several distinct platforms, to support the winemaking sector dealing with its main challenges, namely: INFRAVINI, to cope with climate change; VinCI, to predict productivity and the uncertainty of the markets; DigiFarm2All, to train people, and raise awareness for the use of digital technologies; WATSON, to prevent fraud; and SFT-EDIH, to provide digital services, for the agri-food sector.

The development of spectroscopical based eco-friendly tools for food, feedstuffs and by-products, was also attained by NM, as shown by the high visibility work ‘Potential of Legumes: Nutritional Value, Bioactive Properties, Innovative Food Products, and Application of Eco-friendly Tools for Their Assessment´ (doi/10.1080/87559129.2021.1901292). The versatility of this approach was proven in another work, analyzing not only feedstuffs, but also feces, to determine n-alkane and long-chain alcohol contents, which have been used as markers to assess the feeding behavior of herbivores (doi/10.1016/j.saa.2022.121544).

NM has also worked in the development of climate change adaptation measures, based on the thorough understanding of the Vitis vinifera physiology, mainly of the Touriga Nacional (TN) and Touriga Francesa (TF) varieties, along with the evaluation of specific adaptation measures. In this sense, NM has been co-supervisor of a PhD thesis, which uncovered the effects of kaolin on: i) balancing berry phytohormones and quality attributes of Vitis vinifera in harsh environments (doi/10.1002/jsfa.11413); ii) modulating the relation between xanthophyll-cycle; iii) energy dissipation (doi/10.1016/j.scienta.2021.110584) and iv) photochemical dynamics (doi/10.1016/j.plaphy.2021.03.038), thus proving the actual beneficial effects of this sunscreen approach.

Subsequently, NM coordinated the GT-TF (Working Group ‘TF’), a CoLAB V&W initiative to understand the collapse observed for this variety, in 2020, in the Douro region, strongly affecting the winemakers. Outputs from this initiative have been presented, at VitiVino 2022, in an oral communication by NM entitled “TF: from the 2020 collapse to the resurgence in 2022, how does this variety work?”.

Regarding adaptation to climate change, NM collaborated with UTAD researchers, in the calibration of grapevine phenology development predictions (distinct models under different optimization algorithms (10.3390/agronomy13030679)), besides simultaneous phenological and yield predictions, with a soil–plant–atmosphere system model using the frequentist method (doi/10.3390/agronomy11081659).

Finally, it must be mentioned the participation of NM in the development of the concept, as well as coordination, of the SustainWaine and ReWine Projects. Both initiatives had noticeable impact on public, being recognized by distinct entities, each receiving one prize: "Vida Rural Prizes": Remarkable R&D Prize, awarded to SustainWine, 2021, and "Crédito Agrícola" Entrepreneurship and Innovation Prize, awarded to ReWine, 2022.

NM, while working at CoLAB V&W, has been thoroughly involved in institutional contributions to policymaking, as expert in the CNOIV (OIV National Commission) SUSTAIN group, and CEEV, working in this entity’s 'Roadmap on Sustainability', which was adopted by CEEV's General Assembly, in 2022, and further integrated in the 'EU Code of conduct on responsible food business and marketing practices’. At National level, NM has been co-representative of ADVID/CoLAB V&W, till 2024, in CNCACSA and InovTechAgro, Competences Centers recognized by the Ministry of agriculture, participating actively in the definition of the strategic pluriannual plans of both entities. Also participated in the first meeting of the Northern Regional Innovation Council (CRIN), besides this entity written Consultation, regarding the S3NORTE 2027 strategy, in 2023.

Joining the PhenoBot project, in 2024, NM has been co-developer of the wearable Phenoware technology, which patent process is currently in preparation, presenting partial results of the project, regarding the thermodynamical role of water for photosynthesis, in the International Congress Molecules4Life, in 2025.

In 2025, NM received his 7th recognition, as team member of the project "Pocket Vet", awarded with an Honorable Mention, within the call "Bolsa de Investigação Jorge de Mello", by “Fundação Amélia de Mello”.

2.b. Contributions to the training and career development of researchers and/or research teams

NM, as SPO at CoLAB V&W, in most of the period considered, managed a team of 5 people with distinct expertise areas, composing the Sustainability Axis of this CoLAB. Assuming this role since day 1 of CoLAB V&W, NM developed the team and its members, as well as the functioning processes and team rapport, contributing to this entity consolidation. With NM as SPO, his team was responsible for 2 prizes awarded to ADVID/CoLAB V&W (Sustainwine & Rewine Projects), 2 MSc completed within the wine industry and 13 funded projects from competitive calls, while 2 team members completed a PhD, altogether, displaying NM leadership skills.

NM established, and coordinated, the GT-TF, an ad hoc initiative formed between academia and winemaking enterprises, to understand the shriveling phenomenon observed in 2020 for TF, the most important variety in the Douro Region.

NM contributed to the completion of a PhD thesis, 2021, from UTAD, dedicated to Climate Change adaptation of two grape varieties, as co-supervisor, assuming the same role in a WUR (Wageningen) student Erasmus internship, for a bachelor completion, based on the assessment of predictive phenological models as a tool for the winemaking sector, in 2022.

NM participates in the INESC TEC Summer Internships since he joined this entity, in 2024, as students' mentor, in the preparation of proposals for the students to apply, and support of the activities undertaken during the internships, besides the final presentations’ supervision. Presently, NM is co-supervisor of the Master's thesis, by a former summer intern, in physics engineering: Optimization of the quantum efficiency of photosynthesis in C3 plants: multiscale computational simulation and artificial intelligence of the chloroplast molecular machinery.

In 2025, NM was speaker at the "PhenoBot - the new frontier of regenerative viticulture focused on plant physiology” workshop, by ADVID, where the Phenoware technology, resulting from the PhenoBot project, was demonstrated.

2.c. Contributions to the scientific community

Before joining INESC TEC, NM worked at CoLAB V&W, co-organizing several webinars/workshops, mostly to disseminate the potential of newly developed digital solutions, such as the event “Agriculture 4.0 - Promoting Sustainability for the European Wine Sector”, held by CoLAB V&W within the Portuguese Presidency of the EU (PPUE).

NM was invited Chair of the session: “Mountain and steep slope Vineyards: agronomic practices through new technologies”, in the VII CERVIM Congress, being also co-organizer of the technical demonstration session undertaken within this event. Besides, NM was the representant of CoLAB V&W in the Douro & Porto Hackathon (2021 Edition), a marathon of intensive work with the aim of developing solutions to the Douro viticulture challenges, besides participating in the Lisbon FoodHack meetup - focused on WineTech, presenting and discussing the WaterFlow initiative.

Regarding refereeing, NM integrated the Scientific Committee of IOCAG 2025-The 3rd International Online Conference on Agriculture, with 2000+ participants, and is guest Editor of a special issue, in ‘Agriculture’, entitled “Advances in Sustainable Viticulture”, still ongoing, with three papers already published. NM was also Jury in two grants for MSc researchers, one within the PhenoBot project “AE2025-0273”, and another in

"NPK System and Metabolic Wearables for Plants", both at INESC TEC, and jury for doctoral examinations at Coimbra University.

2.d. Contributions to society

NM has participated in several third-party dissemination events, namely:

i) distinct CoLABs' Annual Meetings:

in the session "Agri-food, Energy and Sustainability: Biodiversity and Forest, Social Services and Tourism"; in a pitch session, to present the achievements of CoLAB V&W; and a meeting of CoLABs and CTI, as co-representative of CoLAB V&W.

ii) round tables:

Galicia Innovation Days 2021 – "Towards Horizon Europe: VINIoT project workshop"; Ciência 2023: session "Innovation, sustainability and food security: what is the positioning and roadmap of the agrifoodector CoLABs in the Agro sector?"; Dão Innovation Sessions: session "Climate Change - Key Drivers"; SmartFarm 4.0 final event: "Innovation and Technology in the Ecosystem".

iii) invited presentations:

Conference 'Sustentabilidade nos Vinhos Verdes': "Sustainable Viticulture: Practices or Regime?" and Conference 'Vida Rural: Verdes Anos': "Mechanization, robotics, DSS platforms, what can make a difference and reduce costs?".

Regarding field demonstrations, NM was mentor of the CoLAB V&W "Vineyard Days", which publicly probed the latest technological solutions for mountain in actual vineyards, and was co-organizer of the event Synergy Days: Robotics and IoT for Vineyards, organized by a consortium.

NM also coordinated the development of the ReWine and SustainWine dissemination projects, intended for winemakers and public, including children, to raise awareness for the sustainability theme.

3. Scientific production and/or selected activities

Waterflow was an initiative firstly developed within the co-creation initiative Douro & Porto Hackathon, 2021, promoted by IVDP - Governmental Institute. NM proposed the challenge to be faced, and worked both on its development and the answer idea to be developed in this Hackathon, which lies on the development of models to predict vine water stress throughput meteorological variables - monitored with low-cost sensors, thus allowing the deployment of a network of sensors (connected through LoraWAN), to map the water stress in a vineyard, resorting AI, to ascertain an optimal water supply. Within this initiative, NM mentored a team of 4 students to win La Caixa Prize 2022 (5 000€) and led the team of CoLAB members proposing the subsequent project, funded by La Caixa Foundation (165 808€).

The development occurred, firstly by a team of CoLAB V&W/UTAD students, which installed a 1st pilot, while, presently, the AI layer is being developed (with NM supervision till 2023) in collaboration with UTAD/INESC TEC.

Webinars/workshops for the dissemination of outputs from projects, co-organized by NM:

i) Webinar: Impact Management of Climate Change in the Vineyard, 2022, INFRAVINI project, to present the Infrastructure of Spatial Data INFRAVINI, an innovative DSS platform;

ii) Workshop: The impact of innovation in supporting SMEs in the Wine Sector, 2023, VInCI and VINIoT projects, presenting a tool for selecting export markets, as well as an IoT based service for the digital transformation of SMEs;

iii) Seminar: Strategic Management in the Wine Sector: How Decision Support Tools Can Increase Competitiveness, 2023, VInCI project, presenting the tools developed for the adaptation of SMEs to the markets' uncertainty, besides complementary platforms by third parties.

iv) webinars PhenoBot: "Bioengineering for Precision Agriculture Based on Plant Physiology; and Representative sampling: Satellite, drone, and point of measurement, 2025, also contributing with the previously mentioned appearances.

In the training and capacity building component of the PhenoBot project, through webinars, in 2025, NM made 3 distinct appearances, entitled: 'Reconstruction and analysis of genome-scale models of Vitis vinifera: energy generation and cellular physiological state'; 'Phenoware: Linking biotechnology and plant physiology-based agriculture for high-productivity and resilient farming' and 'Experimental design and multiscale physiological monitoring: case studies of PhenoBot´.