



N°17, November 2020

# NEWSLETTER



## EUROCAROTEN

EUROPEAN NETWORK TO ADVANCE CAROTENOID RESEARCH  
AND APPLICATIONS IN AGRO-FOOD AND HEALTH

### WELCOME

**We are pleased to welcome you to the 17<sup>th</sup> issue of the EUROCAROTEN newsletter.**

In our final issue, read about EUROCAROTEN's Wrap up meeting held virtually on 7<sup>th</sup> and 15<sup>th</sup> October 2020. We are sure that connections made during this COST Action will continue in future. Also, in Interview rubric, read about experience of Antonio J. Meléndez Martínez as EUROCAROTEN's chair.

Check out Carotenoids in daily life rubric to read about our carotenoid of the month – antheraxanthin and how NADES, a highly viscous mixtures of hydrogen-bond acceptors and bond donors (organic acids, sugars, polyols) could be used in extraction of carotenoids.

In "Think Tank Information" rubric, read about diversity of TT representatives during 4-year duration of the Action. In Working group news, activities within WG4 by were summarized and WG chairs and vice chairs have given their farewell notes.

Also, you can find more information about EUROCAROTEN COST Action on its COST website [http://www.cost.eu/COST\\_Actions/ca/CA15136](http://www.cost.eu/COST_Actions/ca/CA15136) and on our website [www.eurocaroten.eu](http://www.eurocaroten.eu).

*Yours sincerely,  
Anisa Peçuli,  
Ng'andwe Kalungwana,  
Kristina Kljak*



Subscription to the e-mailing list is available via the EUROCAROTEN website.

Send your comments and proposals to [info@eurocaroten.eu](mailto:info@eurocaroten.eu).

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"...being the Chair of EUROCAROTEN has been very beneficial in many senses. For instance I have acquired much more experience in terms of management."

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"It is now evident, however, that antheraxanthin is a widespread carotenoid and is neither confined specifically to anthers, nor always present in pollens which contain carotenoids."

Natural deep eutectic solvents (NADES): Potentials and challenges of a state-of-the-art green technology for carotenoid extraction [Page 7](#)

"Despite NADES's wide use to hydrophilic compounds extraction (i.e. polyphenols, anthocyanins, phenolic acids, etc.), their implementation to carotenoids' recovery to replace hazardous organic solvents (hexane, chloroform) by achieving high extraction efficiency, has attracted notice."

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# NEWS FROM THE ACTION

## CONTRIBUTION FROM THE NETWORK



### Special Issue "Carotenoids Esters in Foods" in Foods (IF = 4.092)

EUROCAROTEN member Dr. Dámaso Hornero Méndez and Dr. Sergio G. Atienza will be guest editors of special issue of Foods – "Carotenoids Esters in Foods".

This Special Issue aims to gather the newest information on the natural occurrence of carotenoid esters in foods and their use as traits for crop breeding and food authentication, as well as the latest advances in the understanding of the carotenoid esterification process.

Deadline for manuscript submissions is 30<sup>th</sup> June 2021.

For more information, visit  
[https://www.mdpi.com/journal/foods/special\\_issues/carotenoid\\_esters\\_foods](https://www.mdpi.com/journal/foods/special_issues/carotenoid_esters_foods).

### Special Issue "Potential Anticancer Effect of Value-Added Plant Food Processing Byproducts from the Fruit and Vegetable Industries" in Nutrients (IF = 4.546)

EUROCAROTEN member Prof. Dr. Monica R. Loizzo and Prof. Paolo Lucci will be guest editors of special issue of Nutrients – "Potential Anticancer Effect of Value-Added Plant Food Processing Byproducts from the Fruit and Vegetable Industries".

In this Special Issue, we shall collect a series of research papers/reviews aiming to highlight novel food byproducts able to prevent cancer development or progression, with particular attention to bioactive compounds obtained by "green" technologies.

Deadline for manuscript submissions is 21<sup>st</sup> May 2021.

For more information, visit  
[https://www.mdpi.com/journal/nutrients/special\\_issues/Potential\\_anticancer\\_effect\\_of\\_value-added\\_plant\\_food\\_processing\\_byproducts\\_from\\_the\\_fruit\\_and\\_vegetable\\_industries](https://www.mdpi.com/journal/nutrients/special_issues/Potential_anticancer_effect_of_value-added_plant_food_processing_byproducts_from_the_fruit_and_vegetable_industries).

# NEWS FROM THE ACTION

## PAST EVENTS

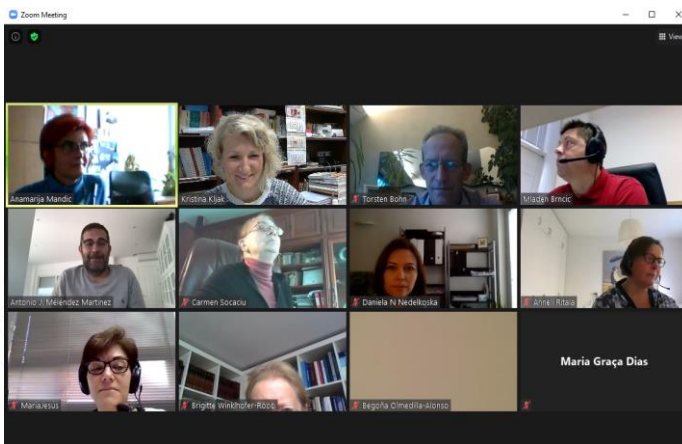
### EUROCAROTEN Wrap-up meeting

7<sup>th</sup> and 15<sup>th</sup> October 2020



The **EUROCAROTEN Wrap-up meeting** was held virtually in two separate meetings on **7<sup>th</sup> and 15<sup>th</sup> October 2020**. The host was **Anamarija Mandić** from University in **Novi Sad, Serbia**, and EUROCAROTEN members with leading roles and in charge of key tasks participated. **Two virtual meetings** a week apart were held that possible ideas formed during the first meeting could be further discussed in more detail during the second meeting.

Given that the **meeting was the last** during duration of EUROCAROTEN, Action chair **Dr. Antonio J. Meléndez-Martínez** presented the status of the **main Action tasks and deliverables**. Also, the sustainability of the Action once COST support finishes was discussed. Meeting participants expressed positive experience working within EUROCAROTEN which they would like to continue, so ideas for dedicated **EUROCAROTEN meetings in future and eventually the foundation of society** were presented.



Once the pandemic situation is over, **satellite events at the conferences** could serve as opportunity to hold meetings. All participants agreed to hold virtual meetings periodically (**approximately every 3-months**) so that the network continues to **collaborate actively**. Additionally, ideas about the application of new COST Action and new projects within different funding bodies were discussed.

# EUROCAROTEN INTERVIEW

TALKING WITH:

**Prof. Antonio J. Meléndez Martínez**

Affiliation	Dept. of Nutrition and Food Science, Universidad de Sevilla
Position	Full Professor
Country	Spain
Area of Interest	Food Quality, Nutrition, Health



## Please, describe your experience as a Chair of COST Action?

Familiarizing myself with COST management issues, getting organized and just getting started involved a lot of work. There were other stressful moments too but it is clear to me that **being the Chair of EUROCAROTEN has been very beneficial in many senses**. For instance I have acquired much more **experience in terms of management of multidisciplinary networks**, through participation in events organized by COST, the organization of workshops, training schools, the info day in Brussels. On the other hand I have had the chance to **team up with excellent professionals** (many of whom I did not know before) who have shared opinions, experiences and knowledge that have been very valuable. Overall, it has been a **very enriching and positive experience**.

## As Chair of the COST Action, what are some of the things you feel could have been done differently during your tenure as Chair or better still, things you would like see implemented in such future co-operative agreements?

Well, there are many ways of organizing and managing a COST Action as well as of distributing the funding into the different COST networking tools, all with pros and cons. I would say that the decisions in this sense of the Management Committee were appropriate to fulfil our objectives. However, it is also true that looking back now it would **have been good to provide the Early Career**

**Investigators with more leadership responsibilities**, for instance as deputy leaders of WGs. Their performance in activities such as the organization of events, dissemination activities or joint reviews has been outstanding, so they would have deserved more leading roles. Maybe next time. In any case I applauded the decision of COST of implementing the conference grants intended for them.

I would **definitely support other networking tools** specifically devoted to them as there are many talented and hard-working ECIS that need support to consolidate their careers.

## Did the EUROCAROTEN fulfil your expectations?

Yes, for sure. The germ of EUROCAROTEN was IBERCAROT (Ibero-American network for the study of carotenoids as functional food ingredients, <https://www.cost.eu/actions/CA15136/#tabs|Name:overview>) another network funded by Ibero-American Programme for Science, Technology and Development (CYTED, <http://www.cytel.org/>), which I also coordinated. In both cases, **my main personal goal was to help establish cohesive multidisciplinary networks interested in carotenoids** in the context of agro-food and health to contribute to tackle global challenges. I think that, with the help and great work of many committed participants, this has been achieved. **The links and collaborations established within IBERCAROT have continued over the years and I am pretty confident that the same will occur with EUROCAROTEN**. It has been 9 since IBERCAROT started and **now we are clearly**





# EUROCAROTEN INTERVIEW

seeing real impacts. For instance, young researchers that were supported and trained in that network are conducting high quality studies with important socioeconomic implications (sustainable practices to improve the nutritional value of crops or to improve the bioavailability of health-promoting compounds, valorisation of neglected fruits and vegetables, etc.). Similar outcomes are starting to be produced in EUROCAROTEN and will continue over time for sure.

On the other hand, sometimes I was not sure whether we were performing properly, although from the accounts of different stakeholders I am confident that ours has been a successful COST Action. I take the opportunity to thank the think tank members for this as they have been instrumental in many activities.

## In your opinion, what is "the legacy" of EUROCAROTEN?

The establishment of a functional, cohesive and wide (both in terms of expertise and geographical coverage) network with a shared interest in versatile compounds that are important to help tackle important challenges in different contexts such as food security, health promotion through the diet or even global warming.

## What are the key lessons learned from the EUROCAROTEN project?

There have been many. Some would be that:

- A network focused on carotenoids can benefit a great deal from participants who do not have much experience in them but bring in new ideas and perspectives. This is very important to think out of the box.
- A COST Action can benefit very much from the talent, work and knowledge of scientists that, unfortunately, do not have the best infrastructures or access to funding for research and innovation. The Management Committee should try to identify such participants and help them advance their career through COST networking tools.

- There is a bunch of talented, hardworking, enthusiastic, trustworthy and cooperative ECIs that will be key players in the field in the near future.

## What is your message to early career researchers that may have been part of this COST Action and are interested to further their knowledge in the field of carotenoid research?

In my view, being an active early career investigator in a COST Action is a very good experience as it gives the chance to network with many colleagues, acquire new skills, learn first hand from references in the field and increase their international visibility. I do encourage all of them to continue connected to carotenoids as they are very versatile compounds and can help address different challenges as already commented. They are essential in photosynthesis, the engine of life on Earth, and for the pollination and the dispersal of seeds (as they attract pollinators and seed dispersers). They are also precursors of phytohormones and other signalling molecules that regulate key processes in plants. Since plants are essential in agro-food the importance of carotenoids in food security is undeniable. Carotenoids are also important from different standpoints in foods as they are colorants and some are precursors of vitamin A, which is essential for humans. Besides, there is evidence that carotenoid-containing foods are involved in health-promoting biological actions and contribute to reduce the risk of diseases such as several types of cancers, cardiovascular diseases, bone, skin, eye or metabolic disorders. Now there is a clear trend to use them in the field of nutricosmetics. Considering all this it is clear that carotenoids are important for different fields and related industries, including photosynthesis, ecology, agriculture, aquaculture, foods, health or cosmetics, just to mention some. Thus, there is a lot of future on carotenoid research, especially integrated in projects with broader scopes. I am sure that the young researchers involved in EUROCAROTEN will contribute to important advances in knowledge and applications in the near future.

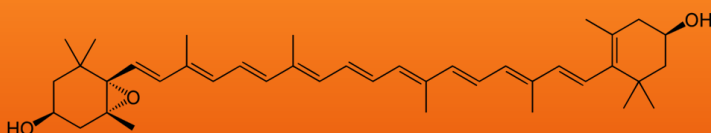
# CAROTENOIDS IN OUR DAILY LIFE

## CAROTENOID OF THE MONTH

Name: Antheraxanthin

Chemical Formula:  $C_{40}H_{56}O_3$

Molecular Weight: 584.9 g/mol



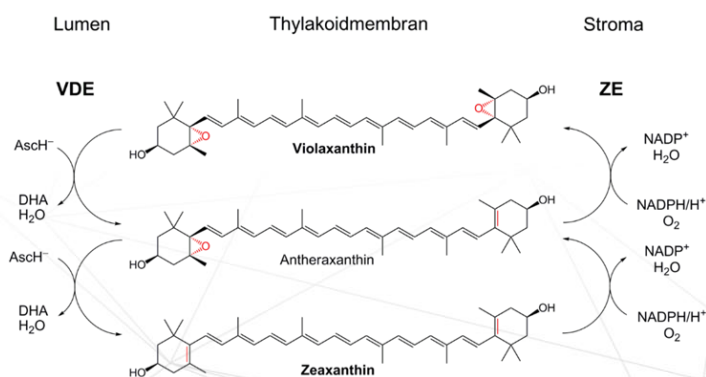
Antheraxanthin was first isolated from the anthers of Tiger lily (*Lilium tigrinum*). It is now evident, however, that antheraxanthin is a widespread carotenoid and is neither confined specifically to anthers, nor always present in pollens which contain carotenoids. Antheraxanthin is both a component in and product of the cellular photoprotection mechanisms in photosynthetic green and red algae, euglenoids, and plants. It has been found in high levels in sun-exposed dandelions (*Taraxacum officinale*).

Antheraxanthin is xanthophyll, and as a epoxy carotenoid, it is named according to the usual rules of organic chemical nomenclature as 5',6'-dihydro-5',6'-epoxy- $\beta,\beta$ -carotene-3,3'-diol.

For plants and algae, exposure to high light levels is deleterious to their photosynthetic machineries. Most photosynthetic organisms protect themselves against

high light caused photo-damages by xanthophyll cycle-dependent thermal energy dissipation. It is generally accepted that high light activates xanthophyll cycle. Antheraxanthin is an intermediate molecule of the xanthophyll cycle in most photosynthetic eukaryotes, namely plants, and some bacteria. Lessening or heightening photoprotection through the xanthophyll cycle allows plants to regulate their own light uptake for photosynthesis. A plant can increase its capacity for non-photochemical quenching and excess heat dissipation by converting the orange pigment violaxanthin to antheraxanthin and then to light-yellow pigment zeaxanthin. For these reasons, antheraxanthin and other photopigments are in their highest concentrations in the leaves of plants under high solar radiation or light/heat exposure.

During light stress, violaxanthin is converted to zeaxanthin via the intermediate antheraxanthin, for which investigations indicate that plays also a direct photoprotective role acting as a lipid-protective anti-oxidant and by stimulating non-photochemical quenching within light-harvesting proteins.



Representation of the xanthophyll cycle

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# CAROTENOIDS IN OUR DAILY LIFE

## NATURAL DEEP EUTECTIC SOLVENTS (NADES): POTENTIALS AND CHALLENGES OF A STATE-OF- THE-ART GREEN TECHNOLOGY FOR CAROTENOID EXTRACTION



Have you ever wondered how carotenoids and other lipophilic compounds are dissolved in nature without the existence of organic solvents? The answer lies in the presence of a third solvent, apart from water and lipids, known as **Natural Deep Eutectic Solvents**. Various natural products (**honey, sugar beet, maple syrup, resurrection plants**) are the first **NADES** systems.

NADES are **highly viscous mixtures** of hydrogen-bond **acceptors (salts, amino acids, organic acids)** and hydrogen bond donors (organic acids, sugars, polyols), leading to a significant decrease of the melting point of the mixture compared to that of its components.

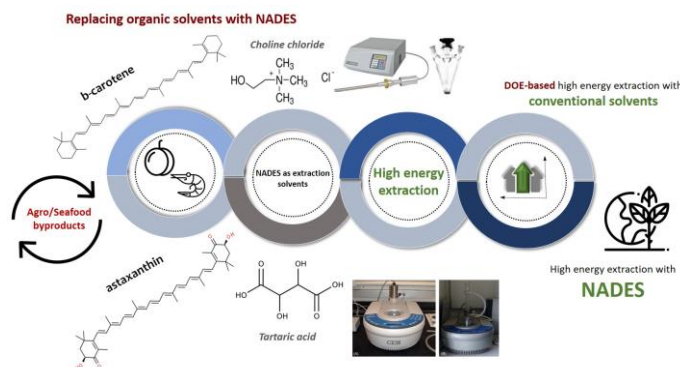
**NADES** plays a prominent role in extraction field, standing in the forefront of sample preparation. Despite **NADES's** wide use to hydrophilic compounds extraction (i.e. polyphenols, anthocyanins, phenolic acids, etc.), **their implementation to carotenoids' recovery to replace hazardous organic solvents** (hexane, chloroform) by achieving high extraction efficiency, has attracted notice.

Current studies focus on **the hyphenation of NADES** with high energy extraction **techniques (UAE, MAE, SFE, PLE)** for the recovery of  $\beta$ -carotene, lycopene and astaxanthin **from natural substrates** (orange peel, apricots, tomatoes, marine plants, microalgae and seafood). The applied extraction techniques provide remarkably high yields in shorter time (around 10-20 minutes) compared to **conventional extraction methodologies**. The most common NADES used for carotenoid extraction are both hydrophilic (**choline chloride-tartaric acid, C9:C10:C11 fatty acids, 1,2-propanediol-choline chloride-water, etc.**) and

hydrophobic systems (menthol-organic acids).

Eventually, **can NADES substitute organic solvents?**  
The answer can be yes since:

- ✓ They provide high extraction yields as they are task-specific solvents
- ✓ It's easy to tune their physicochemical properties
- ✓ They are considered 'green' solvents
- ✓ Their removal from the final extract is not a necessary step



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# THINK TANK INFORMATION

The Think Tank (TT) Committee was established as a support platform for the ECIs, with the goal of helping and promoting the career development of Early Career Investigators (ECI). In this last issue of the newsletter we are glad to conclude that we have reached our main objectives. The TT has been a connecting bridge between Management Committee and ECIs, has built up and used the social media tools (Facebook, LinkedIn, Twitter) in a very effective way for the dissemination of relevant information regarding the COST Action. Furthermore, the TT has been a support pillar and helped in the organization of 3 COST Action workshops and participated in 3 training schools.

The TT Committee has three members, an ECI spokesperson, with the 4-year mandate, and the TT representatives who are chosen annually. Within EUROCAROTEN, ECI spokesperson is Kristina Kljak (University of Zagreb, Croatia) while our representatives have been as below:

## Representatives for 1<sup>st</sup> year:

Joana Corte-Real, Luxembourg Institute of Health, Luxembourg

Paula Mapelli-Brahm, Universidad de Sevilla, Spain

## Representatives for 2<sup>nd</sup> year:

Ludmila Bogacz-Radomska, Wroclaw University of Economics, Poland

Mohammed Iddir, Luxembourg Institute of Health, Luxembourg

## Representatives for 3<sup>rd</sup> year

Marina Green, Nutrition research center, Ireland

Sanja Vlaisavljević Krstić, University of Novi Sad, Serbia

## Representatives for 4<sup>th</sup> year

Anisa Peçuli, Agriculture University of Tirana, Albania

Ng'andwe Kalungwana, University of Leeds, United Kingdom

We have been very pleased by the diversity of the nationality of our representatives as shown in the map, an indicator of the broad involvement of the Action.



OF EARLY CAREER INVESTIGATORS AND  
OTHER YOUNG RESEARCHERS

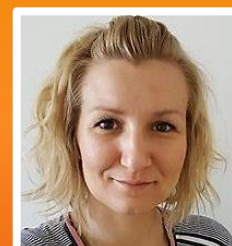
## Representatives for 4<sup>th</sup> grant period:



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## ECI spokesperson:



# WORKING GROUP NEWS

## WG4 Transfer, dissemination and exploitation


The WG4 track during the COST EUROCAROTEN Action has been full of enthusiasm due to the brilliant people implementing various dissemination activities related to carotenoids. The **main objective** of WG4 was to maximize **impact of COST EUROCAROTEN by communication and dissemination** in order to reach out particularly to European citizens so as to improve their knowledge on the importance of carotenoids. To fulfil this, we took full use of perhaps, the most influential tool - our COST EUROCAROTEN web page <https://www.eurocaroten.eu/>.

Professor **Cristina Silva** (University of Porto, Portugal) and **Miguel Braga** (Web designer) skilfully mastered the website. The number of visitors to our web page were impressive as shown in Table 1. In addition, **the annual bytes value of our webpage has been around 50 GB** corresponding to the volume of the transacted **information that is generated upon visits indicating very interactive stays**. The page got more than 120 000 visitors from all over the world from more than 75 countries verifying the truly international nature and importance of carotenoids as topic. Furthermore, more than 300 people follow us in social media channels @eurocaroten @Eurocarotenoids #eurocaroten, which is indeed a good outcome in these overwhelming social media times.


Table 1. Recorded activity of COST EUROCAROTEN web page <https://www.eurocaroten.eu/>

Year	Visitors	Number of visits	Visited pages
2016	~ 700	~ 900	~ 7800
2017	~ 30800	~ 61500	~ 183700
2018	~ 31200	~ 58800	~ 183700
2019	~ 31700	~ 63000	~ 197600
Sep/2020	~ 32100	~ 67200	~ 211500
In total	➤ 120000	➤ 240000	➤ 780000


WG4 has made **three EUROCAROTEN videos** that have **already gained 850 views**. We have **published 17 Newsletters** among the Action participants and **12 Scientific Newsletters** (<https://eurocaroten.eu/node/54>) covering topics from **biosynthesis and production of carotenoids, role in nutrition and health to prevalence and function in plants and animals**. All these materials can be utilized as part of the **dissemination material to promote use of carotenoids** and e.g. to help public **authorities to refine nutritional advice** to advance health and well-being of European citizens.



**EUROCAROTEN**  
Euro Caroten • 95 views • 1 year ago  
EUROCAROTEN is a multidisciplinary European network of researchers from 34 countries whose objective is to implement a ...



**Eurocaroten | Area of nutrition and food science, Universidad de Sevilla**  
fugazzz • 63 views • 8 months ago  
European network to advance carotenoid research and applications in agro-food and health.



**Carotenoids in Nature and importance in the diet and health**  
Euro Caroten • 681 views • 1 year ago  
Carotenoides en la Naturaleza e importancia en la dieta y la salud Carotenoides e a Natureza e importância na dieta e na saúde.  
Subtitles

# WORKING GROUP NEWS

## WG4 Transfer, dissemination and exploitation

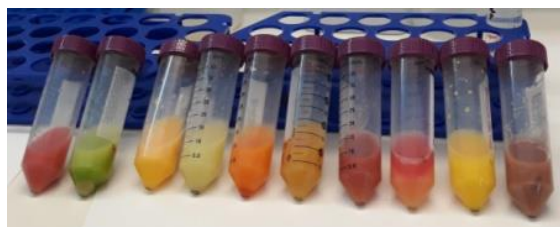
The future is in children - They are the tomorrow's consumers and decision makers. Thus, one of the most important dissemination activities has been taken with school kids and youth. We have organized several outreach events under the headline "Discover the colour of our fruits". These activities included easy hands on experiments to isolate carotenoids from fruits, accompanied with short talks to explain what carotenoids are and their potential health benefits and finalized with recommendations of regular intake of fruits and vegetables rich in carotenoids: Carotenoids every day keep the doctor away!

Dearest COST EUROCARTEN Action participants - You've made our Action to come true in so many excellent ways! It's been a great pleasure to disseminate with you all!

Cheers  
Anneli & George

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WG vice leader: Associate Professor George Manganaris, Cyprus University of Technology  
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# WORKING GROUP NEWS

## WG1, WG2 and WG3 – Notes from WG chairs and vice chairs

### Paul Fraser, WG1

The EUROCAROTEN COST Action facilitated some excellent networking events. The highlights from WG1 were the workshop on "Sustainable production of Carotenoids in Croatia 2017" organised by Joseph Hirschberg (The Hebrew University of Jerusalem, Israel) and Mladen Brncic, (University of Zagreb, Croatia) and the carotenoid analysis training school held at Royal Holloway, University of London, UK. These events had a great mix of experienced and young scientists from across Europe and beyond. It is a shame that larger projects have not been funded to ensure the community and field advances. All the participants and organisers of the events have to be thanked for making the network a fruitful experience.

### Nora O'Brien, WG2

As WG2 leader, I particularly enjoyed working with this group. I want to thank Anamarija for being such a great Co-Leader! The Action was exceptionally enjoyable and productive, in large part because of the enthusiasm of the many participants from across Europe. The Action ran so smoothly because of the excellent organisation skills of our Co-ordinator, Antonio, and his team in Seville and because

of the efforts and hospitality of the local organisers for each meeting venue. The many personal interactions of the participants and the scientific reviews produced by the Action should help foster further progress in the years ahead in research on carotenoids in foods and feeds.

### Torsten Bohn and Joanna Dulinska-Litewk, WG3

Overall, a very positive experience, with good and insightful personal and professional relations with other EUROCAROTEN members. Though not all goals were fully achieved, such obtaining an industrial PhD grant (lack of support), or achieving more clear intake recommendations (to far beyond state-of-the-art), we shared good collaborations, scientific short-term missions, publication writing (3x), SOPs, a carotenoid quiz for students and the general population, the generation of a carotenoid database with tissue levels and many fruitful exchanges in scientific meetings together. An important foundation for further collaboration across various carotenoid-related topics has been laid. We look forward to new projects with the hope to employ these natural compounds toward solving health problems, and also toward the creation of EFSA health claims for carotenoids.

## ACKNOWLEDGEMENTS

**We would like to thank everyone who has so kindly contributed with the content present in this newsletter:**

**Antonio J. Meléndez Martínez and Cristina L.M. Silva** for their guidance and supervision during the making of the EUROCAROTEN Newsletter.

**Antonio J. Meléndez Martínez** for his contribution to our EUROCAROTEN Interview.

**Elton Basha and Thalia Tsiaka** for their contribution to our "Carotenoids In Our Daily Life" rubric.

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**COST** (European Cooperation in Science and Technology) is a pan-European intergovernmental framework. Its mission is to enable break-through scientific and technological developments leading to new concepts and products and thereby contribute to strengthening Europe's research and innovation capacities.

"The EUROCAROTEN COST Action support for the production of this newsletter does not constitute endorsement of the contents which reflects the views only of the authors, and the COST Action cannot be held responsible for any use which may be made of the information contained therein."

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