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Tomato products help to reduce heart-disease risk?
Conference report
Rome, 26th February 2011

www.lycocard.com
• Introduction ................................................................. 3
• Nutrition and cardiovascular prevention .......................... 5
• Evolution of the Processing Tomato: from nutritional to functional food? .......................... 6
• Effect of lycopene on the progression of atherosclerosis development in New Zealand White Rabbits .................................................. 8
• Lycopene: A potential pro-vitamin A carotenoid with an unknown metabolic activation pathway .................................................. 9
• Cardiovascular-related biomarkers as affected by consumption of tomato products – results from human intervention studies .................... 10
• Nutrition and health claims applications related to lycopene, tomato and tomato products under EU Regulation 1924/2006. State of the art .................. 11
• Emerging epidemiologic evidence versus challenges in clinical trial design for the association between lycopene and CVD .................... 12
• Cigarette Smoking and lycopene Isomerisation ................... 13
• New putative bioactive lycopene metabolites: organic synthesis, antioxidant activity and preliminary studies of biological activities .................. 14
• Lycopene and other bioactive compounds in Tomato and Tomato products .................. 16
• LYCOCARD’s integrated communications platform continues to evolve .................. 18
• LYCOCARD – main conclusions and perspectives .................. 20
LYCOCARD was an integrated European project aimed to specify the role of lycopene and tomato products in the prevention of cardiovascular diseases (CVD). LYCOCARD gathered recognised teams in the carotenoid area into a multidisciplinary and transsectorial consortium in order to perform studies from in vitro to whole organisms and from food products to dietary recommendations. During the five years from 2006 to 2011, in vitro experiments as well as animal studies showed various mechanisms of action for lycopene as well as for tomato products. A facilitated transport (specific transporter proteins) of lycopene was shown instead of the formerly described passive diffusion of carotenoids. Lycopene was shown to be able to prevent oxidative stress. Antioxidant activity was determined for different lycopene isomers and for lycopene derived products. Regulation of cholesterol synthesis and efflux by lycopene was also observed. Lycopene inhibited pro-inflammatory cytokine expression in adipose tissue cultures. Summarising the in vitro studies and the animal experiments, various pathways of development of CVD were affected by lycopene and/or tomato products. In contrast, human intervention studies showed only small effects on markers of inflammation, but not on endothelial function and also not on other cardiovascular-relevant biomarkers.

Although there is no conclusive effect of lycopene and tomato products on cardiovascular risk factors, a new potential role of lycopene has been discovered – that of preventing inflammation involved in insulin resistance. Moreover, for the first time, genetic factors were shown to greatly influence the response to lycopene supplementation; this could explain the absence of results in human trials on the cardiovascular prevention of lycopene.

After five years of working together, final results of LYCOCARD as well as closely related topics were presented in February 2011 in Rome by project partners and invited speakers to the different target groups of our project and are now presented as summary with this brochure to all interested readers.

Volker Böhm (LYCOCARD coordinator)
The LYCOCARD Project

Contents

In Vitro Studies
- CHARITE BERLIN
- UNI DEBRECEN
- LJMU LIVERPOOL
- INRA MARSEILLE
- UNI ROME
- INRA AVIGNON
- UNI MURCIA
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In Vivo Studies
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Nutritional Guidelines & Dissemination
Food Product Studies
Nutrition and cardiovascular prevention

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An unfavourable diet in terms of quality and quantity contributes to the development of cardiovascular diseases. Obesity is one of the challenges our society has to face. Environmental factors seducing us to physical inactivity as well as the ubiquitous availability of foods with a high caloric density and sugar-sweetened drinks make weight control and weight loss difficult. There is also a social and educational gradient. Weight loss is less dependent on the type of diet consumed but rather on the frequent contact with a physician or dietician to keep up the motivation for a healthy lifestyle change.

The concept of prevention has moved from focusing on the individual components of a diet to recommending a food pattern. The Mediterranean diet is in many aspects the most favourable dietary pattern with a balanced mixture of components that have metabolically favourable and anti-inflammatory effects such as vegetables, legumes, fruits and cereals (primarily unprocessed), frequent fish consumption, less dairy products, rarely meat, a small amount of saturated fatty acids, but a high proportion of unsaturated fatty acids, particularly olive oil. A moderate consumption of alcoholic beverages mostly as wine and preferably with meals is probably beneficial. The effect of the Mediterranean diet has been evaluated in more than a million persons, in middle (> 55 years) and older (70 - 90 years) age groups, in Greek, European and US-American populations and has been confirmed in the 52-country INTERHEART Study. A high adherence to the Mediterranean diet – as judged by the Mediterranean diet score - is associated with a lower heart attack and a lower stroke rate, a lower cardiac, cardiovascular and cancer mortality and probably also a lower incidence of Alzheimer and Parkinsons disease.

Black tea (without milk) has a beneficial effect on endothelial function and on prognosis; up to 5 cups of coffee a day probably delay the onset of diabetes and have no unfavorable effects on the heart. Nuts are snacks with a beneficial prognostic impact, and chocolate (cocoa >70%) also has some beneficial effect on endothelial function.

Thus, even the optimal preventive diet can be a joyful and diversified experience.

A dietary modification aiming at reducing the global cardiovascular risk will require a long-term commitment to improve daily dietary habits in the direction of a calorie adapted Mediterranean diet. This is valid for healthy persons as well as for patients with vascular disease and patients after myocardial infarction.
Evolution of the Processing Tomato: from nutritional to functional food?
Luca Sandei, SSICA, Parma, Italy

a) The agro-industrial system is facing some tough challenges:

• A growth of food consumption due to an ever-increasing urban population with a higher income;
• A parallel decrease in the consumption of home processed food;
• An evolution in cookery towards middle-class tendencies;
• The diets of an aging population;
• An ever-growing efficiency in the distribution of base and first processed foods;
• Total Sustainability;
• “Ninety percent of the diseases known to man are caused by cheap foodstuffs and a non correct style of life”. You are what you eat (Feuerbach 1885).

b) From 1999 to 2009, global consumption of tomato products grew from 30.2 million tonnes (fresh equivalent) to nearly 40 million tonnes. Studying this period allows us to carry out short-term projections which show that an individual consumption threshold of 6 kg could be exceeded by 2013/2014, whereas global consumption could pass the 44 million tonnes mark by 2015/2016.

c) USDA guidelines and goals recommend eating more fruit & vegetables, fibre, potassium, vitamins, etc. Furthermore, they also recommend eating less food rich in calories, saturated fats and sodium. Since tomato is rich in potassium, rich in insoluble fibre and is a red vegetable it belongs at the centre of these guidelines and goals.

d) Other data (from Italian market research produced in 2010) show that naturalness and freshness are the main drivers for tomato products. Accordingly, an important point studied at SSICA due to these requests from consumer trends and habits is that of Organic Processing Tomatoes.

e) There is a tough global desire for chemical-free food additives:
• The Southampton study (McCann et al.) has continued to affect industry attitudes towards synthetic colours over the last two years. The study concluded that certain mixes of artificial food colours could aggravate hyperactivity in children. It received much media coverage and caused a stir among consumers and food manufacturers globally.

f) EUFIC (The European Food Information Council) defines functional foods as:
• Functional foods are developed specifically to promote health or reduce the risk of diseases. They usually look, smell and taste the same as their regular counterparts. Functional foods potentially offer health benefits but they do not offer a magic bullet against health problems. They are a positive, health enhancing addition to an overall balanced diet and active lifestyle. Combined with a healthy lifestyle, functional foods can make a positive contribution to health and wellbeing.
g) It is important to note that carotenoids are not the only bioactive compounds present in tomato products. In fact, some scientific evidence demonstrates that the antioxidant activity of tomato products is not caused solely by one component (lycopene), but rather by a synergistic effect coming from this macro-component and other micro-components natively contained within the vegetable. For instance, beyond the noteworthy lycopene concentration, tomato skins also contain very important amounts of phenols.

h) Conclusions:
- Despite the existing differences in the interpretation of nutritional data by the FDA, EFSA (NDA) and FAO (JECFA) we’d like to remark that tomato bioactive compounds should be interpreted not from a toxicology viewpoint, but more from one of health effects. Therefore, we should organise a very skilled partnership team for a challenging clinical trial design to assess that, thanks to their natural bioactive complex, tomato and processed tomatoes are indeed able to enhance our healthy lifestyle.
And we must become far more effective in guiding healthy food choices, with a realistic view of both the risks and benefits of processing tomatoes.

Our big challenge is to convince our fellow citizens that all we need is better science and technology.

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Effect of lycopene on the progression of atherosclerosis development in New Zealand White Rabbits

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Objectives: Lycopene is the main plant pigment found in high concentration in tomatoes. Strong epidemiological evidence suggests that lycopene may provide important protection against cardiovascular diseases. We investigated the potential cardiovascular protective effect of lycopene in New Zealand White rabbits after fat-induced atherosclerosis.

Material and methods: 36 animals were divided into four groups with 9 animals each that were fed a standard diet (SD), a high-cholesterol diet containing 0.5% cholesterol (HC), a high-cholesterol diet containing placebo beadlets (HC+P), or a high-cholesterol diet plus lycopene beadlets (HC+L) for a time period of 4 weeks. Lycopene was administered continuously at a dose of 5 mg/kg body weight/day. The levels of serum total cholesterol and LDL-cholesterol were measured. In addition, plasma levels of lycopene, vasoreactivity of isolated aortic and carotid rings as well as plasma levels of cyclic guanosine monophosphate (cGMP) were determined after the experiment. The area of atherosclerotic plaque was evaluated.

Results: We found significantly elevated plasma lycopene levels (mean ± SEM: SD, HC, HC+P 0.00 ± 0.00 µmol/L; HC+L 0.27 ± 0.04 µmol/L) in the lycopene treated group. In animals supplemented with lycopene, up to 50% reductions in total cholesterol (mean ± SEM: SD 31 ± 3 mg/dL; HC 1182 ± 110 mg/dL; HC+P 1078 ± 94 mg/dL; HC+L 664 ± 95 mg/dL; Fig. 1) and LDL cholesterol levels (mean ± SEM: SD 8 ± 1 mg/dL; HC 948 ± 110 mg/dL; HC+P 1020 ± 124 mg/dL; HC+L 581 ± 93 mg/dL; Fig. 1) in serum were observed. Morphological analysis did not reveal a significant decrease in the extent of atherosclerotic lesions or a reduction in the intima-media thickness. In addition, endothelial-dependent and -independent vasodilation measured in isolated rabbit aortic and carotid rings was not different between all treated groups. Plasma cGMP levels remained unaffected.

Conclusion: Lycopene supplementation for 4 weeks increased lycopene plasma levels, and potently reduced total and LDL-cholesterol levels in serum. No significant differences in atherosclerotic lesions and intima-media thickness in the aortae and in vasoreactivity of isolated blood vessels as well as cGMP levels have been observed.
Lycopene: A potential pro-vitamin A carotenoid with an unknown metabolic activation pathway

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Lycopene is a lipophilic carotenoid and provides tomatoes and tomato products with their red colour. It is suggested to be one of the most potent antioxidants found in foods due to its eleven conjugated double bonds. Some studies suggest that lycopene and tomatoes/tomato products are able to positively influence various diseases with a chronic inflammatory background. The mechanism of action of lycopene to elicit these effects is almost unknown and we speculate that nuclear hormone receptor activation via still unknown lycopene-metabolites in the mammalian organisms may occur. In this presentation we want to determine if lycopene, in comparison to the endogenous retinoic acid receptor (RAR)-ligand all-trans retinoic acid, may obtain RAR-activation potential in an in vivo RARE-luciferase reporter mouse model using male and female mice, whole body scanning as well as organ selective bioluminescence scanning and luciferase enzyme activity assay. We observed in male and female mice that lycopene was strongly inducing RARE-mediated signaling in various organs. Its main activity peaks 18 h after treatment, while ATRA-treatment peaked after 6 h. The potent RARE-activation was additionally confirmed by luciferase enzyme activity assay and QRT-PCR-based determination of carotenoid metabolising enzymes, carotenoid transporters as well as retinoid target gene expression analysis. In summary, we observed a tissue and temporal specific RARE-activation pattern of lycopene in this RARE-LUC mouse model and conclude that lycopene may be a precursor of potent RAR-activating lycopene metabolites. These potential RAR-activating metabolites are under further identification in our laboratories.
Cardiovascular-related biomarkers as affected by consumption of tomato products – results from human intervention studies

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Various epidemiological studies showed prevention of cardiovascular diseases (CVD) through the consumption of tomato products, being the main lycopene source in Western diets. Beside this red coloured carotenoid, other ingredients of tomatoes (e.g. ascorbic acid, folic acid, phenolic compounds) may also be responsible for beneficial effects. One possible mechanism of prevention is the antioxidant potential of tomatoes and tomato products. In vitro studies as well as animal experiments showed different mechanisms of action of lycopene. However, in vivo studies are needed to show effects of relevance for human beings. Thus, within LYCOCARD several human intervention trials were done, using different tomato products (tomato purée, tomato passata, tomato juice, tomato ketchup).

Looking for primary prevention effects, volunteers were healthy people without or with CVD risk factors (smokers, postmenopausal women, obese people), ingesting between 12 and 46 mg lycopene per day out of tomato products for one week up to 18 months. Although the lycopene contents in plasma increased in all studies, only small changes were observed in CVD relevant parameters. Some volunteers showed significantly increased antioxidant capacity in plasma. In addition, inflammatory markers were decreased after consumption of tomato products. In contrast, endothelial function remained unchanged as did lipid status parameters. Thus, further studies need to investigate in more detail the CVD-relevant anti-inflammatory effects of tomato ingredients.

Concluding all investigations within LYCOCARD, looking for primary prevention proved to be difficult as all volunteers were healthy and intervention with tomato products was not able to improve the health status. Lycopene dosage and duration of the intervention trials are further aspects affecting the study results. However, these study results did not exclude preventive effects of tomato products. To eat tomato products within a mixed diet is always a good and tasty choice, as lycopene is better absorbed from processed products than from raw tomatoes.
Nutrition and health claims applications related to lycopene, tomato and tomato products under EU Regulation 1924/2006. State of the art

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In December 2006, EU decision makers adopted a Regulation on the use of nutrition and health claims for foods which lays down harmonised EU-wide rules for the use of health or nutritional claims on foodstuffs. One of the key objectives of this Regulation is to ensure that any claim made on a food label in the EU is clear and substantiated by scientific evidence. The Regulation (EC) 1924/2006 on nutrition and health claims made on foods prohibits that a food can be promoted as a possessor of therapeutic or curative properties. The work of EFSA’s Panel on Dietetic Products, Nutrition and Allergies (NDA) includes providing scientific advice on: General function health claims under Article 13.1 of the EU Regulation; New function health claims under Article 13.5 of the EU Regulation; Claims regarding disease risk reduction and child development or health under Article 14 of the EU Regulation; Criteria for setting nutrient profiles. At present, this is an open process and different institutions are focusing their efforts on its recognition for labelling purposes. To date, EFSA has assessed 1,745 claims from a list of 4,637 health claims.

The following is a summary of EFSA’s opinions to date relating to lycopene, tomato and tomato products:

- **Water-soluble tomato concentrate (WSTC I and II) and platelet aggregation.**
  Applicant: Provexis Natural Products Limited, UK.

- **Combination of blackcurrant seed oil, fish oil, lycopene, vitamin C and vitamin E helps to improve dry skin conditions.**
  Applicant: Laboratoires innéov SNC.
  Result: Rejected (21 May 2010).

- **Lycopene-whey complex (bioavailable lycopene) and risk of atherosclerotic plaques.**
  Applicant: Cambridge Theranostics.
  Result: Rejected (3 August 2009).
Emerging epidemiologic evidence versus challenges in clinical trial design for the association between lycopene and CVD

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There are promising, albeit limited, epidemiologic data on the intake of lycopene and tomato-based food products and a lower risk of CVD. As tomatoes are the predominant food source of dietary lycopene, their roles will always be strongly linked and debated. Several plausible mechanisms have been identified through which lycopene and tomato products may reduce CVD risk. This evidence has largely been derived from small-scale clinical trials, while epidemiologic studies with previously collected data are limited and have yet to be fully utilised. Ideally, these mechanisms would consist of intermediate cardiovascular biomarkers (e.g. blood pressure, lipids, glucose or hemoglobin A1c levels) or endpoints (e.g. carotid intima-media thickness) with direct clinical interpretability and utility. Thus far, the epidemiologic evidence has appeared stronger for tomato products than for dietary lycopene based upon data from the Women’s Health Study and other cohort studies. Studies of plasma or serum lycopene have also been examined in relation to CVD, finding stronger potential benefits among women compared with men. Finally, serum lycopene has also been evaluated in relation to changes in carotid intima-media thickness, which represents an important intermediate cardiovascular endpoint. Overall, data are preliminary but indicate potentially modest benefits. Well-designed and conducted clinical trials are particularly important to ensure the selection of the most appropriate, generalisable intervention and clinically relevant scientific aims to maximise the scientific knowledge gained plus the statistical power to detect clinically meaningful effects. One such ongoing US-based clinical trial is testing a lycopene supplement among patients with coronary heart disease to examine changes in carotid intima-media thickness, coronary biomarkers, and other relevant coronary risk factors over a 1 year period and will provide meaningful mechanistic insights for supplemental lycopene.

Ultimately, nutrient- and food-based approaches to clinical research and public health should complement, not compete with, one another. As additional well-conducted basic science and epidemiologic studies emerge, it will be interesting to see what the data for lycopene and tomatoes reveal in relation to CVD prevention.
It is often assumed that smokers have lower plasma antioxidants than non-smokers and these include vitamin E, β-carotene and lycopene. Cigarette smoke is a very complex mixture and it has been demonstrated that one of its constituents, peroxynitrite may cross the lung alveolae, and it has been postulated that it may interact with components of the blood. One such constituent is plasma Low Density Lipoproteins (LDL) that comprises of a protein apolipoprotein B100 and lipids. LDL particles are also largely responsible for transport of lycopene in the blood. We recruited 25 smokers and non-smokers from the Merseyside area, to assess oxidation of LDL particles and if any depletion of lycopene had occurred. Blood was taken from the volunteers and full lipid profiles, oxidation of LDL and HPLC analysis was undertaken to determine measurements of lycopene and its isomers along with β-carotene. The first observation was that the smokers had a pro-atherogenic profile (higher total cholesterol and lower HDL cholesterol). It was also observed that smokers had a greater concentration of oxidised LDL, indicating they were under a greater oxidative stress. β-Carotene concentrations were lower in the smokers (p<0.05) but there was no significant difference in total lycopene (Fig.1). Upon further analysis it was noticed that smokers had more depleted concentrations of all (E)-lycopene compared with non-smokers and an altered all (E):Z lycopene ratio (Fig.2). This ratio was more apparent in heavier smokers (>15 cigarettes per day).

This indicated that smokers were including processed tomato products in their diet, but that cigarette smoke may act to partially deplete the all (E)-lycopene in the smokers.

![Fig. 1 Plasma carotenoid concentrations in smokers and non-smokers.](image1)

![Fig. 2 Changes in all (E)-lycopene and (Z)-lycopene isomers. In heavier smokers a marked decrease in all (E)-lycopene along with slight increases in (Z)-lycopene isomers.](image2)
New putative bioactive lycopene metabolites: organic synthesis, antioxidant activity and preliminary studies of biological activities

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As β-carotene is the precursor of vitamin A, we propose that lycopene could be the precursor of bioactive metabolites which could participate in the protection against degenerative diseases like cardiovascular diseases. Some lycopene derived molecules of the apo-lycopenoid family, i.e. issued from lycopene through an oxidative cleavage, have been detected in fresh tomato and more recently in tomato products and for the first time in humans. In the course of the LYCOCARD project we have prepared series of lycopene putative metabolites using organic synthesis (see scheme below). Four families of molecules were targeted which have different chain lengths and various ending functions: alcohol, aldehyde, carboxylic acid and ester.

Organic synthesis was based on coupling reactions in order to create new carbon-carbon double bonds and to enlarge the chain length. Coupling reactions were of Wittig or Horner-Wadsworth-Emmons type. An example of retrosynthesis of the apo-10'-lycopenoid series is shown in the scheme below.
Then, oxidation or reduction reactions were used to modify the ending function (R). After their synthesis, all the molecules were fully characterised using HPLC/DAD/MS, HRMS and NMR techniques. Their antioxidant activity was evaluated in different antioxidant tests. Using a model of oxidative stress in the gastro-intestinal tract, structure/activity relationships were demonstrated: the longer the chain, the more antioxidant – organic acid function confers better antioxidant activity. Though antioxidant activity is lower than those of other molecules commonly found in food like vitamin E and some phenolic compounds (quercetin, rutin, chlorogenic acid). Finally, preliminary studies showed that some of the obtained molecules were able to upregulate the expression of BCO2, an enzyme cleaving carotenoids excentrically. Studies on physico-chemical properties and biological activities of lycopene putative metabolites are still going on in our laboratories.

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  J. Agric. Food Chem. 2011, 59 (4), 1457-1463
The main aims of the food product studies within LYCOCARD were to find out which factors determine the content, stability and bioavailability of lycopene and other bioactive compounds (phenolic compounds, folates and vitamin C) in tomato and tomato products during processing and during storage. The research activities of this pillar provide new information related to the content of antioxidant compounds in tomatoes and tomatoes products processed under different technological conditions. This information helped the industrial partners to design new tomato products to be tested in the human intervention study to ascertain the beneficial effects of lycopene for the prevention of cardiovascular diseases.

During the five years of the project, the research activities have focused on the following aspects:

**Effect of cultivar, ripening stage, year of harvest and post-harvest ultraviolet light treatment on tomato bioactive compounds**

The content of the bioactive compounds (lycopene, phenolic compounds, ascorbic acid and folates) and antioxidant activity have been analysed in several tomato cultivars grown in Spain. The cultivars were classified as either tomatoes for fresh consumption (salad tomatoes) or tomatoes for industrial processing, with the objective of understanding the changes on bioactive cultivars according to the aptitude of the fruit. In addition, samples were classified following the ripening stage as green, breaker, pink and full red to ascertain the variation of these compounds during vine maturation. The main obtained results have shown that lycopene depends on the maturation stage of tomatoes, showing the highest amounts in the full red stage. However, the content of both ascorbic acid and phenolic compounds is lower in the full red tomatoes compared with the previous stage (breaker and pink). In addition, a positive effect on the content of bioactive compounds and antioxidant activity after the UV-C light exposure has been observed with in-vine and off-vine ripened tomatoes.

**Effect of processing and storage conditions on the bioactive compounds of tomato**

The effect of industrial processing has been evaluated in several tomato products, with the different processing steps being taken into consideration. The tomato products studied during the project were: tomato juice, passata, peeled tomato, tomato purée and diced tomato, and the industrial steps were: thermal treatment, homogenisation, peeling, concentration, cutting and canning. The effect of industrial processing on bioactive compounds is related to the extension of thermal treatment (temperature and time). In addition, new information related to the stability of the different bioactive compounds during storage at different temperatures along the self-life has been determined. Despite the fact that vitamin compounds (ascorbic acid and folates) decrease in tomato juice during storage, lycopene and individual phenolic compounds are more or less stable along the shelf life of tomato juice.
Contribution of bioactive compounds to the antioxidant activity of tomato

The main antioxidant compounds of tomato and tomato products are lycopene, total phenolic compounds and ascorbic acid. The hydrophilic antioxidant activity is related to phenolic compounds and ascorbic acid, when activity is measured by ORAC, FRAP and ABTS methods. The contribution of lycopene to the total antioxidant activity is very low when it is determined using the mentioned methods. The extract of tomatoes exhibit in vitro antioxidant activity in cells against an external oxidant added in the cell culture medium, reducing the ROS generation, lipid oxidation and DNA damage.

In vitro availability of tomato lycopene

Availability of lycopene in passata has been evaluated after in vitro digestion. The total content of lycopene and the isomerisation ratio have been measured after gastric and intestinal digestion, and in the micellar phase. Also, several factors that can be considered important in determining the availability of lycopene have been evaluated.

Study of the in vivo metabolites of lycopene after the intake of tomato products

With the information obtained in the previous activities, two new tomato products (tomato juice and ketchup) have been experimentally designed by the industrial partners to be tested in the human intervention study. Different parameters were analysed in the blood of the volunteers such as absorption and cardiovascular-relevant parameters.

Bibliography:
LYCOCARD’s integrated communications platform continues to evolve

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Communicating the project’s presence, its purpose, activities, ongoing investigations, its ideas and relevance to public health and industry, as well as its successes and discoveries, has been achieved through many forms and channels, both traditional and progressive. Possibly the most far reaching and easily accessible approach to promoting LYCOCARD has been via its online publications.

Starting back in 2006 with the project’s central website (www.lycocard.com), it immediately became obvious that dissemination activities of the project would need to align with the digital communications revolution. Since then, LYCOCARD has expanded its digital outreach on many fronts to create a fully integrated digital communications platform, which is still growing today. In 2007 the project published its first consumer nutrition information website, Tomato and Health (www.tomatoandhealth.com), based on the project’s printed magazine edition, Tomate et Santé, which was published in French in October 2006. In the Autumn of 2009, the German language edition of this site went online and in June of 2010, two more language editions were launched in Italian and Spanish.

These four editions are connected to each other, and to the main project website, and contain a broad variety of content designed to be attractive to consumers, students, primary school educators, food writers and other journalists for science and industry. By linking the sites together and by encouraging industry and others to provide inbound links, the collective web presence of all the sites is raised. SEO (search engine optimisation) takes many forms, including campaigns to place links in relevant weblogs, forums and on news sites. Just one well placed link can drive huge amounts of traffic to the platform in a matter of hours or days. Site content has been designed to be shared via social media sites so that visitors can pass it around, discuss or download the resources, or leave comments. The websites deliver multi-band content for multi-channel pathways and provide a chance for everyone to interact with and learn more about the project and the ideas it promotes. During the last 18 months almost 900 000 hits were registered across the entire collection of LYCOCARD’s online publications.

One specific project work package, WP31, called for an evolution in digital outreach. WP31 is the work package specifically concerned with creating and disseminating nutritional guidelines based upon the work of the project as well as healthy nutritional information in general. LYCOCARD has clearly considerably enriched our understanding of how lycopene and tomato contribute to improved human health and thus reduce the risk of chronic diseases such as cardiovascular disease. CVD may develop over decades and therefore it is very difficult to construct a specific nutritional guideline based only on the 5 year study of the project. The purpose of WP31 was modified to allow the project to more fully comply with the project’s contract to provide accessible heart-healthy dietary information aimed at a younger audience.
Far too many young people today are potentially the heart patients of tomorrow. LYCOCARD developed Love Heart Food as a web-based edition aiming to provide heart-healthy, quick and easy, low cost recipes in video format to help younger people learn how to cook and prepare healthy meals. Love Heart Food links through to all of the other project’s online editions and will massively raise the online presence of all the websites. Patient-care organisations, regional health authorities and the food industry are all involved to help drive interested consumers to the web resources in a positive feedback loop designed to fulfill LYCOCARD’s purpose of helping to reduce heart disease risk in the future.

The six online publications effectively work as separate parts of one edition. Please provide an inbound link to any of these web addresses from your organisation or company, or from your personal weblog or social media account.

www.lycocard.com
www.tomatoandhealth.com
www.tomateysalud.es
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www.tomateundgesundheit.de
www.loveheartfood.com
LYCOCARD is an integrated European project aiming to specify the role of lycopene and tomato products in the prevention of cardiovascular diseases. LYCOCARD gathers recognised teams in the carotenoid area into a multidisciplinary and transsectorial consortium in order to perform studies from in vitro to whole organisms and from food products to dietary recommendations.

While it is clear there is a positive contribution to human health in consuming tomato and tomato products as part of a healthy balanced diet, cardiovascular diseases develop over decades and it is extremely difficult to apply the scientific findings of LYCOCARD’s 5 years studies to show a conclusive effect in reducing CVD risk factors. However, a new potential role of lycopene in preventing inflammation involved in insulin resistance has been discovered. Moreover, for the first time, genetic factors were shown to greatly influence the response to lycopene supplementation (Fig. 1); this could explain the absence of results in human trials on the cardiovascular prevention of lycopene.

It should be mentioned that tomato products present a healthy nutritional profile with low energy and an interesting content of diverse vitamins (folates, vitamin C), minerals and specific components such as lycopene. Notably, carotenoids were shown to display a high stability along the food chain. Moreover, processing improves the bioavailability of carotenoids.

To prove the role of lycopene in the prevention of type 2-diabetes and cardiovascular diseases, lycopene must be tested in populations displaying risk factor(s) by using new omic technologies (genomics, proteomics and metabolomics).

In terms of dietary recommendations, the consortium insists that tomatoes and tomato products contribute to a healthy balanced diet, even though no lycopene intake recommendation could yet be established. Thus, tomatoes can be consumed every day as fresh and processed.
Project partners:

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Integrated project funded by the European Commission within the Sixth Framework Programme

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