TOMATO PRODUCTS FOR HEALTH

The new trends

Montaña Cámara Hurtado

Food Science and Nutrition Department. Pharmacy Faculty. Universidad Complutense de Madrid. Spain.
mcamara@farm.ucm.es
Developed countries face an epidemic of obesity and related chronic diseases.

Advances in Food Science and Technology are centered on developing

→“Novel Foods and New Food Ingredients”

with special reference to healthy foods.

WTPC. MCámara, 2006
“A state of complete physical, mental and social well-being and not merely the absence of disease or infirmity”

“Let food be your medicine and medicine be your food”

(Hipócrates)
SPECIFIC HEALTH-RELATED ISSUES

BIOACTIVE COMPOUNDS

✓ BRAIN HEALTH: Antioxidants, Ca, Fe (Improve cognitive function).

✓ HEART HEALTH: Lycopene, Coenzyme Q_{10}, Vit B_{12} and B_{6}, Vit. C, Folic acid.

✓ BONE HEALTH: Ca, Vit. D, Mg

✓ Other healthy options: low-carbohydrate, high-protein, low-fat.

WTPC. MCámara, 2006
FACTORS AFFECTING BIOACTIVE COMPOUNDS LEVELS

✓ VARIETY
✓ RIPENING STAGE
✓ AGRONOMIC CONDITIONS
✓ POST-HARVEST MANIPULATION
✓ PROCESSING

WTPC. MCámara, 2006
PHYTONUTRIENTS and BIOACTIVE COMPOUNDS IN TOMATO FRUIT

- FIBRE
- FRUCTOOLIGOSACCHARIDES (FOS)
- LYCOPENE
- PHENOLIC COMPOUNDS

WTPC. MCâmara, 2006
- **Beneficial physiological effects:**
  - Cholesterol level reduction
  - Gastrointestinal function regulation
  - Fat absorption modification

- **Variable effect:**
  - Global diet
  - Way of life
  - Individual response

**SOLUBLE FIBRE**: pectins, β-glucans
- HEALTH BENEFIT:
  - Low calorie content
  - Dental caries prevention
  - Similar effects than fibre
  - Prebiotics, promote beneficial bacteria growth

FRUCTOOLIGOSACCHARIDES (FOS)

KESTOSA (GF2)

NISTOSA (GF3)

FRUCTOSIL-NISTOSA (GF4)

WTPC. MCámara, 2006
LICOPENE

Liposoluble compound
High Antioxidant activity
Anti-cancer: prostate
Anti-atherogenic
Others: bone quality, etc

WTPC. MCámara, 2006
LYCOPENE CONTENT IN TOMATO FRUIT

Fernández, 2003
PHENOLIC COMPOUNDS

POLYPHENOLS AND PHENOLIC ACIDS
HYDROXY CYNAMIC ACIDS
(chlorogenic acid, caffeic, p-cumaric)
FLAVONOIDS
(quercetin, naringenin)
LIGANS
TANINS

NON nutritive compounds
Secondary metabolites of plants
Protection for plants

Amount and type depends on:

variety,
ripening stage,
medioambiental conditions during season,
storage and processing conditions

WTPC. MCámara, 2006
PHENOLIC COMPOUNDS

Problems:

Still there is unknow absorption, metabolism and in vivo response

“In vivo”

Prevent cancer due to inhibit nitrosamines formation

Antioxidants properties on LDL-cholesterol fraction
  → atherosclerosis and other cardiovascular disease

Histamine inhibitor → Decrease allergic response

Antiinflammatory activity
TOMATO PRODUCTS FOR HEALTH

FIBRE and FOS
Low LDL-cholesterol
Gastrointestinal effects

LYCOPENE
Cardiovascular disease
Prostate cancer

The effects of technological processes
Interactions between different food ingredients
Absorption and metabolism
Biological effects of compound isomers and metabolites.

PHENOLIC COMPOUNDS
Antioxidant activity

FOLATES
Vitamin B9 activity

WTPC. MCâmara, 2006
"MEditerranean Link COnmittee on the Processing TOmato Research",
sponsored by the European Commission -contract ICA4-CT-2002-50016-

*Melcaptor.org* is a site dedicated to a network of scientific teams involved mainly in research on processing tomato in the Large Mediterranean Region.

**TOMATO Book**

WTPC. MCámara, 2006
Contributors:

Dr. A. Venkat Rao
Dr. David Hunter
Dr. Frederik Khodada
Dr. Darin Kavali
Dr. Josep Camps
Dr. Scott Mustard
Dr. Wilhelms Schick
Dr. George Teitel

Vedanth Rao, Professor Emeritus, University of Guelph, has a distinguished record of research and teaching in the field of nutrition and public health. He is internationally recognized for his contributions to the science of nutrition, particularly in the areas of tomato nutrition and human health.

This is the first high-resolution scientific reference book to cover this subject, ever produced. The health effects and benefits that are discussed here are supported by an enormous and compelling body of evidence.

The release of this book will therefore have a significant and lasting effect on the way in which the scientific community views and values the role of tomatoes in human health. It has now put together a comprehensive and authoritative source of information and knowledge that will be invaluable to all interested in this exciting field.

Edited by Dr. A. Venkat Rao

This book provides a clear picture of the results of the available research to date. The chapters have been authored by leading scientists, and every chapter includes a comprehensive list of references.

Future editions will track the results of ongoing research for many years to come, and the book will remain the definitive and comprehensive reference on tomato nutrition and human health.
EU's sixth framework programme

**PD Dr. Volker Böhm**
Institute of Nutrition
Friedrich Schiller University Jena. Germany

Lycocard partners:

- Volker Böhm, Friedrich Schiller University, Jena (Germany)
- Verena Stangl, Charité, Berlin (Germany)
- Catherine Caris-Veyrat, INRA, Avignon (France)
- Ralph Rühl, University of Debrecen (Hungary)
- Gordon Lowe, Liverpool John Moores University (UK)
- Marià Jesús Periago Castón, University of Murcia (Spain)
- Patrick Borel, INRA Marseille (France)
- Paola Palozza, Catholic University Rome (Italy)
- Alvaro Mordente, Catholic University Rome (Italy)
- Martin Vestweber, Deutsche Herzstiftung, Frankfurt (Germany)
- Pablo Serrano Santos, JUVER, Murcia (Spain)
- Sophie Colvine, AMITOM, Avignon (France)
- Inigo Martinez-Fresneda, AGRAZ, Villafranco del Guadiana (Spain)
- Jesus Espinosa Garcia, CONESA, Villafranco del Guadiana (Spain)
- David Cameron, Caledonian Science Press, Sitges (Spain)
IMPROVEMENT OF VARIETIES.
Breeding and genetics

PROCESSING

END-PRODUCT QUALITY

BY-PRODUCTS UTILIZATION

TOMATO PRODUCTS FOR HEALTH. The new trends

WTPC. MCámara, 2006
Control of multiple ‘independent’ pathways for phytonutrient production in tomato by fruit-specific downregulation of a negative regulator of photomorphogenesis.

Limiting downregulation of DET1 to fruit results in increases in the three classes of natural products shown, without negative effects on overall plant growth and development.

Compounds are:
- LC, lycopene;
- BC, -carotene;
- NC, naringenin-chalcone;
- CGA, chlorogenic acid; QC, quercetin.

PROCESSING

END-PRODUCT QUALITY

HIGH PECTIN CONTENT

HIGH BETA-CAROTENE AND LYCOPENE

LOW SUGAR AND SALT CONTENT
PROCESSING SUITABILITY
NUTRIENTS CONTENT
SENSORY CHARACTERISTICS

PRODUCT DESCRIPTION

TOMATO POMACE
PEELS
SEEDS
TOMATO FIBRE
TOMATO OIL

WTPC. MCâmara, 2006
TOMATO FIBRE

Lycopene
Lyc-O-Mato® is an all-natural extract of red, ripe tomatoes, scientifically standardized to contain 6% lycopene.

Lyc-O-Mato® is valued as a dietary supplement and functional food ingredient because it provides a full complement of tomato carotenoids and other antioxidants to benefit good health. The synergy of the natural tomato Lycopen, phytoene, phytofluene, beta-carotene, phytosterols, and vitamin E results in enhanced activity and this means greater health benefits for you.

The tomatoes used are a high-Lycopen variety from plan in Israel without any genetic modification.
EUROPE - Novel foods

“foods and food ingredients that have not been used for human consumption to a significant degree within the Community before May 1997”


WTPC. MCámara, 2006
HEALTH CLAIMS

FUFOSE (Functional Food Science in Europe)

1. TYPE A: “physical and physiological functionality"
   Not related to specific disease.
   Ej. some non digestible oligossacharides improve growth of beneficial intestinal bacterias
   Cafeine can improve cognitive process

2. TYPE B “disease risk reduction " based on specific nutrient content.
   Ej. Folates may reduce risk of neural tube defects in the new born.
   Adequated calcium intake may reduce osteoporosis risk
   Lycopene intake may reduce the risk of cardiovascular disease

Process for the Assessment of Scientific Support for Claims on Foods

PASSCLAIM

WTPC. MCámara, 2006
Health Claims that Meet Significant Scientific Agreement (SSA)

- **Calcium** and Osteoporosis
- **Dietary Lipids** (Fat) and Cancer
- **Dietary Saturated Fat and Cholesterol** and Risk of Coronary Heart Disease
- **Dietary Non-carcinogenic Carbohydrate Sweeteners** and Dental Caries

- **Fiber**-containing Grain Products, Fruits and Vegetables and Cancer
- **Folic Acid** and Neural Tube Defects

- **Sodium** and Hypertension

- **Soluble Fiber** from Certain Foods and Risk of Coronary Heart Disease

- **Soy Protein** and Risk of Coronary Heart Disease
- **Stanols/Sterols** and Risk of Coronary Heart Disease
<table>
<thead>
<tr>
<th>Label Statement</th>
<th>County</th>
<th>Formulation du libellé</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lycopene: anti-oxidant (or fight free radicals)</td>
<td>US, Japan, Turkey, UK</td>
<td>Lycopène: antioxidant (combattre les radicaux libres)</td>
</tr>
<tr>
<td>Contains Lycopene, Vitamin A &amp; C</td>
<td>US, Argentina, Canada, UK, Germany</td>
<td>Contient du lycopène, des Vitamines A &amp; C</td>
</tr>
<tr>
<td>Lycopene Content (mg per serving)</td>
<td>USA, Japan, Canada, Turkey, Argentina, France, Germany, UK</td>
<td>Teneur en lycopène (mg par portion)</td>
</tr>
<tr>
<td>Lycopene: health maintenance</td>
<td>UK, France, Japan, US</td>
<td>Lycopène: entretient la santé</td>
</tr>
<tr>
<td>Antioxidant comparisons to fresh tomatoes</td>
<td>Japan</td>
<td>Comparaisons en antioxidant par rapport à la tomate fraîche</td>
</tr>
<tr>
<td>Fresh tomato equivalents to make / number of vegetable servings</td>
<td>Japan, Canada, US, France, UK</td>
<td>Equivalent tomate fraichepar préparation / nombre de portions de légume</td>
</tr>
<tr>
<td>Education: Lycopene red pigment, what is antioxidant, tomato is a source of Lycopene</td>
<td>Japan, Turkey, Argentina, US, France, Portugal, Germany, UK</td>
<td>Education: lycopène pigment rouge, qu’est-ce qu’un antioxidant, la tomate source de lycopène</td>
</tr>
<tr>
<td>A healthy diet rich in a variety of vegetables and fruit may help reduce the risk of some types of cancer.</td>
<td>Canada, US, Argentina</td>
<td>Une alimentation saine et variée en fruits et légumes peut contribuer à réduire le risque d’apparition de certains types de cancers</td>
</tr>
<tr>
<td>Lycopene: more bio-available in processed tomatoes than fresh and / or with oil addition</td>
<td>Turkey, Argentina</td>
<td>Lycopène: meilleure biodisponibilité dans les tomates transformées et/ou avec de l’huile</td>
</tr>
<tr>
<td>Education: Healthy life-style, cardiovascular, age related decline, vision, heart health, some cancers, important nutrients</td>
<td>Turkey, Argentina, Japan</td>
<td>Education: référence au style de vie sain, au risque cardiovasculaire, à la sénescence, à la vision, à la santé du cœur, à certains cancers et aux nutriments essentiels</td>
</tr>
</tbody>
</table>
HEALTH CLAIMS debate EFSA (European food safety agency)

Conference on Nutrition and Health Claims
Bologna, Italy November 8-10 2006


Developments in Functional Foods in Europe
ILSI Europe (International Life Science Institute) is organizing an

“International Symposium on Functional Foods in Europe
International Developments in Science and Health Claims"
May 9-11, 2007 in Malta.

http://europe.ilsi.org/events/actslist.cfm?pubactivityid=435
functional.sympo2007@ilsieurope.be
FRESH PRODUCTS

Source of bioactive compounds

FUNCTIONAL FOODS

INDUSTRIAL PRODUCTS

SUPLEMENTS

FRESH PRODUCTS

SUPLEMENTS

WTPC. MCámara, 2006
IMPORTANCE OF ANALYTICAL METHODS APPLIED

GENERAL

- SPECTROFOTOMETRY

SPECIFIC

- GAS CHROMATOGRAPHY

- LIQUID CHROMATOGRAPHY (HPLC)

ÁCIDOS ORGÁNICOS (HPLC, UV)
(Sánchez et al., 2000)

- FTIR: Fourier Transform Infrared Spectroscopy

Difuse Reflectance and transmittance

FA Tomato seeds
Gas Chromatographic profile

VITAMINA C (HPLC, UV)
(Sánchez et al., 2000)
The use of genomics to investigate diet and gene interactions involved in health or disease, often used interchangeably with nutritional genomics.

This term implies that other portions of the genome play a role in the genetic response to a nutrient (even if researchers cannot assess the total genome).
FUTURE WORK

– BIOACTIVE COMPOUNDS IDENTIFICATION

– FUNCTIONALITY EVALUATION
  – “In vitro”, “In vivo” studies (animal, humans)

– MULTIDISCIPLINARY APPROACH
  – Scientist
  – Industry
  – Govermental agencies
  – Communication………

WTPC. MCámara, 2006
A NUTRITION BASED ON SCIENTIFIC EVIDENCE

New trends

TOMATO PRODUCTS FOR HEALTH. The new trends
TOMATO RESEARCH. UCM team 1996–2006

Nutritional and Functional Quality Tomato and Tomato Products

IMPROVEMENT OF VARIETIES. Breeding and genetics

PROCESSING

END-PRODUCT QUALITY

Collaborations with:

UPV, Spain. Genetic Department.
Dr. F. Nuez.

UCDavis.
FST. Dr. Ch. Shoemaker.
Dr. D. Barret Pomology. Dr. Labavitch.

USDA.
Albany. Dr. W. Yokoyama.

INRA. Avignon. Dr. G Bratholine

ENSIA. Paris. Dr M-N. Maillard.

AGRUCON

AMITON

..WPTC

WTPC. MCámara, 2006
**Fresh Tomato papers**


**Tomato Processing papers**

Tomato byproduct papers

- Del Valle, M.; Cáámara, M., Torija. “Posible utilización industrial del subproducto de tomate” Alimentación, Equipos y Tecnología. n°192, 96-100. 2004

Analytical methods: