a place of mind
THE UNIVERSITY OF BRITISH COLUMBIA
Land and Food Systems
Food Science

Strengthening the relationship between food science/technology and nutrition: challenges and opportunities for an ageing population

Ageing Workshop
ILSI Taiwan
10 May 2016

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Food Science and Nutrition

Food as Medicine, Medicine as Food

Regain Your Body's Balance with Healthful Chinese Dishes

"Medicinal foods" and "nutritious foods" have a long history in Chinese culture, and are an important part of Taiwan's approach to food. Through choosing of suitable ingredients and cooking methods according to the season, food and drink consumption is not just a matter of satisfying the appetite for good food and drink, it is also a healthy way of living.

Traditional Culture Medicine and Food from the Same Source

People in Taiwan generally believe that foods have certain properties that can help to improve a person's wellbeing and play a role in maintaining or regaining balance. People who easily feel hot should eat some "cooling down" foods to feel better. People who easily feel cold or who are weak can make themselves stronger if they take the right combination of food and drink. Consuming nutritious foods after operations or childbirth is also an important local tradition. Adding Chinese medicinal herbs to dishes is part of traditional home cooking. Even without having any special requirements, a visit to the Chinese-medicine shop for a bag of medicinal herbs suited for all the family, stewed in a pot with meat, makes for a warming family evening meal.

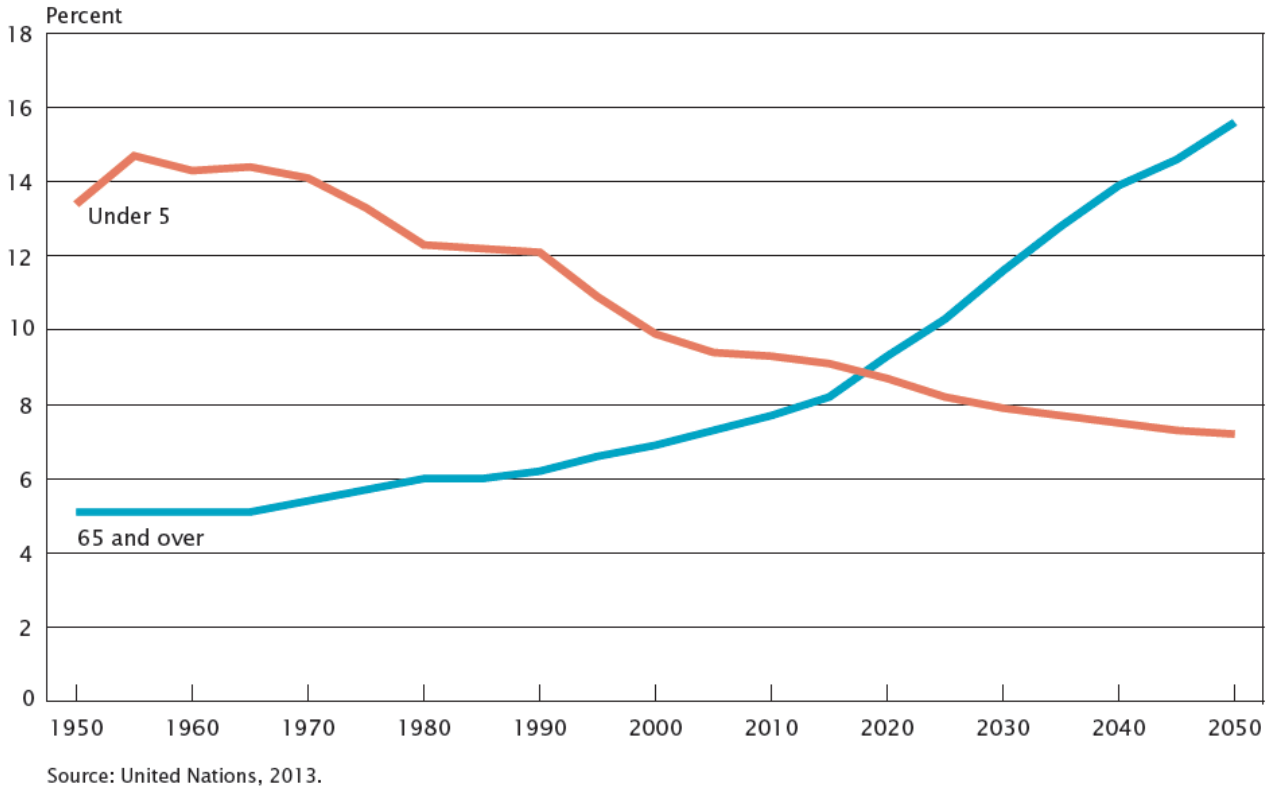
http://go2taiwan.net/medicinal_foods.php

Outline

- Ageing statistics and trends
- What is ageing, why do we age?
- Ageing and nutrition, disorders
- What we eat makes a difference: research into super-foods and whole diet approaches
- Food industry solutions and strategy
- The Future

An ageing world

Figure 2-3.
Young Children and Older People as a Percentage of Global Population: 1950 to 2050



Source: United Nations, 2013.

US Census Bureau/NIA report “An Aging World: 2015”
https://www.census.gov/content/dam/Census/library/publications/2016/demo/p95-16-1.pdf

An ageing world

- The global population of the “oldest old”—people aged 80 and older—is expected to more than triple between 2015 and 2050, growing from 126.5 million to 446.6 million. The oldest old population in some Asian and Latin American countries is predicted to quadruple by 2050.

US Census Bureau/NIA report “An Aging World: 2015”
https://www.census.gov/content/dam/Census/library/publications/2016/demo/p95-16-1.pdf

Ageing in Taiwan

- With various economic analysts warning that Taiwan's GDP is set to decline 0.9% per year due to ageing demographics, the Taiwanese Premier has pointed out that those 65 years of age and older are important consumers and even service providers.

Taiwan Today, June 16, 2015; CNBC, Jan 22, 2015.
http://www.cnbc.com/2015/01/22/japan-no-longer-asias-fastest-aging-nation.html

When does ageing begin?

- Begins as early as late teens
- Accumulation of damage doesn't begin to show until we hit our 30's and 40's
- Supplying your body with all the nutrients it needs may help to slow the process and improve your overall health

S. Barclay, Iowa State University
www.extension.iastate.edu/NR/.../EatingtoSlowtheagingProcess.ppt

Good nutrition is vital to ageing well

- 40-75% of chronic disease related to diet, predictor or management

  - Osteoporosis, heart disease, stroke, dementia, many cancers

- Quality diet predicts longevity and quality of life

  - Normal body weight, moderate alcohol, plant-based Mediterranean diet

  - Nutrient dense; low calories, high nutrients

Exercise plays major role

- Walk briskly for 30 minutes 5 days/week to keep arteries twice as flexible and decrease risk for diabetes, cancer, depression, dementia

- After mid-40's lose ¼ pound of muscle mass per year (lose 40% of muscle between 20-60 years!) Weight training for 30 minutes 2-3 times/week will help prevent-also increases endurance, stronger bones and lowers risk for diabetes

S. Barclay, Iowa State University
www.extension.iastate.edu/NR/.../EatingtoSlowtheagingProcess.ppt

Ageing–related physiological changes that affect nutritional requirements

- dramatic loss of lean body mass
- loss of body water
- large hormonal changes
- appetite changes
- wearing of teeth and decreased jaw strength
- slower gut contractions
- slower emptying of stomach
- atrophic gastritis (chronic inflammation)

Why poor food intake occurs

- Food apathy
- Reduced physical capabilities
- Restricted income
- Depression, social isolation, neglect
- Physiological changes e.g. hormone levels
- Medication use
- Illness
- Cognitive impairment
- Decreased energy needs
- Increased need for repair of tissues
- Decreased efficiency of the body
- Decreased absorption of food
- Decreased efficient utilization of food

Malnutrition amongst the elderly

- A UK study showed that the risk of protein–energy malnutrition in the elderly was between 11% and 19%, and found that it was accompanied by deficiencies of vitamins C and D, and low levels of carotenoids.

- Higher levels of malnutrition (15–60%) have been documented in many countries in older patients who are hospitalized, live in nursing homes or are in homecare programmes.

WHO Report on Health and Ageing, 2015
http://apps.who.int/iris/bitstream/10665/186463/1/9789240694811_eng.pdf?ua=1

Malnutrition amongst the elderly

"The nutrient density of food should be improved, particularly that of vitamins and minerals, but energy and protein intake are important targets. Individualized nutritional counselling has been shown to improve the nutritional status of older people within 12 weeks (Beck et al. 2013)"

WHO Report on Health and Ageing 2015
http://apps.who.int/iris/bitstream/10665/186463/1/9789240694811_eng.pdf?ua=1

Osteoporosis

Osteoporosis and associated fractures are a major cause of illness, disability and death, and are a huge medical expense.

- It is estimated that the annual number of hip fractures worldwide will rise from 1.7 million in 1990 to around 6.3 million by 2050.

Source: WHO Report on Health and Ageing 2015
http://apps.who.int/iris/bitstream/10665/186463/1/9789240694811_eng.pdf?ua=1

Osteoporosis

Women comprise the majority of the older population in virtually all countries, and are disproportionately affected by osteoporosis because their bone loss accelerates after menopause.

- Women suffer 80% of hip fractures; their lifetime risk for osteoporotic fractures is at least 30%, and probably closer to 40%. In contrast, the risk is only 13% for men.

WHO Report on Health and Ageing 2015
http://apps.who.int/iris/bitstream/10665/186463/1/9789240694811_eng.pdf?ua=1

Osteoporosis

- Lifestyle factors – especially diet…are also associated with osteoporosis, which opens the way for primary prevention…Particularly important are adequate calcium intake and physical activity, especially in adolescence and young adulthood.

WHO: Nutrition for older persons

www.who.int/nutrition/topics/ageing/en/index1.html

Dementia

- The global prevalence of dementia in people over 60 years is 3.9%. The regional prevalence varies from 1.6% in Africa, to 3.9% in Eastern Europe, 4.0% in China, 4.6% in Latin America, 5.4% in Western Europe, and 6.4% in North America (Caracciolo et al. 2014. Mechanisms of Ageing and Development 136-137: 59–69).
- 36 million people have dementia worldwide (Wimo and Prince, 2010) and there are 4.6 million new cases of dementia every year (Ferri et al., 2005. . Lancet 366: 2112–2117).

Taiwanese Journal of
Obstetrics & Gynecology

Alzheimer's Disease: Aging, Insomnia and Epigenetics

Tzong Yuan Wu, Chih-Ping Chen, Tzyy-Rong Jinn

Open Access

DOI: http://dx.doi.org/10.1016/S1028-4559(10)60099-X

Article Info

Abstract | References

Summary

Alzheimer's disease (AD) is the most common form of dementia. Severe memory loss, confusion, and impaired cognitive abilities characterize AD. It was only a century after Alzheimer's discovery that scientists were able to shed light on the mystery of its cause, but AD has also become a globally important health issue and the treatment of AD is a challenge for modern medicine. At present, there are five drugs approved in the United States for the treatment of AD, namely, donepezil, galantamine, rivastigmine, and tacrine (which are all cholinesterase inhibitors); and memantine (which is a glutamate receptor antagonist). However, these drugs show only modest effects on AD patients. Thus, new investigations are necessary for pharmacological development in AD. This brief review focuses on new studies that demonstrate the link between epigenetics and AD, and explores the possibility that insomnia may be one factor that effects AD.

Summary

- Diet influences many diseases and is associated with conditions seen with aging, e.g. frailty
- Older adults need high quality diets
- High quality diets can be difficult to attain
- Older adults typically need to improve their food intake

Diet intervention

Top-scoring foods (per 100 grams)

1. Prunes
2. Raisins
3. Blueberries
4. Blackberries
5. Kale
6. Strawberries
7. Spinach
8. Raspberries
9. Brussels sprouts
10. Plums

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www.extension.iastate.edu/NR/.../EatingtoSlowtheagingProcess.pp

Top–scoring foods

11. Alfalfa sprouts
12. Broccoli flowers
13. Beets
14. Oranges
15. Red grapes
16. Red bell pepper
17. Cherries
18. Kiwi fruit
19. Pink grapefruit
20. Onion

S. Barclay, Iowa State University
www.extension.iastate.edu/NR/.../EatingtoSlowtheagingProcess.pp

Anti-ageing by natural dietary compounds

- **Carotenoids**

carotenoidsociety.org

- **Isothiocyanates**

diseaseproof.com

- **ω-3 fatty acids**

nestle.ca

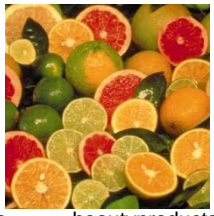
- **Flavonoids and flavonolignans**

realage.com

- **Terpenoids**

made-in-ch[illegible]a.com

top100foods.blogspot.ca



beautyproducts.beautorium.com

- **Other polyphenolic compounds**

webmalayalee.com

precisionnutrition.com

- **Proanthocyanidins**

http://segments-of-life.blogspot.ca

tradinorganic.com

Pan et al. 2012. Mol. Nutr. & Food Res. 56: 88–115

Diet

- Houston et al. 2005. Am. J. Clin. Nutr. 81 (2): 515-522
- 16,000 participants (age 45 to 64 years), done over 9 years
- Participants who ate at least 2 servings of dairy and six servings of fruits and vegetables daily lowered risk for becoming feeble by 30%
- Speculate calcium and vitamin D counteracts osteoporosis and decreased muscle strength, antioxidants reduce damage to tissues

S. Barclay, Iowa State University
www.extension.iastate.edu/NR/.../EatingtoSlowtheagingProcess.pp

Houston et al. 2005. Am. J. Clin. Nutr. 81 (2): 515-522

What Is Acerola Cherry?

Last Updated: Jan 30, 2014 | By Sandi Busch

A close up of acerola cherries Photo Credit monica-photo/iStock/Getty Images

Acerola cherries provide more vitamin C than all other food sources, according to the U.S. Department of Agriculture. Acerola juice is such a rich source that MedlinePlus warns against drinking the juice if you also take vitamin C supplements. Whether you know them as acerola cherries or by one of their other names, such as Barbados cherry and West Indian Cherry, chances are you'll only find them as supplements or in juices because the fresh fruit is highly perishable.

http://www.livestrong.com/article/115854-acerola-cherry/

Super fruit: Vitamin C content

Rating	Food	Vitamin C content (mg / 100 g)
Excellent source	Kakadu plum	3100
	Acerola	1677.6
	Bell peppers Red, raw slices	190
	Parsley, fresh	130
	Broccoli, steamed	90
	Kiwifruit	90
	Orange	50
	Raspberries	30
	Spinach	30
Very Good source	Blueberries	10
	Grapes	10
Good source	Banana	9
	Apple	6
	Pear	4

USDA National Nutrient Database for Standard Reference, Release 20 (2007)

Super fruit: Acerola carotenoid content

A total of 17 different carotenoids were identified in acerola fruit (Medrazi et al. 2005. Euro. Food Res. Technol. 220 (1): 63-69).

- β-carotene, β-cryptoxanthin, lutein, and violaxanthin were found to be the major carotenoids.
- Carotenoid content increase over ripening.
- In ripe fruit, β-carotene and lutein were the main pigments.

Antioxidant activity of various fruits using ORACFL assay

Fruit name	TAC (μmol TE / g fruit)
Apple Fuji	25.93
Strawberry	35.77
Apple Red Delicious (w/peel)	42.75
Raspberry	49.25
Blackberry	53.48
Blueberry	62.20
Plums	62.39
Cranberry	94.56
Acerola (partially mature)	96.00

Wu, et al. 2004. J. Food Compost. Anal. 17: 407-422.

Antioxidant activity of Acerola fruit

- The antioxidant activity of acerola fruit has been attributed to vitamin C and to phenolic compounds (anthocyanins and flavonoids) (Righetto et al. 2005. Food Sci. Technol. Int. 11(4): 315 - 321).
- Hanamura et al. (2005.Biosci. Biotechnol. Biochem. 69(2):280-286) reported that the acerola anthocyanins possessed O_2 scavenging activity and inhibitory effects on both glucosidase and advanced glycation end product formation *in* v*itro*.

Summary: Acerola fruit

Acerola Cherry fruit provides:

- One of the richest sources of vitamin C;
- Vitamin C content of acerola fruit changes with maturity;
- A total of 17 different carotenoids were identified in acerola fruit (β-carotene, & lutein are major carotenoids);
- Carotenoid content increase over ripening;
- The antioxidant activity of acerola fruit is also attributed to anthocyanins and flavonoids;
- Acerola cherry shows very high antioxidant activity using the $ORAC_{FL}$ assay

Mediterranean Diet

- No single healthy component
- Mostly plant foods-fruits, vegetables, beans, nuts, whole grains
- Lots of fish and smaller amounts of beef, poultry and dairy
- Drink alcohol in moderation
- Don’t limit fats but use primarily olive oil

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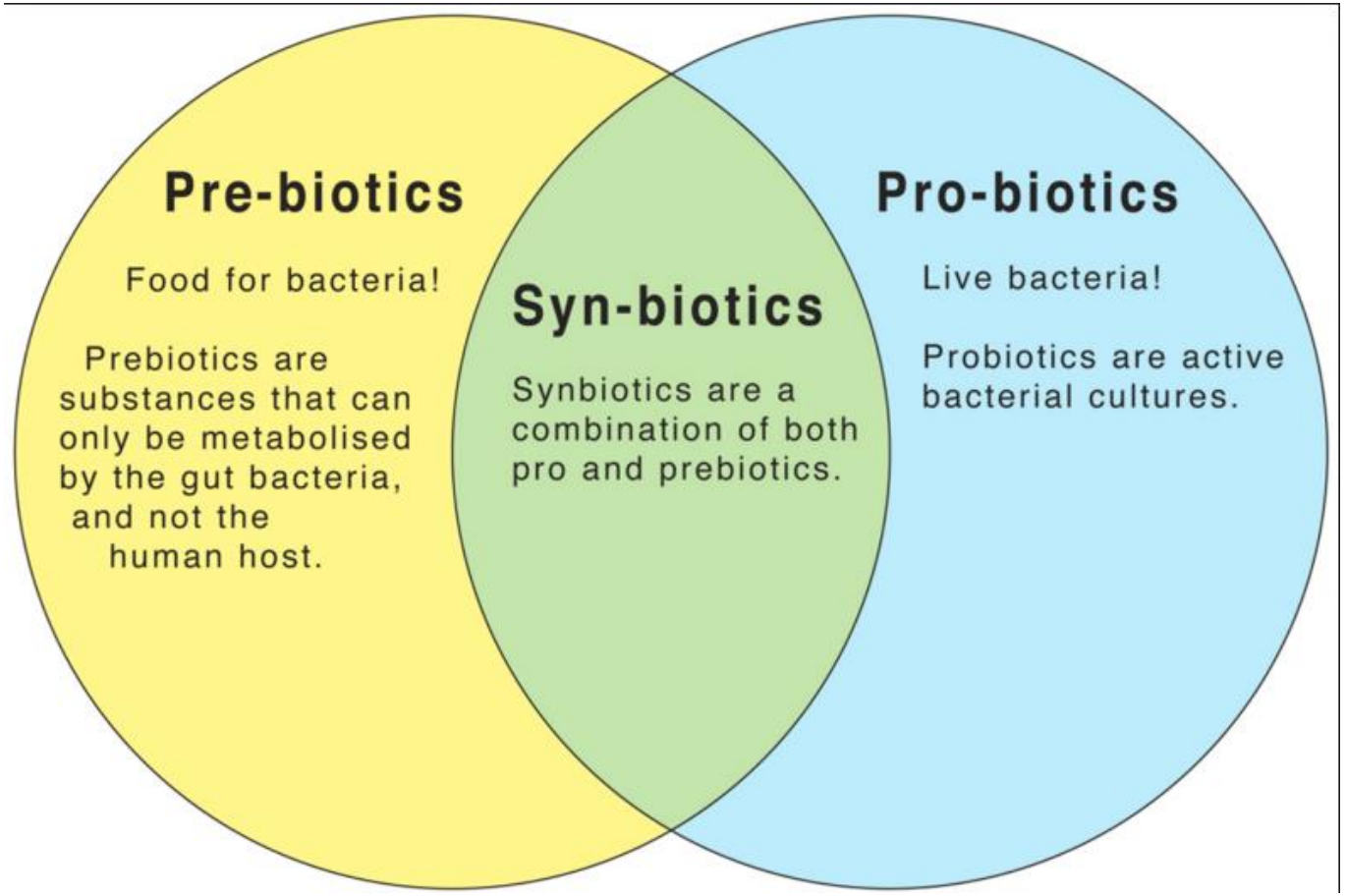
Mediterranean Diet

NU-AGE: New dietary strategies addressing the specific needs of elderly population for an healthy aging in Europe: 2011-2016, Franceschi et al. (University of Bologna), EU Project. http://www.wagralim.be/uploads/documents/evenements/NuAge-ACGouder.pdf

- aging is typically associated with a chronic, low grade, inflammatory status named ***inflammaging*** that plays a pivotal role in the most important geriatric conditions, such as sarcopenia, frailty, and disability.

Santoro et al. 2014. Mechanisms of Ageing and Development 136-137: 1–2

Pre– and Probiotics



https://www.google.ca/search?q=images+prebiotics+probiotics&biw=1600&bih=775&tbm=isch&tbo=u&source=univ&sa=X&ved=0ahUKEwjkqpehlbnMAhVSzWMKHaLGBBMQsAQIHw#imgrc=f0vebmUGH8Xa5M%3A

Journal of Clinical Gerontology and Geriatrics

Volume 5, Issue 1, March 2014, Pages 3–6

Open Access

Review article

The aging gut and the role of prebiotics, probiotics, and synbiotics: A review

Pragnesh J. Patel, MD[a], Shailesh K. Singh, MD[b], Siddak Panaich, MD[c], Lavoisier Cardozo[a]

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doi:10.1016/j.jcgg.2013.08.003

Abstract

The United States (US) Census Bureau estimates the current US population at 301 million with elderly people (>65 years old) accounting for 36 million. Within this group, the fastest growing segment of the population is >85 years of age, which currently numbers ~5 million and is expected to rise to ~20 million by 2050. Over the decades there has been speculation that gastrointestinal structure and function decline with age. Therefore, the physiological changes in the gut with aging and their clinical implications have become important topics for discussion. This review also attempts to document the role of probiotics in enhancing gut activity in older persons.

J Drugs Dermatol. 2016 Jan 1;15(1):9-12.

Anti-Aging Effects of Probiotics.

Sharma D, Kober MM, Bowe WP.

Abstract

The body of evidence demonstrating the beneficial effects of probiotics on the skin continues to grow in the published literature. Insights into their effects at the molecular level, in animal models, and in human clinical trials build the case for their role in slowing the skin manifestations of both intrinsic and extrinsic aging. The reports reviewed in this manuscript demonstrate that probiotics can restore acidic skin pH, alleviate oxidative stress, attenuate photoaging, improve skin barrier function, and enhance hair quality.

 J Drugs Dermatol. 2016;15(1):9-12.

Journal of the Chinese Medical Association

Volume 78, Issue 3, March 2015, Pages 154–157

Open Access

Review Article

Can probiotics be used to treat allergic diseases?

Ren-Bin Tang[a, b], Jia-Kan Chang[a, b], Hui-Lan Chen[c]

Show more

doi:10.1016/j.jcma.2014.08.015

Abstract

Probiotics are proprietary formulations of specific microorganisms and quantified populations of live bacteria that are intended to confer a health benefit on the host. These different strains and combinations of microorganisms have a wide and varying range of clinical and immunologic capacities that can modify intestinal microbial populations in ways that can benefit the host. The enhanced presence of probiotic bacteria in the intestinal microbiota has been found to correlate with protection against atopy. The prevalence of allergic diseases such as asthma, allergic rhinitis, and atopic dermatitis has increased sharply over the past 2–3 decades in many countries, and allergies are now the most common chronic disease among children throughout the world. In the past few years, probiotics have been advocated for the management of allergic diseases in many parts of the world. So far, probiotics have shown more promise, albeit limited, in the primary prevention of allergic disease rather than in the treatment of established disease.

Keywords

allergic diseases; allergic rhinitis; asthma; atopic dermatitis; probiotics

Review

Modulation of Gut Microbiota–Brain Axis by Probiotics, Prebiotics, and Diet

Xiaofei Liu†, Shangqing Cao#‡, and Xuewu Zhang*†
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J. Agric. Food Chem., **2015**, *63* (36), pp 7885–7895
DOI: 10.1021/acs.jafc.5b02404
Publication Date (Web): August 25, 2015

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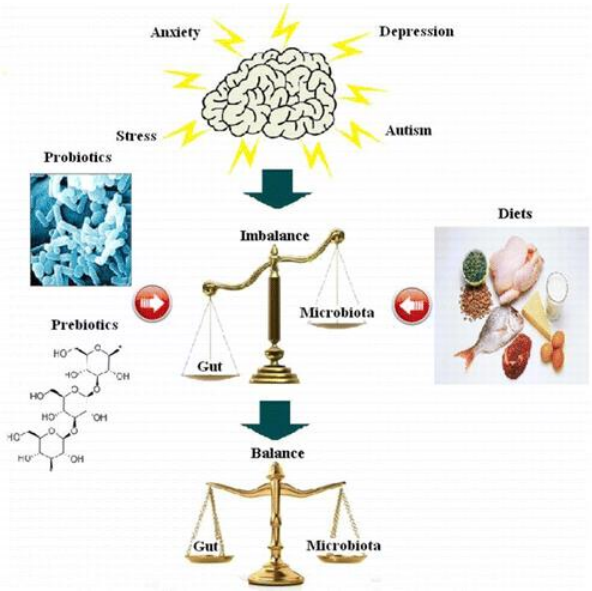

Research results

People who maintain the highest blood levels of antioxidant nutrients are also likely to live longer and healthier

Eating plenty of “power” foods:

- Raised antioxidant power of human blood

  10-25 %

- Prevented some loss of long-term memory and learning ability in middle-aged rats

S. Barclay, Iowa State University
www.extension.iastate.edu/NR/.../EatingtoSlowtheagingProcess.ppt

Challenges/issues in designing foods for older adults

- Older adults are very heterogeneous

  A 75 year old could be…..

  - A first time father or a first time great-grandfather

  - Embarking on a world cruise or entering a long term care facility

  - Running a marathon or re-learning to walk after a stroke

Challenges/issues in designing foods for older adults

- Nutrient quality is very important

  - Increased need for micronutrients B6, B12, folate, calcium

  - Increased need for protein to prevent sarcopenia (muscle wasting) and falls

- Challenge

  - Nutrient needs must be taken into consideration when designing foods for older age groups

Challenges/issues in designing foods for older adults

- Sensory changes are not uniform across the entire population

  - Olfactory and gustatory ability can decrease with age

  - Texture perception also changes and is dependent on dentition, muscle tone, salivary secretion

- Challenge:

  - How do you design a food to meets the needs of all older adults?

Strategies for the food industry

- Several important opportunities for food industry:
  - Nutrient-dense foods
  - Protein enhancement
  - Micronutrient enhancement
  - Packaging solutions (font sizes, high contrast, easy opening and handling, single or double serving)
- Segmenting the heterogeneous population is key: Early involvement of target market in development to define opportunity and values

Dr. Heather Keller, University of Waterloo;
IUFoST January 2014
http://www.iufost.org/iufostftp/IUF.SIB.Meeting%20the%20Food%20Needs%20of%20the%20Ageing%20Population.pdf

Strategies for the food industry

- Flavour enhancement
  - -Addition of inherent flavours
  - -Herbs, spices, Mono Sodium Glutamate
- Taste enhancement
  - -e.g., addition of sucrose, citric acid to beverages
- Portion Size
  - -smaller sizes that invite rather than intimidate
- Compensatory strategies
  - -Textural changes/Irritant addition (e.g., pepper to enhance sensory abilities)

Dr. Lisa Duizer, University of Guelph
IUFoST, January 2014
http://www.iufost.org/iufostftp/IUF.SIB.Meeting%20the%20Food%20Needs%20of%20the%20Ageing%20Population.pdf

Strategies for the food industry

Preventative nutrition solutions (e.g., protein, micronutrient enhanced) should be delivered in a carrier that already has wide acceptance amongst the elderly to be effective.

- using food carriers that consumers perceive favourably can increase consumer uptake rates
  - a dairy based carrier (e.g. drinkable yogurt) may be the most ideal because the elderly are aware of the health benefits of dairy-based foods

Source: Collins and Bogue, 2015. . Brit. Food J.117 (12): 3003 – 3023.

van Der Zanden et al. 2015. Food Qual. Pref. 42: 130-138.

Strategies for the food industry

Good marketing strategies that avoid emphasis on the burdens of growing old will likely contribute to greater product uptake and maximize the associated beneficial health impacts.

- positive messages of wellbeing could be targeted at the ageing consumer segment without over-categorising ageing food products.
- online marketing campaigns that focus on a positive and preventative nutrition approach may reach a large proportion of the ageing consumer group

Collins and Bogue. 2015. Brit. Food J.117 (12): 3003 – 3023.

Lian and Yen. 2014. Computers in Human Behavior 37:133-143.

Other potential market opportunities

The size of the elderly market presents many other opportunities for the agri-food sector in the development of food products whose focus is:

- Sodium reduction (blood pressure regulation)
- Trans fat reduction
- Dietary fibre (cholesterol levels and laxation)
- Ready-made meals

Agriculture and Agrifood Canada, 2012

http://www.agr.gc.ca/eng/industry-markets-and-trade/statistics-and-market-information/by-product-sector/processed-food-and-beverages/reports-and-resources-food-processing-innovation-and-regulations/market-opportunities-for-foods-with-added-health-benefits-for-an-aging-canadian-population/?id=1351859627654

Value-add and waste stream

Value–add pectin

Can pectin supplementation can ameliorate age-associated disturbances in peripheral insulin and leptin actions?

- Seven-month-old male Wistar rats were divided into three groups: control (rats fed ad libitum a standard-diet), pectin (standard-diet supplemented with 10% pectin), and pair-fed (rats pair-fed with the pectin group).
- pectin supplementation was found to decrease body-fat content and ameliorate age-related insulin and leptin resistance contributing to better metabolic health.

Source: Palou et al. 2015. Mol. Nutr. Food Res. 59: 2022–2033.

Waste stream – Value–add

Study to evaluate the potential of waste olive seed to produce antioxidant and antihypertensive peptides:

- Waste olive seed material treated with Thermolysin enzyme produced a hydrolysate that showed an important antihypertensive capacity.
- Bioactivity of the hydrolysate was retained after being subjected to *in vitro* gastrointestinal digestion.
- olive seed proteins constitute a cheap and valuable source of antioxidant and antihypertensive peptides.

Esteve et al. 2015. Food Chem. 167: 272–280.

Industry–government partnerships

New Nestlé Research Centre (NRC) Asia to focus on Healthy Ageing in partnership with Singapore's Agency for Science, Technology and Research (A*STAR):

- biotransformation – the use of natural processes, such as fermentation, to transform raw materials into ingredients with nutritional or functional benefits
- investigate the role of nutrition and lifestyle on immune robustness and frailty, in order to develop nutritional interventions to improve immunity and wellbeing in the elderly

Nestle Research Centre, Singapore's Agency for Science, Technology and Research (A*STAR), April 1, 2016.
https://www.a-star.edu.sg/Media/News/Press-Releases/ID/4626/Nestle-expands-research-and-innovation-activities-in-Asia-with-new-Research-Centre-in-Singapores-Biopolis.aspx

Trending

- Food Science traditional focus on sensory attributes
- Recent consumer recognition of the importance of food, diet, nutrition and health
  - Foods with desired sensory and nutritional properties
- Merging of food science and nutrition departments
  - Students with strong fundamental background in areas of food science, nutrition, sustainability, regulatory issues, etc.

Future

- Emerging technologies
- Multidisciplinary/interface technologies

Nanotechnology

Nanotech 2011 Vol. 3
Nanotechnology 2011: Bio Sensors, Instruments, Medical, Environment and Energy

Chapter 3: Bio Nano Materials

Preparation, Characterization and Antioxidative Activity of Anti-aging Nanoemulsion and Lipid Nanoparticls

Q. Xia, H. Wang, J. Tang, J. Wang
Southeast University, CN

248 - 251
bio nano materials, lipid nanoparticles

Nanoemulsions (NEs) and lipid nanoparticles (LNs) were regarded as suitable nanosized carriers of water-insoluble active components. These nanosized carriers could be used to load with drugs, nutrients and cosmetic actives and provide the appropriate application approach for the active compound which was very good but unable to be used due to some limitations. Alpha Lipoic Acid (ALA), Coenzyme Q10 (CoQ10) and Vitamin E (VE)are practically insoluble and chemically labile in water and should be incorporated in some carriers such as NE or LN to improve their stability and realize the final application as a versatile anti-oxidants. Both NEs and LNs were prepared by HPH (High Pressure Homogeneity) based on the phase behavior results obtained from the phase diagram. The stability results were obtained using several factors such as temperature, storage time, pH, dilution and high speed centrifugation. The good physical and chemical stability of particles was proved by Photon Correlation Spectroscopy (PCS) and UV/HPLC for different storage times up to two years. UV /HPLC measurements showed that the loading capacity of active after production could reach 10% for ALA, 8% for CoQ10 and 10% for VE. The high entrapment efficiency (nearly 100%) was obtained for all formulations. To elucidate the antioxidative activity of ALA-NLC and CoQ10-NLC, colorimetric method was employed to value the scavenging effects of Hydroxyl radicals, and using the 2, 2-diphenyl-1-picrylhydrazil(DPPH) radical scavenging assay to analyze the cell-based antioxidative activity. The results revealed that active substance loaded LNs expressed antioxidant activity at a similar magnitude as pure active substance. The production line with 100 KG per batch was founded to meet the needs of real industrial application. It includes the operation module, pre-and post- treatment module and assistant module with electric control all the process. The study of industrialization showed that it is possible to realize the industrial production using this production line to obtain the same products as it from labs.

Nutrigenomics

Nutrigenomics is the study of how genes affect the body's response to consumed foods, beverages and supplements.

- A Toronto start-up company (Nutrigenomix) provides dietary consultation services to assess clients' genetic predispositions to long term diseases (cancer, heart disease, stroke and type 2 diabetes) whose expression may respond to dietary modification and optimization.

http://mydietclinic.com/services/nutrigenomix-testing/

3D printing of food

Flavoured sugar produced from a 3D food printer.
Source: Digital Trends, April 2015.
http://www.digitaltrends.com/cool-tech/3d-food-printers-how-they-could-change-what-you-eat/

3D printing of food

- three-dimensional meals are generated by placing layers of compounded food on top of each other
- many nursing homes in Germany produce a pureed 3D-printed food product called “smoothfoods” to residents who have difficulty ingesting foods, or even chewing them.
- possible to embed insects and other alternative protein sources in familiar dishes to relieve global price pressure on meats from growing population.

S. Charlebois, *Globe and Mail,* Jun. 17, 2015

http://www.theglobeandmail.com/report-on-business/rob-commentary/is-3-d-printing-the-future-of-global-food/article24981139/

Final summary

- By 2050 the global population of elderly individuals (age 65 and older) will approach 16%
- A dramatic associated growth in the burden of age-related disorders such as osteoporosis, malnutrition and dementia is forecast for most countries
- Many of the most common diseases and disorders of the elderly owe their etiology to poor nutrition, hence quality of life amongst the elderly can be improved with dietary modifications
- Foods rich in bioactives such as antioxidants, antihypertensives and other compounds can play a prophylactic role as individuals age

Final summary

- Whole diet approaches such as the Mediterranean Diet show great promise in reducing local and systemic inflammation that may play a key role in cognitive and immune system decline with ageing
- The food industry should focus on producing nutrient-dense foods with enhanced protein and micronutrient content, whose packaging design and marketing strategy maximize uptake amongst the elderly
- Future research at the nexus of food science, nutrition and ageing includes the use of Nutrigenomics to assess individual risk and maximize the prophylactic effect of individually tailored diets combined with emerging technologies, e.g., 3D Printing

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Some Food for Thought

Thank you