Introducing mild food processing

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Content

- Organic food regulations
- Organic food quality: definitions and evaluation
- Classification of food processing methods
  - NOVA food classification
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  - Definitions on minimally processed foods and careful processing
- Beneficial food compounds and effects of processing.
- New mild processing technologies

Organic food

- Certified organic products are those which have been **produced, stored, processed, handled and marketed in accordance with precise technical specifications** (standards) and certified as "organic" by a certification body. The organic label is therefore a production process claim as opposed to a product quality claim. (FAO)
- It is important to note that an organic label applies to the production process, ensuring that the product has been produced and processed in an ecologically sound manner. (IFOAM)

Organic food

- Regulations and guidelines, e.g.
  - Council Regulation (EC) No 834/2007 on organic production and labelling of organic products,
  - Commission regulation (EC) No 889/2008 laying down detailed rules for the implementation of Council Regulation (EC) No 834/2007
  - International Federation of Organic Agricultural Movements (IFOAM),
  - Reports of Expert group for Technical Advice on Organic Production (EGTOP)
  - EU food legislation

EU regulation 834/2007, Article 6

Specific principles applicable to processing of organic food… shall be based on the following specific principles:

(a) the production of organic food from organic agricultural ingredients, except where an ingredient is not available on the market in organic form;

(b) the restriction of the use of food additives, of non organic ingredients with mainly technological and sensory functions and of micronutrients and processing aids, so that they are used to a minimum extent and only in case of essential technological need or for particular nutritional purposes;

(c) the exclusion of substances and processing methods that might be misleading regarding the true nature of the product;

(d) **the processing of food with care, preferably with the use of biological, mechanical and physical methods**.

EU regulation 834/2007, Article 19

- Substances and techniques that reconstitute properties that are lost in the processing and storage of organic food, that correct the results of negligence in the processing of these products or that otherwise may be misleading as to the true nature of these products shall not be used.

Commission regulation (EC) No 889/2008,

- Article 26

  Additives, processing aids and other substances and ingredients used for processing food or feed and any processing practice applied, such as smoking, shall respect the principles of **good manufacturing practice.**

- Article 27

  Only following substances can be used in the processing of organic food (not wine)

  (b) preparations of micro-organisms and enzymes normally used in food processing (not GMO);

  (c) substances, and products … labelled as natural flavouring substances or natural flavouring preparations...

  (f) minerals (trace elements included), vitamins, aminoacids, and micronutrients, only authorised as far their use is legally required in the foodstuffs in which they are incorporated.

Organic food quality definitions

- The existing regulations, organic food quality is defined as food production based on organic standards.
- Organics are processed without
  - GMO or ionic radiation
  - The use of chemical processing techniques (like modified starch, fat hydolyses etc.)
- And with limited use of additives and processing aids.
- ”Quality” as general term is not defined, but the goal is to produce high quality.
- ”Natural”, ”vital quality” and ”organic integrity” are not defined
- Expected impact of the agricultural production process on the food is not described.

Kahl et al. 2010 Food Technology 64

Evaluation of organic food quality (1/2)

- Organic Food Quality and Health Association (FQH) has developed the food quality consepts and methods for determination.
- Five major underlying principles of organic food production and food quality were identified: naturalness, health, sustainability, **process and product orientation**, and system approach.
  - Most important aspects to be succesful on market are sensory quality, freshness, regionalism, careful processing and minimum use of additives.
  - Quality assessment of the food itself includes the **product aspects,** which can be further described as product related criteria.

Kahl et al. (2011)

Evaluation of organic food quality (2/2)

- Product related **criteria**.
  - Price (as extrinsic), brand/label (as extrinsic), safety, nutrition, enjoyment/pleasure, vital qualities and true nature
- Each criterion can be characterized/determined by **indicators**.
- The determination of indicators should be through parameters, which are described by **methods** (e.g. sensory profile analysis)
- Organic food quality can be evaluated through these four levels: aspect, criterion, indicator and parameter.

Kahl et al. (2011)

Consumer preferences (Italian study)

- Organic products are associated with health.
- Good, tasty and nourishing products, because pleasure and wellbeing are their most important values.
- Easy to use products which are not perishable.
- In product development, better packaging and organoleptic quality standards should be a target for organic farmers and processors.
- More information, e.g. how organic production and processing is different from the conventional one.
- Interested in more ”natural” products
- How organic products can be distinguished? (Zanoli & Naspetti 2002).

Natural vs. organic

- Organic Agriculture is based upon a systematic approach and standards that can be verified and are recognized internationally.
- Natural foods, on the other hand, have no legal definition or recognition, and are not based on a systematic approach.
- While natural products may generally be minimally processed, there are no requirements to provide proof, leaving open the possibility for fraud and misuse of the term. (IFOAM)

Organic vs. functional food

- Claims of the influence of the food positively on health can only be accepted true when the claims have been tested and the validated by the EU Commission. It seems rather difficult to establish the health claims of organic foods. Because organic food as a whole has no placebo for comparison. (Kahl et al. 2012.)
- Although health is an important aspect for both functional food and organic food consumption, there is a different understanding of health: organic food consumption is influenced by an overall holistic healthy lifestyle, while functional food consumption is characterized by small ”adjustements” to lifestyle. An overlap between the consumption of organic and functional food was also observed. (Goetzke, Nitzko & Spiller 2014).

Two reviews of health effects

- The scientific evidence from human studies is insufficient to conclude whether organic foods are more beneficial for health in some respects than are conventional foods (Brantsæter et al. 2016)
- No long-term cohort studies focusing on chronic diseases (CVD, diabetes, cancer, neurodegenerative conditions and no controlled human intervention studies (Baranski et al. 2017)

Food process overview

- Selection and control of raw materials, additives, processing aids etc.
  - Variations in quality (e.g. cultivars, seasonal variation)
  - Subcontracting, automatisation
- Pretreatment and processing
  - Good manufacture practices
- Packaging
  - Type of package, alternatives in package sizes
- Cleaning and disinfection
  - EGTOP report 2016
- Storage and transportation
- Quality assurance,
  - own-check based on HACCP principles

NOVA Food classification

- Food classification that categorises foods according to the extent and purpose of food processing, rather than in terms of nutrients.
- Now recognised as a valid tool for nutrition and public health research, policy and action, in reports from the Food and Agriculture Organization of the United Nations and the Pan American Health Organization.
- Group 1: Unprocessed or minimally processed foods
- Group 2: Processed culinary ingredients
- Group 3: Processed foods
- Group 4: Ultra-processed food and drink products

Monteiro et al. 2016

NOVA: Unprocessed or minimally processed foods

- Minimally processed foods are natural foods altered by processes such as removal of inedible or unwanted parts, drying, crushing, grinding, fractioning, filtering, roasting, boiling, pasteurisation, refrigeration, freezing, placing in containers, vacuum packaging, or nonalcoholic fermentation.
- None of these processes adds substances such as salt, sugar, oils or fats to the original food.

Monteiro et al. 2016

Processed foods (US study)

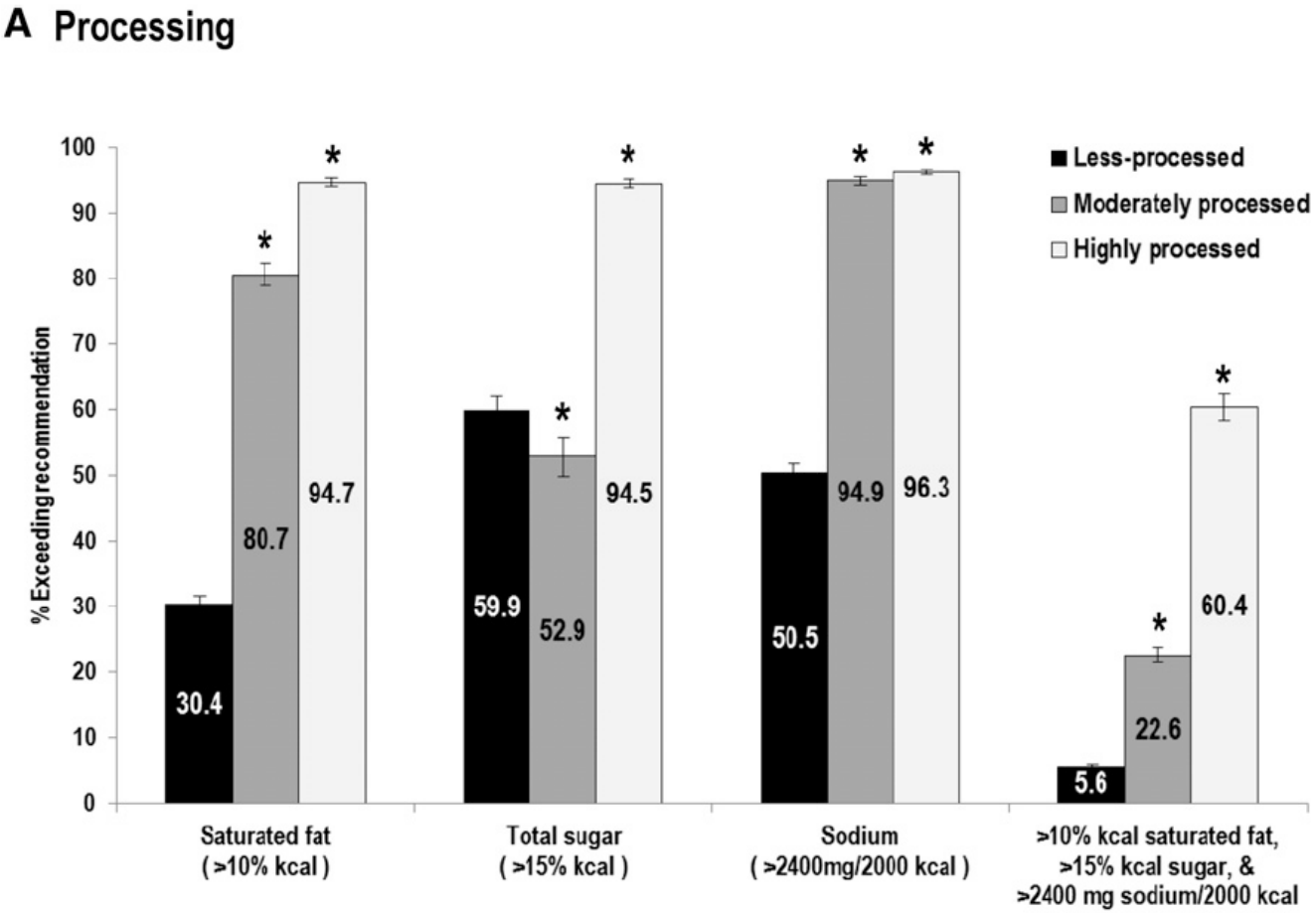
- Processed foods are defined as any foods other than raw agricultural commodities and can be categorized by the extent of changes occurring in foods as a result of processing.
- Conclusions about the association between the degree of food processing and nutritional quality are discrepant.
- Classification: Categories of industrial food processing and product convenience.

Processing	Convenience
• Less processed (minimal/ basic) • Moderately processed • Highly processed	• Requires cooking/preparation • Ready-to-heat (RTH) • Ready-to-eat (RTE)

Poti et al. 2015

Processed foods (US study)

- Less processed
  - Unprocessed/minimally processed: single-ingredient foods with no or very slight modifications, e.g. fresh plain milk, cream, honey, herbs, fresh, frozen or dried plain fruit, vegetables.
- Basic processed
  - Processed basic ingredients: single isolated food components obtained by extraction or purification using physical or chemical processes that change inherent properties of the food, e.g. whole grain pasta, oil, unsalted butter, egg whites.
  - Processed for basic preservation or precooking:
- Wide variation in nutrient content suggests food choices within categories may be important. (Poti et al. 2015)



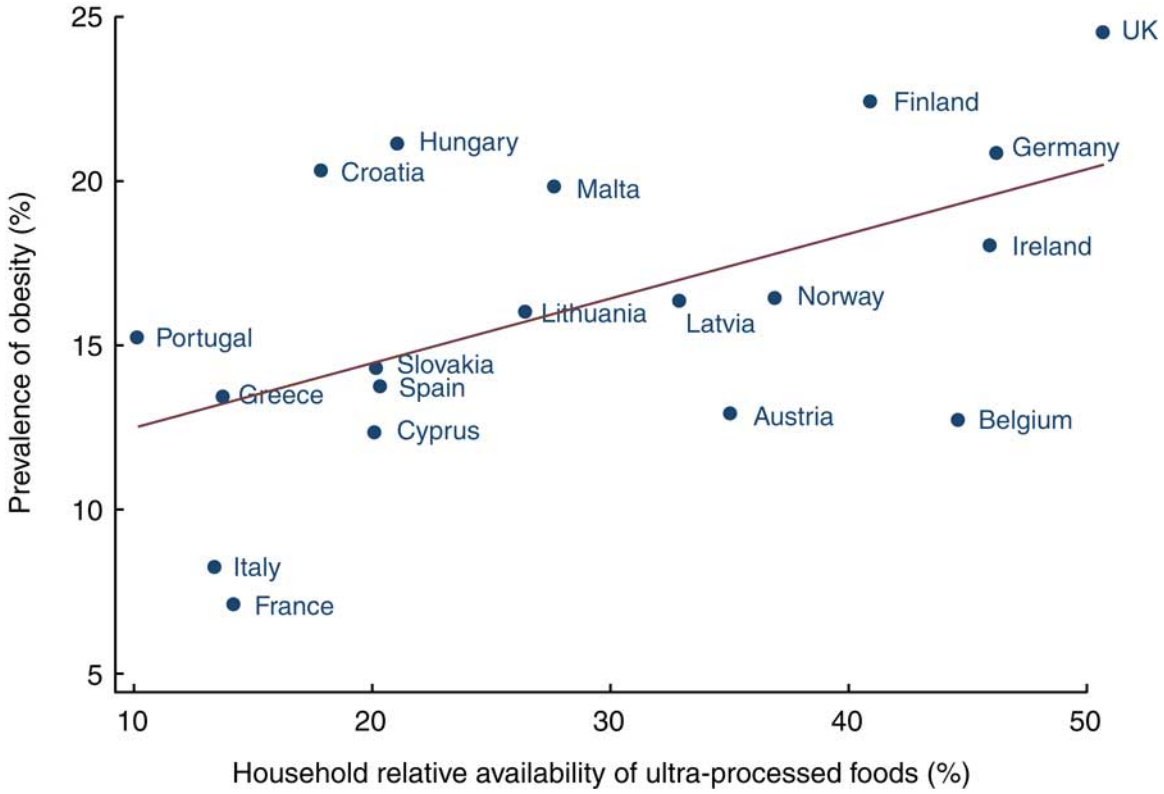
Highly processed food purchases had higher adjusted median saturated fat, sugar and sodium content and were significantly more likely to exceed DGA/FDA-recommended limits for all 3 components in combination compared with less processed (unprocessed/minimally or basic processed) food purchases. (Poti et al. 2015)

Ultraprocessed foods in Europe

The consumption of ultra-processed foods is associated with an increased risk of diet-related non-communicable diseases.

The need for public policies and actions that promote consumption of unprocessed or minimally processed foods

Ultra-processed foods less available and affordable.



Monteiro et al. 2018.

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Examples about careful processing (physical)

- Use of gravity, vacuum or air pressure in liquid pumping instead of centrifugal pumps and careful design of piping systems.
- Rapid and efficient heat treatment in pasteurization or cooling systems in freezing in order to avoid losses and to preserve vitamins.
- Avoid mixing of oxygen to ovoid colour and flavour defects. (Nuora 2013).

Biological careful processing: Fermentation

- Can be used both in conventional and organic production
- Biological process, suitable for raw materials of animal and plant origin.
- Lactic acid bacteria produce vitamins (e.g. Vitamins K and B), and bioactive compounds
- They form acids which lower the pH and preserve the product and
- Digestibility is improved when di- and oligosaccharides are metabolized.
- Tailored lactic acid starter cultures enhance the hygiene, sensory, nutritional and shelf life properties. (DiCagno et al. 2013).

Beneficial food compounds

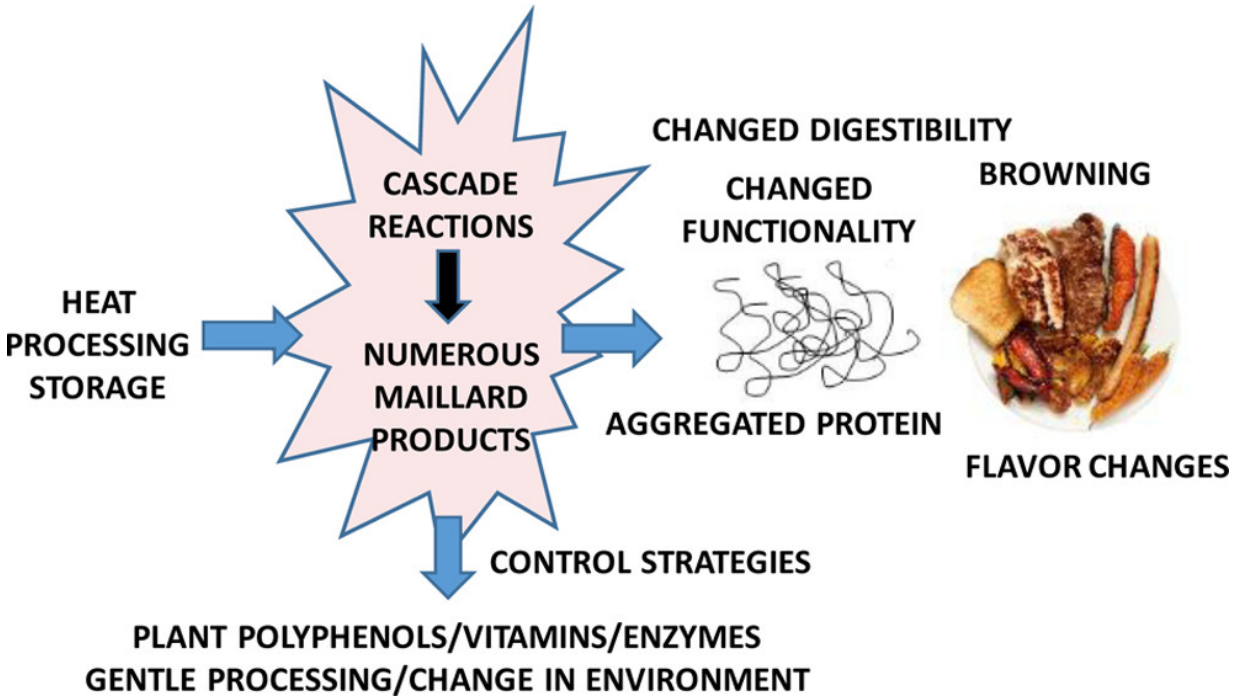
- Organic plant products have higher content of some essential or beneficial food compounds
  - Vitamin C content
  - Phenolic compounds
- Lower content of nitrates and pesticides in organic food (Lima & Vianello 2011)
- Seasonal variation of milk in pasture-based feeding systems has been shown in milk fatty acid composition (Schwendel et al. 2015). Also, the contents of individual whey proteins except for bovine serum albumin and vitamins have shown seasonal variation (Brodziak et al. 2017)

Effect of processing on beneficial compounds

- Vitamin C: Heating destroys partly
- Polyphenols
  - Relatively heat resistant
  - High polyphenol content reduces Maillard reaction and generation of harmful compounds
  - Improved nutritional quality by optimization of processing methods and combining novel and traditional processing methods.
  - Potential bioactivity of polyphenol compounds can be enhanced by processing (McDougall 2017)
- More research is needed

Maillard reaction

Maillard reactions affect multiple food quality parameters, including organoleptic properties, color, and protein functionality.
The later stages of Maillard reactions include the formation of advanced glycation endproducts (AGEs), where most of the characterized compounds are derived from modifications of Lys and/or Arg as described above.



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SUSMEATPRO - Sustainable plant ingredients for healthier meat products - proof of concepts

- Many epidemiological and experimental studies suggest that a high intake of red and processed meat is associated with increased colorectal cancer risk.
- The addition of complex antioxidant plant extracts to processed meat could result in healthier products due to decreased level of oxidation in the meat, thus preventing the inflammation reactions upon consumption.
- Local horticultural plant material and side streams were collected and screened for antioxidant and antimicrobial capacities in different test systems in vitro. Extracts of superior capacities were selected and tested in conceptual meat products with promising results.
- Website: https://sites.google.com/site/susmeatpro/home

New mild process techniques

- New mild preservation techniques, such as high-pressure processing (HPP) and pulsed electric field processing (PEF), inactivate micro-organisms as effectively as standard heating techniques – and moreover have the added bonuses of retaining flavour, texture and nutritional value while consuming less energy. As a result, shelf life is extended and products do not have to be thrown out so soon.
- Strawberries: HPP at ambient temperature conditions combined with vacuum packaging in high barrier packaging materials and refrigerated storage resulted in high quality product with relatively good storage stability of phytochemicals over at least 3 months. (Terefe et al. 2009)

New processing technologies

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What do they promise?

- Emerging technologies allow replacing conventional ones
- Based on the mechanism of action preservation or structure modification can be achieved
- Commercial viability is dependent on value creation, mode of operation, energy requirements as well as scale
- The techniques are ready for industrial application or close

Food waste occurs as a result of spoilage

- Consumers continue to demand minimally or nonthermally processed products for a variety of reasons.
- Reducing or eliminating thermal treatments increases susceptibility to spoilage and decreases shelf life.
- Fungi are problematic spoilage organisms in processed foods.
- Preservative elimination, sodium and sugar reduction, and the use of natural flavors have the potential to increase the threat of fungal spoilage. (Snyder & Worobo 2018)

Summary

- There is an important need for clear principles and related criteria for the evaluation of additives and processing methods.
- The principle of carefulness/careful processing might be helpful for the communication between manufacturers/retailers and consumers. (Kretzschmar & Schmid 2011)
- Food production/processing sidestreams can be used as sources of natural plant based additives, which have antioxidative activity. If they are used in organic food products, their production method should meet the organic requirements and their safety should be evaluated.
- Careful processing may lead to shorter shelf life of food products. The processing hygiene including the selection of raw materials, process design as well as packaging must be well designed.


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Thank you!

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