NOVEL PRESERVATION TECHNOLOGIES

RYN

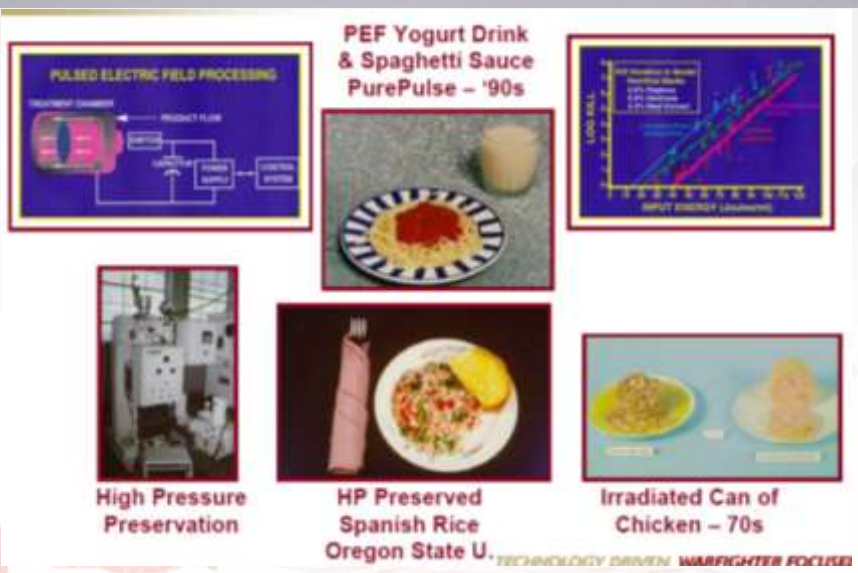
PROSES THERMAL:

- High energy
- Penurunan kualitas (vitamin, aroma, rasa, nutrisi, dll)

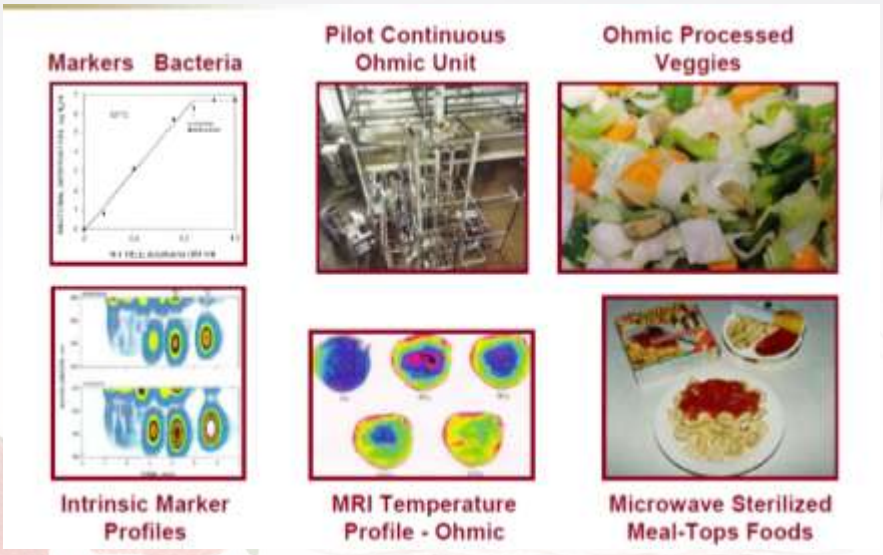
PROSES NON THERMAL:

Proses berlangsung pada suhu di bawah suhu pengolahan thermal

Teknologi Non Thermal



Advanced Thermal Technologies



Advantages of Novel Preservation technologies

- "Fresher" taste and texture
- Pasteurization with minimal chemical and physical changes (nonthermal)
- Possible Sterilization by combination processes
- Improved nutrient content
- Maintain higher quality of extended shelf life
- New product categories – nutraceuticals/natural additives
- Possible integration to improve classic food processing unit operations

Capabilities and Constrains of Processes

PROCESS	CAPABILITY	CONSTRAINT
Ohmic & MW flow Processes	Flow system for particulates; Can formulate to heat solids before liquid phase	Residence time/heat gradients; packaging interface
Microwave retort	Rapid heating of prepackaged solids	Uniformity/depth of penetration; Incompatible w/foil layer
RF	Rapid heating of packaged solids	Uniformity & compositional dependence
High Pressure	Instant transmission in fluids & solids; Treat any food in flexible containers	Does not inactive spores except at high temp; Equipment capital cost
Pulsed Electric Field	Pumpable products	High conductivity and particulates problems

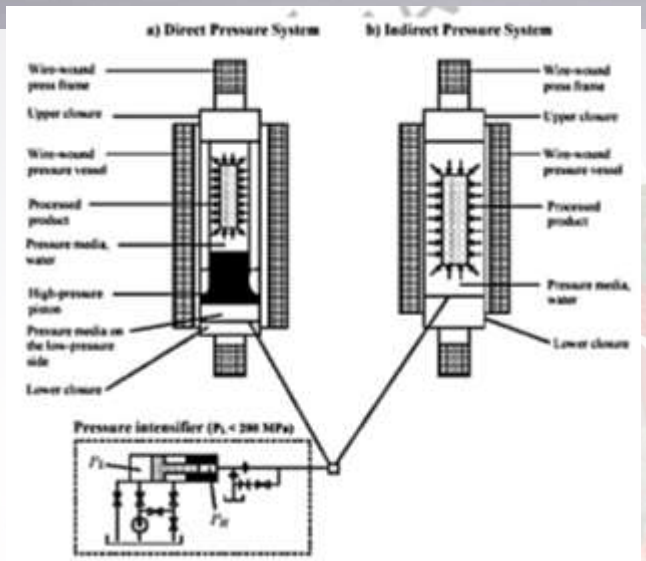
PROCESS	CAPABILITY	CONSTRAINT
Pulsed Light & UV	Can inactivate all classes of microbes incl viruses	Only at surfaces or in clear liquids
E-beam/ Gamma Irradiation	Sterilizes packaged meat & complex foods (E); all foods (Gamma)	Short penetration depth & Complex operation (E); Req. radioactive source (Gamma); Chem by-pdt
Ozone	Can react with vegetative organisms and spores on foods as a wash	Food matrix consumes ozone and diminishes effect
Dense Phase CO_2	May react with spores & vegetative organisms	Best for liquids

High Hydrostatic Pressure (HHP)

High Hydrostatic Pressure (HHP) is applied at uniform pressure throughout the food, enabling total preservation and retaining the quality of the food. HHP is not time/mass dependent, so processing time is minimal.

- Expose bahan makanan pada tekanan 300 – 800 Mpa untuk beberapa saat, dalam beberapa detik ataupun menit, dapat meng- inaktivasi bakteri patogen maupun jamur, tanpa diikuti perubahan yang tidak diinginkan akibat panas.
- Teknologi HHP mengaplikasikan tekanan pada bahan pangan yang berada di dalam bejana bertekanan.
- Terjadi perubahan suhu yag sangat kecil (Untuk air murni, tekanan 600 Mpa, perubahan suhu 15 ^{o}C)

- Tekanan di transmisikan melalui fluida (Hukum Pascal) ➔ tekanan yang sama dari segala arah menekan makanan
- Tidak tergantung pada bentuk dan ukuran bahan
- Tidak tergantung waktu (waktu yang dibutuhkan untuk tekanan mencapai posisi bagian tengah makanan sangat singkat)
- Pengaruh tekanan terhadap inaktivasi bakteri tergantung waktu



Prinsip hidrolis

$$A_1 \times P_1 = A_2 \times P_2$$

Biological Effects

High Pressure ==> kerusakan membran sel

Membran sel berperan penting pada respirasi dan transportasi.

Perubahan drastis pada permeabilitas membran ➔ kematian sel

Peningkatan tekanan ➔ meningkatkan inaktivasi mikroba, tetapi penambahan waktu tidak meningkatkan laju kematian mikroba

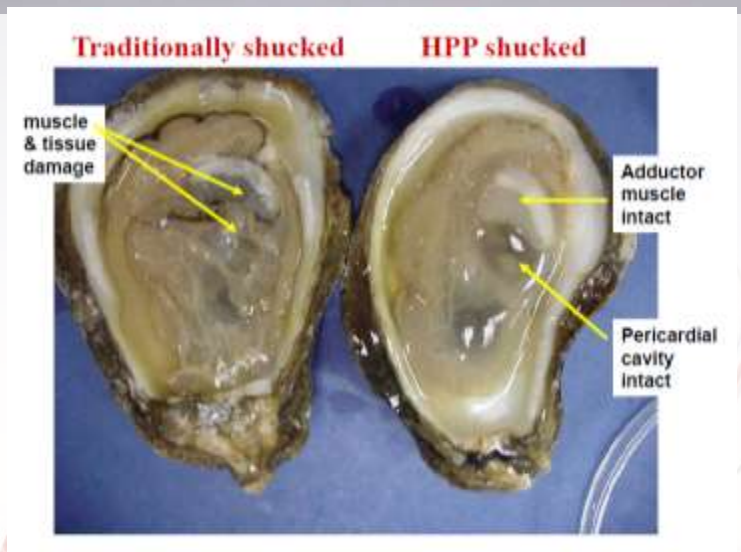
HHP dapat meginaktifasi enzim krn tekanan merusak sisi aktif enzim

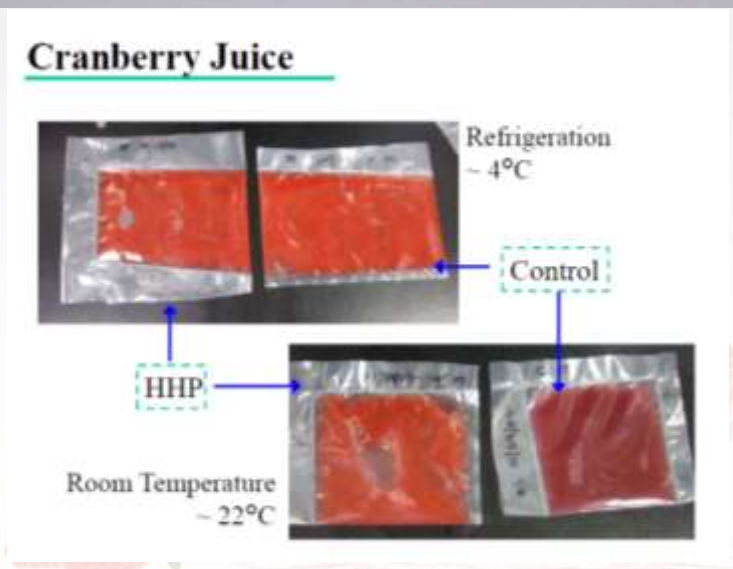
Pada umumnya perlakuan tekanan tidak mencukupi untuk menginaktfasi enzim, shg sering di kombinasikan dgn perlakuan lain

1. Increasing initial temperature for high pressure treatment will increase effectiveness for vegetative bacteria. Best above 40^0C. Significant bacterial injury fraction.
2. Bacterial spores are not easily inactivated by high pressure; therefore, shelf-stable processes can now only be obtained with acid pH foods.
3. Combination preservation strategies, e.g. using temperature or additives in combination with HPP will be needed to produce true shelf stable foods.
4. Sensory studies show food properties have more fresh-like character than thermally processed counterparts. High protein foods are subject to texture changes by HPP. Pretreatment and formulation are vital to optimize quality.

HHP Market Segmentation Matrix

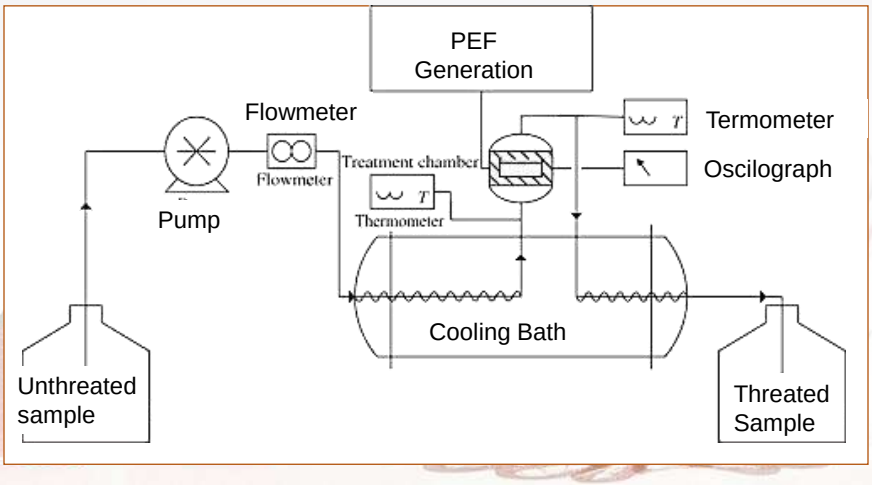
CONTOH APLIKASI HHP/HPP



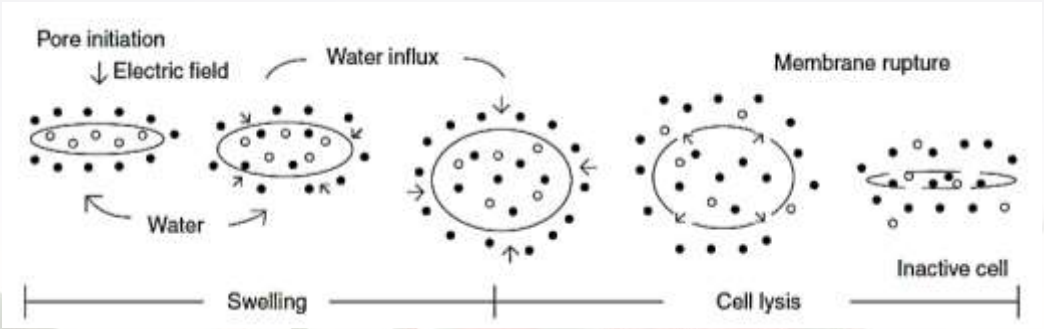


PULSED ELECTRIC FIELDS

Aplikasi Denyutan Tegangan Tinggi pada makanan yang di tempatkan di antara dua elektroda



Mekanisme inaktivasi sel



Food and Drugs Administration

Conduct a scientific evaluation of the process to determine if the aseptically produced product poses a potential public health hazard, and if all the critical factors necessary to render the product commercially sterile are monitored and controlled. The filing information of the new process must contain

1. Equipment design: a description of the system, control mechanisms used, and fail safe procedures
2. Product specifications: a full description of the product, including physical/chemical aspects, critical factors, and influence of processing on the critical factors
3. Process design: a complete description of the critical/processing conditions used in the manufacture of the product
4. Validation: a physical demonstration of the accuracy, reliability, and safety of the process

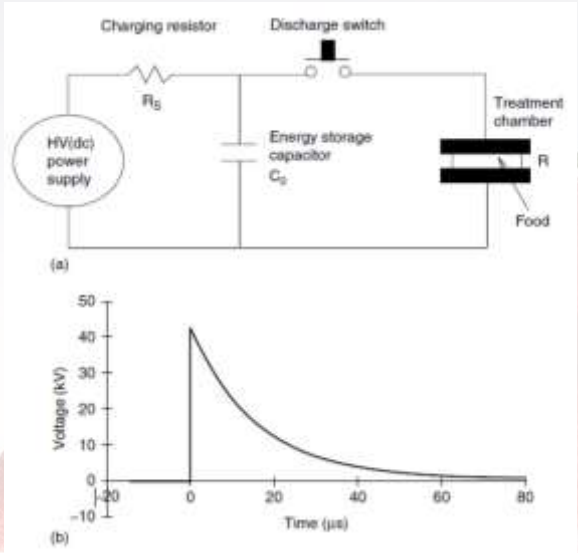
The concept of pulsed power

Electric energy at low power levels is collected over an extended period and stored in a capacitor ➔ discharged instantaneously at very high levels of power.

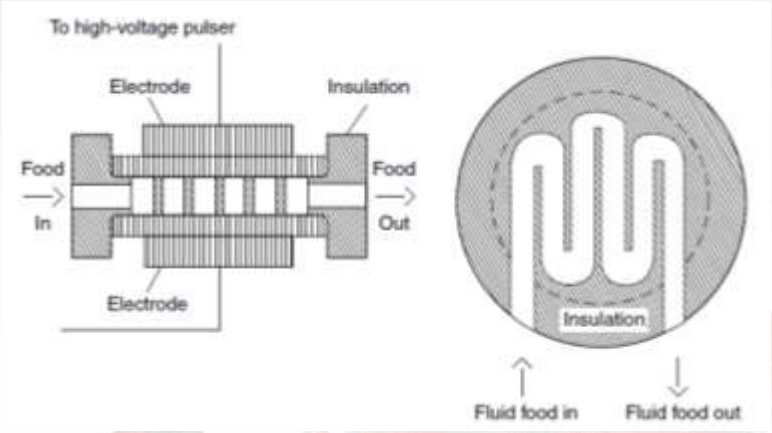
Two major devices :

A pulse power supply

Treatment Chamber which convert the pulsed voltage into PEFs

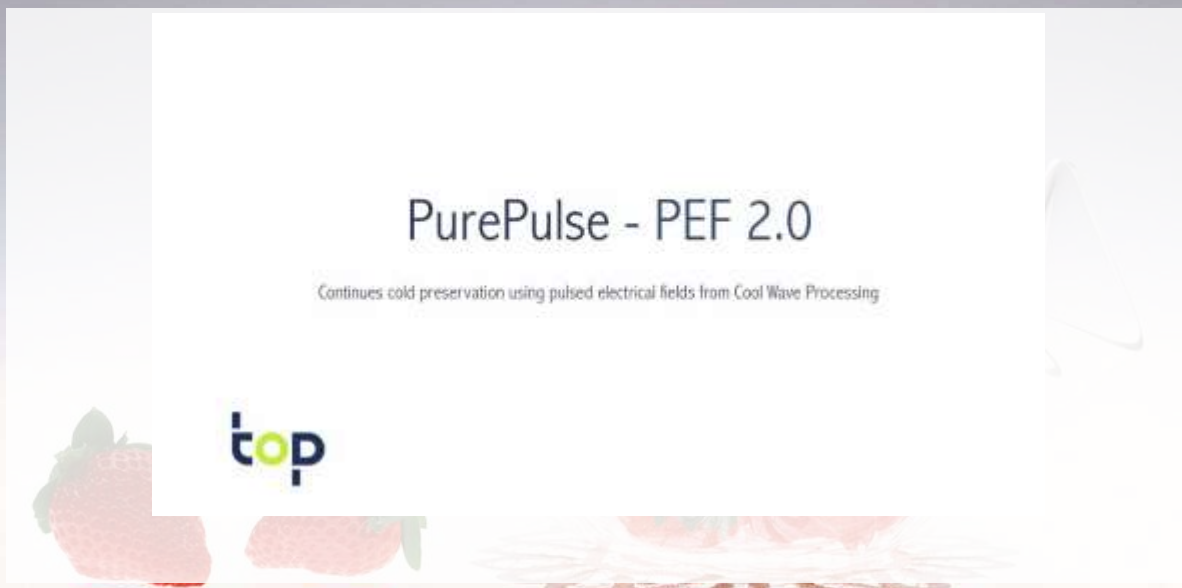


Skema Tipe Kontinyu



- **Sensitivity to PEF Treatment:**
  - parasites > yeast & molds > Gm(-) bacteria > Gm(+) bacteria
- **Resistant to PEF:**
  - Yeast ascospores; Gm(+) bacterial spores
  - Parasite oocysts; Viruses
- **Environmental Effects on Sensitivity**
  - Lower pH increases sensitivity + for fruit juices
  - Higher temps. >30C increase sensitivity
  - High conductivity and air bubbles interfere
- **First commercial PEF food application, Genesis Juice in Fall 2005 – pilot system from OSU – Spring 07**
- **Established thermal pasteurization capability for commodity items vs. Incentive of Juice HACCP**

Aplikasi PEF



Ionizing Radiaton

- **Radiation: Mode of heat transfer in vacuum**
- **Non-Ionizing Radiation: RF, microwaves, IR**
- **Ionizing Radiation: X-rays, gamma rays, and energy from radioactive isotopes.**

Irradiation: Ionizing radiation

What is food irradiation?

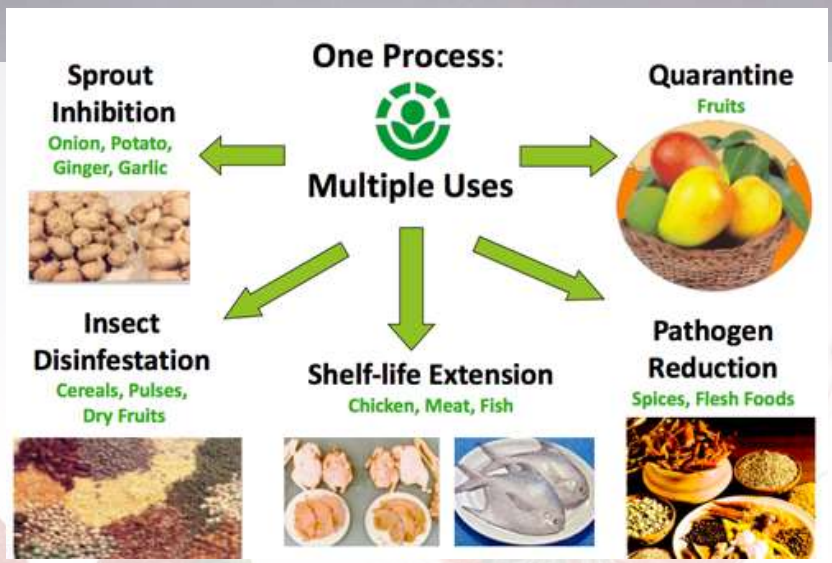
Food irradiation involves exposing foods to large doses of ionizing radiation, in order to kill or deactivate bacteria, molds, insects or other food-borne organisms, and to inhibit plant growth and maturation

Food irradiation can use any of three types of ionizing radiation: x-rays, gamma radiation or electron-beams.

Sebagian energi radiasi di serap oleh molekul dalam makanan ➔ menstimulasi elektron, bbrp keluar orbit ➔ bermuatan ➔ molekul terbelah.

Mekanisme utama deaktivasi bakteri: pembelahan molekul air menjadi hidro (H+), hidroksil (OH-) dan oksigen (O-2).

Jumlah energi radiasi yan diserap disebut dosis irradiasi (Gy. 1 Gy = 1 joule/kg)


One Process:
Multiple Uses
Sprout Inhibition
Onion, Potato, Ginger, Garlic
Quarantine
Fruits
Insect Disinfestation
Cereals, Pulses, Dry Fruits
Shelf-life Extension
Chicken, Meat, Fish
Pathogen Reduction
Spices, Flesh Foods


Asparagus
Control 36 days at 34F
Irradiated at 400Gy 36 days at 34F

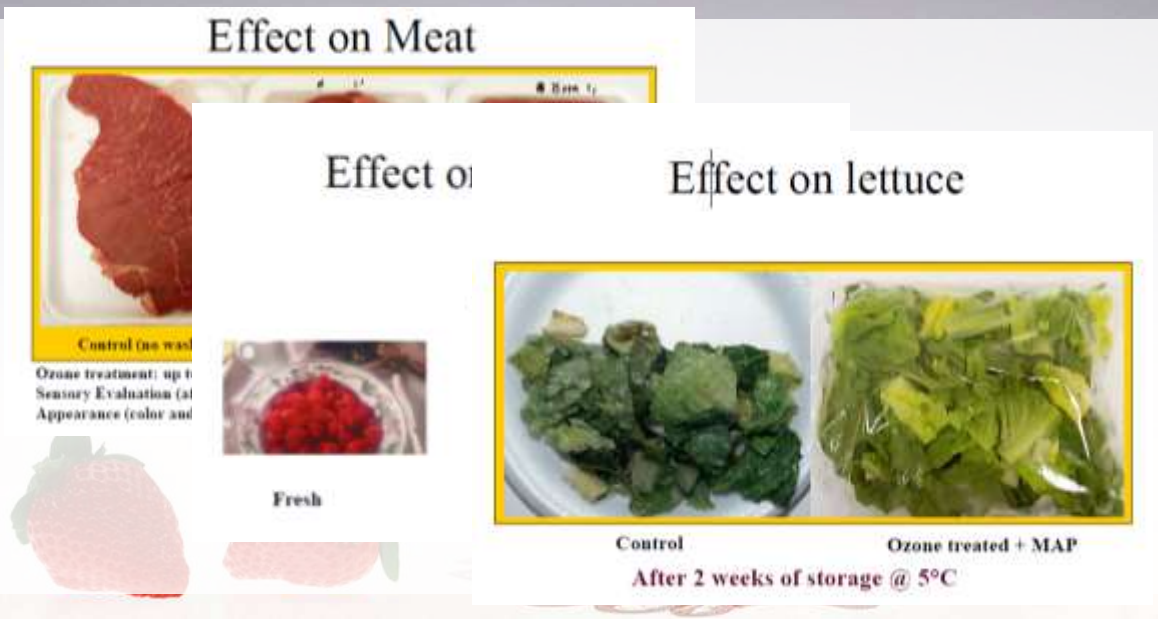

control compared to tomatoes irradiated at 1.0 kgy at 10 days
Tomatos

"The greatest disadvantage of food irradiation is its name…evokes unpleasant associations of radioactivity, nuclear threats, high technology, genetic mutation, and cancer"

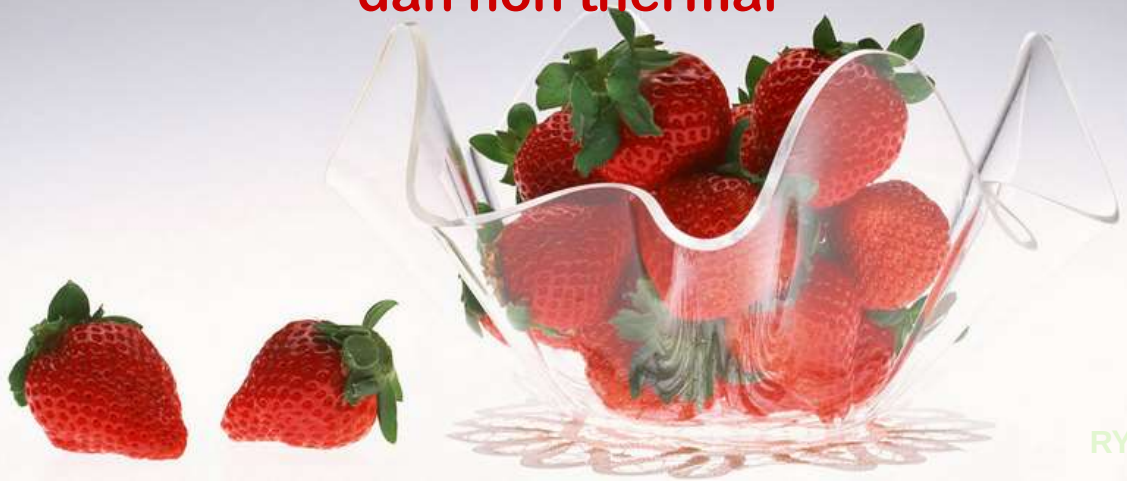
Apakah iradiasi makanan itu benar-benar aman?

Ozone Processing

- A gas - triatomic form of oxygen.
- Most powerful oxidizing agent available for conventional water treatment – highly reactive.
- Unstable - must be generated onsite and used.
- Slightly soluble in water, but more so than oxygen.



Pengembangan teknologi thermal baru dan non thermal



Criteria for Success

- Microbiological Safety and Stability
- Sensory Acceptance (Hedonic Skala 9)
- Chemical/Chemical/Biochemical Stability

Road Map

Referensi

- Canovas B, et al, Non thermal Processing of Foods and Emerging Technologies, EOLSS
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Thank You
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