Current Issues related to Shelf Life of Foods

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Main References:

Hariyadi, P. 2006. Handouts and Modules of Shelf Life Determination (in Bahasa Indonesia). Seafast Center/Department of Food Science and Technology, Faculty of Agriculture Technology, Bogor Agricultural University.
What is Shelf life?

Everything has a shelf life
What is Shelf life?

Everything has a shelf life

What is Shelf life?

The period between manufacture and retail purchase of a food product during which the product is of **satisfactory quality** (IFT; 1974).
What is Shelf life?

The time during which the food product will:
1. remain safe;
2. be certain to retain **desired** sensory, chemical, physical and microbiological characteristics;
3. comply with any label declaration of nutritional data, when stored under the recommended conditions. *(IFST Guidelines, 1993)*

What is Shelf life?

Shelf-life as the period during which a food product maintains its microbiological safety and suitability at a specified storage temperature and, where appropriate, specified storage and handling conditions *(Codex Alimentarius, CAC/RCP-46; 1999)*.
Issues related with Shelf life of Food?

Inconsistency in date labeling contributes to misunderstanding about how dates on labels relate to food quality or safety.

- Discarded food based on the sell by date: 25%
- Discarded food past the use by date: 37%
- Believe using food past its best by date is a serious health risk: 10%

This misunderstanding is among the factors contributing to food waste.
What is Shelf life?

Period of time between manufacture and possible latest consumption, wherein the characteristics of a food product are considered to remain acceptable.

Acceptable? (= “satisfactory” or “desired” quality?)
- Comply to government regulation
- Comply to claimed nutritional/functional value
  - prime aspect for food; maintain claims on products
- Comply to company specification
  - commercial stability? : package integrity, look; key for customers/at point of sale
  - consumer defined quality (gain & maintain consumers loyalty)

Refs? → END of SHELF LIFE?

- Comply to government regulation

Safety & Quality standard?
- SNI → Obligatory/Voluntarily?
- Decree of Head of NADFC (Perka BPOM RI)
  - No 21, 2016 (Food category)
  - No 16, 2016 (Microbial specification)
- CODEX STAN
- ???
Refs? → END of SHELF LIFE?

- Comply to **claimed** nutr./functional value → C

  - Decree of Head of NADC RI  
    (Perka BPOM RI) No 13, 2016

    *(Pengawasan Klaim pada Label dan Iklan Pangan Olahan)*

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Refs? → END of SHELF LIFE?

- Comply to company **specification** → S

  - **Private standard?**  
    - Company Standard  
      - Company policy/strategy  
      - ???

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Which one? \( \rightarrow \) END of SHELF LIFE?

![Graph showing relative quality (Q) vs. storage time (months).](Image)

- **Maximum possible shelf life**
- **Minimum requirement** (Safety & Quality regulation)

END of SHELF LIFE? Which one?

\( \rightarrow \)
Which one? → **END of SHELF LIFE?**

[Graph showing relative quality against storage time with a question mark indicating the end of shelf life.]
Which one? → END of SHELF LIFE?

Check Regulation

Cs = ?
Cs = ?

END of SHELF LIFE? Which one?

Which one? → END of SHELF LIFE?

Cs = ?
Cs = ?

END of SHELF LIFE? Which one?

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Except in situations in which safety is an issue, the definition of shelf-life (and determination of END of Shelf Life) is related to the **positioning of the product in the market in terms of quality and customer perceptions of that quality.**

**Which one ? END of SHELF LIFE?**

What is “critical factor” determining END of Shelf-life?

R, C, or S?
## What is “critical factor” determining END of Shelf-life?

### Table A1.1 Deterioration of fruit and vegetable products

<table>
<thead>
<tr>
<th>Product</th>
<th>Deterioration mechanisms</th>
<th>Limiting changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soft fruit</td>
<td>Enzymic breakdown</td>
<td>Textural softening</td>
</tr>
<tr>
<td></td>
<td>Mould growth</td>
<td>Visible mould</td>
</tr>
<tr>
<td></td>
<td>Moisture loss</td>
<td>Dry appearance</td>
</tr>
<tr>
<td>Hard fruit</td>
<td>Enzymic action</td>
<td>Textural softening, bruising</td>
</tr>
<tr>
<td></td>
<td>Moisture loss</td>
<td>Dry texture</td>
</tr>
<tr>
<td>Potatoes</td>
<td>Enzymic action</td>
<td>Softening, poor cooking</td>
</tr>
<tr>
<td></td>
<td>Sprouting</td>
<td>Sprouting, toxin production</td>
</tr>
<tr>
<td>Cucumber</td>
<td>Enzymic action</td>
<td>Loss of crispness, gross structure breakdown</td>
</tr>
<tr>
<td>Coleslaw</td>
<td>Moisture loss from vegetables</td>
<td>Loss of viscosity in dressing, apperance changes, microbial growth</td>
</tr>
</tbody>
</table>

### Table A1.2 Deterioration of meat and meat products

<table>
<thead>
<tr>
<th>Product</th>
<th>Deterioration mechanisms</th>
<th>Limiting changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh red meat</td>
<td>Oxidation</td>
<td>Loss of red colour, rancidity</td>
</tr>
<tr>
<td></td>
<td>Microbial growth</td>
<td>Off-odours and flavours</td>
</tr>
<tr>
<td>Frozen meat</td>
<td>Oxidation</td>
<td>Rancidity</td>
</tr>
<tr>
<td></td>
<td>Ice sublimation</td>
<td>Freezer burn</td>
</tr>
<tr>
<td>Fresh fish</td>
<td>Microbial growth</td>
<td>Microbial</td>
</tr>
<tr>
<td></td>
<td>Chemical reactions</td>
<td>Off-odours</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Appearance changes</td>
</tr>
<tr>
<td>Fresh poultry</td>
<td>Microbial growth</td>
<td>Microbial</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Off-odours</td>
</tr>
<tr>
<td>Fresh sausages</td>
<td>Microbial growth</td>
<td>Microbial</td>
</tr>
<tr>
<td></td>
<td>Oxidation</td>
<td>Rancidity</td>
</tr>
<tr>
<td>Fresh bacon</td>
<td>Microbial growth</td>
<td>Microbial</td>
</tr>
<tr>
<td></td>
<td>Oxidation</td>
<td>Rancidity, colour change</td>
</tr>
<tr>
<td>Canned ham</td>
<td>Chemical reactions</td>
<td>Flavour loss</td>
</tr>
<tr>
<td></td>
<td>Can deterioration</td>
<td>Gas generation</td>
</tr>
</tbody>
</table>


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What is “critical factor” determining END of Shelf-life?

**Table A1.3** Deterioration of cereal and other dry products

<table>
<thead>
<tr>
<th>Product</th>
<th>Deterioration mechanisms</th>
<th>Limiting changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bread</td>
<td>Starch retrogradation</td>
<td>Scale texture and flavour</td>
</tr>
<tr>
<td></td>
<td>Moisture migration</td>
<td>Dry texture, mould growth</td>
</tr>
<tr>
<td>Snack foods</td>
<td>Moisture uptake</td>
<td>Loss of crispness</td>
</tr>
<tr>
<td></td>
<td>Oxidation</td>
<td>Rancidity</td>
</tr>
<tr>
<td>Cakes</td>
<td>Moisture loss</td>
<td>Drying and hardening</td>
</tr>
<tr>
<td></td>
<td>Starch changes</td>
<td>Stale flavour and texture</td>
</tr>
<tr>
<td></td>
<td>Microbial growth</td>
<td>Mould formation</td>
</tr>
<tr>
<td>Dried pasta</td>
<td>Starch changes</td>
<td>Texture changes, breakage</td>
</tr>
<tr>
<td></td>
<td>Protein changes</td>
<td>Softening (cereals), hardening (fruits)</td>
</tr>
<tr>
<td>Breakfast cereals</td>
<td>Moisture migration</td>
<td>Softening (cereals), hardening (fruits)</td>
</tr>
<tr>
<td></td>
<td>Starch retrogradation</td>
<td>Scale flavour and texture</td>
</tr>
<tr>
<td></td>
<td>Oxidation</td>
<td>Rancidity</td>
</tr>
<tr>
<td>Dry mixes</td>
<td>Moisture uptake</td>
<td>Coking</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Non-enzymic browning</td>
</tr>
<tr>
<td>Spices</td>
<td>Microbial growth</td>
<td>Mould and bacterial growth</td>
</tr>
<tr>
<td></td>
<td>Volatile loss</td>
<td>Flavour changes</td>
</tr>
<tr>
<td></td>
<td>Chemical reactions</td>
<td>Colour loss</td>
</tr>
<tr>
<td>Chocolate</td>
<td>Fat migration</td>
<td>Fat crystallisation (bloom)</td>
</tr>
<tr>
<td>Confectionary</td>
<td>Oxidation</td>
<td>Texture changes</td>
</tr>
<tr>
<td>Sugar</td>
<td>Moisture uptake</td>
<td>Softening, rancidity</td>
</tr>
<tr>
<td>Confectionary</td>
<td>Oxidation</td>
<td>Rancidity</td>
</tr>
</tbody>
</table>


What is “critical factor” determining END of Shelf-life?

**Table A1.4** Deterioration of beverages

<table>
<thead>
<tr>
<th>Product</th>
<th>Deterioration mechanisms</th>
<th>Limiting changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbonated beverages</td>
<td>Gas evolution/oxidation</td>
<td>Carbonation loss</td>
</tr>
<tr>
<td>Beer</td>
<td>Oxidation</td>
<td>Flavour loss, off-flavours, rancidity</td>
</tr>
<tr>
<td></td>
<td>Microbial growth</td>
<td>Turbidity</td>
</tr>
<tr>
<td>Coffee</td>
<td>Volatile loss</td>
<td>Flavour change</td>
</tr>
<tr>
<td></td>
<td>Oxidation</td>
<td>Rancidity</td>
</tr>
<tr>
<td>Fruit juices</td>
<td>Oxidation</td>
<td>Flavour and nutrient loss</td>
</tr>
<tr>
<td></td>
<td>Enzymic reactions</td>
<td>Cloud instability</td>
</tr>
<tr>
<td>Tea</td>
<td>Volatile loss</td>
<td>Flavour loss</td>
</tr>
<tr>
<td></td>
<td>Oxidation</td>
<td>Off-flavours</td>
</tr>
<tr>
<td>Wine</td>
<td>Oxidation</td>
<td>Off-flavours</td>
</tr>
<tr>
<td>Low-calorie soft drinks</td>
<td>Hydrolysis</td>
<td>Colour change</td>
</tr>
</tbody>
</table>

What is "critical Factor" determining END of Shelf-life?

Which one?

a. (Micro)biological factors: bacteria, mold, yeast
b. Chemical factors: vitamin C., thiamin, riboflavin, etc

c. Nutritional factors: protein, fats, digestion quality, etc
d. Functional factors: enzyme activity, probiotic activity, antioxidant activity, etc
e. Physical factors: Viscosity, texture, color, emulsion stability, etc

f. Organoleptic factor: appearance quality, odor, taste, etc

---

Table 7.6 Approximate order of importance of specific deterioration indices for certain foods: 1 = most important, 7 = least important

<table>
<thead>
<tr>
<th>Foods</th>
<th>Microbial changes</th>
<th>Inherent changes</th>
<th>Moisture changes</th>
<th>Oxidation Taint</th>
<th>Light</th>
<th>Physical damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baked goods</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Raw &amp; cooked meats</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Fish</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Shellfish</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Potatoes</td>
<td>2</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>Green vegetables</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Soft fruits</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Salads</td>
<td>2</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Breakfast cereals</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>4</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Chocolate</td>
<td>5</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>-</td>
</tr>
</tbody>
</table>

Acknowledgement is made to Blackie Scientific and Technical for permission to reproduce this material from Paine, F., A Handbook of Food Packaging, London, Blackie, 1983, p. 197.
FACTORS INFLUENCING SHELF-LIFE OF FOODS

A. intrinsic (properties of the final product):
- Water activity (aw) (available water).
- pH value and total acidity; type of acid.
- Available oxygen.
- Nutrients.
- Natural microflora and surviving microbiological counts.
- Natural biochemistry of the product formulation (enzymes, chemical reactants).
- Use of preservatives in product formulation (e.g. salt).

What is “critical factor” determining END of Shelf-life?

B. Extrinsic factors (factors the final product encounters as it moves through the food chain):
- Time–temperature profile during processing.
- Temperature.
- Relative humidity (RH).
- Exposure to light (UV and IR).
- Environmental microbial counts.
- Composition of atmosphere within packaging.
- Subsequent heat treatment (e.g. Reheating/cooking before consumption).
- Consumer handling.
What is “critical factor” determining END of Shelf-life?

Open shelf-life dating

Open dating is the use of dates (means the use of legible terms such as a day, month, and year; NOT a code, or a symbol) on a can or package of food that gives the consumer (including distributors, wholeseller or retailers) an indication of when the food was packaged or by when it should be sold or used.
Open shelf-life dating

Why?

1. Encourages better handling practices by wholesalers, retailers, and consumers by expediting the sale or use of food near the end of shelf life.
2. Increase consumer confidence in the freshness of food purchased.
3. Better handling practices attributed to open dating could minimize nutrient loss.

Can be expressed as:

1. date of pack or manufacture,
2. pull date or sell-by date,
3. best-if-used-by date,
4. expiration date or use-by date, or
5. combination of two of the above.
**Open** shelf-life dating

Expressed as **Expiration date**

- Date that indicates that before that date food products is still in “satisfactory quality” or “desired” condition (provided that product stored under the recommended conditions)
- END of shelf life
**Open** shelf-life dating

Expressed as *Expiration date*

- **Expiration date**
- **Sell by**
- **Use by**
- **Display until**

**Graphic:**
- Graph showing percentage decrease in quality over storage time.
- Formula: $F_0$
- $Q$ relative
- Storage Time (months)

2. **Shelf Life → Ingredient?**

- Penurunan Quality selama pengolahan?
- $F_0$
- penentuan "overage".
- shelf life of **Ingredients**?

**Table:**

<table>
<thead>
<tr>
<th>Date</th>
<th>Weight</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 May</td>
<td>0.348</td>
<td>5.67</td>
</tr>
<tr>
<td>8 May</td>
<td>2.57</td>
<td>2.07</td>
</tr>
</tbody>
</table>

**Figure:**

- Graph showing the decrease in quality over storage time.
2. **Shelf Life** → **Ingredient?**

**Step 2**

- **Penentuan Spesifikasi Ingredien**
- **Penentuan pengaruh pengolahan pada nilai Q**
- **Penentuan Spesifikasi Produk**
- **Penetuan Spesifikasi Produk tak-layak**

**Process criteria:** e.g. pasteurisation or sterilization time/temperature

**Product criteria:** pH, aw, salt, acid, etc. = f(functionality, Q, R)

---

**Ingredient Spec:**
- Acceptable spec by Industry

→ will affect the formulation

- Quality I
- Quality II
- Quality III

**Quality Limit** (expiration date) set by supplier

**Storage Time (months)**

---

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2. **Shelf Life → Ingredient?**

Example → Formula: 10 kg/ton

Quality I

Quality II

Quality III

<table>
<thead>
<tr>
<th>Storage Time (months)</th>
<th>Q relative</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>90</td>
</tr>
<tr>
<td>4</td>
<td>80</td>
</tr>
<tr>
<td>6</td>
<td>70</td>
</tr>
<tr>
<td>8</td>
<td>60</td>
</tr>
</tbody>
</table>

Quality Limit (expiration date) set by supplier

### Example

- Formula: 10 kg/ton

### Formula

- 10 kg/ton

### Quality II

- Formula: 11.1 kg/ton

### Quality III

- Formula: 11.1 kg/ton

<table>
<thead>
<tr>
<th>Storage Time (months)</th>
<th>Q relative</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>90</td>
</tr>
<tr>
<td>4</td>
<td>80</td>
</tr>
<tr>
<td>6</td>
<td>70</td>
</tr>
<tr>
<td>8</td>
<td>60</td>
</tr>
</tbody>
</table>

Quality Limit (expiration date) set by supplier
2. **Shelf Life** \( \rightarrow \) Ingredient?

![Graph showing shelf life and ingredient quality](image)

- **Formula**: 12.5 kg/ton
- **Quality Limit (expiration date) set by supplier**

Another graph showing:

- **Formula**: 14.3 kg/ton
- **Quality Limit (expiration date) set by supplier**

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2. **Shelf Life → Ingredient?**

**Ask the supplier:**
The Ingredients still “good” → Can the shelf life be extended?

Formula → 14.3 kg/ton

Quality Limit (expiration date) set by supplier

Storage Time (months)

Quality I

Quality II

Quality III

Q relative

0 2 4 6 8 10

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2. **Shelf Life → Ingredient?**

Theoretically … Yes you can …

→ As long as the product you produce comply with regulation (Food Quality and Safety standard)

→ And … if technically possible

Quality Limit (expiration date) set by supplier

EOSL Is Not SAFETY factor?

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2. **Shelf Life → Ingredient?**

Theoretically ... Yes you can ...
→ As long as the product you produce comply with regulation (Food Quality and Safety standard)
→ And ... if technically possible
→ Adjust formula → 16.6 kg/ton

<table>
<thead>
<tr>
<th>Storage Time (months)</th>
<th>Quality I</th>
<th>Quality II</th>
<th>Quality III</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>100</td>
<td>90</td>
<td>70</td>
</tr>
<tr>
<td>2</td>
<td>90</td>
<td>80</td>
<td>60</td>
</tr>
<tr>
<td>4</td>
<td>80</td>
<td>70</td>
<td>50</td>
</tr>
<tr>
<td>6</td>
<td>70</td>
<td>60</td>
<td>40</td>
</tr>
<tr>
<td>8</td>
<td>60</td>
<td>50</td>
<td>30</td>
</tr>
<tr>
<td>10</td>
<td>50</td>
<td>40</td>
<td>20</td>
</tr>
</tbody>
</table>

Quality Limit (expiration date) set by supplier

EOSL Is Not SAFETY factor?

2. **Shelf Life → Ingredient? → Potential legal problem??**

**Food Law**:

**PRESIDEN REPUBLIK INDONESIA**

UNDANG-UNDANG REPUBLIK INDONESIA
NOMOR 18 TAHUN 2012
TENTANG
PANGAN

DENGAN RAHMAT TUHAN YANG MAHA ESA
PRESIDEN REPUBLIK INDONESIA,
2. **Shelf Life → Ingredient?**
   → Potential legal problem??

**Food Law :**

Pasal 90

1. Setiap Orang dilarang mengedarkan Pangan tercemar.
2. Pangan tercemar sebagaimana dimaksud pada ayat (1) berupa Pangan yang:
   a. mengandung bahan beracun, berbahaya, atau yang dapat membahayakan kesehatan atau jiwa manusia;
   b. mengandung cemaran yang melampaui ambang batas maksimal yang ditetapkan;
   c. mengandung bahan yang dilarang digunakan dalam kegiatan atau proses Produksi Pangan;
   d. mengandung bahan yang kotor, busuk, tengik, terurai, atau mengandung bahan nabati atau hewani yang berpenyakit atau berasal dari bangkai;
   e. diproduksi dengan cara yang dilarang; dan/atau
   f. sudah kedaluwarsa.

---

2. **Shelf Life → Ingredient?**
   → Potential legal problem??

**Food Law :**

Pasal 99

Setiap Orang dilarang menghapus, mencabut, menutup, mengganti label, melabel kembali, dan/atau menunak tanggal, bulan, dan tahun kedaluwarsa Pangan yang diedarkan.
Managing Shelf Life

Shelf-life is established within “Design” and managed through all stations.

<table>
<thead>
<tr>
<th>DESIGN</th>
<th>PROCUREMENT</th>
<th>CONVERT</th>
<th>DISTRIBUT</th>
<th>CUSTOMER</th>
<th>CONSUMER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Products</td>
<td>Praw Materials</td>
<td>Raw Materials</td>
<td>Storage &amp; distr. conditions</td>
<td>Storage &amp; distr. conditions</td>
<td>Storage conditions</td>
</tr>
<tr>
<td>Raw Materials</td>
<td>Packaging</td>
<td>Packaging materials</td>
<td>1st in, 1st out</td>
<td>1st in, 1st out</td>
<td>Prep. instructions</td>
</tr>
<tr>
<td>Safety incl. HACCP and Allergens</td>
<td>Supplier certification HACCP</td>
<td>Raw Mat’s receiving</td>
<td>Manage stocks, remaining shelf-life</td>
<td>Manage stocks, remaining shelf-life</td>
<td>Use within shelf-life</td>
</tr>
<tr>
<td>Regulatory compl. labels/specs</td>
<td></td>
<td>Allergens Coding, labels</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. Managing Shelf Life

![Graph showing shelf life and quality value over storage time]

- **Q0-1**: Initial quality value
- **Limit (critical) Q**: Quality value limit
- **Shelf Life-1**: Graph showing shelf life in months vs. quality value

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3. Managing Shelf Life

1. Improve Initial Q ($Q_0$)

2. Shelf Life-1

3. Shelf Life-2

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Managing Shelf Life

2. Reduce the rate constant (k)

3. Identify weak link?

1. Product characteristics
2. Processing technology
3. Packaging
4. Condition of storage, distribution & handling
Managing Shelf Life:  
= Shelf Life is determined by the weakest link

1. Product characteristics (RM, ingredients)
- nutrients, water ($a_w$), acids (pH), microbial load, etc.
Managing Shelf Life:
= Shelf Life is determined by the weakest link

2. Processing technology
- Temp (T) & Time (t)
- Cleaning (4T)
- Hygienic practices, etc.

3. Packaging
- WVTR?
- OTR?
- Light protection?
- Physical protection?

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Managing Shelf Life:
= Shelf Life is determined by the weakest link

Quality

4 Condition of storage, distribution & handling
- T, RH, light?
- Handling practices?
- Transportation practices?
- Storage practices?

Shelf Life

Managing Shelf Life:
= Shelf Life is determined by the weakest link

Responsibility of food Industry: Optimizing Shelf Life

Quality

1. Product characteristics
2. Processing technology
3. Packaging
4. Condition of storage, distribution & handling

Assurance that "at possible latest consumption the characteristics of food product are remain acceptable"

Shelf Life
Current Issues Related to Shelf Life of Foods

Taken from Labuza (2007)
http://www.ardilla.umn.edu/tplabuza.html

“Madam . . . the dates on the milk are all the same.”
DAVID HARDING

Terimakasih
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