Objectives

- Understand the different types of food production and distribution systems
- Recognise the different cook chill systems available
- Understand the advantages and disadvantages of different production and distribution systems

Cook Fresh, Cook/Hot hold, Cook Serve

Foods are prepared > Held for a short time > Served

**Advantages**
- ‘In house’ quality control
- Less specialised equipment
- Less prepared storage
- Regional buys

**Disadvantages**
- Daily, busy meal times
- Workloads vary
- Production occurs over the whole day, every day

Cook Fresh

Salads, sandwiches, fresh/cold dairy desserts also in cook chill systems

Cook Chill

Foods are prepared > Chilled > Hot or Cold Plating/Retherm

**Advantages**
- Uniform workflow
- Menu variety
- Reduced production costs
- 5 day production
- Area wide menus
- Quality control

**Disadvantages**
- Specialised equipment
- Storage requirements
- Some recipes aren’t suited
- Some foods not suitable - grills
Equipment

Short shelf life

Equipment

Long shelf life

Cook Chill

(Cold plating, retherm)

Cook Chill Delivery Systems

Food Service Systems

Williams, PG. Journal of the American Dietetic Association 1996; 96(5): p491
Cook Freeze
Foods are prepared > Frozen > Hot or Cold Plating/Retherm

- Advantages
  - As for cook chill

- Disadvantages
  - As for cook chill
  - Recipe modification re: thickeners
  - Thawing step

Food service systems in NSW hospitals (%)

<table>
<thead>
<tr>
<th>System</th>
<th>1993 All</th>
<th>2001 All</th>
<th>2001 &lt;100 beds</th>
<th>2001 100 beds +</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cook fresh</td>
<td>81</td>
<td>54</td>
<td>77</td>
<td>29</td>
</tr>
<tr>
<td>Ext Cook chill</td>
<td>6</td>
<td>29</td>
<td>11</td>
<td>47</td>
</tr>
<tr>
<td>Int Cook chill</td>
<td>12</td>
<td>13</td>
<td>9</td>
<td>16</td>
</tr>
<tr>
<td>Combination</td>
<td>1</td>
<td>5</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
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</table>

Manager’s satisfaction with their foodservice system Mean rating
(1 = very dissatisfied; 10 = very satisfied)

<table>
<thead>
<tr>
<th>Hospital size (beds)</th>
<th>Cook Fresh</th>
<th>Cook Chill</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-24</td>
<td>8.7</td>
<td>8.0</td>
</tr>
<tr>
<td>25-49</td>
<td>8.0</td>
<td>7.1</td>
</tr>
<tr>
<td>50-99</td>
<td>8.3</td>
<td>6.2</td>
</tr>
<tr>
<td>100-249</td>
<td>7.9</td>
<td>5.6*</td>
</tr>
<tr>
<td>250+</td>
<td>7.0</td>
<td>5.8</td>
</tr>
<tr>
<td>All</td>
<td>8.1</td>
<td>5.9**</td>
</tr>
</tbody>
</table>

Meal plating location – % NSW hospitals

<table>
<thead>
<tr>
<th>Location</th>
<th>1993 All</th>
<th>2001 All</th>
<th>2001 &lt;100 beds</th>
<th>2001 100+ beds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centralised</td>
<td>96</td>
<td>89</td>
<td>91</td>
<td>87</td>
</tr>
<tr>
<td>Decentralised</td>
<td>4</td>
<td>11</td>
<td>9</td>
<td>13</td>
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</tbody>
</table>

Meal delivery systems % NSW hospitals 2001

<table>
<thead>
<tr>
<th>Hot delivery systems</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulated cover and base</td>
<td>34.5</td>
</tr>
<tr>
<td>Heated pellet</td>
<td>26.9</td>
</tr>
<tr>
<td>Fails cover only</td>
<td>14.3</td>
</tr>
<tr>
<td>Hot and cold delivery cart</td>
<td>4.7</td>
</tr>
<tr>
<td>Heated bulk food trolleys</td>
<td>1.9</td>
</tr>
<tr>
<td>Total</td>
<td>79.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chilled or Frozen systems</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Convection ovens</td>
<td>10.5</td>
</tr>
<tr>
<td>Infra-red ovens</td>
<td>4.8</td>
</tr>
<tr>
<td>Microwave ovens</td>
<td>3.8</td>
</tr>
<tr>
<td>Conduction heating</td>
<td>1.9</td>
</tr>
<tr>
<td>Total</td>
<td>21.0</td>
</tr>
</tbody>
</table>

Mibey R, Williams P. Food Service Technology 2002; 2:95-103
St Vincent’s Campus

Distribution Systems

Delivered in Bulk heated using a van
Plated on Site

Delivered in bulk Plated on site

D & A

Delivered in bulk Plated on site

SVPH Kitchen

Delivered in bulk Plated on site

Mental Health

Palliative care & Rehab

Centralised Plating
- Hot metal
- Wax pellet in base
- Insulated plate base & cover
- Insulated tray
- Trolley cart with heat/refrigeration

Decentralised Plating
- Bulk food in chilled/heated trolleys
- Bulk food in insulated containers
- Frozen/chilled food distributed

Decentralised System

Advantages
- Labour saving
- Allows meal checking/staff supervision
- Economies of space and equipment
- Saving in overheads – maintenance, fuel, cleaning
- Allows batch cooking
- Reduced food waste
- Improve menu variety

Disadvantages
- More pressure on staff at meal periods
- Must stagger meal hrs
- Issues with communication between ward and kitchen
- Physical location of some wards impacts on meal aesthetics

Trends

Outsourcing Food Production
Room Service
Retail Outlets in Hospitals
- McCafe RPAH,
- Gloria Jeans RNSH

Distribution Systems cont.

- Semi centralised – food plated centrally and distributed for reheating
  - Central tray setting
  - Decentralised heating
  - Specialised Trolleys

Centralised System

Advantages
- Labour saving
- Allows meal checking/staff supervision
- Economies of space and equipment
- Saving in overheads – maintenance, fuel, cleaning
- Allows batch cooking
- Reduced food waste
- Improve menu variety

Disadvantages
- More pressure on staff at meal periods
- Must stagger meal hrs
- Issues with communication between ward and kitchen
- Physical location of some wards impacts on meal aesthetics
Food Service Systems

- Cook Fresh
- Cook Chill
- Cook Freeze

- Advantages and disadvantages
- Types of equipment

NUTRIENT LOSSES

Objectives

- Understand the how different cooking and preparation methods affect the nutrient content of foods

Nutrient losses

Natural vs Processed

- Climate
- Soil
- Handling
- Maturity
- Feeding regimes (for animals)
- Genetic
- Preparation, milling
- Heating
- Drying
- Chilling
- Freezing
- Irradiation
- Packaging
- Storage

Why process foods?

1. Raw foods are perishable. Processed to preserve, pack or for storage (e.g. canned foods).
2. To produce a desired product (e.g. baked goods).
3. To prepare food for service.

Nutrients can be destroyed when food is processed due to:
- Sensitivity to the pH of the solvent
- Oxygen
- Heat
- Light and/or any combination.

6 processing principles that preserve

1. Removing moisture (e.g. drying)
2. Treating with heat (e.g. pasteurisation, cook)
3. Cold temperature (e.g. fridge, freezer)
4. Acidity control
5. Chemical additives
6. Irradiation
### Effects of Processing

**Positive vs Negative**

- Anti-digestive factors may be destroyed
- Increased starch digestibility
- Bioavailability increased
- Reduced microbial load
- Addition of antioxidants
- Reduction of heat sensitive vitamins
- Vitamins & minerals leached
- Reduced availability of some minerals and amino acids

### Stability of nutrients

- **Losses of 60-100% (Unstable)**
  - Vitamin C, folate, biotin, niacin, riboflavin, thiamin

- **Losses of 20-60% (Moderately stable)**
  - Vitamin A, B6, D, E, pantothenic acid

- **Losses of < 20% (Stable)**

### Critical nutrients

- **Vitamins**
  - Vitamins A, B6, C, thiamin, riboflavin and folate
  - Vitamin C and folate most unstable

- **Minerals**
  - Iron, zinc and calcium

- **Dietary fibre**

### Primary sources of nutrient losses

**Animal products**
- Thaw drip
- Cooking drip
- Leaching
- Cooking & holding losses

**Plant products**
- Trimming, slicing, soaking
- Leaching
- Heat losses
- Storage
- Reheating

### Processing steps in large scale food service

- **Purchasing**
- **Storage**
- **Preparation**
- **Cooking**
- **Texturing modification**
- **Chilling**
- **Chilled storage**
- **Reheating**
- **Hot holding**
Processing steps and losses

Purchasing (fresh*/frozen/canned*)
- Can occur with any type. Greater vitamin loss with canned, although ‘fresh’ depends on storage time. (e.g. Spinach can lose >50% Vitamin C if at 20°C for 2 days).
- Drying causes significant losses, especially as more water is removed.

Storage
- Depends on the time, temperature* and the stability of temperature.
- Frozen & canned products can continue to lose nutrients (e.g. Vitamin C) in storage, but lower than the initial processing losses.

*Significant loss is possible

Processing steps and losses

Preparation
- Thawing meat can result in significant vitamin losses, especially if in water. Using the fridge or microwave is best.
- Trimming fruits and vegetables increases losses (e.g. oxidation).
- Soaking* also enhances losses (e.g. leaching). Aim to soak or wash for a short time to minimise loss. (Current trend is to utilise pre-prepared salads etc.)

Processing steps and losses

Cooking**
- Most losses in this stage
- Boiling causes greater losses than steaming (Consider water volume used).
- Grill & roasting have smaller losses than braising.
- Microwaving, stir frying & steaming seem similar when using with minimal water.
- Baking/frying no significant leaching losses, but greater vitamin destruction due to the high temperatures.

Chilling
- Small losses if chilling is rapid (within 2hrs). Significant losses if extended (6hrs)*. IHHC Guidelines recommend within 1.5hrs for a gastronorm tray of food.

Vitamin C loss in chilled storage

![Vitamin C loss in chilled storage graph](image)


Processing steps and losses

Reheating
- Smaller loss with individual microwaving.
- Large scale food service, usually mass reheating.
- Limited data, appears loss is greater when chilled food heated in bulk, rather than individually- due to the time involved?
- There appears to be no significant differences in losses in reheating, considering infrared, convection, conduction.

Processing steps and losses

Chilled storage
- Vitamin C is most labile; has a linear loss with time. Speculation about greater loss in long term cook chill, but lack of D2 may influence.
- Overall, losses still lower in chilled storage, than with hot holding.

Chilled storage
- Significant losses. Even 30 minutes can cause losses.
- Hot holding should be kept to <90 minutes.
Vitamin C and folate in cook-chill and cook/hot-hold systems

- After 1 day chilled storage, then reheating results in a similar effect on Vitamin C to the following hot holding times:
  - 91 minutes for Vitamin C
  - 87 minutes for 5MeTHF
- Plated and reheated after 3 days of being in chilled storage would retain ~28% Vitamin C & 58% 5MeTHF.
- In contrast, hot hold for 2hrs resulted in the retention of ~40.3% Vitamin C and 67.7% 5MeTHF.
- If hot hold <90 minutes, vitamin retention is better in a cook-serve than in a cook-chill system.

Williams, PG et al. 1995

Effects of processing in hospital catering

- Vitamin C losses increase over the 5 days of storage.
- Losses increase with hot holding time, ‘Ideal’ 30 mins.
- Awareness of where losses occur, enables better planning.

West, A et al. 1998; p285

Loss of Vitamin B6 in hot holding

- Riboflavin & niacin fairly stable
- Thiamin usually less than 10% loss, for up to 2hrs
- Vitamin C is lost rapidly
- Vitamin B6 is lost
  - Minimum loss of 10% after 1hr
  - Up to 40% at 3hrs

Williams, PG, 1996

Percentage losses after canning

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Folacin</th>
<th>B1</th>
<th>B2</th>
<th>B3</th>
<th>B6</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asparagus</td>
<td>75.2</td>
<td>66.7</td>
<td>55</td>
<td>46.6</td>
<td>64</td>
<td>54.5</td>
</tr>
<tr>
<td>Carrot</td>
<td>58.8</td>
<td>66.7</td>
<td>60</td>
<td>33.3</td>
<td>80</td>
<td>75</td>
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<tr>
<td>Corn</td>
<td>72.5</td>
<td>80</td>
<td>58.3</td>
<td>47.1</td>
<td>0</td>
<td>58.3</td>
</tr>
<tr>
<td>Tomato</td>
<td>53.75</td>
<td>16.7</td>
<td>25</td>
<td>0</td>
<td>-</td>
<td>26.1</td>
</tr>
</tbody>
</table>

Karmas, E & Harris, RS. 1988; p344
Percent carotene retention in stored canned foods

<table>
<thead>
<tr>
<th>Temperature</th>
<th>10°C</th>
<th>10°C</th>
<th>18°C</th>
<th>27°C</th>
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<tbody>
<tr>
<td>Months</td>
<td>12</td>
<td>24</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>Apricots</td>
<td>94</td>
<td>91</td>
<td>84</td>
<td>76</td>
</tr>
<tr>
<td>Carrots</td>
<td>94</td>
<td>90</td>
<td>95</td>
<td>91</td>
</tr>
<tr>
<td>Peaches</td>
<td>95</td>
<td>75</td>
<td>64</td>
<td>63</td>
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<tr>
<td>Spinach</td>
<td>91</td>
<td>80</td>
<td>80</td>
<td>81</td>
</tr>
<tr>
<td>Tomatoes</td>
<td>94</td>
<td>75</td>
<td>75</td>
<td>74</td>
</tr>
</tbody>
</table>

Karmas, E & Harris, RS. 1988: p345-347

Percent ascorbic acid retention in stored canned foods

<table>
<thead>
<tr>
<th>Temperature</th>
<th>10°C</th>
<th>10°C</th>
<th>18°C</th>
<th>27°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Months</td>
<td>12</td>
<td>24</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>Apricots</td>
<td>96</td>
<td>94</td>
<td>90</td>
<td>56</td>
</tr>
<tr>
<td>Pineapple</td>
<td>100</td>
<td>83</td>
<td>78</td>
<td>53</td>
</tr>
<tr>
<td>Peaches</td>
<td>98</td>
<td>98</td>
<td>80</td>
<td>53</td>
</tr>
<tr>
<td>Asparagus (Gr)</td>
<td>97</td>
<td>93</td>
<td>91</td>
<td>86</td>
</tr>
<tr>
<td>Beans (Gr)</td>
<td>92</td>
<td>88</td>
<td>81</td>
<td>74</td>
</tr>
</tbody>
</table>

Karmas, E & Harris, RS. 1988: p345-347

Vitamin C in fresh & frozen vegetables

Peas, Broccoli, Green beans, Spinach, Carrots

Day 0 Garden fresh
Day 3 Ambient Day 3-7 Ambient
Day 2-3 Chilled Day 3-7 Chilled
Day 3-7 Chilled/Ambient

Favell, D.J. Food Chemistry, 1998: p59-64
### Thiamin content of frozen steak (mg/100g)

<table>
<thead>
<tr>
<th>Temp (+ 1°C)</th>
<th>Constant</th>
<th>Fluctuating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>-10°C</td>
<td>2.8</td>
<td>1.8</td>
</tr>
<tr>
<td>-20°C</td>
<td>2.9</td>
<td>2.1</td>
</tr>
<tr>
<td>-30°C</td>
<td>3.0</td>
<td>2.6</td>
</tr>
</tbody>
</table>

Karmas, E & Harris, RS. 1988: p561

### Method of cooking broccoli vs phenolic compound contents

- Compared the influence of cooking methods on phenols in broccoli. 150g broccoli, 150ml water
  - (A) High pressure  3 min
  - (B) Low pressure  5 min
  - (C) Steaming       3.5 min
  - (D) Microwaving 5 min

Microwave > Highest losses?  
Overcooked  
Steaming superior- short time & no water contact

Valejo, F et al. 2003: p1515

### Irradiation

- **Uses**
  - Controls insects in spices, herbs, nuts & grains
  - To reduce the level of bacteria in meat
  - Minimise sprouting in fruits & vegetables

- **Influence on nutrition**
  - Similar vitamin losses to heat processing
  - No significant impact on carbohydrates, protein and minerals
  - May increase fat oxidation

### Further research required on phytochemicals & antioxidants

**Effect of processing on major flavonoids in onions**

- Significant (50%) reduction with peeling & chopping
- 90% of quercetin (flavonoid) is in the 1st & 2nd layers
- Fairly heat stable thereafter


### Blanching & freezing on bioactive compounds in vegetables

- 20-30% losses of antioxidant activity & total phenolics
- Up to 30% vitamin C lost with blanching
- Up to 50% folate lost
- Carotenoids & sterols stable

In Summary

Recommendations to maximise nutrient retention

Dry Goods
- Store dry goods at <20°C

Fresh goods
- Minimise the time stored
- Shop 2-3 times per week, if possible, to optimise the retention of the nutrient value and appearance
- Protect from heat and light
- Stable refrigeration temperature
- Always wash before use

Recommendations

Frozen foods
- Keep freezer temperatures stable
- Thaw in the refrigerator

Preparation
- Cut foods just prior to service

Cooking
- Cook larger vegetable portions
- Restrict the time for ‘hot holding’
- Use minimal water to cook vegetables
- Consider steaming, microwaving and stir frying

References


Williams, PG, Ross, H. and Brand-Miller, JC. Ascorbic acid and 5-methyl-tetrahydrofolate losses in vegetables with cook/chill or cook/hot-hold foodservice systems. Journal of Food Science 1995; 60, p541-546

Williams, PG. Food in Hospitals. PhD thesis. 1994


Williams, PG, Ross, H. and Brand-Miller, JC. Ascorbic acid and 5-methyl-tetrahydrofolate losses in vegetables with cook/chill or cook/hot-hold foodservice systems. Journal of Food Science 1995; 60, p541-546

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