Dairying

National Centre for Excellence in Mathematics & Science Teaching & Learning

Created By: Dr. Maeve Liston
Senior Projects Officer in Biological Sciences
maeve.liston@ul.ie
**Typical Life Cycle of a Cow**

- **Birth**
- **Breeding**
  - 15 months
- **First Calf**
  - 24 months
- **Weaning**
  - 6-8 weeks
- **Dry off**
  - 2 months before next calving
- **Breeding**
- **Cows average**
  - 2.5 lactations
- **Calving**
  - 10 months after successful breeding

*Usual goal is 12 month calving interval*
Domestic milk intake up 2.6% in November

Domestic milk intake by creameries and pasteurisers was estimated as 273.1 million litres for November 2007. This was 2.6% above the corresponding 2006 figure. (See graph).

Comparing the November 2007 milk produce figures with those for November 2006 shows that (see Table 1):

- Total milk sold for human consumption decreased by 1.1% to 43.6 million litres.
- Butter production was up 21.9% to 8,900 tonnes.

The information used to compile this release was collected under EU Directive 96/16/EC.

<table>
<thead>
<tr>
<th>Domestic Milk Intake</th>
<th>2006</th>
<th>2007</th>
<th>% change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>million litres</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nov</td>
<td>266.1</td>
<td>273.1</td>
<td>2.6%</td>
</tr>
<tr>
<td>Jan-Nov</td>
<td>4,932.6</td>
<td>4,947.5</td>
<td>0.3%</td>
</tr>
</tbody>
</table>

From CSO webpage
<table>
<thead>
<tr>
<th>Country</th>
<th>Jan-Aug 2006</th>
<th>Jan-Aug 2007</th>
<th>% change</th>
</tr>
</thead>
<tbody>
<tr>
<td>European Union</td>
<td>90174</td>
<td>90347</td>
<td>0.2</td>
</tr>
<tr>
<td>Austria</td>
<td>1822</td>
<td>1824</td>
<td>0.1</td>
</tr>
<tr>
<td>Belgium</td>
<td>1927</td>
<td>1987</td>
<td>3.1</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>547</td>
<td>520</td>
<td>-4.9</td>
</tr>
<tr>
<td>Cyprus</td>
<td>92</td>
<td>96</td>
<td>4.2</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>1628</td>
<td>1661</td>
<td>2.0</td>
</tr>
<tr>
<td>Denmark</td>
<td>3036</td>
<td>3064</td>
<td>0.9</td>
</tr>
<tr>
<td>Estonia</td>
<td>411</td>
<td>405</td>
<td>-1.5</td>
</tr>
<tr>
<td>Finland</td>
<td>1602</td>
<td>1579</td>
<td>-1.4</td>
</tr>
<tr>
<td>France</td>
<td>15459</td>
<td>15419</td>
<td>-0.3</td>
</tr>
<tr>
<td>Germany</td>
<td>18156</td>
<td>18545</td>
<td>2.1</td>
</tr>
<tr>
<td>Greece</td>
<td>494</td>
<td>480</td>
<td>-3.0</td>
</tr>
<tr>
<td>Hungary</td>
<td>976</td>
<td>947</td>
<td>-3.0</td>
</tr>
<tr>
<td>Ireland</td>
<td>3876</td>
<td>3898</td>
<td>0.6</td>
</tr>
<tr>
<td>Italy</td>
<td>6974</td>
<td>6891</td>
<td>-1.2</td>
</tr>
<tr>
<td>Latvia</td>
<td>388</td>
<td>428</td>
<td>10.2</td>
</tr>
<tr>
<td>Lithuania</td>
<td>832</td>
<td>902</td>
<td>8.4</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>174</td>
<td>179</td>
<td>2.9</td>
</tr>
<tr>
<td>Malta</td>
<td>28</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Netherlands</td>
<td>7140</td>
<td>7219</td>
<td>1.1</td>
</tr>
<tr>
<td>Poland</td>
<td>5956</td>
<td>5942</td>
<td>-0.2</td>
</tr>
<tr>
<td>Portugal</td>
<td>1295</td>
<td>1269</td>
<td>-2.0</td>
</tr>
<tr>
<td>Romania</td>
<td>756</td>
<td>779</td>
<td>3.1</td>
</tr>
<tr>
<td>Slovakia</td>
<td>659</td>
<td>655</td>
<td>-0.5</td>
</tr>
<tr>
<td>Slovenia</td>
<td>344</td>
<td>362</td>
<td>5.4</td>
</tr>
<tr>
<td>Spain</td>
<td>3960</td>
<td>3668</td>
<td>-2.3</td>
</tr>
<tr>
<td>Sweden</td>
<td>2134</td>
<td>2054</td>
<td>-3.8</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>9536</td>
<td>9372</td>
<td>-1.7</td>
</tr>
</tbody>
</table>

Source: New Cronos database, Eurostat (except Ireland and European Union total, CSO).

1 Figures for EU do not include Malta.

* Confidential
Lactation

• A cow gives 4,000 – 6000 kg of milk in 300 – 350 days.
• A buffalo gives 2,500 kg in 250 days
• A dairy goat gives 800 – 1000 kg in 300 days
• A goat is more efficient as it weighs about 1/10 of a cow and gives ¼ of the output of a cow.
• Goats also do not require as much feeding.
## Classification of the principal cattle breeds in Ireland

<table>
<thead>
<tr>
<th>Dairy Breeds</th>
<th>Dual-purpose Breeds</th>
<th>Beef Breeds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Produce milk only</td>
<td>Produce milk and</td>
<td>Produce beef animals only</td>
</tr>
<tr>
<td></td>
<td>beef animals</td>
<td></td>
</tr>
<tr>
<td>Holstein</td>
<td>Friesian</td>
<td>British</td>
</tr>
<tr>
<td>Jersey</td>
<td>Dairy shorthorn</td>
<td>Hereford</td>
</tr>
<tr>
<td>Ayreshire</td>
<td></td>
<td>Aberdeen angus</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Continental</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Charolais</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Limousin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Simmental</td>
</tr>
</tbody>
</table>
# Average lactation yields

<table>
<thead>
<tr>
<th>Breed</th>
<th>Yield (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holstein</td>
<td>5,800</td>
</tr>
<tr>
<td>Jersey</td>
<td>3,400</td>
</tr>
<tr>
<td>Ayreshire</td>
<td>4,000</td>
</tr>
<tr>
<td>Friesian</td>
<td>5,000</td>
</tr>
<tr>
<td>Dairy shorthorn</td>
<td>4,000</td>
</tr>
</tbody>
</table>
Dairy Breeds of cow

• Dairy cows come in different sizes and shapes. Those having the same size, shape, colour, temperament, and abilities are classed by breed.

• The major US dairy breeds are Ayrshire, Brown Swiss, Guernsey, Holstein, Jersey, and Milking Shorthorn.

• The largest dairy breed in terms of number of cows is the Holstein
Holstein/Friesian

• from Holland.
• They weigh 1,500 pounds when mature. They produce the most milk on average.
Holstein/Friesian

- A healthy calf: 40 kg.
- Mature Holstein cow: 650 to 700 kg and stands 148 cm tall at the shoulder. Holstein heifers can be bred at 13 months of age, when they weigh around 380 kg.
- Aim: heifers to calve for the first time between 23 and 26 months of age.
• averages 7655 litres/year throughout 3.2 lactations with pedigree animals averaging 8125 litres/year over an average of 3.43 lactations.
Other Dairy Breeds

Ayrshire

- from the County of Ayr in Scotland
- They weigh 1,200 pounds when mature.
Brown Swiss

- from Switzerland
- They weigh 1,500 pounds when mature.
Guernsey

• from the Isle of Guernsey, an island in the English Channel off the coast of France
Jersey

• from the Isle of Jersey.
• They weigh 900 pounds when mature.
Milking Shorthorn

- Northeastern England
- Milking Shorthorn cattle are red or white or any combination.
- A mature cow usually weighs about 1400 pounds.
<table>
<thead>
<tr>
<th>Age (yr)</th>
<th>Lactation no.</th>
<th>Lactation yield as % of maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1</td>
<td>75</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>85</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>90</td>
</tr>
<tr>
<td>5</td>
<td>4</td>
<td>95</td>
</tr>
<tr>
<td>6</td>
<td>5</td>
<td>100</td>
</tr>
</tbody>
</table>
Composition of milk

• Human milk has the highest amount of sugar i.e. 7% lactose
• Horses milk contains 6% lactose
• Cows milk contains 5% lactose
Composition of milk

• Cows milk contains 4% fat
• Rabbits milk contains 18% fat
Breeds of cattle – contrast in milk composition %

<table>
<thead>
<tr>
<th>Breed</th>
<th>Total solids</th>
<th>Fat</th>
<th>Protein</th>
<th>Lactose</th>
<th>Weight</th>
<th>Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresian/Wholestyle</td>
<td>12.4</td>
<td>3.7</td>
<td>3.4</td>
<td>5.0</td>
<td>600 kg</td>
<td>4,500 kg</td>
</tr>
<tr>
<td>Ayrshire</td>
<td>13</td>
<td>4.1</td>
<td>3.6</td>
<td>5.0</td>
<td>500 kg</td>
<td>4,000 kg</td>
</tr>
<tr>
<td>Jersey</td>
<td>15</td>
<td>5.5</td>
<td>4.0</td>
<td>5.0</td>
<td>400 kg</td>
<td>3,500 kg</td>
</tr>
<tr>
<td>Months</td>
<td>Not pregnant</td>
<td>Lactating</td>
<td>Pregnant</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>--------------</td>
<td>-----------</td>
<td>----------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Milking - Lactation

• is the continuous secretion and storage of milk in the udder.
• The milk ejection or ‘let-down’ reflex effect is short term,
• inhibited by pain or fear but stimulated by good husbandry practices.

• 10% of secreted milk will be retained in the udder as residual milk.
• Removal of milk is achieved when external forces such as suckling or milking open the teat duct at the teat end.
Lactating

• When lactating a cow can be either pregnant or non-pregnant.
• When dry $\rightarrow$ pregnant.
• Try to get the cow to complete the cycle in one year.
• The length of the cycle depends on how long it takes for her to get pregnant again.
Suggest

- 305 days of lactation
- 56 days of a dry period
- 82 day interval between calving to mating
- Cow carries calf for $9 \frac{1}{2}$ months
- If it goes over 82 days, it will go over the 1 year cycle.

Or

- Pregnancy: 283-286 days
- Dry period: 40 days
- Lactation: 305 days
Lactating Curves

• The shape of the lactation curve differs among different species.
Lactation curve of a machine milked cow

Milk yield

Early lactation

Mid lactation

Late lactation

Dry period

0 weeks: calving
Milking machine versus cow with calf

Milk yields/day (Kg)

Time (months)

Milk machine

Cow with calf
Milking machine versus cow with calf

Milk yields/day (Kg)

Time (months)

Milk machine

Cow with calf
Milking machine versus cow with calf

Milk yields/day (Kg)

Time (months)
Milk yields/day (Kg)

- Milk machine
- Cow with calf

Time (months)
Milk yields/day (Kg)

Time (months)

Milk machine

Cow with calf
Factors influencing the lactation curve/total yield
Milking intervals

- affect the amount of residual milk carryover between milkings. Equal intervals of 12 hours give highest lactation yields but the effect of unequal intervals is small up to 16 and 8 hours and can be minimised if the highest yielders are milked first in the morning and last in the afternoon.
Milking Frequency

• affects total daily production. Milking three times instead of twice daily will raise milk yields by an average 10%–15% but up to 10% of this increase will be required to cover extra costs. Chemical composition of milk is unaffected.
Incomplete Milking

• Incomplete milking either from excessive amounts of residual milk or end-of-milking strippings can be avoided by effective milk ejection stimulation and by efficient fast milking by hand or machine.
Milking systems

• SYSTEM OF MILKING HAND MILKING is a labour intensive system in which capital investment, running costs, labour productivity and milking performance are minimal. Clean milking clothes, buckets, udders and hands are essential for good hygienic quality milk.
The Milking Machine

• Traditionally women did milking and housework.
• First put iron bars/ pipes up the tit to keep them open (not practical)
• Next tried to apply a vacuum to the teeth but lead to mammary gland infections.
• Next tried to immitate the calf: alternation between a vacuum and no vacuum.
• **Machine Milking** will create a pleasant sensation for the cows if the machine is kept clean, maintained properly and operated according to the manufacturer's instructions. Attach and remove clusters carefully to avoid vacuum fluctuations which cause mastitis. Readjust slipping teatcups and replace fallen clusters immediately.
The Milking Machine

• to extract milk from the cow by vacuum.
• apply constant vacuum to the end of the teat to suck the milk out, convey it to a suitable container, to give a periodic squeeze applied externally to the whole of the teat to maintain blood circulation.
• A milking machine installation consists of a pipework system linking various vessels and other components which together provide the flow paths for air and milk.
• atmospheric pressure forces air, and intra-mammary milk pressure which forces milk, into the system and the combination of these forces causes flow.
The Milking Machine

• Requirements
  – Well designed
  – Correctly installed
  – Well maintained
  – Properly used
The Milking Machine

• If the milking machine is faulty:
  – Injury and infection to the milk tract
  – Slow milking
Different types of milking machines

• the same basic components.
• The air is removed by a vacuum pump at a constant rate.
• In a bucket or direct-to-can machine milk is removed from the system by disconnecting the milk container; in milking pipeline and recorder machines the milk is removed by a milk pump or releaser.
Bucket Milking Machine

• was developed to mechanise cowshed milking.

• The units and ancillary equipment are carried from cow to cow and the milk transported, lifted and tipped manually
Bucket Milking Machine
Bucket Milking Machine

- Move from tap to tap to suck milk from two cows at a time.
- Old fashioned system.
Bucket Milking Machine

- Cooling

- Clean the milking equipment and cooler by rinsing in clean water, scrubbing in hot (≥45°C) detergent/disinfectant solution and finally rinsing in chlorinated (50 ppm) water
In summary Bucket Milking Machine

(a) Bucket (cowshed)
The Milking Pipeline Machine

• high investment, low labour cost system,
• suited to large and medium sized herds milked in parlours with bulk milk collection.
The Milking Pipeline Machine
The Milking Pipeline Machine

Air pipe line

• It must have a **direct diameter** for the desired air flow, **smooth internally** with **swept bends** and only bends where essential.

• It should be **short** and have a **drain facility**, it should be **slightly sloping forward** i.e. away from the pump.

• Sloping towards the drain at the other end, to keep moisture away.
The Milking Pipeline Machine
The Milking Pipeline Machine

The Sanitary Trap
• Present in pipeline and recorder system

1. Is the connection between the vacuum and the milk system.
2. Usually transparent vessel
3. Minimum capacity 3L
4. Drain system
5. Automatic cut-off
The Milking Pipeline Machine
The Milking Pipeline Machine

The Receiver

- Transparent
- 18L capacity
- Collects all milk together before sending it to the bulk tank
- Sometimes can have 2 balanced stainless steel receiver jars
- For cleaning purposes a spreader is fitted at the end.
The Milking Pipeline Machine

• The releaser pump
• Centrifugal or newmatic
• It takes milk out of the receiver and against the vacuum, sending it to the bulk tank.
• Operates intermittently, when there is a certain amount of milk in the receiver.
The Milking Pipeline Machine
Recorder Milking Machine

The power source

- Vacuum pump assembly the vacuum pump is connected to an electric motor by ‘V’ belts.
  - Runs from electric motor to vacuum pump.
Recorder Milking Machine

(c) Recorder (parlour)

Principal types of milking machines
Recorder Milking Machine

- The vacuum pump
- Exhausted out back of building
- Release of air
- Silencer
- Anti-reverse device
- On /off switch and isolator switch
- A guard
- Pump in a seperated well ventilated room but near the milking parlour to avoid long pipe run.
Recorder Milking Machine

(c) Recorder (parlour)

Principal types of milking machines
Recorder Milking Machine

Facilities on or near the pump, to record

- speed of pump
- extraction capacity pump
- Vacuum level pump
Recorder Milking Machine
Recorder Milking Machine

The interceptor and regulator assembly

• The interceptor prevents milk or moisture from getting into the vacuum pump.
• Automatic cut off
• May have automatic drainage facility
• 15L in volume.
Recorder Milking Machine

The Regulator

• Keeps vacuum at the desired working level
• Spring loaded device attached above the pipe-line
• If vacuum gets too strong, it pulls the string down and lets more air in.
Recorder Milking Machine

(c) Recorder (parlour)

Principal types of milking machines
Recorder Milking Machine

The Recorder Jar

- Holds each cows production for measurement
- Sampling and rejection purposes
- Transparent
- Minimum capacity of 23 L
- Eye level
- Graduated
- Long milk tube
Recorder Milking Machine

(c) Recorder (parlour)

Principal types of milking machines
Recorder Milking Machine

Flexible tubes
• Nontainting
• Does not wear away easily
• Correct diameter
• Correct wall thickness
Teat cups and liners

- Direct contact with cows body
- When collapsed the liners should not meet or are in contact with the shell
- The claw has 80mls capacity with air aperature.
Teat cup liner shields

- These are fitted in the teatcup liners to reduce mastitis by preventing contaminated milk droplets impacting the teat ends when the vacuum fluctuates in the liner.
One way valves

• These are fitted in the claw, in the short milk tube or in the teatcup liner to reduce mastitis by preventing reverse-flow of milk
Recorder Milking Machine

The Jetters

• Cleaning fluid
• Milk pipelines are made of stainless steel/glass → cleaned easily, does not taint.
Recorder Milking Machine

The Pulsator
It alternates the vacuum with atmosphere in the claw.
Recorder Milking Machine

The Pulsator
Simultaneous pulsation: all 4 vacuums at the same time
Alternate pulsation: operate 2x2
A master pulsator: controls all the clusters from a central location
An individual pulsator: controls each cluster
Cross-section of a teatcup cluster
Maintenance of Milking machine

- check pipelines and interceptor are free from milk or water, if found, drain and flush with chlorinated water (100 ppm)

- check for water behind teatcup liners if found drain

- check oil level in pump, if necessary
- top-up to correct level
Maintenance of Milking machine

• check vacuum level and rate of recovery, if level too high check vacuum regulator, if recovery is slower than usual to reach working level, look for leaks into machine.

• during milking listen to ensure that regulator is continuously letting air into the vacuum system.

• check air admission hole in claw is clear.
Milking Rate

• Milk flow from the teats increase with:
  • increasing vacuum but strippings also increase. (Normal vacuum range 40–50 kPa).
  • Increasing pulsation rate but this increases air to be pumped from the machine. (Normal rates 50–60 cycles/min)
  • widening pulsation ratio, ie liner open to liner collapse time. (Normal range 50/50 to 70/30)
Teat Cup Liners

• Teatcup liners have important effects on milk flow and completion of milking.

1. the liner mouthpiece affects the quantity of strippings
2. narrow bore (<24 mm) and low tension (stretch) milk more slowly.

• choose liners appropriate for the size of cows teats to be milked.
Three rooms – parlour
  - pump house (machine room)
  - dairy (bulk tank)
Milking Parlours

• At first, static parlour design followed the cowshed stall arrangement with the cows standing side-by-side and a milking unit positioned between each pair of stalls.

• In these abreast parlours, cows enter across the operator's working area and both are on the same floor level. Later, a step was included to elevate the cows 0.3–0.4 m. Even with this addition milking cannot be carried out in an upright position and it was not until the introduction of the tandem parlour that genuine two-level milking became possible. In these, the cows stand head-to-tail in individual stalls on one or both sides of the operator's pit or work area with a floor level difference of 0.8 m. Each stall is fitted with an entry and exit gate giving access to and from a passage flanking the stalls.
Types of Milking parlours

**Abreast parlours**

- Construction costs low per cow place. Operators must bend or crouch.
- Milking efficiency is hindered by cows crossing the operator's work area.
- Cows in the exit passage are remote from the operator's control.
- Individual stalls allow individual attention during milking.
Tandem Parlours

- Construction costs are high per cow place.
- Operators can milk standing upright.
- Cows in the entry/exit passages are remote from the operator's control.
- Size of parlour and throughput are limited by the distance (2.5m) between udders.
- Individual stalls allow individual attention during milking.
• A simplified version of the tandem, known as the **chute** parlour, eliminates the need for separate access passages by having batch entry/exit of cows through the stalls when a division between each stall is opened. The number of cows in each batch equals the number of stalls on each side of the operator's pit. In both the tandem and the chute the distance between udders of adjacent cows is 2.5 m. This disadvantage renders large parlours impracticable, a problem which was solved by the development of the **herringbone** parlour
Chute Parlour

- Cheaper, batch milking version of the tandem.
- Cows enter and leave through the stalls.
- Operator has control over cow entry/exit.
Herringbone parlour

• By standing a batch of cows in echelon formation at an angle of 30°–35° to the sides of the operator's pit, the distance between udders is reduced to 0.9 m. There are no individual stalls, the cows being restrained on the platform (or standing) by an entry gate, an exit gate and a rump rail parallel to the pit side. Herringbones have become popular in all major milk producing countries, being suitable for herds of 50 to 400 cows. In a recent modification, called the side-by-side, the cows stand at right angles to the pit so that 3 cows can occupy the space required for 2 cows in a herringbone.
Herringbone Parlours

- Cows stand in echelon formation at 30°–35° to the operator's pit with no division between cows.
- Distance between udders is reduced to 0.9 m.
- Operator has control over cow entry/exit
- Cows enter and leave in batches. Suitable for herds of 50–400 cows
Side by Side

- Modification of the herringbone.
- Cows stand at right angles to the operator's pit, so that 3 cows occupy the length required for 2 in the herringbone.
- Cows must be milked through the back legs.
Rotary Abreast

- Least expensive rotary per cow place in terms of cost and space requirement.
- Cows face inwards separated by static tubular metal divisions.
- No moving parts on the platform. Operator standing at the platform perimeter can assist cow entry but cannot see the cows during rotation.
Rotary Tandem

- Most expensive per cow place in terms of cost and space requirement. Cows stand nose-to-tail in stalls circling the operators work area. Operator cannot assist cow entry but can see all cows easily during rotation.
Rotary Herringbone

- Cows stand in echelon formation facing outwards around a central work area. Designs vary from simple yoke ties only on the platform to rotationally operated moving divisions which position the cows and allow entry and exit.