3) What are the major physiological transitions that occur at birth?

5) How does colostrum differ from milk? What is special about milk proteins? Milk carbohydrate? Milk fats?

6) What are the major nutritional differences between mother’s milk and artificial milk replacers? Why

8) Are there any known nutritional determinants of preterm labor? Of SGA (small for gestational age)

9) Why is parenteral nutrition not always an ideal solution for infants that do not tolerate oral

Infant mortality:

- The dynamic growth experienced in infancy is the most rapid of any age.
- Inadequate nutrition in infancy, however, leads to consequences that may be lifelong, harming both future growth and development.
Energy stores in newborn infants and animals (Fletcher, 1992)

<table>
<thead>
<tr>
<th>Species</th>
<th>Weight birth (kg)</th>
<th>Fat store (g/kg)</th>
<th>Muscle glycogen (g/kg)</th>
<th>Liver glycogen (g/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humans</td>
<td>3.5</td>
<td>160</td>
<td>7.5</td>
<td>3.8</td>
</tr>
<tr>
<td>Guinea P.</td>
<td>6.1</td>
<td>110</td>
<td>4.5</td>
<td>5.5</td>
</tr>
<tr>
<td>Rabbit</td>
<td>0.05</td>
<td>58</td>
<td>2.3</td>
<td>2.7</td>
</tr>
<tr>
<td>Sheep</td>
<td>4.5</td>
<td>30</td>
<td>8.8</td>
<td>2.2</td>
</tr>
<tr>
<td>Pig</td>
<td>1.3</td>
<td>11</td>
<td>20.9</td>
<td>2.1</td>
</tr>
<tr>
<td>Rat</td>
<td>0.005</td>
<td>11</td>
<td>1.8</td>
<td>5.8</td>
</tr>
</tbody>
</table>

Key Nutrition Concepts

- Early nutrition services and other interventions can improve long-term health and growth among infants born with a variety of conditions.
- The number of infants requiring specialized nutrition and health care is increasing due to the improved survival rates of small and sick newborns.
- Infants who are born preterm or who are sick early in life often require nutritional assessment and interventions that ensure they are meeting their nutritional needs for growth and development.

Benefits of Breastfeeding

- Benefits for mothers
  - Nutritional benefits
  - Immunological benefits
  - Cognitive benefits
  - Reduced morbidity
  - Socioeconomic benefits
  - Analgesic effects

Key Nutrition Concepts

- Human milk is the best food for newborn infants for the first year of life or longer.
- Feeding infants early in the post delivery period whenever possible is important to successful breastfeeding.
- Maternal diet does not significantly alter the protein, carbohydrate, fat and major mineral composition of breast milk, but it does affect the fatty acid profile and the amounts of some vitamins and trace minerals.

Nutrient contents of colostrum/milk (pigs) (Darragh & Moughan, The Lactating Sow)

| Component               | Miscella Magna | Milk milk | MILK
|-------------------------|----------------|-----------|-------
| Protein                 | 29.7           | 14.0      | 21.4  |
| Fat                     | 4.1            | 3.4       | 3.5   |
| Carbohydrate            | 28.0           | 22.0      | 20.0  |
| Ash                     | 2.8            | 2.8       | 3.0   |
| Lactose                 | 3.0            | 5.9       | 5.9   |
| Fat content             | 4.0            | 3.8       | 3.4   |
| Fat free solids         | 14.0           | 14.0      | 14.0  |
| Water content           | 68.0           | 69.5      | 76.0  |
| Crude protein            | 22.0           | 30.0      | 28.0  |
| Cholesterol content     | 1.0            | 0.3       | 0.3   |

Milk nutrients in different species: (Bailey et al., 2000)

- Immune components in human milk
  - Leucocytes
    - B lymphocytes
    - Macrophages
    - Neutrophils
  - T lymphocytes*
  - Secretory immunoglobulin A (SlgA)
  - Oligosacharides
  - Bifidus factor
  - Lysozyme
  - Lactoferrin
  - Gamma-interferon*
  - Nucleotides*
  - Cytokines*

The intestinal immune system: (Paras et al.)
**Breast milk & allergy/intolerance**

**Allergy:**
- Exaggerated immunological response to intact foreign food proteins
- Breast milk protective
- Interactions with resident microflora

**Intolerance:**
- Non-immunological negative response to food
- Spices, odors, oils
- Lactose

---

**Lactose deficiency:**

*Sahar et al.*

**Probiotics - mode of action**

*McDonald et al.*

**Pre-biotics - mode of action in the intestine**

*McDonald et al.*

**Gut bacteria and immune system “cross-talk”**


**Gut atrophy: effects on absorption & immunology**

*Hand et al., 2000, Ch.22*

---

**The nutritional transition at birth:**

- Parenteral nutrition: 85%
- Enteral nutrition: 15%

**The newborn intestine depends on nutrition**

*American Journal of Physiology* 279, 2000

**Infants at Risk**

- Low birthweight infants
- Preterm infants born before 34 weeks of gestation
- Infants born with consequences of abnormal development
- Infants at risk for chronic health problems
- Families of infants with special health care needs
**Weight, age at birth and mortality**

Table 4.3: Range of weights by gestational age (%)

<table>
<thead>
<tr>
<th>Gestation (Weeks)</th>
<th>Range (g)</th>
<th>Median (g)</th>
<th>0.5%</th>
<th>25%</th>
<th>Median</th>
<th>75%</th>
<th>97.5%</th>
<th>99.5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>569-1144</td>
<td>869</td>
<td>96</td>
<td>94</td>
<td>869</td>
<td>89</td>
<td>1124</td>
<td>1144</td>
</tr>
<tr>
<td>21</td>
<td>685-1339</td>
<td>1001</td>
<td>106</td>
<td>104</td>
<td>1001</td>
<td>105</td>
<td>1339</td>
<td>1339</td>
</tr>
<tr>
<td>22</td>
<td>817-1778</td>
<td>1200</td>
<td>122</td>
<td>120</td>
<td>1200</td>
<td>122</td>
<td>1778</td>
<td>1778</td>
</tr>
<tr>
<td>23</td>
<td>974-1990</td>
<td>1400</td>
<td>145</td>
<td>143</td>
<td>1400</td>
<td>145</td>
<td>1990</td>
<td>1990</td>
</tr>
<tr>
<td>24</td>
<td>1,132-2,629</td>
<td>1600</td>
<td>166</td>
<td>164</td>
<td>1600</td>
<td>166</td>
<td>2,629</td>
<td>2,629</td>
</tr>
<tr>
<td>25</td>
<td>1,320-3,869</td>
<td>1900</td>
<td>197</td>
<td>194</td>
<td>1900</td>
<td>197</td>
<td>3,869</td>
<td>3,869</td>
</tr>
<tr>
<td>26</td>
<td>1,514-4,800</td>
<td>2100</td>
<td>217</td>
<td>214</td>
<td>2100</td>
<td>217</td>
<td>4,800</td>
<td>4,800</td>
</tr>
<tr>
<td>27</td>
<td>1,710-5,800</td>
<td>2300</td>
<td>237</td>
<td>234</td>
<td>2300</td>
<td>237</td>
<td>5,800</td>
<td>5,800</td>
</tr>
<tr>
<td>28</td>
<td>1,915-6,800</td>
<td>2500</td>
<td>257</td>
<td>254</td>
<td>2500</td>
<td>257</td>
<td>6,800</td>
<td>6,800</td>
</tr>
<tr>
<td>29</td>
<td>2,120-7,800</td>
<td>2700</td>
<td>277</td>
<td>274</td>
<td>2700</td>
<td>277</td>
<td>7,800</td>
<td>7,800</td>
</tr>
<tr>
<td>30</td>
<td>2,325-8,800</td>
<td>2900</td>
<td>297</td>
<td>294</td>
<td>2900</td>
<td>297</td>
<td>8,800</td>
<td>8,800</td>
</tr>
<tr>
<td>31</td>
<td>2,530-9,800</td>
<td>3100</td>
<td>317</td>
<td>314</td>
<td>3100</td>
<td>317</td>
<td>9,800</td>
<td>9,800</td>
</tr>
<tr>
<td>32</td>
<td>2,735-10,800</td>
<td>3300</td>
<td>337</td>
<td>334</td>
<td>3300</td>
<td>337</td>
<td>10,800</td>
<td>10,800</td>
</tr>
<tr>
<td>33</td>
<td>2,940-11,800</td>
<td>3500</td>
<td>357</td>
<td>354</td>
<td>3500</td>
<td>357</td>
<td>11,800</td>
<td>11,800</td>
</tr>
<tr>
<td>34</td>
<td>3,145-12,800</td>
<td>3700</td>
<td>377</td>
<td>374</td>
<td>3700</td>
<td>377</td>
<td>12,800</td>
<td>12,800</td>
</tr>
<tr>
<td>35</td>
<td>3,350-13,800</td>
<td>3900</td>
<td>397</td>
<td>394</td>
<td>3900</td>
<td>397</td>
<td>13,800</td>
<td>13,800</td>
</tr>
<tr>
<td>36</td>
<td>3,555-14,800</td>
<td>4100</td>
<td>417</td>
<td>414</td>
<td>4100</td>
<td>417</td>
<td>14,800</td>
<td>14,800</td>
</tr>
<tr>
<td>37</td>
<td>3,760-15,800</td>
<td>4300</td>
<td>437</td>
<td>434</td>
<td>4300</td>
<td>437</td>
<td>15,800</td>
<td>15,800</td>
</tr>
<tr>
<td>38</td>
<td>3,965-16,800</td>
<td>4500</td>
<td>457</td>
<td>454</td>
<td>4500</td>
<td>457</td>
<td>16,800</td>
<td>16,800</td>
</tr>
</tbody>
</table>

Good prospects - beyond 28 weeks; beyond 1 kg.

**Diseases and low birth weight:**

Table 4.14: Diseases and other conditions in infants related to smallness or immaturity at birth

<table>
<thead>
<tr>
<th>Disease/Condition</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preterm/Small for gestation</td>
<td>Ref: Low birth weight, prematurity, etc.</td>
</tr>
<tr>
<td>Preterm/Small for gestation</td>
<td>Ref: Low birth weight, prematurity, etc.</td>
</tr>
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<td>Ref: Low birth weight, prematurity, etc.</td>
</tr>
<tr>
<td>Preterm/Small for gestation</td>
<td>Ref: Low birth weight, prematurity, etc.</td>
</tr>
<tr>
<td>Preterm/Small for gestation</td>
<td>Ref: Low birth weight, prematurity, etc.</td>
</tr>
<tr>
<td>Preterm/Small for gestation</td>
<td>Ref: Low birth weight, prematurity, etc.</td>
</tr>
<tr>
<td>Preterm/Small for gestation</td>
<td>Ref: Low birth weight, prematurity, etc.</td>
</tr>
</tbody>
</table>

**Perinatal problems in famous people**

<table>
<thead>
<tr>
<th>Name</th>
<th>Fed</th>
<th>Total</th>
<th>Fed</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Johannes Kepler</td>
<td>1711</td>
<td>1771</td>
<td>1711</td>
<td>1771</td>
</tr>
<tr>
<td>Isaac Newton</td>
<td>1693</td>
<td>1700</td>
<td>1693</td>
<td>1700</td>
</tr>
<tr>
<td>F.M. de Voltaire</td>
<td>1697</td>
<td>1700</td>
<td>1697</td>
<td>1700</td>
</tr>
<tr>
<td>John Garfield</td>
<td>1749</td>
<td>1750</td>
<td>1749</td>
<td>1750</td>
</tr>
<tr>
<td>Winston Churchill</td>
<td>1774</td>
<td>1775</td>
<td>1774</td>
<td>1775</td>
</tr>
<tr>
<td>Pablo Picasso</td>
<td>1881</td>
<td>1882</td>
<td>1881</td>
<td>1882</td>
</tr>
</tbody>
</table>

Perinatal problems do not always lead to poor mental/intellectual ability.

**Key Nutrition Concepts**

- Nutrient requirements of term newborns have to be modified for preterm infants.
- Knowing the needs of sick and small newborns results in greater understanding of the complex nutritional needs of all newborns and infants.
- Changing feeding practices, such as the care of infants outside the home and the early introduction of foods, markedly affect nutritional status of infants.

**Multi-fetus pregnancies:**

- Increased late gestation problems
- Haemodynamics & jaundice

**The preterm pig intestine is highly responsive to external nutrition**

**Intestinal weight**

<table>
<thead>
<tr>
<th>Value relative to birth (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPN 6d</td>
</tr>
</tbody>
</table>

**Key Nutrition Concepts**

- Human milk is the preferred feeding for all premature and sick newborns with rare exceptions.
- Breastfeeding women need consistent, informed, and individualized care in the hospital and at home after discharge.

**Preterm & term milk – differences?**

- Multi-fetus pregnancies:
  - Increased late gestation problems
  - Haemodynamics & jaundice
Small intestinal weight in piglets

-20 -10 0 10 20 30
Years before and after birth (days)

Suckling
Newly-weaned
with diarrhea
Adult
healthy gut
Newborn
cross section

Plasma galactose after lactose bolus

0 50 100 150 200 250 300 350
0 20 40 60 80
Age before and after birth (days)

Colostrum, 24h
Formula, 24h
Newborn, 6h

Response to the first enteral milk:
Mucosa proportion

0.5 1.0

Term
Fetal
Preterm
Preterm+TPN

Plasma galactose after lactose bolus

-20 -10 0 10 20 30
Years before and after birth (days)

Suckling
Newly-weaned
with diarrhea
Adult
healthy gut
Newborn
cross section

Physological adaptation of newborn lambs:

CAESAREAN SECTION
LOW MATERNAL FEED INTAKE

Body temperature regulation depends on stimulus at birth.

Caesarean section vs vaginal birth

Caesarean section
Vaginal birth

Body temperature response to suckling

OPP MATURE PREDICTABLE

PAST MATURE PREDICTABLE

Thermo-regulatory adaptation in newborn lambs:

NST: non-shivering thermogenesis (Symonds et al., 1989)
Temperature regulation in newborns

Temperature regulation – response to birth and feeding

Rectal temperature following preterm birth

Temperature regulation in newborns

Nutrient contents of colostrum/milk (pigs)

Table 5.2. The major components of sow's colostrum and milk

<table>
<thead>
<tr>
<th>Component</th>
<th>Normal milk</th>
<th>TPN-fed milk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein</td>
<td>25.9%</td>
<td>30.1%</td>
</tr>
<tr>
<td>Fat</td>
<td>3.8%</td>
<td>3.3%</td>
</tr>
<tr>
<td>Carbohydrates</td>
<td>39.2%</td>
<td>37.9%</td>
</tr>
<tr>
<td>Mineral elements</td>
<td>3.1%</td>
<td>3.1%</td>
</tr>
<tr>
<td>Water</td>
<td>42.0%</td>
<td>42.0%</td>
</tr>
</tbody>
</table>

Complications with TPN

Early and later lactation milk

Bioactive components in milk

Milk components

Physiological transitions at birth

Percentiles of birth weight with age

Nutrient contents of colostrum/milk (pigs)
**Human Milk Composition**

- Colostrum
- Water
- Energy
- Lipids
  - effect of maternal diet on fat composition
  - DHA
  - cholesterol

**Key Nutrition Concepts**

- Most medications, including over-the-counter as well as prescription drugs, drugs of abuse, alcohol, nicotine and herbal remedies taken by nursing mothers are excreted in breast milk.
- Twins and other multiples can be successfully breastfed without formula supplementation.

**Other Concerns**

- Breastfeeding multiples
- Infant allergies
- Food intolerance
- Near-term infants
- Human milk and preterm infants
- Medical contraindications to breastfeeding
- Breastfeeding and HIV infection

**Assessing Newborn Health**

- Birthweight as an outcome
- Infant mortality
- Combating infant mortality
- Standard newborn growth assessment

**Infant Development**

- Motor development
- Critical periods
- Cognitive development
- Digestive system development
- Parenting
Energy and Nutrient Needs
- Caloric needs
- Protein needs
- Fats
- Metabolic rate, calories, fats and protein—how do they all tie together?

Other nutrients and non-nutrients
- Fluoride
- Vitamin D
- Sodium
- Fiber
- Lead

Feeding in Early Infancy
- Breast milk and formula
- Cow’s milk during infancy

Energy and Nutrient Needs
- Energy needs
- Protein requirements
  - Form of protein
- Fats
- Vitamins and minerals

Common Nutritional Problems
- Nutrition risks to development
- Developmental delay
- Down syndrome

Severe Preterm Birth and Nutrition
- How sick babies are fed
  - Food safety
- What to feed preterm infants
- Preterm infants and feeding
  - Fatigue
  - Low tolerance of volume
  - “Disorganized feeding”

Congenital Abnormalities and Chronic Illness
- GI tract disorders
  - Diaphragmatic hernia
  - Tracheoesophageal atresia
- Cleft lip and palate
- Genetic disorders
  - Maple syrup urine disease
  - DiGeorge syndrome
KONKLUSION:
Tarmen i umodne og/eller små nyfødte er ekstremt følsom overfor ernæring.
- Odentype
- Fødselstype
- Blodvæsent
- Nutritional transition at birth
- Development of blood cortisol before birth
- Fødselsvægt og vitalitet hos grise

Animal models in infant nutrition?

Are the piglet and infant similar?

- Skift i ernæringsforhold ved fødsel:
- Nutritional transition at birth
- Development of blood cortisol before birth
- Fødselsvægt og vitalitet hos grise

Transmission of passive immunity in different species:

<table>
<thead>
<tr>
<th>Species</th>
<th>0h (no transfer)</th>
<th>1-2d (variable degrees of transfer)</th>
<th>20d (variable degrees of transfer)</th>
<th>40d (variable degrees of transfer)</th>
<th>&lt;5d (variable degrees of transfer)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horse</td>
<td>+++</td>
<td>0++</td>
<td>++</td>
<td>+++</td>
<td>+++</td>
</tr>
<tr>
<td>Man, monkey</td>
<td>0++</td>
<td>++</td>
<td>++</td>
<td>+++</td>
<td>+++</td>
</tr>
<tr>
<td>Rabbit</td>
<td>0+++</td>
<td>++ (16 d)</td>
<td>++</td>
<td>++</td>
<td>+++</td>
</tr>
<tr>
<td>Guinea pig</td>
<td>++ (40d)</td>
<td>+ (1-2d)</td>
<td>++</td>
<td>++</td>
<td>+++</td>
</tr>
<tr>
<td>Fowl</td>
<td>+++ (1-2d)</td>
<td>+ (20d)</td>
<td>++</td>
<td>++</td>
<td>+++</td>
</tr>
<tr>
<td>Dog, cat</td>
<td>+++ (180d)</td>
<td>0+++</td>
<td>0+++</td>
<td>0+++</td>
<td>0+++</td>
</tr>
<tr>
<td>Wallaby</td>
<td>+++ (24h)</td>
<td>0+++</td>
<td>0+++</td>
<td>0+++</td>
<td>0+++</td>
</tr>
<tr>
<td>Ox, goat, sheep</td>
<td>+++ (24h)</td>
<td>0+++</td>
<td>0+++</td>
<td>0+++</td>
<td>0+++</td>
</tr>
<tr>
<td>Pig</td>
<td>+++ (24h)</td>
<td>0+++</td>
<td>0+++</td>
<td>0+++</td>
<td>0+++</td>
</tr>
</tbody>
</table>

Grise fødes relativt små og med lille depot (Fletcher, 1992):

- Så hurtigt forsvinder depoterne:

<table>
<thead>
<tr>
<th>Fødsel</th>
<th>24h faste varmt</th>
<th>48h faste varmt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plasma glucose (mM)</td>
<td>5.25</td>
<td>5.17</td>
</tr>
<tr>
<td>Liver glycogen (mg)</td>
<td>472</td>
<td>283</td>
</tr>
<tr>
<td>Muscle glycogen (mg)</td>
<td>400</td>
<td>333</td>
</tr>
</tbody>
</table>

Grise fødes relativt små og med lille depot (Fletcher, 1992):

- Så hurtigt forsvinder depoterne:

<table>
<thead>
<tr>
<th>Fødsel</th>
<th>24h faste varmt</th>
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</thead>
<tbody>
<tr>
<td>Plasma glucose (mM)</td>
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<td>283</td>
</tr>
<tr>
<td>Muscle glycogen (mg)</td>
<td>400</td>
<td>333</td>
</tr>
</tbody>
</table>
**NEC in premature, formula-fed pigs**

- NEC incidence (%): 57* vs. 0.57*
- Blood acidity (pH): 7.43 ± 0.04 vs. 7.24 ± 0.03*
- Intestinal mucosa (%): 75.6 ± 1.1 vs. 65.0 ± 3.5*
- Villus height (m): 556 ± 37 vs. 263 ± 37*
- Malate activity (U/g): 6.18 ± 0.89 vs. 1.31 ± 0.28*
- Lactase activity (U/g): 19.6 ± 2.8 vs. 10.2 ± 2.2*
- Aminopeptidase N: 7.76 ± 0.91 vs. 5.11 ± 0.70
- Aminopeptidase A: 4.22 ± 0.28 vs. 2.73 ± 0.34*
- Glucose absorption: 1.02 ± 0.09 vs. 0.59 ± 0.07*

**Nutritional transition at birth**

Parenteral nutrition → Enteral nutrition → Birth

**Diet-dependent gut responses to enteral nutrition in preterm pigs**

- **TPN-induced mucosal damage?**
- **Sow colostrum**
- **Formula**
- **Cow**
- **Premature cesarian section**
- **TPN for 3d**
- **Enteral nutrition for 2 d**

**Hvad påvirker fostrets modning forud for fødsels**

- 99% (90-100)
- 93% (85-95)
- 92% (80-95)

**Vægt af mave-tarmkanalen relativt til kropsvægten:**

<table>
<thead>
<tr>
<th>Animal</th>
<th>% of Body Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheep</td>
<td>90-95</td>
</tr>
<tr>
<td>Cattle</td>
<td>93-95</td>
</tr>
<tr>
<td>Humans</td>
<td>90-95</td>
</tr>
</tbody>
</table>

**Is the intestine particularly sensitive to nutrition and the gut microflora at birth and weaning?**

- **No swallowing of amniotic fluid before birth**
- **Continuation of TPN after birth**
- **Premature piglets reared in incubators on enteral nutrition**
Preliminary summary:
1) The nutritional transition is enormous at birth
2) Gut function is a critical barrier to good nutrition
3) Gut develops rapidly at birth – in all species?
4) Gut maturation interacts with microflora/nutrition?

Premature piglets reared in infant incubators on parenteral nutrition

Nutrients:
- 180-230 mL/kg/d
- 8-11 g protein/kg/d
- 600-800 kJ/kg/d

TPN fluid:
- 3200 kJ/L
- Glucose: 72 g/L
- Amino acids: 45 g/L
- Fat: 31 g/L

Milk (sow/cow):
- 3350 kJ/L
- Lactose: 45 g/L
- Protein: 46 g/L
- Fat: 39 g/L

Physiology:
Does physiology relate to infants?
Can reasons/treatments be found?
Philosophical?
Why should we save newborns?
OK to kill piglets but not infants?

Preterm or term birth?
Parenteral versus enteral nutrition?
Value relative to birth (=1.0)

Is diet and age important?

Do nutrition interact with the gut microflora?

Intestinal NOS activity and vit. E in preterm and term piglets

E-vitamin indhold i tarmvæv - sammenhæng med inflammation?
Age-related maturation of intestinal enzymes in baboons (primates) and pigs

In primates: Earlier maturation of disaccharidases (lactase?)
Later maturation of aminopeptidases

Bacteria in the gastrointestinal tract

Most common groups of bacteria in the lower genital tract of pregnant women during weeks 34-40

<table>
<thead>
<tr>
<th>Aerobes</th>
<th>Anaerobes</th>
</tr>
</thead>
<tbody>
<tr>
<td>corynebacteria</td>
<td>bacteroides</td>
</tr>
<tr>
<td>enterobacteria</td>
<td>lactobacilli</td>
</tr>
<tr>
<td>lactobacilli</td>
<td>peptococci</td>
</tr>
<tr>
<td>micrococci</td>
<td>peptostreptococci</td>
</tr>
<tr>
<td>staphylococci</td>
<td>propionibacteria</td>
</tr>
<tr>
<td>streptococci</td>
<td>coliforms</td>
</tr>
</tbody>
</table>

Microbial load on health and performance

Benefits, potentially beneficial / harmful
and pathogenic attributes of bacteria in the large intestine

Gnotobiotic Acute infection

Prophylaxis / Growth promotion / Therapy / Vaccination / Antibiotics / Antibodies / Prebiotics / Probiotics
Birth mode & bacterial colonization

- The intestinal flora depends on the mode of delivery up to at least 12 months after delivery
- Children delivered by cesarian are more likely to develop allergic disease

HOW DOES COLDSTRUM DIFFER FROM MILKY
(PIGS, m.f. Klobasa, 1987)

PROTEINS

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