Chapter 9. Animal Growth and Carcass Composition

I. ANIMAL GROWTH

A. Chronological vs. physiological

1. **Chronological growth** – the increase in size or body function due to an animal growing older.

2. **Physiological growth** – the increase in size or body function due to increases in tissue and organ growth and development.
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I. ANIMAL GROWTH
A. Chronological vs. physiological

3. Terms relating to growth:
   a. hypertrophy –
   b. hyperplasia –
   c. anabolism –
   d. catabolism –
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B. Measures of Growth

1. Measurements can be objective or subjective, varies by the intended use of the animal

a.) meat animals

-- Live weight, BCS, loin eye area, back fat thickness

Body condition score
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b.) breeding animals: ability to produce offspring. - - Live weight, age at first estrus, and testicle size

c.) other specialty products - - milk, wool, eggs
Figure 1
Scrotal circumference is measured by holding the testicles to the bottom of the scrotal sack and placing the tape around the widest point (minimum of 30 cm).

Figure 2
Pelvic area is measured by taking the product of vertical and horizontal measurements (13 X 14 cm = 175 cm²).
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c.) work animals:

- Body weight
- Agility/Speed
- Endurance
- Cutting ability
- Pulling power
- Rate of learning
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2. Average Daily Gain (ADG) – measurement of growth rate.

\[ \text{ADG} = \frac{\text{last weight} - \text{initial weight}}{\text{ending time} - \text{begin time}} \]

- commonly used measurement of meat animals.
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● Other Growth Measures:
For example:
Body weight at 52 days of age in broiler chickens/
Number of days to 230 lbs in swine
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C. The Growth Curve

1. Commonly represented as the gain in weight over time.
2. Livestock growth curve generally separated into 3 phases:

a.) **prenatal**: the increase in weight from conception to birth (i.e., zygote, embryo, & fetal phase)

Factors: AOD, uterine quality, and gender of fetus

What is a hinny?
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Heterospermic natural matings of NZW doe to large, medium, and small breeds of buck (Flemish Giant, Californian, and Florida White).
2. Livestock growth curve generally separated into 3 phases:

b.) preweaning: birth to weaning

- age/body size of dam
- milk production
- gender
- no. of teats/litter size

(>14 teats in swine; no > 9 kits in rabbits)

“cross-fostering”
c.) **postweaning**: weaning to harvest

- affected by pre-weaning background
  - genetics
  - gender
  - environment
  - nutrition
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D. Factors affecting growth

1. Hormonal growth
   a.) Hormones are chemical messengers.
   b.) Hormones coordinate growth and development of body tissues structures, and organs – help ensure “homeostasis”

Homeostasis:

Is the property of a system that regulates its internal environment and tends to maintain a stable, relatively constant condition of properties such as temperature or pH (Wikipedia, 2012).
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c.) Hormone secretion:
  - endocrine glands
  - circulation
  - target tissue
  - response
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d.) types of growth related hormones:

1. Somatotropin (ST, “Growth Hormone”)
   - secreted from the anterior pituitary
   - regulates development of bone and muscle
   - increases milk yield
   - bST increases milk yield by repartitioning nutrients from fat to the mammary tissue
pST increases meat yield by increasing protein deposition by 30% and decreases fat by 45%

2. **Thyroxine**
   - secreted by the thyroid gland
   - regulates basal metabolic rate
   - too little impairs bone and muscle growth – “hypothyroidism”
too much thyroxine results in less nutrient utilization due to high metabolic rate – “hyperthyroidism”

exogenous hormone used to increase feathering in poultry, wool and milk production in sheep
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3. Androgens
   - The hormone, testosterone, is involved in secondary sexual development in males.
   - Testosterone increases bone and muscle growth in males and females.
   - Testosterone is a major androgen that is produced in the testes and in the adrenal glands.
4. **Estrogens**
   - secreted from the ovaries
   - increases muscle growth in ruminants and fat deposition in poultry
   - slows growth of these tissue types in other species
5. **Glucocorticoids**
- secreted from the adrenal glands
- involved in stress and inflammation
  - stimulates feeding (increase appetite)
  - repartitions nutrients (to produce energy for growth)
E. General Growth Factors:

1. Genetics

   a.) genetic predetermination at conception of animal’s body size and growth rate

   b.) preweaning growth largely dependent on milk availability, but postweaning growth gain is largely dependent on the animal’s genetics

   c.) genetic or hormonal imbalance can harm growth potential
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2. Milk Production

- In beef cattle, about 50% of variation in weaning weights of calves is due to differences among cows in milk production.

- In rabbits, it is said that the litter is “made in the nestbox”.
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3. Gender

a.) androgens vs. estrogens

- Males grow faster than females
- Differences are larger in cattle, goats, and sheep than in swine

Belgian Blue Bulls
Figure 3
Effect of sex on growth curves of Hereford and Angus cattle. Note the higher growth rate of the males.
(Source: Adapted from Brown, et al., Arkansas Agr. Exp. Sta. Bull. 570 and 571, 1956.)
Figure 2
Theoretical growth curves of three pairs of animals. Note the captions for each pair of growth curves.
(Source: Iowa State University.)
4. Nutrition

a.) diet affects immediate and subsequent growth traits

too much = fat deposition = decreased bone and organ growth and development

b.) compensatory gain
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Compensatory gain

a.) very rapid growth when an animal on a nutrient poor diet switched to a nutrient rich diet
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5. Antibiotics/Feed Additives/Implants

- reduce incidence of disease
- increase growth and nutrient efficiency
- alter rumen micro-organisms which may improve nutrient utilization
6. Physical environment

a.) shelter, flooring, cage size, population density, sounds, and climate affect growth

7. Management

a.) animal care and well-being
II. Carcass Composition

A. 3 main constituents

1. bone ➔ muscle ➔ fat

- a.) total amount of increase or change as growth occurs.

- b.) proportion of each constituent will differ

Younger animals > bone & muscle than older animals > fat
<table>
<thead>
<tr>
<th>Live Weight in Pounds</th>
<th>150</th>
<th>175</th>
<th>200</th>
<th>225</th>
<th>250</th>
<th>300</th>
<th>400</th>
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<tr>
<td>Dressing percent</td>
<td>73.7</td>
<td>78.9</td>
<td>78.3</td>
<td>79.3</td>
<td>78.6</td>
<td>83.2</td>
<td>83.7</td>
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<tr>
<td>Fat cuts, percent of carcass&lt;sup&gt;a&lt;/sup&gt;</td>
<td>29.02</td>
<td>32.05</td>
<td>34.59</td>
<td>36.66</td>
<td>36.99</td>
<td>39.90</td>
<td>46.18</td>
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<tr>
<td>Lean cuts, percent of carcass&lt;sup&gt;b&lt;/sup&gt;</td>
<td>54.58</td>
<td>53.95</td>
<td>52.95</td>
<td>51.63</td>
<td>50.95</td>
<td>48.84</td>
<td>44.68</td>
</tr>
<tr>
<td>Ham, percent of carcass</td>
<td>18.91</td>
<td>19.03</td>
<td>18.64</td>
<td>18.51</td>
<td>17.58</td>
<td>17.08</td>
<td>16.27</td>
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<tr>
<td>Percent lean in the ham</td>
<td>66.24</td>
<td>65.06</td>
<td>63.17</td>
<td>60.23</td>
<td>61.11</td>
<td>60.60</td>
<td>52.63</td>
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<tr>
<td>Percent of entire carcass:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Lean</td>
<td>51.52</td>
<td>48.55</td>
<td>45.00</td>
<td>43.48</td>
<td>43.04</td>
<td>41.08</td>
<td>34.34</td>
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<td>Fat</td>
<td>32.40</td>
<td>37.38</td>
<td>41.79</td>
<td>44.33</td>
<td>44.90</td>
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<td>Bone</td>
<td>10.45</td>
<td>9.33</td>
<td>8.79</td>
<td>7.58</td>
<td>7.56</td>
<td>7.09</td>
<td>5.86</td>
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<tr>
<td>Skin</td>
<td>5.30</td>
<td>4.45</td>
<td>4.16</td>
<td>4.20</td>
<td>4.17</td>
<td>3.88</td>
<td>4.19</td>
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</table>

<sup>a</sup>Includes leaf lard, fatback, belly, clear plate, jowl, and fat trim.

<sup>b</sup>Includes loin, ham, Boston butt, picnic, and lean trim.

<sup>c</sup>Most mid-1990s meat-type market hogs approach or exceed 57 percent lean—indicating significant genetic improvement since the above study was conducted.

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c.) rate of tissue proportion changes depends on:

- species
- breed
- animal type
- gender
- diet
- age