Food Safety Program /2nd Level 2nd

Course: Animal Production 3 (Poultry)

Title of lecture : Factors Affecting Hatchability

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Factors Affecting Hatchability

Numerous factors have pronounced influence on the hatchability of chicken eggs. Many of these are important long before the eggs are placed in the incubator. For example, breeder flock , health, nutrition, breed, age of breeders, and breeder flock.

Egg collection, storage, and handling must be optimum to maintain embryonic viability before and during incubation. After setting in the incubator, temperature, turning, humidity, ventilation in the incubators and incubator rooms, sanitation, and general hatchery management are all critical factors to ensure embryonic survival and hatchability.

- **A. FERTILITY**

fertility is the most important factor in determining hatchability performance.

1. **Determining Fertility**

There are three common methods to determine fertility. The first opportunity to sample fertility is with freshly laid eggs. The second opportunity involves candling eggs that have been incubated for 7 to 12 days and breaking out clear eggs to differentiate between infertility and early embryonic mortality. The third method is the breakout of unhitched eggs on hatch day.

a. Fresh Egg Breakout

fresh egg breakout can provide the current status of fertility in a flock, it has several disadvantages. The most serious disadvantage of fresh egg breakout is that it provides information only on fertility and does not measure other valuable information on additional important causes of reproductive failure such as embryonic mortality and contamination.

Fourth disadvantage of a fresh egg breakout is that it is more difficult to distinguish between fertility and infertility in fresh eggs than when eggs have been incubated for several days.

There are three criteria that should be used to determine fertility of germinal disc: shape, size, and color intensity.

• **Shape**, a blastoderm (indicating fertility) is usually roundas a white symmetrical ring with a clear area in the center of the ring.

• **Size.** The blastoderm is almost always larger in appearance (one-quarter to one-third larger) than the blastodisc.

• **Color** intensity. The blastoderm almost always appears to be a less intense color of white than the blastodisc .The blastodisc appears as more of a small, intense white spot on the surface of the yolk.

b. Candling and Breakout Analysis

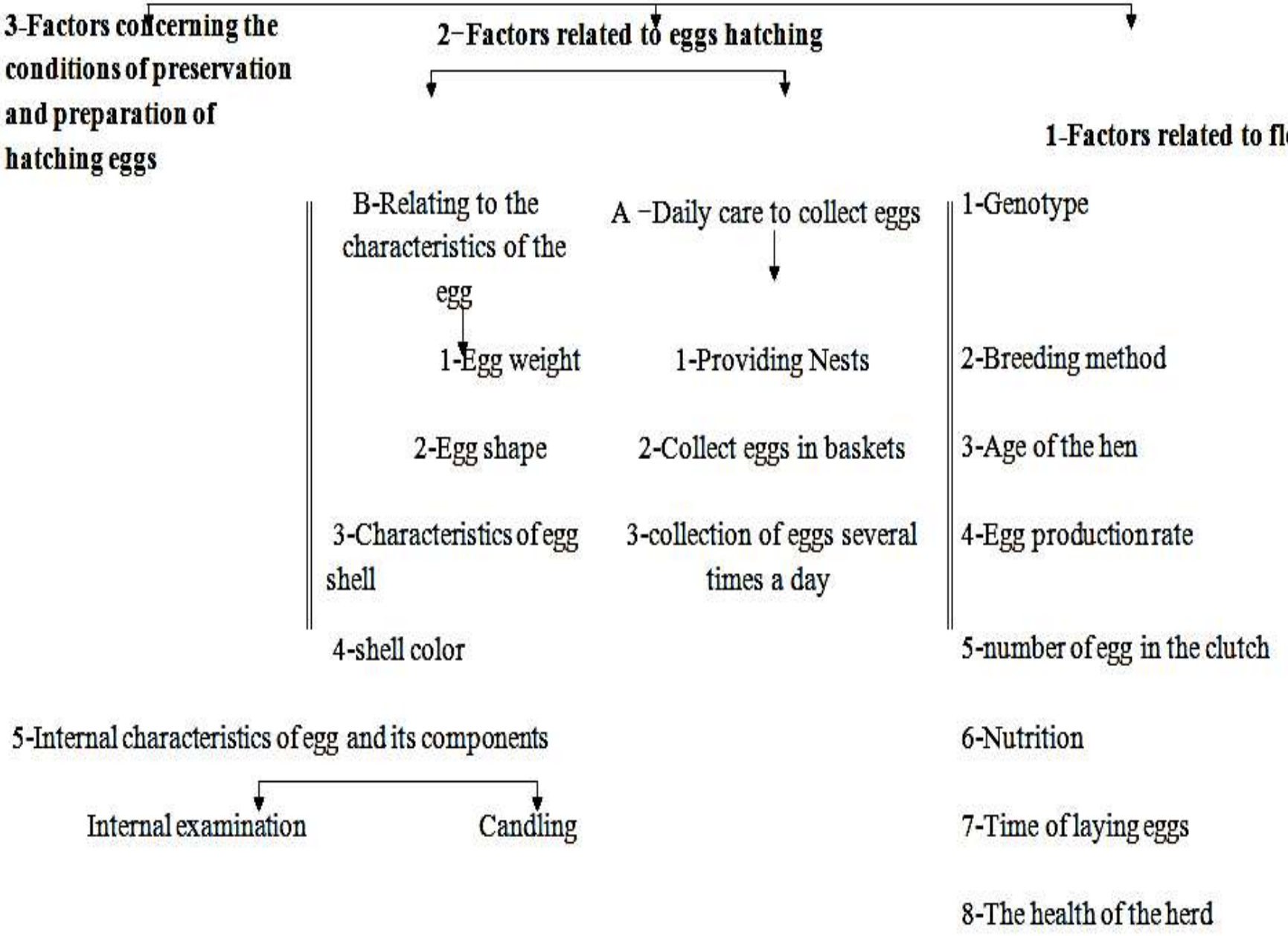
Candling and breaking the clear eggs is considered the most accurate method to determine fertility. It is also useful for determining other sources of breeder flock or hatch failures, such as percentages of eggs setup side down, cracked, and embryos that have died early.

Candling can be done as early as five days of incubation, but errors in candling often occur at this time. Because of the rapid growth rate of the embryos during the second week of incubation, very few, if any, candling errors are made on the ninth or tenth day of incubation.

Clear eggs consisting of infertile and early embryo mortality emit more light than eggs with viable embryos and are removed for breakout.

A minimum of four trays per breeder flock(>500 eggs) is needed to ensure that estimates for fertility, eggs set upside down, farm cracks, and cull eggs are meaningful. Take trays from different areas in the incubator, as this will provide a more random sample of flock performance

Factors Affecting Hatchability



SEX OF CHICKS

There is no method for determining the sex of the blastoderm from the time the egg is laid until the chick hatches. The ratio of males to females is nearly equal at the time ova are fertilized (primary sex ratio), but unequal mortality of the sexes during embryonic development usually causes more males than females to hatch (secondary sex ratio).

the presence of sex-linked lethal genes which most frequently affect the heterogametic sex (females).

- **Moisture Weight Loss Varies**

When eggs have an average daily loss less than 0.55%, it is necessary to lower the humidity settings in the setter to compensate . Table 39-6 presents results describing the influence of incubation relative humidity (RH) on hatchability and chick quality. The normal humidity range used by commercial hatcheries is about 55%.

tray weight = 6.65 lb
egg and tray weight = 25.80 lb (day 0)
egg and tray weight = 23.70 lb (day 15)

Formula: egg weight = egg and tray weight − tray weight

Example: day 0 egg weight = 25.8 − 6.65

= 19.15 lb

day 15 egg weight = 23.70 − 6.65

= 17.05 lb

Formula: $$\%\ \text{weight loss (day 15)} = \frac{(\text{day 0 egg weight} - \text{day 15 egg weight})}{\text{day 0 egg weight}} \times 100$$

Example: $$\%\ \text{weight loss (day 15)} = \frac{(19.15 - 17.05)}{19.15} \times 100$$

= 10.97%

Formula: $$\text{average daily loss} = \frac{\%\ \text{weight loss (15 day)}}{\text{15 days}}$$

Example: $$\text{average daily loss} = \frac{10.97}{15}$$

= 0.73%

Factors which may influence the degree of moisture weight loss during incubation include setter humidity control, setter room humidity, season of year, ambient relative humidity, age of breeder flock, egg size, shell quality and shell porosity. However, the relative humidity in the setters has the most pronounced influence on the moisture loss.

TEMPERATURE DURING INCUBATION

1. Physiological Zero

Physiological zero is that temperature below which embryonic growth is arrested, and above which it is reinitiated.

The most frequent suggestion is that the physiological zero for chicken eggs is about 75°F (24°C).

2. Optimum Temperature for Incubation

Temperature is the most critical environmental concern during incubation because the developing embryo can only widths and small fluctuations during the period. During the first 18 days of incubation (setter phase) the range for incubation temperature is 98.5 to l00.25°F (37.2° to 38.2°C).During the last three days (hatcher phase) the temperature is lowered to between98°F and 99°F (37° and 37.5°C). **The following factors may influence the proper temperature:**

- egg size
- shell quality
- genetics (breed or strain)
- age of egg at setting time
- incubation humidity

Most incubation is done with multi-stage machines which incubate eggs from different flocks with varying ages, and even different breed/ strains. To alleviate this condition, the industry is starting to experiment with single-stage machines. Single-stage incubation has a seeming advantage over multi-stage because the incubation conditions of temperature, humidity, and air flow can be tailored for a single setting of eggs.

the In single-stage incubator provides heat during the first 10 days, and cooling is required for the second half of incubation. When power fails, incubators have a serious problem. All multi-stage machines and single-stage machines containing eggs that have been incubated 10 or more days will overheat. However, this is rarely a problem because nearly all commercial hatcheries have back-up generators to provide electricity during power outages.

INCUBATION HUMIDITY

Incubation humidity determines the rate of moisture loss from eggs during incubation.

most incubator manufacturers recommend an incubation relative humidity ranging between 55 and 60%. After eggs are transferred to the hatcher the relative humidity requirements increase to about 65%. As piping and hatching increase on the last day of incubation the relative humidity will increase to about 75%.

1. Measuring Relative Humidity:-

The dry bulb records the temperature of the ambient air. The wet-bulb thermometer is an ordinary thermometer in which the bulb has been covered with a water-mois tened wick which measures the temperature of air at saturation or 100% RH.

Table 39-7. Percentage Relative Humidity as Determined by Wet-Bulb

Wet-bulb Temperature		Dry-bulb Temperature			
		98.0°F (36.7°C)	98.5°F (37.0°C)	99.0°F (37.2°C)	99.5°F (37.5°C)
(°F)	(°C)	Relative Humidity (%)			
80	26.7	46	45	44	43
82	27.8	51	50	49	48
84	28.9	56	55	54	53
86	30.0	62	61	59	58
88	31.1	67	66	65	64
90	32.2	73	72	71	70
92	33.3	79	78	77	76

2. Carbon Dioxide Tolerance

Carbon dioxide (C02) is a natural by-product of metabolic processes during embryonic development which begins during gastrulation. In fact, CO2 is being released through the shell at the time the egg is laid.

Table 39-12. Gaseous exchange during incubation

Day of Incubation	Absorption of Oxygen (ft^3)	Expulsion of Carbon Dioxide (ft^3)
1	0.50	0.29
5	1.17	0.58
10	3.79	1.92
15	22.70	11.50
18	30.00	15.40
21	45.40	23.00

During the first 4 days in the setter, the tolerance level of CO2 is about 0.3%.Carbon dioxide levels above 0.5% in the setter reduce hatchability, with significant reductions at 1.0%, and are completely lethal at 5.0%.

POSITION AND TURNING OF THE EGG DURING INCUBATION

Frequent turning and egg orientation are important during the first 14 days of incubation. Artificially incubating eggs should be held with their large ends up. It is natural for the head of the chick to develop in the large end of the egg near the air cell

When eggs are incubated with the small end up, about 60% of the embryos will develop with the head near the small end. Thus, when the chick is ready to hatch, its beak cannot break into the air cell to initiate pulmonary respiration.

Eggs should not be turned continuously in a circle; this practice will rupture the yolk sac resulting in embryonic mortality. Most eggs are turned to a position of 45° from vertical, then reversed in the opposite direction to 45° from vertical. One incubator turns them to a position of 90° from vertical, then reverses them to the opposite position. Rotation less than 45° is not adequate to achieve high hatchability as shown in Table 39-14.

- **Table 39-14. Effect of Angle of Turning Eggs during Incubation**

Angle Turned to Each Side of Vertical	Hatch of Fertile Eggs (%)
20°	69.3
30°	78.9
40°	84.6

- **Transferring Eggs to the Hatcher**

Hatcheries transfer the eggs from setter to hatcher between 17 and 19 days of incubation. This is done either manually or mechanically.

Pneumatic transfer machines are the best for gentle transfer and for reducing cracks. It is best to transfer eggs in front of the hatcher and not in front of the setter.

:Table 39-15. Effect of Turning Eggs on Hatchability:

Times Turned Daily	Hatch of Fertile Eggs (%)
2	78.1
4	85.3
6	92.0
8	92.2
10	92.1

- **Table 39-16. Effect of Turning Hatching Eggs at Various Times during Incubation:**

Period Turned during Incubation (Day)	Hatch of Fertile Eggs (%)
no turning	28
1–7	78
1–14	95
1–18	92

Several factors influence the length of the incubation period- breed, gender, age of eggs, size of eggs, shell quality, etc.

When setting times are correct, all eggs should hatch within 18 hours females hatch before males. There is evidence that when fresh eggs are incubated, females hatch as much as 3 hours before males .

Normally, the chick embryo develops with the head in the large end of the egg (near the air cell) and with its head under its right wing. But there are many embryos that do not develop in this position. These are called malposition's,

5. Abnormal Embryos:-

Embryos that develop abnormally, but still hatch, should be culled during chick grading.

Table 39-18. Chick Abnormalities:

small head	crooked neck	clubbed down
popeyed	twisted spine	short down
one eye	thickened hocks	dwarf
no eyes	extra leg	spraddle legged
parrot beak	unabsorbed yolk	star gazer
crossed beak	curled toes	brain outside head
short beak	wingless	extra appendages

EMBRYONIC MORTALITY PATIERNS

There are four periods during the development of the embryo.

- **1. Period I (Preovipositаl Mortality):-**

There is also an increase in embryonic mortality during egg holding if the period of gastrulation has not been completed when the egg is laid.

The movement of the egg through the oviduct is influenced by several factors that may lengthen the time of oviposition . Larger eggs take longer than smaller eggs, and eggs with thick shells take longer than those with thin shells to pass through the oviduct.

Poorer producing hens lay eggs which remain in the oviduct a longer period of time, sometimes as long as 27 hours, with embryo growth having advanced too far when the egg is laid.

2. Period /I (Early-Dead Embryos)

Period II represents embryos that die during the first week of incubation . Some do not reinitiate development once the eggs are placed in the setter . This may be the result of poor egg-holding conditions between the time the eggs are laid and the time they are placed in the incubator, which lowers embryo vitality.

The normal percentage of Period II embryonic mortality is about 2.75% during the life of the breeder flock.

3. Period 11/ (8- to l8-day Mortality)

Embryonic mortality during Period III should remain very low, less than 0.75%. Nutritional deficiencies in the breeder diet have their greatest effect on the embryo in Period III, although too little vitamin A may cause excessive embryonic mortality.

- **Stages Of Embryonic Mortality During Incubation:-**

Phase 1 (from 3 to 5 days)	- Low or high temperature - Low or high relative humidity - The embryo may fail to get red harmful gases -Pad conditions during storing eggs -No turning of eggs
Phase 2 (at 12 day)	-Decreasing of nutritional elements needed for the embryo especially deficiency of vit. B2 (riboflavin)
Phase 3 (from 18 to 21 days)	-The embryo may fail to start in pulmonary respiration -High or low temperature -Low or high relative humidity -The presence of hereditary or semi –fatal genetic factors -The general weakness of the embryo is unable to hatch -Failure of embryo to turn nutrition from albumen to yolk -Failure of embryo to take normal position of hatching