

COURSE CODE:	APH508
COURSE TITLE:	Hatchery Technology and Management
NUMBER OF UNITS:	3 Units
COURSE DURATION:	Three hours per week

COURSE DETAILS:

Course Coordinator:	Dr. L. T. Egbeyale
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Other Lecturers:	Prof. S. S. Abiola, Dr. O. M. Sogunle and Dr. (Mrs.) K. A. Sanwo

COURSE CONTENT:

Establishment of hatchery and layout of infrastructure. Management of breeders with particular reference to nutrition and health. Major factors affecting fertility of eggs. Prevention of trans-ovarian diseases in breeders. Egg formation in female reproductive tract, egg abnormalities. Physical characteristics of hatch-able eggs. Pre-incubation care of hatch-able eggs. Incubation periods in poultry species. Incubator types and hatchery sanitation. Ventilation, temperature and humidity regulation in an incubator. Egg candling and turning. Embryonic development and mortality. Major factors influencing hatchability of eggs. Sexing and marketing of chicks. Brooding and management of chicks. Hatchery waste management.

COURSE REQUIREMENTS:

This is a compulsory course for all 500 level students in the Department of Animal Production and Health. Students are expected to participate in all the course activities and have minimum of 70% attendance of lectures and practical work to be able to write the semester examination.

READING LIST:

Benefits from Hatchery to Farm. 2004. Chick Master Avida Systems.

LECTURE NOTES

ESTABLISHMENT OF HATCHERY

The hatchery is the building or manufacturing unit where equipment such as machines (e.g. setters, hatchers, fumigators, candlers, etc) and appliances are installed for the production of day-old chicks. Its raw products are the fertile hatching eggs; the manufacturing process is the incubation of eggs while the finished products are the day-old chicks. Whether or not the hatchery is successful depends largely on the number of eggs that produce saleable stock.

The plan for the hatchery is dictated by the following considerations:

- (a) Room temperature – Temperature should be 21^oC in the incubator room for best results. This may involve the use of air conditioners or ceiling fans. However, if this is un-economical, the building should be constructed to allow straight through ventilation
- (b) Space – Incubator room should be spacious and provide opportunity for expansion.
- (c) Work flow – Arrangement of rooms should make for efficient work flow.
Auxiliary rooms (e.g. tray, box or dressing rooms) should be located conveniently to support the “main flow”.

MACHINES AND APPLIANCES IN THE HATCHERY:

1. FUMIGATORS – Equipment used for the fumigation of eggs to prevent transmission of diseases (e.g. Chronic Respiratory Disease, Salmonellosis, etc.) to the developing embryos. Potassium permanganate and formalin can be used at ration of 1:2 (20g/40ml) for 30 minutes.
2. SETTERS – Fumigated eggs are stored here for 18 days at temperature of 37^oC with RH of 50 – 60% depending on the type of incubator. Here eggs are kept inside egg trays with broad end up and turned on hourly basis.
3. EGG CANDLER – Used for fertility test at 10th and 18th day of incubation.
4. HATCHER – Hatchable eggs are stored here as from the 18th day of incubation for a period of 3 days using temperature of 35^oC and RH of 70 – 75%

MANAGEMENT OF BREEDERS

Primary breeding, parent breeder production and multiplication for the production of egg or meat-strain day old commercial chicks, poults, ducklings etc depend on the hatching process. However, the fertility of egg will depend on the following factors in the management of breeders;

1. Nutrition: Deficiencies of vitamins A and E can affect spermatogenesis. Deficiencies of some vitamin B complex will result in deformity of embryos at different stages of development.
2. Mating ratio: To prevent precocious mating, males and females can be managed separately till maturity during which time a mating ratio of 1:8 (large strain) or 1:10 (light strain) can be used.
3. Age of breeders: Over 1 year, libido declines in male while ability to retain calcium declines in female.
4. Environmental temperature: Heat stress causes depression in feed intake, reduction in frequency of mating, deformed spermatozoa and low sperm count.
5. Health of breeders: Necessary vaccinations and medications should be provided from day old to maturity to avoid trans-ovarian diseases.

EGG ABNORMALITIES

The following are the type of abnormalities that could be observed in the egg:

1. Pullet size: Can be due to disease (New castle disease, CRD etc) or nutritional deficiencies (deficiency of essential fatty acids).
2. Internal defects: Can be associated with double yolk, blood and meat spot.
3. Oblong eggs: Can be associated with amount of albumen secreted, size of magnum and isthmus, diseases etc.
4. Shellless eggs: Can occur when egg spends less than required time in the uterus, can be due to diseases or nutritional deficiencies.
5. Cracks: Can be associated with the age of the layers.

PRE-INCUBATION CARE OF HATCHABLE EGGS

The following steps should be taken before eggs are set into the incubator:

1. Selection: Select eggs without physical defects, eggs between 48 – 55g, eggs 7 – 10 days after lay.

2. Storage: Store hatchable eggs in sanitary holding facility at 10°C – 15°C and 70 – 80% RH.
3. Fumigation: Fumigate with formalin and potassium permanganate.
4. Setting: Set eggs with small end down.

EMBRYONIC DEVELOPMENT IN CHICKEN (EMBRYOGENESIS)

Fertilization occurs about 24 hours before the egg is laid. A sperm cell, actually a number of sperm cells penetrates the blastodisc on the yolk, and a new life begins (as blastoderm). When the egg is laid, the blastodisc contains several hundred cells. When the egg cools, embryonic development stops. Embryonic development starts again when the temperature is increased. If the temperature is then decreased to room temperature a second time, the embryo may die.

The first cleavage usually takes place in the isthmus after 5 hours of ovulation. **Cleavage** is a process of cellular division in the embryo without increase in the cytoplasm. Series of cleavage or division usually takes place in uterus and shell gland until 256 cell stage is reached, then there will be **Gastrulation**. Gastrulation is the movement of cells within the embryo to form the area of specific organs which usually called 3 germinal layers (Ectoderm, Mesoderm and Endoderm). These layers are definite organ forming region.

The first thing to be formed is usually the **brain** and **neural tissues** and it is usually within the first day. This occurs in incubator.

After 48 hours, the development of the heart, circulatory system and rudimentary gut (intestine) will occur. After 72 hours, while the embryo is developing, temporary structures are formed to support life. They are called **extra-embryonic**, because they do not become a part of the embryo. The one that is visible at the earliest stage of development is the **amnion**.

Amnion: It looks like a small pool in which the embryo is floating. Its purpose is to protect the embryo.

The allantois is a structure that collects the waste that the embryo produces before it hatches. Many of the nutrients that the embryo needs are removed from the yolk by the yolk sac. Its blood vessels can carry nutrients from the yolk to the embryo.

The last structure is the **chorion**, which lies between the embryo and the shell. An important function is for it to exchange the carbon dioxide produced by the embryo and bring oxygen to the embryo. The chorion also is important for dissolving mineral from the shell and making it available to the chick for forming bones

The first 4 days are a time of dramatic change. Mistakes sometimes occur in this process. If it is a serious mistake, the defect is lethal and the embryo dies. In the incubation process, these mistakes cause "early deaths." If the biological mistake is not as serious, the embryo may develop longer before dying, or it may survive with a congenital defect.

Beginning at day 18, several major changes occur. One is that the embryo pokes its head through the inner membrane into the air cell, and then begins to breathe. It also takes any remaining yolk into its abdomen through the navel. After 21 days of incubation, the chick finally begins its escape from the shell. The chick begins by pushing its beak through the air cell. The allantois, which has served as its lungs, begins to dry up as the chick uses its own lungs. The chick continues to push its head outward. The sharp horny structure on the upper beak (egg tooth) and the muscle on the back of the neck help cut the shell. The chick rests, changes position, and keeps cutting until its head falls free of the opened shell, then kick free of the bottom portion of the shell. The chick is exhausted and rests while the navel openings heal and its down dries. Gradually, it regains strength and walks. The incubation and hatching is complete.

Events in Embryonic Development

Before Egg Laying:

- Fertilization

- Division and growth of living cells

- Segregation of cells into groups of special function (tissues)

Between Laying and Incubation

- No growth; stage of inactive embryonic life

During Incubation:

First day:

- 16 hours - first sign of resemblance to a chick embryo

- 18 hours - appearance of alimentary tract

- 20 hours - appearance of vertebral column

- 21 hours - beginning of nervous system

- 22 hours - beginning of head

- 24 hours - beginning of eye

Second day:

25 hours - beginning of heart

35 hours - beginning of ear

42 hours - heart beats

Third day:

60 hours - beginning of nose

62 hours - beginning of legs

64 hours - beginning of wings

Fourth day - beginning of tongue

Fifth day - formation of reproductive organs and differentiation of sex

Sixth day - beginning of beak

Eighth day - beginning of feathers

Tenth day - beginning of hardening of beak

Thirteenth day - appearance of scales and claws

Fourteenth day - embryo gets into position suitable for breaking shell

Sixteenth day - scales, claws and beak becoming firm and horny

Seventeenth day - beak turns toward air cell

Nineteenth day - yolk sac begins to enter body cavity

Twentieth day - yolk sac completely drawn into body cavity; embryo occupies practically all the space within the egg except the air cell

Twenty-first day - hatching of chick

Table 1: Incubation Periods of some Poultry Species

Species	Incubation Period (days)
Domestic fowl	21
Turkey	28
Duck (Muscovy)	33-35
Duck (others)	28
Goose	29-31
Guinea fowl	26-28
Pigeon	16-20
Japanese quail	16-19
Pheasants	22-24
Ostrich	40-42

EMBRYONIC MORTALITY

Embryonic mortality has to do with the death of embryo at various stages of development. The early embryonic mortality is called **dead-in-germ** while late embryonic mortality is called **dead-in-shell**.

Causes of dead-in-germ

- Deformed spermatozoa- low sperm count, infertile sperm
- Nutritional problems- deficiency of Vitamin B complex in the ration of breeder.
- Improper/inadequate turning of eggs in the incubator.
- The condition of the incubator with particular reference to temperature (low or high), humidity (low or high, accumulation of CO₂, lactic acid, NH₃ as a result of gasses produced by the egg when there is no adequate ventilation)

Causes of dead-in-shell

- Inadequate turning
- Malpositioning of the embryo. Normal position of embryo is that head should be positioned to broad end so that it will use its beak to tear off the air space membrane thereby breath in the first air in the air space. Any position apart from this is mal-positioning.
- The thickness of egg shell – it causes mortality because at times chick may not be strong enough to break the shell.
- Deficiency of Vitamin B complex (Nutritional problem)
- Twinning- this can cause mortality because the twin in the egg will be competing for the nutrient and be unable to break the shell because of their weakness.
- The condition of the incubator and hatcher (temperature, humidity, ventilation)
- Contamination of the hatching egg (egg condition)
- Time taking during the fertility test- wasting of time from incubator to candling room to hatcher leads to loss of temperature and humidity from the eggs.
- Improper handling during the candling.

SEXING OF DAY-OLD CHICKS

Sexing of day-old chicks is done to determine the gender of the chick i.e. the differentiation of the sex of the birds into male and female. In avian, the spermatozoa are homogametic. The chromosomes are the same i.e. they carry the W-chromosome. In case of the female,

the chromosomes are heterogametic because they carry Z-chromosome. In other words, it is the female that determines the sex of the chicken in avian. In most cases, more than 50% in chicken hatched are males.

Methods of sexing Day-old chicks

Cloacal, or vent sexing, was the first method perfected and is the oldest method used today to distinguish between day-old hens and roosters. Although this method is not easy to accomplish, with proper training and experience, the individual performing this method can generally get positive results. This method involves examining the baby chicken's vent, located under its tail, looking for a genital organ. If the genital organ is present in the vent, it will resemble a small pimple and the chicken is a rooster.

Machine sexing is the second oldest method of determining the sex of day-old baby chickens. The machine method came into existence in the 1950s. These machines worked by a telescopic tube with a light inserted into an evacuated vent of the baby chicken in question. The tester carefully looks into the lens of the instrument and makes a determination of the sex of the chicken by seeing whether the chicken has testes or ovaries.

Feather sexing became possible in 1969 after several years of genetic research by the Tegels Poultry Breeding Company. This method used to determine the sex of newly hatched chicks is only possible if a female from a slow-feathering breed is crossed with a male from a fast-feathering breed. The sex of the chicks produced from this cross can be determined during the first 48 hours after hatching by looking at the primary and secondary feathers located on the chick's wings. The primary feathers will be noticeably longer than the secondary feathers on a female chick. On a male, the primary and secondary feathers are the same length.

Colour sexing is the newest method of determining the sex of a day-old chicken. In 1975, commercial breeders were developed and the day-old chickens of these breeders can be identified as hens and roosters by the colour of their plumage. The plumage on day-old hens is generally white while the plumage on day-old roosters is brown.

BROODING AND CHICK MANAGEMENT

Pre –Brooding Management of chicks

This is all the management practices before brooding or before receiving the chicks in other sense various measures, which we provide in preparation for new-hatched chicks arriving at our farm. Poultry house sanitation begins with a clean sanitized house prepared well in advance of arrival of chicks. Each house should remain empty at least two weeks after, it is disinfected and fumigated. The effectiveness of sanitizing a house is depended upon the extent of the cleaning before the germicide is applied. This cleaning helps to control disease because,

- It reduces number of pathogenic organisms.
- Remove material that helps in multiplication of pathogens.
- Expose surface to the disinfectant and fumigants.

In the process of pre-brooding management following measures are generally considered for taking good results. Most important factors, is the selection of area in the shed. The house should be cleaned and disinfected, immediate preparation is necessary so that the building may lie empty for one to two weeks prior to placing new chicks in them. All equipment must be washed with KMnO_4 and disinfected. The equipment should be moved outside the house in sun an area inside the fenced enclosure to complete the cleaning process. The equipment should be moved back into the house. Disinfection and fumigation will kill most of the disease-producing organisms. An empty house will break the life cycle of pathogens. During this period done all the repairing work like repairing work of gas pipes, brooders, electrical equipments, windows and doors.

Check all equipment to see that it is working properly. Operate brooder stoves for at least 24 hours before the chicks arrive. This will warm the house, dry the litter and allow you to check the accuracy of the brooder control and thermostat. When chicks arrive, be ready for them and place them near the waterers.

Brooding of Chicks

Brooding is the care of the chick from one day old to six weeks of age. It consists primarily of the provision of heat, air, water and feed. It is the efficient combination of these factors that determines the level of physical and physiological development and the mortality of the chicks. The mortality of the chicks during this period should normally not exceed **5%**.

Set the brooder area temperature at about 95 degrees Fahrenheit (35°C) in cold weather and 90 degrees (32°C) in hot weather. Make sure the temperature is adequate before

placing the chicks under the hover. Maintain the room temperature for day-old chicks in a cold-room system at a minimum of 65°F; where an economical source of fuel or a well-insulated house is available, it is desirable to maintain a temperature of about 75°F.

Place the chicks under the hovers as soon as possible after they arrive. Keep chicks comfortable. Their actions provide a good guide to their comfort. Chicks crowd together near heat when they are too cold, and they pant and gasp (often at the outer edge near the chick guard ring) when overheated. Check the chicks periodically to make final temperature adjustments.

Follow the brooder manufacturer's recommendations on temperatures for operating the brooder. In general, drop the temperature 5 degrees each week until the chicks are five weeks old; then maintain the temperature at 70 degrees.

The cardboard chick guard ring keeps the chicks near the source of heat the first week. Make sure, however, that there is enough room within the ring area for the chicks to move away from the heat in case they become overheated. A diameter of 6 feet should provide plenty of space for 50 chicks. In cold weather with larger brooder stove operations, place the guard on the floor 2 feet from the other edge of the brooder. Move the guard farther away from heat every day, and remove it after about a week, or when it is no longer needed.

Keep track of the temperature at chick level by hanging a thermometer inside the cardboard ring at the same height as the chicks about 3 inches inside the outer edge of the hover. Check the temperature under the hover twice daily during the first week. Continue to check it twice a day as long as the chicks need heat. Adjust the height of the lamp to adjust the temperature. Raising the lamp a few inches a week should be about right. Measuring of the ambient air temperature under infrared lamps is not a direct measurement of the heat that the chicks will feel. Watch the chicks' reactions and adjust the height of the lamp.

Provide heat until chicks are well feathered. Birds are more likely to develop respiratory troubles if heat is removed too early. Do not crowd chicks. Larger breeds and older birds require more space. Birds may pile up or smother if they do not have enough space or if they are frightened. For summer brooding, protect chicks against temperatures above 95°F. Keep them comfortable.

Some people cover litter for the first few days of brooding. If you do, use rough, crinkled paper. Smooth paper causes chicks to slip and develop straddled legs. Moulds will develop if paper is left on the litter more than three or four days. Remove guard after seven days.

Keep litter as dry as possible. Whenever necessary, stir the litter to keep it from packing. Move feeders and waterers to new locations to help prevent the development of wet areas. As wet spots develop, remove the wet and "caked over" litter and add new, dry material. Provide plenty of fresh air for chicks. Do not close up the brooder house to keep it warm. Chicks need fresh air, and air also carries moisture out of the house. The floor will be drier and the chicks healthier when proper ventilation is provided. A 15-watt bulb for each 200 square feet of floor area should be kept on the chicks at night for the first week.

Vaccination

Vaccination is an effective means to prevent and/or reduce the adverse effects of specific diseases in poultry.

Marek's disease vaccine is usually administered to chickens at the hatchery on the day of hatch. It is given subcutaneously (under the skin) at the back of the neck. It is best to order chicks already vaccinated at the hatchery.

Chicks are often vaccinated at the hatchery against Newcastle disease and infectious bronchitis with a combination vaccine. The combination Newcastle-Infectious Bronchitis vaccine can also be given at 10-35 days. The vaccine can be administered via the drinking water, intraocular route or intranasal route.

Hatchery By-Products

Hatchery by-products include egg shell, dead chicks, un-saleable chicks and un-hatched incubator eggs. Several metric tonnes of the by-products are usually produced annually. They constitute nuisance to the hatchery industry because of the problem of disposal and also result in economic losses to the industry. However they could be processed into hatchery waste meal and incorporated in animal feed as protein source.

INTRODUCTION TO FERTILITY AND HATCHABILITY

The words "fertility" and "hatchability" are often used incorrectly by small producers. These terms are important and have very important meaning.

Percent Fertility is the percentage of fertile eggs of all eggs produced.

$$\% \text{ fertility} = \frac{\# \text{ of fertile eggs}}{\# \text{ of total eggs produced or set}}$$

Percent Hatchability is the percentage of fertile eggs which actually hatch out as live young.

$$\% \text{ hatchability} = \frac{\# \text{ of eggs which hatch out}}{\# \text{ of fertile eggs}}$$

Care of Hatching Eggs

Before setting eggs in an incubator, you must obtain or produce quality fertile eggs from a well managed, healthy flock which are fed properly balanced diets.

1. Keep the nest full of clean, dry litter. Collect the eggs early in the morning and frequently during the day to prevent excessive chilling or heating of the eggs.
2. DO NOT wash eggs unless necessary. If it is necessary to wash eggs always use a damp cloth with water warmer than the egg. This causes the egg to sweat the dirt out of the pores. Never use water cooler than the egg. Also, do not soak the eggs in water. If the egg is allowed to soak in water for a period of time, the temperature difference can equalize and bacteria have a greater chance of entering through the pores. Be sure eggs are dry before storing. Never place damp or wet eggs in a styrofoam carton for storage.
3. Store the clean fertile eggs in an area which is kept at 55°- 60°F and 70-75% humidity. Never store eggs at temperatures about 75°F and at humidity lower than 40%. These conditions can decrease hatchability dramatically in a very short period of time. Slant or turn the fertile eggs daily while they are being stored. Store the eggs small end down and slanted at 30-45 degrees. Putting a piece of 2" x 4" under one end of the carton or storage container and changing it to the other end daily works well. Do not store eggs for more than 10-14 days. After 14 days of storage, hatchability begins to decline significantly.
4. Just before setting the eggs, allow them to warm to room temperature (70-80°F) and remove any cracked eggs.

Incubation

Four factors are of major importance in incubating eggs artificially: temperature, humidity, ventilation and turning. Of these factors, temperature is the most critical. However, humidity tends to be overlooked and causes many hatching problems. Extensive research has shown that the optimum incubator temperature is 100°F (37.8°C) when relative humidity is 60 percent. Concentrations of oxygen should be above 20 percent, CO₂ should be below 0.5 percent, and air movement past the egg should be 12 cubic feet per minute. There are two types of incubators commonly used:

1. Forced-air incubators which have a built in fan to circulate the air.
2. Still-air incubators which have no fans, so the air is allowed to stratify.

The forced-air incubator should be set at 99-99.5°F and 60-65% relative humidity (83-88°F wet bulb). The advantage of the forced-air incubator is that it is easier to maintain humidity at a constant level because of air circulation.

Still air incubators are smaller and air flow is harder to manage. Set still-air incubators at 100 to 101°F at egg height. This is important since the air stratifies in these incubators. There can be as much as a 5° difference in temperature from the top to the bottom of some of the still-air incubators. Humidity should be 60-65% (80-90° wet bulb) during incubation and 70-75% (92-97° wet bulb) at hatching time. It is very easy to overheat the eggs in still-air incubators and difficult to maintain proper humidity. It should be noted that the various incubators (dependent on size and source of power) that exist could either be still-air or forced air incubator.

Temperature

During the warm-up period, the temperature should be adjusted to hold a constant 101°F for still air, 99°- 100°F for forced air. To obtain reliable readings, the bulb of the thermometer should be at the same height as the tops of the eggs and away from the source of heat. Using two thermometers is a good idea to ensure you are getting an accurate reading. Incubator temperature should be maintained between 99° and 100°F. The acceptable range is 97° to 102°F. Mortality is seen if the temperature drops below 96°F or rises above 103°F for a number of hours. If the temperature stays at either extreme for several days, the eggs may not hatch. Overheating is more critical than under-heating. Running the incubator at 105°F for 15 minutes will seriously affect the embryos, while running it at 95° for 3 or 4 hours will only slow the chick's metabolic rate.

An incubator should be operated in a location free from drafts and direct sunlight. An incubator should also be operated for several hours with water placed in a pan to stabilize its internal atmosphere before fertile eggs are set. Do not adjust the heat upward during the first 48 hours after eggs are set. This practice cooks many eggs. The eggs will take time to warm to incubator temperature and many times in small incubators the incubator temperature will drop below 98°F for the first 6-8 hours or until the egg warms to 99°-100°F.

In Case of Power Outage

If you experience a power failure, do not scrap the hatch. Most of the time, the hatch can be saved. The key is to keep the eggs as warm as possible until the power returns.

This can be done by placing a large cardboard box or blankets over the top of small incubators for additional insulation. To warm the eggs, place candles in jars, light them and place the jars under the box that covers the incubator. Be careful not to put any flammable material closer than a foot from the top of the candles. The heat from the candles can easily keep the eggs above 90°F until the power returns.

Embryos have survived at temperatures below 90°F for up to 18 hours. You should continue to incubate the eggs after the outage; then candle them 4 to 6 days later to check for further development or signs of life. If, after 6 days, you do not see life or development in any of the eggs, then terminate incubation. Most of the time, a power outage will delay hatching by a few days and decrease the hatchability to 40-50 percent.

Humidity

The relative humidity of the air within an incubator should be about 60 percent. During the last 3 days (the hatching period) the relative humidity should be nearer 65-70 percent. (Too much moisture in the incubator prevents normal evaporation and results in decreased hatch, but excessive moisture is seldom a problem in small incubators.) Too little moisture results in excessive evaporation, causing chicks to stick to the shell, remain in the pipped shells, and sometimes hatch crippled.

The relative humidity in the incubator can also be varied by changing the size of the water pan or by putting a sponge in the pan to increase the evaporative surface. The pan should be checked regularly while the incubator is in use to be sure that there is always an adequate amount of water. Adding additional water pans to small still-air incubators is also helpful to increase humidity.

During the hatching period, the humidity in the incubator may be increased by using an atomizer to spray a small amount of water into the ventilating holes. (This is especially helpful when duck or goose eggs are hatching). Whenever you add water to an incubator, it should be about the same temperature as the incubator so you do not stress the eggs or the incubator. A good test is to add water just warm to the touch.

Using a wet-bulb thermometer is also a good way for determining relative humidity. The wet-bulb thermometer measures the evaporative cooling effect. If the wet and dry bulb read the same temperature, you would have 100 percent humidity. The greater the evaporation taking place, the lower the temperature reading on the wet-bulb thermometer and the larger the spread will be between the wet- and dry-bulb readings. To make a wet-bulb thermometer, just add a cotton wick to the end of a thermometer. Then place the tail of the wick in water. The cotton then absorbs the water.

As the water evaporates from the cotton it causes a cooling effect on the thermometer. The table below (Relative Humidity) will enable you to calculate relative humidity using readings from a wet- bulb thermometer and the incubator thermometer.

Table 2: Incubation temperature and humidity

Incubator Temperature	Wet Bulb Readings					
100°F	81.3	83.3	85.3	87.3	89.0	90.7
101°F	82.2	84.2	86.2	88.2	90.0	91.7
102°F	83.0	85.0	87.0	89.0	91.0	92.7
Percent Relative Humidity	45%	50%	55%	60%	65%	70%

(From Egg to Chick, Northeast State Cooperative Extension Service)

Ventilation

The best hatching results are obtained with normal atmospheric air, which usually contains 20-21 percent oxygen. It is difficult to provide too much oxygen, but a deficiency is possible. Make sure that the ventilation holes are adjusted to allow a normal exchange of air. This is critical on home-made incubators. It is possible to suffocate the eggs and chicks in an air-tight container. However, excessive ventilation removes humidity and makes it difficult to heat incubators properly.

Turning

Eggs set on their sides must be rotated 1/2 turn at least 3 times daily (Mostly at odd number of times). Eggs set with the air cell end up should be tilted in the opposite direction 3 times daily. This keeps the embryo centred in the egg and prevents it from sticking to the shell membrane. When using hand turning, to insure proper turning, mark each side of the egg

with a pencil. Put an "x" on one side and an "o" on the opposite side. Stop turning the eggs for the last three (3) days of the incubation cycle (at 18 days for chickens, 25 days for waterfowl, etc.) and do not open the incubator until the hatch is completed to insure that a desirable hatching humidity is maintained. Note that the relevance of egg turning to the developing embryo cannot be over emphasized: It is aimed at ensuring even distribution of nutrients for the growing embryo and also to prevent the embryo from sticking to one side of the egg shell.

Hatch Time

Do not help the chicks from the shell at hatching time. If it doesn't hatch, there is usually a good reason. Also, prematurely helping the chick hatch could cripple or infect the chick. Humidity is critical at hatching time. Don't allow your curiosity to damage your hatch.

As soon as the chicks are dry and fluffy or 6 to 12 hours after hatching, remove the chicks from the incubator. It is good practice to remove all the chicks at once and destroy any late hatching eggs. Hatching time can be hereditary and you can control the uniformity of hatching by culling late hatchers. If you keep every chick which hatches late, in a few years each hatch could last 4 days or longer.

Sanitation of Incubator and Equipment

No matter what type of incubation you use, it is important that you thoroughly clean and disinfect the incubator before and after you use it. It is just as important that the incubation room and egg storage area are kept equally clean. The lack of sanitation will decrease hatchability.

Immediately after each hatch, thoroughly clean and disinfect all hatching trays, water pans and the floor of the hatcher. Scrape off all egg shells and adhering dirt. Wipe clean surfaces thoroughly with a cloth dampened in quaternary ammonium, chlorox or other disinfectant solution.

Incubation *Periods of Other Species

One of the miracles of nature is the transformation of the egg into the chick. In a brief three weeks of incubation, a fully developed chick grows from a single cell and emerges from a seemingly lifeless egg.

Incubation Periods (species and days required to hatch)

Bobwhite Quail	(23-24)	Guinea	(27-28)
Chicken	(21)	Muscowy Duck	(35)
Chukar Partridge	(23-24)	Pheasants	(24-26)
Coturnix Quail	(16-18)	Ostrich	(42)
Ducks	(28)	Swan	(35)
Geese	(28-33)	Turkey	(28)

*The values so stated are averages of what holds in reality due to some inherent genetic factors affecting fertility and hatchability.

SINGLE- AND MULTI-STAGE INCUBATION

There is no best way to set eggs. Individual circumstances dictate which way is best. The mother hens methods need to be monitored, fine tuned and then adapted to circumstances.



While **Multi-Stage** is a system of **Continuous Averages** that suits the **majority** of eggs, **not the extremes**.

It is disadvantaged in that young (coldest) and old (warmest) eggs suffer because **average conditions are maintained** thereby causing higher levels of early and late deaths. Single stage on the other hands creates **no extremes**. The eggs in each individual zone are **exactly the same** (age and flock). It can provide the **exact conditions** desired at each stage of the embryonic development for **every batch of eggs**.

Completely sealing (using a sealed box) the cabinet for 9-10 days is **needed** to obtain the **benefits** of Single-Stage. This creates a **totally stable**, homogenous, environment **free** from temperature, humidity and ventilation fluctuations. It also **minimises** moisture loss from eggs. Completely sealing the cabinet also helps to **maintain albumen pH** at levels **best to fight** infection. Albumen **alkalinity** is also **optimised** to promote **calcium transfer** from shell to embryo.

The Need for Paddle Fan in Mixing High Concentrations of Heavy Gas in an Incubator

Many setter manufacturers use the **horizontal air flow** paddle fan because it is **better** at mixing the **CO₂** (a heavy gas) within the setter cabinet. However, **Vertical air flow**, impeller fan, systems are much **less efficient** at distributing high concentrations of **heavy gas**. Customers/Hatcheries using the vertical air flow (impeller) air flow ventilation system found **similar increases** in hatch and the early feeding on farm. Interestingly **differences** in the **grow-out data**, especially that birds reached kill weight up to 4 days early, were **not** noted.

Birds stopped rapid weight gain early in the grow-out cycle and usually reverted to the **same weight** (or kill day) as the multi-stage birds. This is occasioned by the fact that lack of proper distribution of the CO₂ prevents birds from developing a stronger skeletal system. It should be noted that the birds' skeletal support could not add muscle and meat at the same rate as birds that had benefited from horizontal fan effect of CO₂ distribution.



**Horizontal Air Flow
Paddle Fan**



**Vertical or downward flow
Impeller Fan**

Appropriate Egg Weight Loss during Incubation in Single- and Multi-Stage Incubation

The target weight loss in an egg (Multi-Stage) is 11-13%. It has been reported that less weight loss than that will cause, in effect, drowning of the chick. It will not be able to pip out. However, the target weight loss in Single-Stage is really in the 8-10% range. This is because the embryo absorbs **more** of the egg shell and moisture so the **shape** of the air sac **changes** - it still extends on the top to the wide point of the egg but it doesn't hold the same volume of CO₂. Just enough to let the healthy chick pip out!

Multi-Stage CO₂ Enhancement Kit

With the knowledge and experience gained from modern high performance Single-Stage incubation practice, the **Multi-Stage CO₂ Enhancement Kit** was developed to increase productivity from existing Buckeye Multi-Stage Setters. The effect of increasing water cooling and reducing the fresh air intake encourages similar environmental conditions to those found in a typical modern Single-Stage setter.

The Benefits

- ✓ Increased Hatchability (HOF) about *0.3% on Average*
- ✓ Better Quality Chicks *to "Single-Stage standard"*
- ✓ Tighter Hatch Window
- ✓ Energy Savings of up to about N57 000* per setter p/a
** If using the Vostermans Fan option*
- ✓ Higher Chick Weight and Better Uniformity
- ✓ Broilers have Lower Mortality and Greater Weight Gain

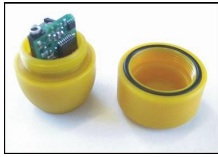
The Kit is composed of:

- ✓ Double Bank Cooling Coils
- ✓ High-seal Rear Extraction Dampers
- ✓ CO₂ Sensor (set at 0.6%)
- ✓ Multi-Valve Cooling Solenoid
and Return Manifold
- ✓ PLC and Touch Screen Updates
- ✓ High Performance Vostermans Fan and Plastic Fan-Board Assembly (*optional*)

How Does It Work?

Standard Buckeye Multi-Stage systems typically rely on 75% water cooling and 25% air cooling. This Kit upgrades setters to 100% Water Cooling. The upgraded machine has a very stable environment with a tighter band of temperature distribution throughout the entire egg mass. Little or no fresh air intake reduces the requirement for artificial humidification. More stable moisture levels within the cabinet also means that embryonic heat transfer is much more efficient. More stable temperature results in less "heat-on" time which in turn results in improved hatch and better chick quality. It is believed that higher levels of CO₂ stimulate improved vascular and skeletal development of embryos.

EGG DATA LOGGER



Connects directly to your computer for instant access and visual display of temperature readings

It provides full temperature traceability from farm to hatchery and beyond. It has the following benefits:

- ✓ Easy to use PC software to launch and offload
- ✓ Memory capacity of 8,000+ readings
- ✓ Temperature range of 0° - 45°C
- ✓ Accurate to within 0.1°C (@ 37°C)
- ✓ Has resolution steps of 0.01°
- ✓ Rugged waterproof enclosure

Maximizing Performance from Single Stage Machines

Understanding the concept

There is no doubt that this could be the first hurdle as the concept of single stage operation is totally different to that of multistage. Many hatcheries have been running on a multistage operation for a good number of years. It may be difficult for the existing hatchery manager and his or her staff to come to terms with this new way of working. However, like all of us, we have to face changes in our lifetime and have learned to adopt. A hurdle at first maybe, but within time this will be less of an issue.

Training nevertheless will pay a vital part in aiding a smooth transition from the multistage to single stage operations. The customer service team will pay a vital role in assisting any existing hatchery changing to the single stage operation, especially in the early weeks and months.

Management skills

The success of the operation will depend much on the skills of the hatchery manager; he or she will need to above all fully understand the concept. It is not rocket science however and should be well within the capabilities of the majority of hatchery managers working within the industry. Within the single stage operation the manager is much more able to take full control of the daily operations. To get the best out of single stage, the manager needs to be

able to take control. Whereas, good results are achievable using a standard recipe, fine-tuning will optimise results. This is especially true with Breeder hatcheries. An example of this would be the controlling of weight loss to compensate for chicks destined for a long journey and risk of dehydration.

Simple or more complicated?

It is generally thought that the single stage operation requires a greater level of understanding. This aside, however, with the automated process it is fact generally a more simplified operation to that of multistage. This again is all dependent on the manager skills to manage the staff but at this level the routine operation should not give rise to any concern.

Skill Requirements of General Staff

There is absolutely no reason why current staff working within a multistage operation will not be able to adapt to single stage. As mentioned, with the automation the process it is in fact simpler and requires probably less input from the staff carrying out the routine operation of loading and transferring from machines. With the automated process providing that the manager takes particular attention to how the machine is loaded, once loaded and under normal circumstances no further intervention is required until the machine is transferred some 18 days later. The manager should monitor the machine over the 18 days and has the very useful Galaxy system tool in which to facilitate this.

Maintenance Engineer

Whereas the system may not be complicated, due to the Control system and CO₂ sensor etc, the maintenance engineer will require some expertise. He or she needs to have a good understanding of the machine so that they are kept in good working order. This would be a very important position in the Hatchery. Co₂ and Humidity sensors are sensitive devices and will need be checked and calibrated at regular intervals.

Operation – Maximising the benefits

Key Objectives

Recent developments over the last few years has revolutionised single stage operation. Whereas, the benefits of concentration of CO₂ levels is not fully understood research has concluded that CO₂ converts insoluble CaCO₃ into soluble CaO, used to build the skeleton.

CO₂ is thus a desirable element in the air surrounding the egg. The concentration of CO₂ levels as soon as possible at the start of the set stimulates and encourages embryo development.

However, not only is the CO₂ levels concentrated within the cabinet but also the sealing of the machine creates a very stable environment. For the first 10 days (chicken) the machine is totally sealed, this holds in the humidity within the machine. High humidity within the machine produces excellent convection properties creating an even temperature throughout. There is line of thought that this in itself could be playing a major part to the benefits. This new concept in single stage operation is actually very simple as probably follows more closely to nature than we first thought.

During the time that the machine is sealed for the first 10 days, the eggs are endothermic meaning that the egg capacity is requiring heat to hold in its body mass temperature. Since the machine is sealed the humidity and temperature is held within due to the insulated panels of the machine structure. Trials have proven that apart from the heat required to heat the machine initially, very little heat is required after the first 12 hours or so. The sealed cabinet produces an environment of self-containment.

During the 10-day period there is little or no weight loss as the high humidity condition is held throughout until the damper is opened at the end of the 10th day. Once past 10 days the eggs become exothermic, which by this time are giving off heat, at this time the damper is opened to release the heat, depress the CO₂ level and ventilate the eggs with fresh air. Now that the eggs are exothermic cooling is assisted with the aid of fresh air into the machine.

At this time, we are also able to get the dry down which was not possible during the 10 days when the machine was sealed. The damper position will open to 100% to give vigorous ventilation to facilitate the necessary weight loss.

Because of the high humidity conditions within the machine for the first 10 days artificial humidification is not required and appropriate settings are applied to disable the system. The following attributes of the single stage machine produces an airtight environment for the first 10 days:

- The dampers have a seal to be near as possible gas tight.
- The doors have a double door seal.
- The motor pulley guard is completely sealed with the motor shaft running on a lip seal.

The 10 day rule (14 days for turkey and ducks)

- To raise the CO₂ level as quickly as possible, 0.3% within 3 days is the target.
- To allow the CO₂ to rise as high as possible within the first 10 days. (14 days for turkey and ducks) Expected levels are 0.6% to 1.2% the figure will be at its highest from young flocks when the fertility is at its highest.
- Sealing of the machine will give rise to very high humidity conditions and will be as high as 85 to 90% RH.

The 8-day rule (11 to 18 days chicken and 15 to 25 days for duck and turkeys)

- To ventilate the machine to achieve the required weight loss. Dropping the CO₂ set point to 0.3% forces the damper to a 100% opening.
- The vigorous ventilation assists cooling
- Control the damper position if necessary to control unwanted weight loss

Practical Considerations:

Pre Warming, Machine warming, loading and warm up time

Eggs need to be pre warmed to around 24 degrees Centigrade. It is not advisable to take the eggs straight from the cold room. The machine should be run for a few of hours to bring it up to running temperature. This policy will greatly assist in a swift time to temperature and will help reduce the hatching window.

Incubation does not start until the machine is at 37.8 °C (100.0 F). Warm up time will depend on the machine capacity. Depending on the machine capacity this can take up to 12 hours or even longer if the eggs are loaded cold.

This factor is extremely important to take into consideration and should not be confused with the pre warm up before the machine is loaded. If anything, this is where it can go wrong, it is absolutely essential that the 12 hours it takes to bring the eggs up to incubation temperature is considered at all times. *Unlike Multistage, the incubation period does not start as soon as the machine is loaded.* Failure to observe this will result in late hatches.

A low temperature alarm of 20°C for the warm up period is normal to prevent unwanted machine alarms. Typical warm up times for machines types are:

- A6 – 8 hours
- A12 – 10 hours
- A24 – 12 hours

Humidity System

The humidity system is disabled throughout the incubation period. Appropriate settings need to be applied. A set point of 30% RH for the first 10 days (14 days ducks and turkeys) and 20% RH for the last 8 days (15 to 25 days for turkey and ducks) should be applied. Humidity alarms should be set accordingly, the high alarm needs to be set at 95% RH for the shut up period and then reduced gradually for the last 8 days.

Temperature staged settings

Temperature settings at the start of incubation need to be high to stimulate development, it needs to then stage down to transfer at a setting of 37°C.

CO₂ Settings – (If CO₂ Sensor fitted)

The CO₂ setting is in actual fact irrelevant when running the damper in the manual mode for the first 10 days. If running the damper in automatic, a set point of 1.5% would be appropriate. For the last 8 days the CO₂ set point needs to be lowered to 0.3% and the damper placed into automatic. This will force the damper open to release the CO₂ and ventilate the machine with fresh air. If using manual damper settings, then set the damper settings accordingly, at day set the setting for 50% for 1 day and then 100% for the remaining time.

The CO₂ alarm setting is a very useful tool in detecting abnormal conditions. For the first 10 days we are concerned with building humidity as soon as possible. The CO₂ low alarm setting needs to reflect the expected build up of humidity relative to each step of the staged program. For example, should the dampers fail to close properly then the CO₂ would not concentrate within the machine.

The High CO₂ alarm setting is not that important for the first 10 days. For the last 8 days, however, this is very important and should be set to reflect dangerous CO₂ levels in this period.

Vent Settings (damper)

The damper should be in the manual mode for the first 10 days and then in the automatic mode for the last 8 days.

Turning Mode

The system has the capability of selecting the turning mode required for each step of the stage program. With the trays in the level position, the airflow over the eggs is increased which assists in transferring unwanted heat from the eggs.

Consequences and Benefits

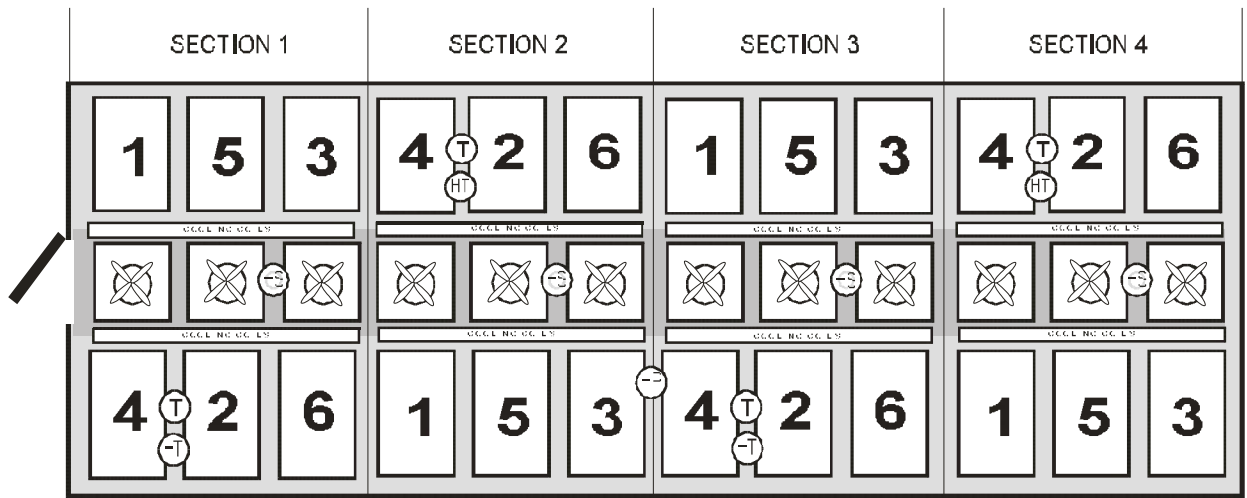
We have seen that the concept of sealing the machine for the first 10 days creates an environment of high humidity and CO₂ levels. This is a very stable environment from which the high humidity produces excellent convection properties. This aids heat transfer and the temperature within the machine is distributed evenly throughout.

The benefits are considerable, but the benefits are more pronounced on young and old flocks and can be as much as 5% over multistage. Other benefits include a narrower hatching window and a much stronger and bigger chick. Trials have also proven that chick mortality is reduced with better grow rates and food conversions on the farm. We can explain this improvement in many ways to that of just the CO₂ concentration, which are:

- Better temperature distribution throughout improved by airflow and high humidity conditions.
- No interruption from start to finish with no artificial humidity required.

Figure 1 shows the typical setting pattern of a multistage machine. It can be seen that on one particular new set, setting number 6 is adjacent to adjacent to setting number 1. The plot shows what happens on setting number 1 when setter number 6 is introduced. The result is overheating of the older eggs in setting number 1. This is not always appreciated as the control probes do not detect this condition. Temperatures can reach as high as 38.5 degrees C with obvious consequences.

Figure 1: Typical setting pattern of a multistage machine



SM24 twenty four trolley, four section multi-stage setter

KEY:

HUMIDITY PROBE	HIGH TEMPERATURE ALARM	TEMPERATURE PROBE	HUMIDITY SPRAY
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Heating and Cooling

The next two plots show the heating and cooling activity within the single stage setter. These again are screen shots taken from the Galaxy system for an A12 setter.

The vertical lines represent the heating and cooling activity; where a line stops at a value of 1 represents a period of activity for heating and a line that stops at 2 represents a period of activity for cooling.

Total Control of Incubation Process

The earlier sections have shown the key objectives and the practical considerations to optimising performance. This section is dedicated to the tools that are provided to the hatchery manager to achieve this. Programming of the stage recipe can be performed either from the Touch Screen control or from the Galaxy system. The easiest method of programming is from the Galaxy system. The system is very user friendly and is all achieved from keyboard entry and a few clicks of the mouse. The system allows the user to download, upload and save stage programs. It is also possible to batch transfer a program to a maximum of 20 machines all in one go. The hatchery manager is then able to adjust and fine-tune the settings according to flock age etc.

To assist in management of the machines, programs can be downloaded to the machine when in manual run and whilst the machine is out of service. Once loaded, the machine can be placed into the program, run and ready to start. All the operator has to do is load and start the machine. The rest is automated!

Delayed Start

The single stage machine has a delayed start facility; this allows the manager to load the machine and program the machine to start at a predetermined time. This is particularly useful when starting times are outside of normal working hours. There is no heating during this period of delay other than the paddle fans are started up and ran for 5 minutes on the hour of each hour during the delayed starting period.

Auto Level System

Programmable from the Touch Screen the user can program the turning to stop for a predetermined amount of time in the level position. For example it is possible to have the turning stop at the level position for 10 minutes over a 60-minute turning interval. There is a definite advantage from this as this increases the air gap between the eggs and thus improves airflow. This is particularly advantageous after the 14th day of incubation when the heat given off by the eggs increases. The improved airflow assists in heat transfer from the eggs.

Summary – Advantages of Single Stage

- **Bio security – Supermarkets – Veterinary Inspections**

Increasingly, the market is dictating on bio security, the process and the design of the machine are well suited to satisfy these requirements.

- **CO₂ Concentration**

The machine can benefit from the concentration of CO₂ levels. The environment created has properties of self containment and good temperature distribution through the high humidity conditions.

- The hatchery manager is able to take full control of the process through the Touch Screen or Galaxy system
- Narrower hatching window
- Increased quality and quantity of hatchery output. Hatchability is much improved over multistage especially for younger and older flocks. Chicks are stronger and bigger resulting on the farm with less mortality and better grow out rates.

- Reduced labour requirement, due to the automation and in the method of the operation less labour is required.
- The process is simpler. It is not required to have skilled staff at the operative level

EGG FORMATION IN FEMALE REPRODUCTIVE TRACT

Structure and egg composition

The egg is an important product derived from keeping poultry. It is primarily storage of nutrients for the chick embryo. It weighs about 58g in the temperate but lowers in the tropics. When an egg weighs between 60-70g is regarded as being heavy. Egg shell is about 0.33mm thick with over 7500 pores through which micro- organisms may enter the egg to cause spoilage.

The edible portion of egg is enveloped by the inner egg membrane which consist of the yolk and albumen (Albumen is white when cooked and transparent when raw). Yolk is spherical in shape and bright yellow when raw or cooked. Floating on top of the yolk is a white spot known as BLASTODISC (which is the only living portion of the egg capable of developing into chick if the egg is fertilized before it is laid.

The formation of egg has both structural and hormonal influences. The egg is synthesized partly in the ovary and oviduct; although yolk is formed in the ovary the proteins it contains are synthesized in various parts of the body principally in the blood to the ovary.

The yolk is released from the ovary and taken up by the infundibulum. The fertilization of the egg involving the fusion of the sperm with germinal disc or nucleus of the egg occurs in this part of the oviduct before the other components of the egg are added. Fertilisation occurs only as a sequel to mating and the complete formation of the egg is independent of the fertilization process. The egg spends 15 minutes in the infundibulum. It then moves to the magnum where it spends 3hours, and part of the albumen in formed. The membranes are formed in the Isthmus for about 1hr 15minutes. If the Isthmus is abnormal it may distort the egg shape.

The formation of the albumen continues in the uterus or shell gland for 19 – 20 hours, where the shell is also formed and normal egg shape assumed. The shell is formed slowly during the first half of the period spent in the uterus and rapidly during the remaining half.

Minerals, mainly calcium and phosphorus utilized for the formation of the shell.

Care and Incubation of Hatching Eggs

1. Selection of Hatching Eggs

- Select eggs from breeders that are

- (1) Well developed, mature and healthy;
 - (2) Compatible with their mates and produce a high percentage of fertile eggs;
 - (3) Not disturbed much during the mating season;
 - (4) Fed a complete breeder diet; and
 - (5) Not directly related [brother, sister, mother, father, etc.].
- Avoid excessively large or small eggs. Large eggs hatch poorly and small eggs produce small chicks.
 - Avoid eggs with cracked or thin shells. These eggs have difficulty retaining moisture needed for proper chick development. Penetration of disease organisms increase in cracked eggs.
 - Do not incubate eggs that are excessively misshapen.
 - Keep only clean eggs for hatching. Do not wash dirty eggs or wipe eggs clean with a damp cloth. This removes the egg's protective coating and exposes it to entry of disease organisms. The washing and rubbing action also serves to force disease organisms through the pores of the shell.

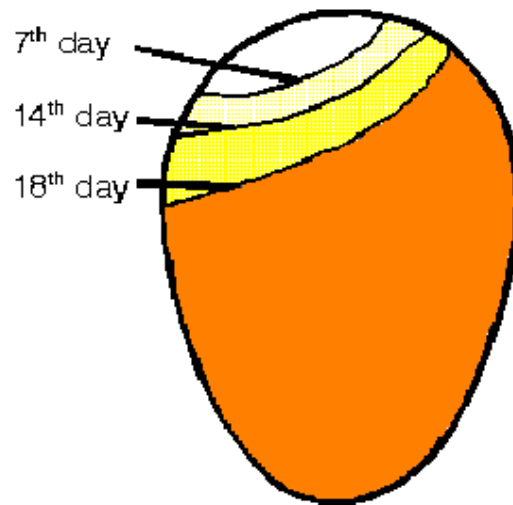
2. Egg Care and Storage

- Collect eggs at least three times daily. When daily high temperatures exceed 85 degrees F. increase egg collection to five times daily. Collect two or three times in the morning and one or two times in the afternoon.
- Slightly soiled eggs can be used for hatching purposes without causing hatching problems, but dirty eggs should not be saved. Do not wash dirty eggs.
- Store eggs in a cool-humid storage area. Ideal storage conditions include a 55 degree F. temperature and 75% relative humidity. Store the eggs with the small end pointed downward.
- Alter egg position periodically if not incubating within 4-6 days. Turn the eggs to a new position once daily until placing in the incubator.
- Hatchability holds reasonably well up to seven days, but declines rapidly afterward. Therefore, do not store eggs more than 7 days before incubating. After 3 weeks of storage, hatchability drops to almost zero. Plan ahead and have a regular hatching schedule to avoid storage problems and reduced hatches.
- Allow cool eggs to warm slowly to room temperature before placing in the incubator. Abrupt warming from 55 degrees to 100 degrees causes moisture condensation on the egg shell that leads to disease and reduced hatches.

3. Incubating Conditions

Poor results are most commonly produced with improper control of temperature and/or humidity.

- Poor results also occur from improper ventilation, egg turning and sanitation of the machines or eggs.
- Maintain a still-air incubator at 102 degrees F. to compensate for the temperature layering within the incubator.
- If the eggs are positioned in a vertical position, elevate the thermometer bulb to a point about ¼- to ½-inch below the top of the egg. The temperature is measured at the level where the embryos develop (at the top of the egg). Do not allow the thermometer's bulb to touch the eggs or incubator. Incorrect readings will result.
- Humidity is carefully controlled to prevent unnecessary loss of egg moisture. The relative humidity in the incubator between setting and three days prior to hatching should remain at 58-60% or 84-86 degree F., wet-bulb. When hatching, the humidity is increased to 65% relative humidity or more.



Size of air cell on 7th, 14th and 18th day of incubation

EGG ABNORMALITY NOT SUITABLE FOR THE HATCHERY

TOO LARGE AND TOO SMALL EGGS- Leads to internal egg deformities

Double Yolk Eggs:

Double Yolk eggs appear when ovulation occurs too rapidly, or when one yolk somehow gets "lost" and is joined by the next yolk. Double yolkers may be by a pullet whose productive

cycle is not yet well synchronized. They're occasionally laid by a heavy-breed hen, often as an inherited trait.

No Yolk:

No-yolk eggs are called "dwarf", "wind" [or, more commonly, "fart"] eggs. Such an egg is most often a pullet's first effort, produced before her laying mechanism is fully geared up. In a mature hen, a wind egg is unlikely, but can occur if a bit of reproductive tissue breaks away, stimulating the egg producing glands to treat it like a yolk and wrap it in albumen, membranes and a shell as it travels through the egg tube.

More Than Two Yolks:

Occasionally, an egg contains more than two yolks. Record breaking eggs are likely to be multiple yolk eggs. The Guinness Book of Records lists the world's largest [chicken] egg (with a diameter of 9 inches/22.5 cm) as having five yolks and the heaviest egg (1 pound/0.45 kg) as having a double yolk and a double shell.

No Shell

Every once in a while we get an egg with a membrane, but without a shell. It feels like a water balloon. This is another accident of the hen's reproductive system and is not necessarily an indication of any problem

Egg Within An Egg:

An egg within an egg, or a double shelled egg appears when an egg that is nearly ready to be laid reverses direction and gets a new layer of albumen covered by a second shell.

Sometimes the reversed egg joins up with the next egg and the two are encased together within a new shell.



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Another example:



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EXTERNAL EGG ABNORMALITIES

Odd Shaped Eggs

This happens from time to time and is just an "accident". The long, thin egg below was laid by one of our Barred Rock hens in June, 2004. It is over 2 1/2 inches long and less than 1 1/4 inches across the middle.



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Very Odd Shaped Eggs!:



Hen Produces Spoon-Shaped Egg - from www.ananova.com (UK online news service) 31 January 2005. A spoon-shaped egg, 8.5 centimeters long and 35 grammes in weight.

Wormy Eggs:

Wormy eggs are extremely rare, occurring only in hens with a high parasite load. Finding a worm in an egg is not only unappetizing, but is a clear indication that you are not doing a good job in keeping your hens healthy and parasite-free.

Shell Discoloration:

This is fairly common and occurs most often in brown eggs. The pigment is sometimes deposited on the egg unevenly during production resulting in one end being a light tan and the other a darker brown. The large end usually has the darker colour. The deposit of the pigment rarely forms a recognizable pattern (like seeing shapes in clouds).

Blood Spots:

This involves having blood or meat spots in eggs.

EGG CANDLING

It is necessary to candle eggs for fertility when you are incubating eggs artificially using an incubator. Infertile or bad eggs can be discarded so that there is no risk of them going bad and exploding inside the incubator, contaminating the other eggs and if you are using a separate incubator or hatcher for the last few days of incubation to hatch your eggs, the extra space can be used for more eggs. Candling does not damage the embryos inside the eggs as long as you don't heat the egg up too much with the heat from the candling device. Candling gets its name from days gone by when people used to use candles as the light source of course these days, you can buy or make your own candler using a light bulb as the light source. The cheapest way to create a DIY candler is to place a light bulb (low energy light bulbs are best as you can get a very bright bulb that doesn't generate as much heat as a conventional bulb) and light fixture inside a cardboard box. Cut a small, round hole in the top of the box, just big enough to sit the pointed end of your egg into. Place your egg onto

this hole and turn the light on. You should be able to see what is inside the egg and with practice you will be able to identify fertile eggs by the spider-like blood veins spreading out much like a spider's legs, bad eggs (sometimes called dead germs) where the embryo starts to develop but later died and infertile eggs that are clear except for the shadow of the yolk. Dark shelled eggs are much harder to see through so you will need the brightest light source you can get and if you still can't tell, you will have to wait longer until the embryo has developed further and can be seen more easily. Eggs are normally tested after 5 to 7 days of incubation. The most critical period of incubation during the development of the embryo is the first week so it is best to be patient and only take a look after the first week. You will see more after a week and can be more certain about the fertility. Here are some photos of candling eggs which will help you to know what to look for.



Candling an Infertile Egg.

The Yolk can't be seen as it is the opposite side but can sometimes be seen as a dark cloud towards the centre of the egg.



Candling a Fertile Egg. Day 8.

The Embryo is the dark patch in the centre, blood vessels can also be seen. Notice the air sack at the top.