

The Domestic Chicken

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 **Fact Sheet**

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Domestication

On the basis of archaeological and paleoclimatic evidence most authors consider chickens were first domesticated from the Indian and Southeast Asian red jungle fowl (domestic form *Gallus gallus*) well before the sixth millennium BC and became established in China about 6000 BC. They were domesticated in India about 2000 BC and introduced to Japan via Korea about 300 BC-300AD. The Iron Age was the main period for dispersion of chickens throughout Europe, derived from China via Russia (West and Zhou, 1989).

Modern poultry industry

The housing systems of the modern intensive poultry industry developed in the 1940s and 1950s to reduce the land areas required to run poultry and to provide better control of the birds' environment. Under intensive systems, food and water are always available, the duration and intensity of light can be controlled and disease control is enhanced. Birds can be inspected regularly, leading to more rapid disease diagnosis and allowing more effective treatment through better controlled water or feed medication (UFAW, 1994).

The poultry industry consists of two major elements, the egg industry and the chicken meat industry. In the former, the majority of birds are reared in cages housed in large commercial

units. However, there is an increasing use of free-range and open-barn systems. In the chicken meat industry, the birds are raised entirely on deep litter in large sheds. The welfare of laying hens in conventional cages has been under scrutiny because of the bird's limited ability to express some natural behaviours. Regulations introduced in 2003 by the EU allowed a minimum of 550cm²/hen with minimum height, feeding and watering specifications. Cage fronts now have generously spaced horizontal bars which have replaced the vertically-spaced wire fronts in older cages. Furnished cages have been introduced to allow hens greater opportunity to express some natural behaviours.

The most common alternative egg production systems are barn, aviary, and free-range systems which enable layers to express more natural behaviours. The disadvantages of these alternative production systems are lower production efficiency, higher mortality and more labour and environmental pollution if they are not managed properly (Glatz, 2008).

Breeds

Some of the traditional breeds are still kept by poultry fanciers and these are typically divided into the heavy, medium and light birds. The commercial meat birds of today come from the

heavier types while the egg producers stem from the lighter strains.

In Australia the predominant commercial laying bird is a “brown eggger” derived from imported strains selected for light body weight, high egg production, feed conversion efficiency, egg weight and liveability. Eggs or day old chickens might be obtained from the breeder companies while started pullets may be obtained from commercial suppliers. All the commercial broiler (meat) strains are also derived from imported strains, obtainable from the local breeding franchises. These breeds have been developed for rapid growth and efficient feed conversion.

Egg and meat production

Each hen has only one functional ovary, usually on the left side of the body, containing a mass of ova. Only some of these will eventually form an egg. Commercial egg layers commence egg production from 16-22 weeks of age and can produce 250-300 eggs by 70 weeks of age. Meat birds grow quickly and can reach market weight by 42 days of age.

Housing and husbandry

Chickens can be successfully raised in small rooms of an animal house, using spot or whole house brooding. To rear 20 layer type chicks spread shavings on the floor to a depth of seven cm and place a 30 cm high surround (masonite or metal) three m in diameter to enclose the brooding area. Suspend a gas or electric hover brooder about 60 cm above the floor level and warm the brooder area at chick level to 32°-33°C. Reduce the temperature by 1° - 2°C per week until a temperature of 23°C is reached. Alternatively, a reverse cycle air conditioner can be used to maintain the room at the required temperature. Filters of the air conditioner need cleaning daily and an exhaust fan should be utilised to remove stale air if ventilation is inadequate. Place butcher’s paper to cover

about one third of the brooding area and provide chicks with a water bottle and one feed tray. Scatter feed on the paper to encourage the chicks to feed. After three days, remove the paper and allow the chicks to consume water from a bell waterer or a nipple line and to feed from a hanging tube feeder.

Day length and light intensity have a key role in the development of the reproductive system. Birds intended for egg production are best reared on a constant 10-12h day length from 3 weeks of age. This however, is only possible in light proof housing. If this is not available allow birds natural day length but in both cases increase day length using lights from about 12-15 weeks of age in weekly steps until it is about half an hour longer than the longest day length for that latitude. Once in lay, the lighting for birds is held constant at 16-17 hours a day to achieve maximum egg production (Barnett, 2001). The minimum intensity of lighting is 5 lux. Under this intensity it is still possible for someone to read a newspaper.

Birds can be reared on the floor to maturity by providing an area for perching (from six weeks of age) and nest boxes installed for hens at 16 weeks of age 50 cm above the floor level. Alternatively, when pullets reach 16 weeks of age they can be housed in layer cages. A small bank of cages with nipple waterers, trough feeders and egg rollout can be purchased from poultry equipment agents. Trays containing sawdust can be suspended from the cages to collect faeces. Clean trays twice weekly. Check cage space allowances for birds from your institution’s Animal Ethics Committee.

Meat chickens can be reared on the floor in the same manner as layer chickens. They are started for the first few days with 24 hours light, then allowed normal day length but the light intensity can be kept quite low, just enough for the birds to see (3-4 lux). As meat chickens have been genetically selected to reach slaughter weight by about 6-7 weeks of age, it is not recommended they be kept much beyond this age because of the possible development of leg problems.

It is recommended that bird handlers read the section of the Australian Model Code of Practice for the Welfare of Animals: Domestic Poultry, relating to bird handling. Day-old chicks should be picked up in one hand and gently restrained with thumb and fingers. Older birds should be removed from cages singly to avoid injury. They should be held by both legs and care taken to avoid their wings hitting solid objects. Birds should not be carried by the wings.

Feeding

The digestive tract of the chicken is simple, relatively short and highly efficient. Granivorous birds such as the domestic fowl have numerous well-developed mucous salivary glands in their upper and lower beaks and in the tongue. Food is coated with saliva to form a bolus before passing undigested through the oesophagus to the crop. The food then passes via the proventriculus to the gizzard (muscular organ). Food is moved by peristalsis through the small intestine where most of the digestion and absorption of food takes place. Digestion also occurs in the caeca, two blind sacs at the junction of the small and large intestine.

Because the chicken is economically important for the production of food, much effort has been expended to determine its critical nutritional needs (Standing Committee on Agriculture, 1987). For layer chicks, feed a layer chick starter ration from 0-6 weeks, grower ration from 7-16 weeks and layer ration from 17 weeks of age. Meat chickens are fed a broiler starter ration from 0-2 weeks, a grower ration from 3-4 weeks and a broiler finisher ration until market weight at 6 weeks.

Beak trimming

Cannibalism, egg eating, feather pecking and vent pecking are common traits where birds are housed together under high light intensity. Beak trimming is an animal husbandry practice commonly carried out in the poultry industry

involving the removal of part of the top and bottom beak of a bird to blunt the beaks enough so that pecking cannot do any great damage. It is commonly done with a heated blade according to a beak trimming accreditation procedure (Glatz and Bourke, 2006). Beak trimmers should not remove more than three mm of the upper beak and two and a half mm of the lower beak at hatch, not more than four and a half mm of the upper beak and four mm of the lower beak trimmed at ten days (Glatz and Lunam, 1994) and not more than two mm of upper and lower beak removed when re-trimming (Glatz, 1987). Re-trimming may also be carried out if a bird's beak grows back enough to cause pecking damage. Birds are often re-trimmed at 8-12 weeks-of-age to avoid this happening. Some non-trimmed adult birds may need trimming if a pecking outbreak occurs. Recently an infrared method of beak trimming has been introduced (Glatz, 2005). It uses a non-contact, high intensity, infrared energy source to treat the beak tissue. Initially the beak surface remains intact but after a few weeks the sharp hook of the beak erodes.

The welfare of birds subject to beak trimming was investigated by Lunam et al, (1996) and Glatz and Hinch (2008). A video is available to demonstrate best beak trimming practice using a hot blade (Glatz and Lunam, 1996).

Major poultry diseases

Marek's disease is caused by a lymphotropic herpes virus that varies widely in its ability to cause disease. Tumours can be seen at 6 weeks in unvaccinated birds and from 14 weeks in vaccinated flocks. It affects the nervous system and also produces tumours in many of the internal organs and the body muscles. The vaccine is most effective when given to day-old chickens and has been very successful although occasional outbreaks can still occur.

Coccidiosis - there are various species of Eimeria parasites causing disease in chickens. The species affecting the caecum produce

bloody faeces and are more acute than those which only affect the intestine. The latter species can produce diarrhoea and chronic wasting. Modern anti-coccidial agents in the feed give a high level of control.

Fatty liver in layers - sudden death associated with haemorrhage from ruptured livers usually in overweight birds.

Roundworms - caecal worm, hair worms and large round worms (intestine) can cause considerable problems.

Infectious laryngotracheitis is a highly infectious herpes virus disease in broilers, pullets and layers. The acute form results in coughing of blood. Vaccination is effective.

Leucosis - is the group name for several cancerous conditions caused by oncogenic RNA viruses, largely affecting chickens over about 20 weeks of age. It has been virtually eliminated from major breeding units.

Lice - Parasites of the skin, especially around the vent and under the wings. Heavy infestation can affect birds' performance. Species include the yellow body louse, the head louse and the wing feather louse.

Fleas - brownish-black jumping insects which attach to the comb and wattle then remain stuck fast.

Mites - blood sucking parasites that irritate the bird and can cause anaemia and depressed performance or even mortality. The red mite feeds off the fowl during the night and rests in crevices during the day. The northern fowl mite lives continuously on the fowl. There is also a scaly leg mite and an air sac mite, although the latter is rare in poultry.

Vaccination

Most of the economically important diseases can be prevented and controlled by vaccination.

These include Marek's disease, infectious bronchitis (IB), infectious laryngotracheitis (ILT), *Mycoplasma gallisepticum* (MG), coryza, cholera and fowl pox. Many vaccines can be given in the birds' water supply or by eye drop, while others may need to be given by injection. Chicks should be vaccinated at hatch against Marek's disease, at 2-3 weeks, and 6-8 weeks and at four months for IB; at six to eight weeks for MG, at 6-8 weeks and repeated at 12-14 weeks for ILT and anytime up to about 14 weeks for fowl pox. A video is available to demonstrate vaccination via water (Critchley, 1996).

Zoonoses

Diseases transmissible to man include:

- Chlamydiosis (psittacosis) — birds can carry this organism and show few signs until stressed. It is rare in chickens, but there are a number of reports in association with slaughter of ducks and close association with pigeons and parrot species.
- Avian influenza – highly pathogenic strains of avian influenza, for example H5N1 have been circulating globally, mostly in Asia, since 2003. Over 300 humans have been infected directly by poultry with over 200 deaths over the past 5 years.
- Insect-borne viruses, such as Murray Valley Encephalitis and Ross River Fever. There are many viruses whose natural host is the bird and which in man can cause mild to severe disease. Domestic poultry are rarely infected but they do have the potential to harbour such viruses.
- Bacteria (*Salmonella*, *Campylobacter*). In common with most species, poultry can become infected with these enteric bacteria, usually from contaminated feed stuffs or environment. The organisms are shed in the faeces and are a common source of food poisoning if the meat is not properly cooked or stored.

Blood sampling

Blood samples can be obtained from the wing (brachial) vein where it runs over the muscles surrounding the humerus. Depending on the bird's size, a 21-23 gauge needle can be used with a syringe or a vacutainer. Place the bird on a table on its side and gently extend the upper wing from the body. Antiseptic should be applied to clean the skin. Feathers located in the vicinity of the brachial vein can be removed with scissors to more clearly show the line of the vein from the abdomen to the wing. A small desk lamp is often needed to provide extra light. Insert the needle through the outer layers of the skin into the vessel, the best approach being to have the needle pointing toward the wing tip and away from the body. Make your approach from a low angle to the vein and in line with the vessel. Withdraw blood and after removing needle, apply pressure over the site for 30 seconds to seal the vein and minimise leakage of blood into surrounding tissue.

Anaesthesia

Birds, particularly small species and young chicks, possess a high basal metabolic rate reflected in a rapid heart rate and a body temperature of 42°C. In addition, birds have a less efficient ability to maintain body temperature compared to mammals and a complex respiratory system with associated air sacs. As birds have complete tracheal rings, intubation must be affected cautiously. These features need to be accommodated for successful induction and maintenance during the periods of anaesthesia and recovery. Furthermore, birds that are anaesthetised with injectable agents should be ventilated using oxygen.

A wide range of anaesthetic agents has proven suitable for use in different species of bird. In the laboratory we use either tribromoethanol by injection or the inhalational anaesthetic agent isoflurane. The choice of the anaesthetic agent

is dependent on the duration of anaesthesia required.

Tribromoethanol is particularly suitable for relatively short procedures. An intraperitoneal (i/p) dose of 200 mg/kg body weight provides induction within one to five minutes with a duration of anaesthesia of 15 - 25 minutes. To avoid penetrating the caudal air sacs, i/p injections are made in the mid-line, half way between the cloaca and sternum, the needle being inserted in a cranial direction, so that it lies just beneath and parallel to the abdominal wall.

The main advantage of inhalational anaesthetic agents is that the depth of anaesthesia can be readily altered, thereby decreasing the risk of respiratory depression and allowing rapid induction, maintenance of depth of anaesthesia required as well as rapid recovery. The halogenated anaesthetic agents halothane, isoflurane and sevoflurane, are non-flammable, non-explosive and are all excellent for birds. The indications for and contraindications against use of each of these three anaesthetic agents is briefly addressed in this fact sheet. For detailed reviews of the use of these anaesthetic agents in different species of bird see Ludders (2001), Lichtenberger and Ko (2007).

The anaesthetic agent of choice is isoflurane. Halothane is rapidly losing acceptance as an anaesthetic agent due to its occupational health and safety risks to operating personnel. It also has limited availability and causes arrhythmias. The use of sevoflurane is limited by its high cost of purchase compared to either halothane or isoflurane. In humans, the rate of induction and recovery from sevoflurane anaesthesia exceeds that with isoflurane. Although we have no experience of sevoflurane-anaesthesia in birds we have found induction and recovery from isoflurane-induced anaesthesia is very rapid compared to that with halothane. Rapid induction and recovery with sevoflurane-induced anaesthesia has also been reported in different avian species by other workers (Ludders, 2001; Lichtenberger and Ko., 2007).

The reason for the rapid induction and recovery is likely the result of both isoflurane and sevoflurane being less soluble in blood and body tissues than halothane.

Although isoflurane provides excellent muscle relaxation it is considered to irritate the respiratory mucosa to a greater extent than either halothane or sevoflurane. Each of the three inhalational anaesthetic agents has been reported to have a similar potency in birds as in mammals. This is defined as the minimal alveolar anaesthetic concentration or MAC (Eger et al., 1965) which at one atmosphere of pressure will abolish a reflex response to a painful stimulus in 50% of the animals. The MAC for avian species is 0.8-1.12% for halothane, 1.35-1.44% for isoflurane and 2-3% for sevoflurane.

To minimise risk of exposure of laboratory personnel to the anaesthetic agents, (halothane in particular is hepatotoxic to certain susceptible individuals (Lunam et al., 1985), we use a closed anaesthetic delivery system with the expired gas vented directly into a fume hood (Figure 1). This delivery system proved to be very effective and to be an inexpensive alternative to an anaesthetic vaporiser. In the absence of a fume hood, expired anaesthetic gases should be scavenged by an appropriate system.

The bird's head is placed into the glass anaesthetic mask with latex rubber forming a firm seal around the feathers. The latex is cut from a surgical glove and secured to the mask using a rubber band. The mask should be placed on an electric blanket heated to 40°C in a draft-free environment (not a fume hood) to minimise loss of body heat from conduction and convection. Feather removal should be kept to a minimum to maintain thermal insulation. Control of heat loss is particularly critical during anaesthesia of very young chicks.

After induction (one minute of 2 - 4% isoflurane (or halothane) in O₂ (flow rate of 1-2 l/min) the concentration of isoflurane or halothane should

be immediately lowered to either 1.1-1.3% or 0.8-1% respectively. Anaesthesia approaches one MAC when the response to pinching the comb, cere or toes is abolished. The flow of O₂ to the vaporiser is interrupted at ten minute intervals and diverted directly to the mask for one to two minutes. At the end of the anaesthetic procedure, 100% O₂ is delivered to the mask for two to five minutes. To minimise loss of body heat and prevent injury to the wings during recovery, the bird is wrapped in aluminium foil and placed in a draft-free box heated from above using a 60 watt pearl light bulb. The aluminium foil should be loose enough so as not to restrict respiratory movements.

Using this procedure we successfully anaesthetise chicks as young as three days of age. As birds are particularly prone to stress from handling, birds weighing more than 250g are sedated using tribromoethanol at 100 mg/kg i/p before placing into the anaesthetic mask.

The chicken as an experimental animal

Because chickens can be easily bred and housed they are being increasingly used as experimental animals in many areas of scientific research. The main technical and scientific studies since the 1960s are listed below:

- Breeding and genetics, growth, performance and performance testing;
- Embryology, incubation, fertility, artificial insemination, hatchability and anatomy;
- Health, hygiene, disease, toxicology and pharmacology;
- Husbandry, environment, housing, equipment, transport, behaviour and welfare;
- Meat and egg science (processing and products), product quality, poultry by-products and waste;
- Nutrition and feeding;
- Physiology, biochemistry, endocrinology and neurobiology; and
- History and archaeology.

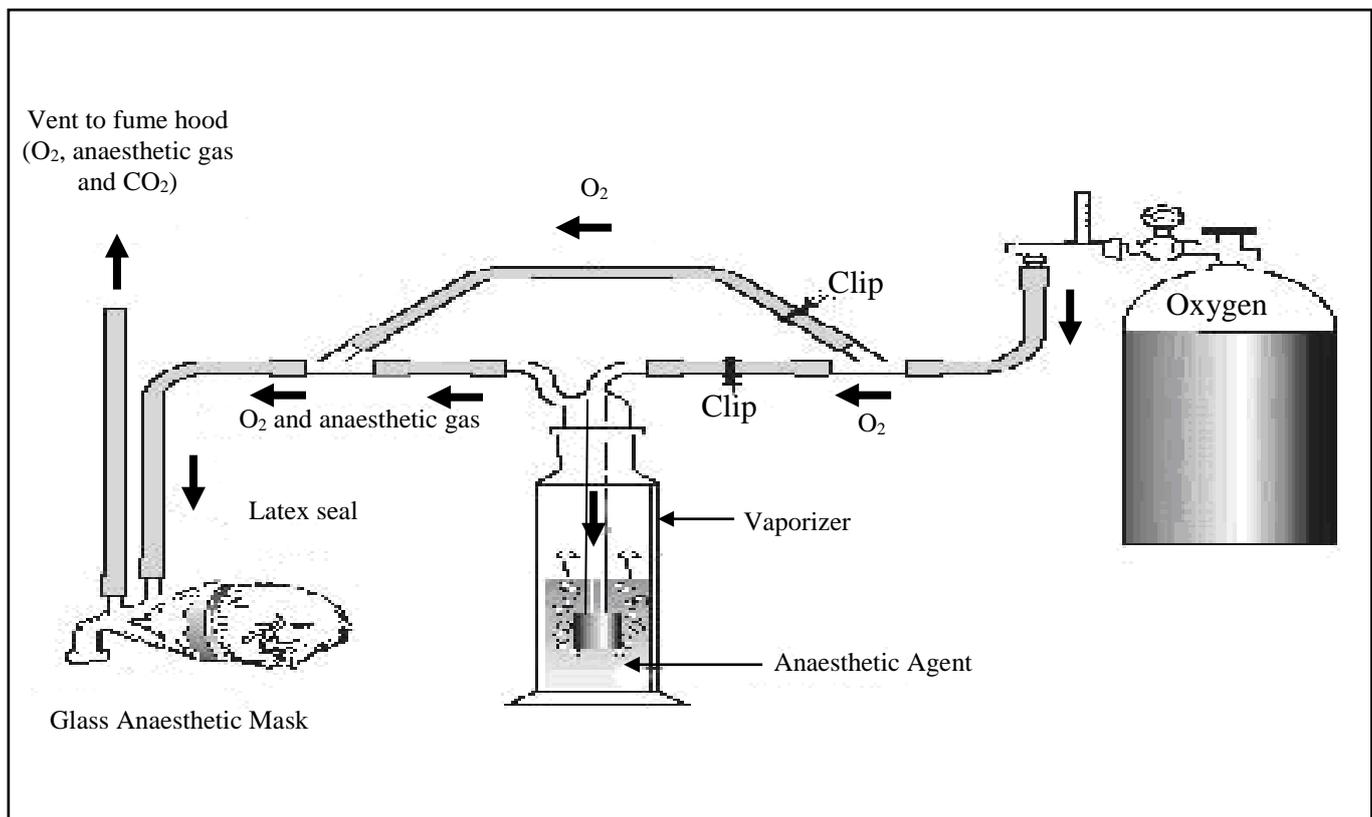


Figure 1 Most basic form of apparatus for delivery of gaseous anaesthesia to birds.

Physiological and biochemical data

Useful physiological data and biochemical data on poultry can be obtained from Freeman (1971, 1983 and 1984).

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